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Birth Outcomes In Georgia: Socioeconomic and Ecological Analyses of Low Birth Weight, 2000-2006

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BIRTH OUTCOMES IN GEORGIA: SOCIOECONOMIC AND ECOLOGICAL ANALYSES

OF LOW BIRTH WEIGHT, 2000 - 2006

by

KELLEY G. CHESTER

(Under the Direction of Gerald Ledlow)

ABSTRACT

Despite advances in medical and preventive care in the U.S., the low birth weight percentage continues to rise in the U.S. and the state of Georgia. The purpose of this study was to examine the relationship of socioeconomic status, county type (rural vs. urban), and adequacy of prenatal care on low birth weight in the state of Georgia for the years 2000 to 2006. The study also applied practical methods such as spatial analysis and geographic information systems (GIS) in order to pinpoint the at-risk populations for adverse birth outcomes.

This study involved the use of secondary data analysis, specifically vital records, to examine the relationships between socioeconomic status, adequate prenatal care, gestational age, and birth weight, controlling for certain maternal characteristics such as age, race, marital status, and education, for infants born in the state of Georgia. Ecological analyses were also conducted using the Georgia OASIS Mapping Tool from the Georgia Division of Public Health.

Statistically significant associations were found for the maternal characteristics of age, race, and marital status. Mean birth weight was lower for those mothers who were African

American, unmarried, and were either under the age of 19 or over the age of 40. The number of education years completed by the mother was also significant; as the level of education increased birth weight of the infant also increased.

Logistic regression results found that there were associations between the three variables of interest and birth weight; socioeconomic status, county type, and adequacy of prenatal care. Based on the analyses, the women in the study population with the worst low birth weight outcomes were; women of advanced maternal age, unmarried women, African American women, women with adequate plus level of prenatal care, lower middle and lower socioeconomic strata, and women living in rural counties. Based on the results of the ecological analysis, the women who are most at-risk can be found primarily in southwestern counties of Georgia. Future research is needed to evaluate existing programs throughout Georgia that may provide additional important pieces of data to confirm the results of this study.

INDEX WORDS: Low birth weight, Maternal health, Infant health, Infant mortality, Geographic information systems, Georgia, Socioeconomic status, Risk factors, Prenatal care, Ecological analysis

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DEDICATION

To my husband, Heath, your never-ending patience,
love and support made this goal achievable

To my heart, Taylor, you inspire me

To my family, you support me in ways I cannot describe

and

To my friends and to my fellow 2007 cohorts, you kept me moving forward
even in the face of doubt and uncertainty

I am thankful for each and every one of you

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Go Eagles!

You gain strength, courage and confidence by every experience in which you really stop to look fear in the face. You must do the thing you think you cannot do.

~Eleanor Roosevelt

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CHAPTER ONE INTRODUCTION

Infant mortality during the neonatal period accounts for nearly two thirds of all infant deaths and an infant who is low birth weight is 40 times more likely to die in the first 28 days of life (Kiely, Yu, & Rowley, 1994; Matthews & MacDorman, 2010). Low birth weight (LBW) is a major contributor to infant mortality and childhood morbidity and is considered a priority issue in the United States (Grady, 2006). According to the Institute of Medicine, the estimated economic impact of low birth weight and preterm birth is $26.2 billion dollars annually (Institute of Medicine, 2006). The overall cost of low birth weight can include medical costs of the infant from delivery through early childhood, maternal delivery costs, education and intervention, and lost household and labor market productivity (Russell, et al., 2007). Average expenditures for low birth weight infants were estimated at more than 10 times the expenditures of normal newborns. Low birth weight is defined as an infant who weighs less than 2500 grams, or 5 pounds 8 ounces, at birth. Both LBW and preterm birth are critical risk factors of infant mortality (Almond, Chay, & Lee, 2005).

The infant mortality rate is an important indicator of a nation's health and is associated with many factors affecting health (MacDorman & Matthews, 2008). The infant mortality rate is measured as the number of deaths of infants less than one year of age per 1,000 live births. In 2006, the infant mortality rate (IMR) in the United States was 6.69 per 1,000 which have generally declined since 1900. However, the infant mortality rate has not significantly declined since 2000's rate of 6.89 per 1,000. There have been advances in addressing two significant causes of infant mortality, congenital malformations and sudden infant death syndrome (SIDS)

(Matthews & MacDorman, 2008). The slowed progress on further reduction to infant mortality can be linked with the increase in low birth weight and preterm delivery and the barriers to overcome both (Shore & Shore, 2009).

The U.S. infant mortality rate is higher than many other industrialized nations and the gap between the U.S. and other countries is widening. In 2004, the United States ranked 29th in the world against 40 other industrialized countries (National Center for Health Statistics, 2007a). The U.S. ranking has fallen from 12th in 1960 to the recent 29th position in 2004.

Birth Outcomes in the United States

In 2006, more than 4.26 million births were recorded in the U.S. (Martin, et al., 2009). From 1990 to 1997 there was a downward trend in the number of births from 4.16 million in 1990 to 3.88 million in 1997, but since then the trend has moved steadily upward. Multiple births, such as twins and triplets, saw a sharp increase from 1980 (19.3 per 1,000) to 2006 (33.7 per 1,000). However, from the years 2004 to 2006 the multiple birth rate decreased only slightly from 33.9 to 33.7 (Martin, et al., 2009). Many multiple births in the U.S. can be attributed to the increased availability and use of fertility-enhancing therapies (Reynolds, Schieve, Martin, Jeng, & Macaluso, 2003). Multiple births present a higher risk of adverse birth outcomes such as low birth weight and preterm delivery.

Despite advances in medical and preventive care in the U.S., the rate of low birth weight saw a steady increase from 1980 to 2006 (Yang, Greenland, & Flanders, 2006). In 1998 the low birth weight percentage was 7.6% of all live births and in 2006 the rate increased to 8.3% (National Center for Health Statistics, 2007b). The increase in low birth weight rate for 2006 was the highest level reported in the U.S. in four decades (Martin, et al., 2009). The rate of 8.3% is up 9% since 2000 and up 24% since 1985. The rate of low birth weight can be attributed partially to the increase in the number of multiple births; however the rate among singletons has also increased. The rate of low birth weight among singletons in 2000 was 6.0% and increased to 6.49% in 2006. The rates of low birth weight among different races show a disparate trend. Among non-Hispanic African Americans the low birth weight percentage for singleton births was 11.85% in 2006 and among non-Hispanic Whites was 5.37%. Figure 1 below shows the trends of low birth weight for singleton births by race from 1990 to 2006 (Martin, et al., 2009).

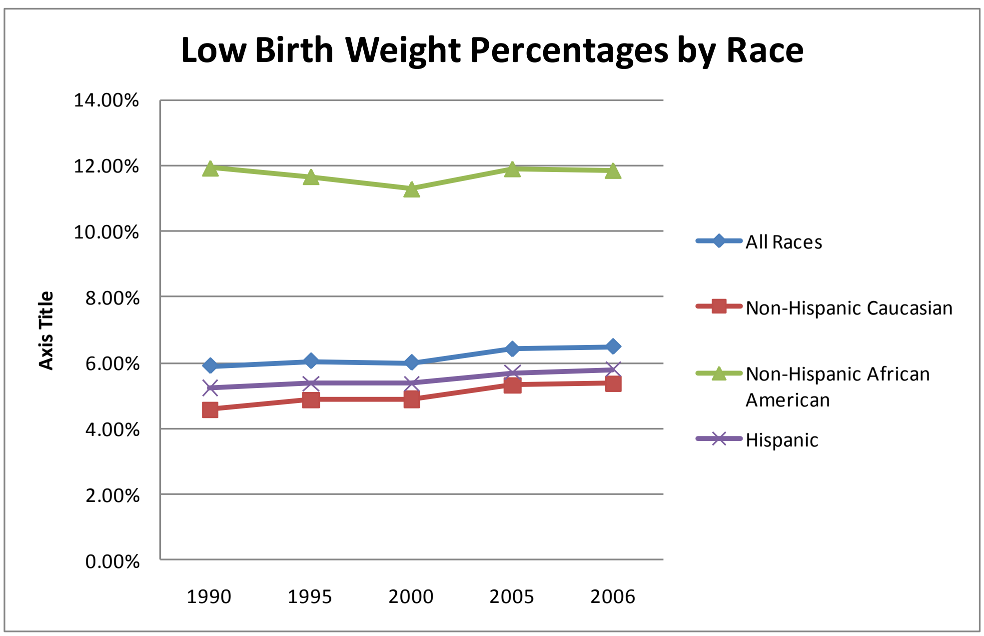

Figure 1. Low birth weight percentages among singletons by race in the United States: 1990, 1995, 2000, 2005, and 2006 (Martin, et al., 2009)

The primary contributors to low birth weight are intrauterine growth restriction (IUGR) and preterm delivery (i.e., birth at less than 37 weeks of gestation). Approximately 12.7% of infants born in the U.S. in 2005 were preterm (MacDorman & Matthews, 2008). The preterm rate has increased from a rate of 11.6% in 2000, a 9% increase. The percentage of preterm infants increased slightly to 12.8% in 2006 (Martin, et al., 2009). In 2005, 68.6% of all infant deaths were attributable to infants less than 37 weeks of gestation. Among singleton births the percentage of preterm births increased from 10.12% in 2000 to 11.09% in 2006. Disparities among different races exist for preterm deliveries. In 2006 the percentage of preterm infants for non-Hispanic Whites was 11.8% and 18% for non-Hispanic African Americans. Figure 2 below shows the trends of preterm births by race from 1990 to 2006 (Martin, et al., 2009).

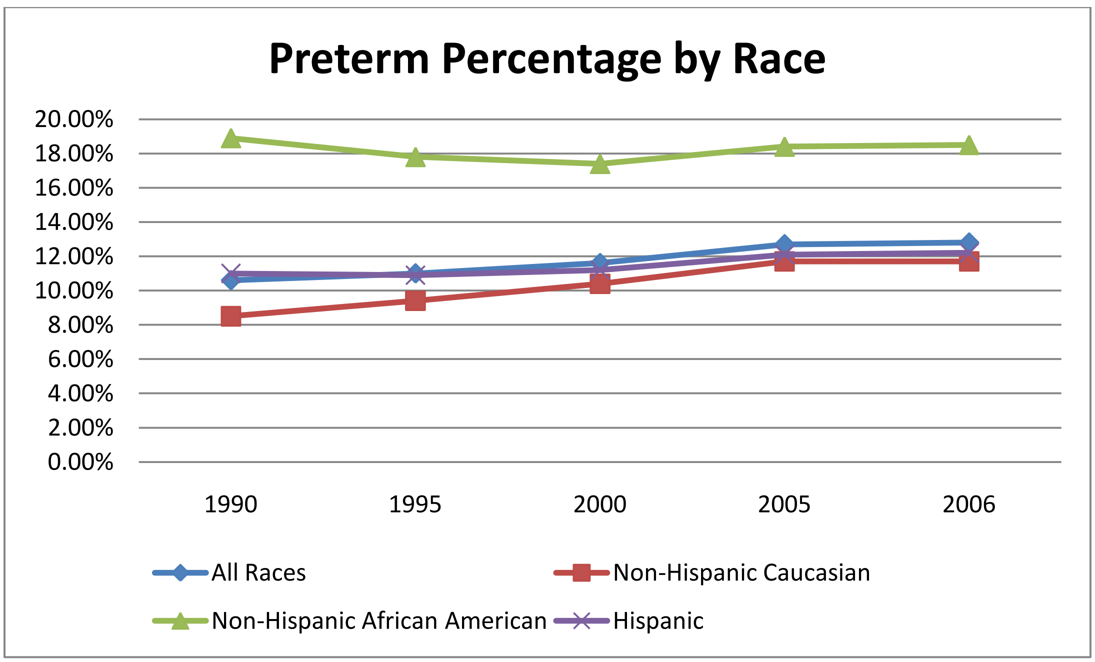

Figure 2. Preterm percentages of live births by race of mother in the United States: 1990, 1995, 2000, 2005, and 2006 (Martin, et al., 2009)

Infants who are born low birth weight and survive the first year are more likely to have long term development and neurologic disabilities as compared to infants of normal birth weight (Grady, 2006). In addition to the medical complications of low birth weight, there is also an economic impact. Health care costs have continued to rise over the previous decades as low birth weight infants and preterm infants survive because of expensive technological advances in neonatal medicine (Cuevas, Silver, Brooten, Youngblut, & Bobo, 2005). Approximately half of all healthcare costs for infants in the United States are spent on care for the approximately 13% of infants who are low birth weight or preterm.

Background of the Study

In 2006, the infant mortality rate in the U.S. was 6.69 per 1,000 live births; in Georgia the rate was 8.1 per 1,000 live births (Georgia Department of Community Health, 2009b; Heron, et al., 2009). The neonatal mortality rate, death of a live born infant less than 28 days of age, was 4.45 per 1,000 live births in 2005 (Matthews & MacDorman, 2008). In Georgia, the neonatal mortality rate was 5.8 per 1,000 live births. Nationally, the major causes of infant mortality were congenital malformations and disorders relating to short gestation and low birth weight. According to America's Health Rankings, Georgia was ranked 41st with respect to its infant mortality rate (United Health Foundation, 2009).

Low birth weight, a key factor in infant mortality, increased from 7.6% in 2000 to 8.3% in 2006 (National Center for Health Statistics, 2007b). In Georgia, the rate of low birth weight was 8.6% in 2000 and increased to 9.6% in 2006 (Georgia Department of Community Health, 2009b). Similarly, Georgia's preterm rates were also higher than the national rates. The rate of preterm infants in the United States was 12.8% as compared to Georgia's rate of 14.2% in 2006 (Martin, et al., 2009).

The nation's Healthy People 2010 initiative established a defined set of health objectives to be achieved over the first decade of the new century. One of the goals defined within Healthy People is to "improve the health and well-being of women, infants, children and families" (U.S. Department of Health and Human Services, 2000, p. 16-3). The Healthy People 2010 initiative provides objectives concerning infant and neonatal mortality as well as for low birth weight. The goal for the reduction of infant mortality as defined by Healthy People 2010 Objective 16-1 was set at 4.5 deaths per 1,000 live births based on a baseline of 7.5 deaths per 1,000 in 1997 (U.S. Department of Health and Human Services, 2000, p. 16-12). The 2006 rate of 6.69 per 1,000 for the nation and 8.1 per 1,000 for the state of Georgia falls short of Objective 16-1. Objective 16-10 for the reduction of low birth weight was set at 5.0% of all births based on the 1998 baseline of 7.6% (U.S. Department of Health and Human Services, 2000, p. 16-32). The percentage of low birth weight in the nation as well as the state of Georgia has increased from previous years and has not come close to meeting the Healthy People Objective. In 2006, the U.S. rate was 8.3% and Georgia's rate was 9.6%.

Statement of the Problem

The causes of low birth weight are complex and are frequently unknown. Risk factors have been researched and identified and include factors such as maternal age, ethnicity, education level, previous history and parity (Chen, et al., 2007; Colen, Geronimus, Bound, & James, 2006; Conley & Bennett, 2000; Cramer, Chen, Roberts, & Clute, 2007; Martin, et al., 2009; Partington, Steber, Blair, & Cisler, 2009). These risk factors have been used for surveillance purposes to target women who may need intervention to prevent adverse birth outcomes. Other variables that have been addressed include socioeconomic status (Joseph, Liston, Dodds, Dahlgren, & Allen, 2007), prenatal care (Alexander & Korenbrot, 1995), maternal stress during pregnancy (Baffour, Gourdine, Domingo, & Boone, 2009), and place of residence (Hillemeier, Weisman, Chase, & Dyer, 2007).

Identifying at risk populations for adverse birth outcomes continues to be explored in order to eliminate disparities and to meet the goals of the Healthy People 2010 initiative. However, there has been a lack of research in the area of applying practical methods such as spatial analysis and geographic information systems (GIS) in order to pinpoint the at-risk populations for adverse birth outcomes. Healthy People 2010 objective 23-3 targets a 90% increase to the proportion of all major national, State and local health data systems that use geocoding to promote the use of GIS (U.S. Department of Health and Human Services, 2000).

Research Question/Hypotheses

Research Question

The purpose of this study is to examine the relationship of socioeconomic status, county type (rural vs. urban), and adequacy of prenatal care on low birth weight in the state of Georgia for the years 2000 to 2006. The research question this study will address is:

> What is the relationship between socioeconomic status, county type, adequacy of prenatal care, and birth weight, controlling for certain maternal characteristics, for infants born in the state of Georgia between the years 2000 and 2006?

Hypotheses

H_{10}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{1a}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is positively associated with birth weight (i.e., as socioeconomic status increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status and education.

H_{20}: County type as defined by the Georgia Office of Rural Health is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{2a}: County Type as defined by the Georgia Office of Rural Health is associated with birth weight (i.e., infants born to urban mothers will have a higher birth weight) controlling for the maternal characteristics of age, race, marital status and education.

H_{30}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{3a}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is positively associated with birth weight (i.e., as the level of prenatal care increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status, and education.

Based on the results of analyses to answer the research question, this study will produce an ecological analysis of low birth weight at the county level in Georgia using geographic information systems (GIS) and spatial analysis.

Healthy People 2010 and Low Birth Weight

This study was supported by the systematic approach to health improvement framework (U.S. Department of Health and Human Services, 2000). The Healthy People 2010 initiative has a vision of “Healthy People in Healthy Communities” which links individual health closely with the health of the community. The health of a community is influenced by beliefs, attitudes and behaviors of all who reside within that community. Figure 3 shows The Systematic Approach to Health Improvement based on Healthy People 2010.

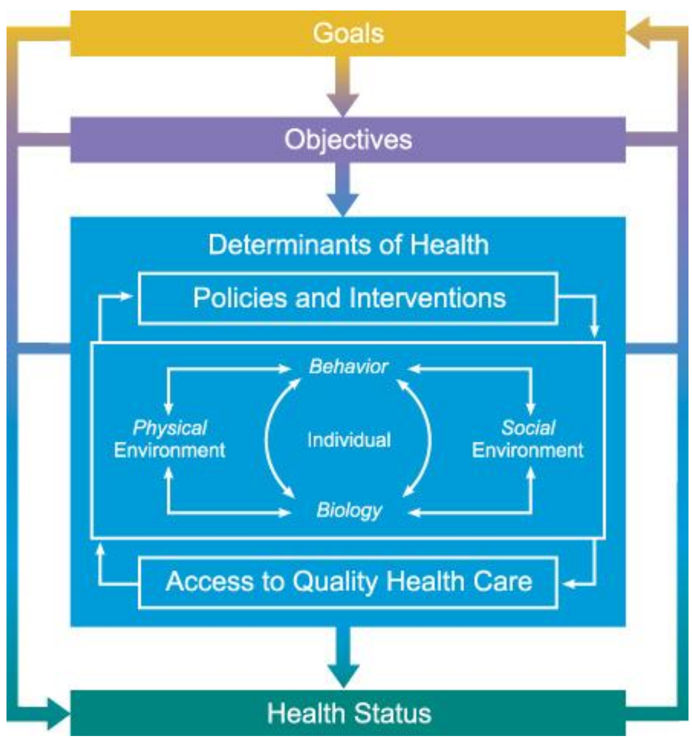

Figure 3. The Systematic Approach to Health Improvement (U.S. Department of Health and Human Services, 2000)

The Healthy People 2010 goal this study will address is to improve the health and well-being of women, infants, children, and families (U.S. Department of Health and Human Services, 2000, p. 16-3). Within the framework, the goal provides a general direction and objectives are used to measure progress within a specific period of time. The determinants of health focus on the physical and social environments and the policies and interventions that also affect the access to quality health care. Individual behaviors and biology in turn affect the environment and community collectively. Success of each high-level goal is measured by the health status of the targeted community or population. Figure 4 summarizes the targeted goal and objectives this study will address.

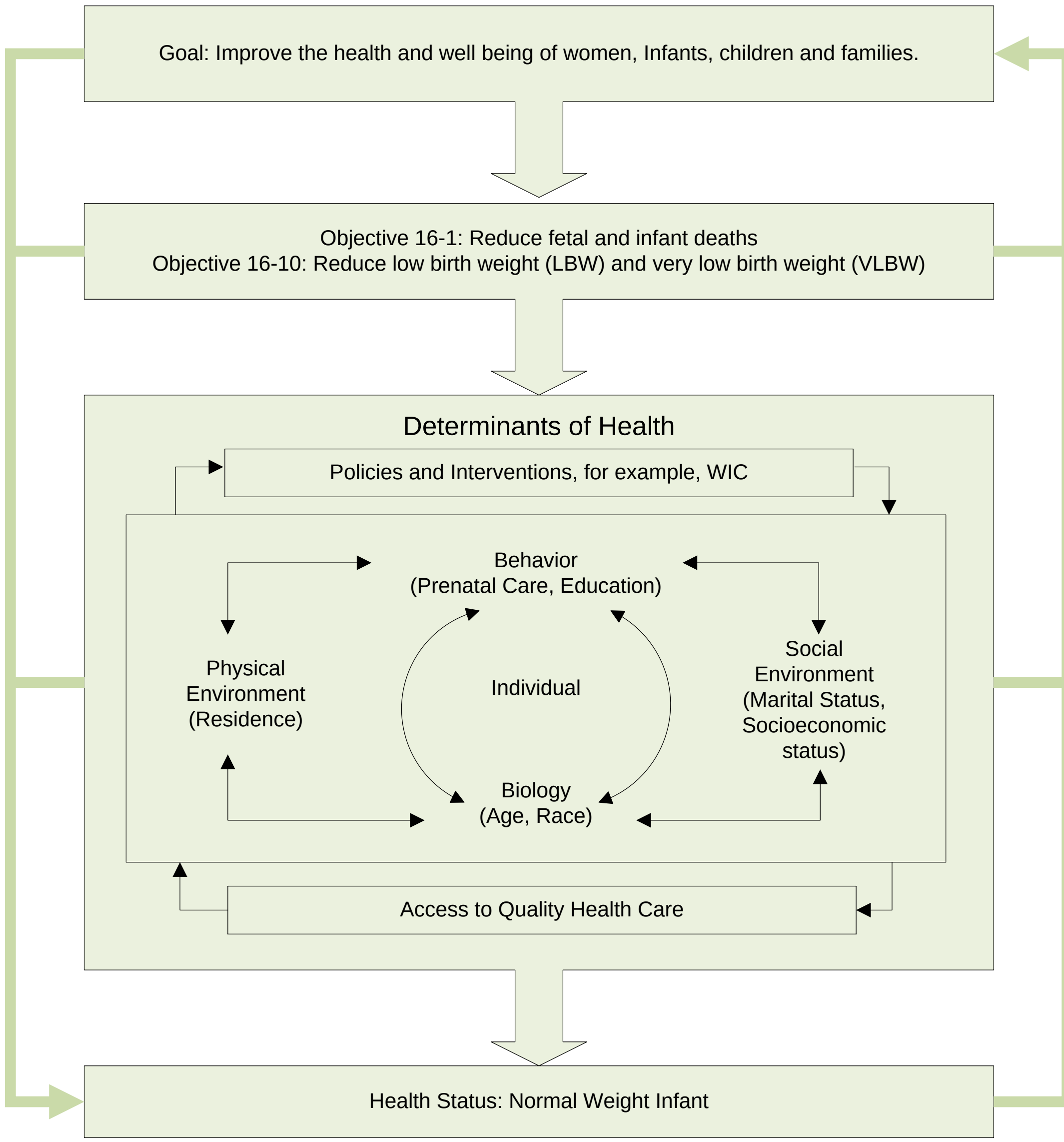

Figure 4. Study Framework based on the Systematic Approach to Health Improvement

Significance of the Study

In Georgia, the infant mortality rate (8.1 per 1000), neonatal mortality rate (5.2 per 1,000) and percent low birth weight (9.6%) was recorded in 2006. These rates are higher than the national average in the United States during the same year at 6.69 per 1,000, 4.45 per 1,000, and 8.3%, respectively. The rates also do not meet the goals of the Healthy People 2010 objectives. Despite federal and state programs to target the health and welfare of women and children, the rate of low birth weight has not decreased(Alexander & Kotelchuck, 2001).

The population in the state of Georgia is diverse in ethnicity as well as in socioeconomic conditions. Of the 8 million persons in the state, 65.1% are non-Hispanic white and 28.7% are classified as non-Hispanic black (U.S. Census Bureau, 2000). The percentage of families in the state of Georgia live below the poverty line is 9.9% and only 24.3% of Georgians have a bachelor's degree or higher. Disparities exist in the infant mortality rate and the percentage of low birth weight births in the state. In 2006, the infant mortality rate for non-Hispanic whites was 6.0 per 1,000 and for non-Hispanic blacks was 12.8 per 1,000 (Georgia Department of Community Health, 2009b). The percentage of low birth weight births for non-Hispanic whites was 7.1% and for non-Hispanic blacks was 14.4%. Non-Hispanic whites also experience a lower rate of late or no prenatal care at 3.7% than non-Hispanic blacks at 5.0%.

According to the current state health rankings for 2009, Georgia overall ranks 43rd in the country, which is down from the 41st rank in 2008 (United Health Foundation, 2009). The ranking stems from a number of health related issues in the state including: a high incidence of infectious disease, high level of air pollution, and high rates of uninsured families. These indicators all point to an overall decline in the health of Georgians, and the current trends show that the decline in health status will likely continue.

Because previous efforts to reduce low birth weight and preterm birth have not had a significant impact on improving birth outcomes, such as infant mortality, the focus of researchers and policymakers has shifted to maternal health and maternal factors that influence birth outcomes (Shore & Shore, 2009). This study will take into consideration multiple maternal factors that affect birth outcomes including socioeconomic status, adequacy of prenatal care, and maternal place of residence (urban versus rural). Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles provides a classification system that takes into consideration many relevant demographic factors to more accurately assign individuals to an appropriate socioeconomic status category. The categorization allows a shift from a gross socioeconomic status classification to a defined categorization which will increase the ability to define at risk populations in Georgia. The demographic profile categorizations have not been previously used in published studies. This research provides an opportunity to utilize the demographic profile classification for birth data in Georgia.

Additionally, the study will include an ecological analysis using geographic information systems (GIS) that will provide a picture of at risk populations to improve the information used by Georgia policy and decision makers. The use of information is an essential component of public health practice and the efficiency and effectiveness of geocoding and mapping data has increased the usefulness of health related information. The resulting analyses and outcomes of this study are intended to provide information that will help improve birth outcomes in the state of Georgia.

Definitions of Terms

Gestational age: The age of a newborn infant which is generally calculated either from the first day of the woman's last menstrual period (LMP) or from 14 days before conception (fertilization).

Infant mortality rate: The number of deaths of infants less than one year of age per 1,000 live births.

Intrauterine growth retardation: Also called small for gestational age is birth weight less than the tenth percentile for gestational age.

Low birth weight: An infant who weighed less than 2500 grams, 5 pounds 8 ounces, at birth.

Neonatal mortality rate: The number of death of infants less than 28 days of age per 1,000 live births.

Preterm birth: Birth at less than 37 weeks of gestation.

Very low birth weight: An infant who weighed less than 1500 grams, 3 pounds 5 ounces, at birth.

CHAPTER TWO LITERATURE REVIEW

Low Birth Weight

Low birth weight (LBW) is a major public health problem in the United States which contributes to infant mortality and childhood morbidity (Grady, 2006). A low birth weight infant is defined as a baby who weighs less than 2500 grams, or 5 pounds 8 ounces, at the time of birth. Low birth weight is used to describe two distinct health problems: intrauterine growth retardation (IUGR) and preterm birth (Farley, et al., 2006; Kramer, Segui, Lydon, & Goulet, 2000; Ricketts, Murray, & Schwalberg, 2005). Intrauterine growth retardation, also termed small for gestational age (SGA), is defined as an infant whose weight is below the 10th percentile for its gestational age (Battaglia & Lubchenco, 1967; Hutcheon & Platt, 2008). Preterm birth is defined as an infant who is born at less than 37 weeks (Luke, Williams, Minogue, & Keith, 1993).

In 2006, the rate of premature births had risen to 12.8% of all births (Martin, et al., 2009). The rate of low birth weight can be largely attributed to the birth of twins or multiples; however the rate of LBW among singleton births continues to rise in the United States (Almond, et al., 2005; Ricketts, et al., 2005; Russell, et al., 2007). As of 2006, the national low birth weight rate had reached 8.3 % of the estimated four million births in the United States (Martin, et al., 2009). The LBW rate is at its highest level in the previous four decades rising 19% since 1990. Over the years of 2004 to 2006, the rate of multiple births has begun to level out showing little or no increase.

Assisted reproductive technology (ART) has been in use in the United States since 1978 to treat infertility in women (Sunderman, et al., 2009). The most common ART procedure is in vitro fertilization (IVF) and has increased in popularity since the first ART birth in 1981. The number of procedures has more than doubled since 1996 from 64,681 to 138,198 in 2006. In 2006, ART procedures resulted in 41,343 live births and 54,656 infants. There is an increased risk of low birth weight and preterm birth associated with ART. In 2006, of the singleton births 9% were low birth weight and 13% were preterm. Multiple births are also associated with ART and in 2006, 25,967 infants were multiples (Sunderman, et al., 2009). Approximately 41% of all ART infants were born preterm and accounted for approximately 4% of all preterm births in the U.S. in 2006.

Birth Weight and Infant Mortality

In the United States infant mortality is measured by the number of deaths that occur in the first year of life. Infant mortality is divided into two categories: neonatal deaths, which occur at less than 28 days after birth, and post neonatal deaths, which occur at 28 days up to one year. In 2006, there were 4.26 million live births and 28,509 infant deaths and the infant mortality rate, the number of infant deaths per 1,000 live births, was 6.68 per 1,000 (Matthews & MacDorman, 2010). The infant mortality rate (IMR) is defined as the incidence of death during the first year and is typically expressed per 1,000 live births (Matthews, Marian, MacDorman, & Menacker, 2002). The trend in infant mortality for the United States has changed significantly over the previous five decades. This rate fell three percent from 2005's rate of 6.86 per 1,000. The three leading causes of infant mortality for 2006 were: congenital disorders and malformations, low birth weight, and sudden infant death syndrome which when taken together accounted for 46% of all infant deaths, approximately 13,000 deaths. The infant mortality rate for the total population declined by 6.9 percent for low birth weight infants from 2000 to 2006.

Low birth weight is a strong predictor of infant mortality (Institute of Medicine, 1985; Sable & Herman, 1997). Low birth weight infants have a higher infant mortality rate than those who are born at a normal weight (Farley, et al., 2006; McCormick, 1985; McIntire, Bloom, Casey, & Leveno, 1999). Nearly two-thirds of all infant deaths occur in the neonatal period, the first four weeks after birth, as a result of low birth weight (Luke, et al., 1993). In 2005, only 8.2% of all births were low birth weight, but accounted for 69.1% of all infant deaths (Matthews & MacDorman, 2008). Compared with full term births, infants who are born preterm have a 15-fold increase in infant mortality (Russell, et al., 2007). When LBW infants survive, they often face long-term health and development issues which can cause a high cost burden to society.

There are disparities among racial and ethnic groups with regards to the infant mortality rate. The rates ranged from a low 4.55 per 1,000 for Asian Pacific Islanders to a high of 12.90 for non-Hispanic African Americans (Matthews & MacDorman, 2010). The rate for non-Hispanic Whites was 5.57 per 1,000. Infants that are born at a low gestational age and low birth weight have a large impact on infant mortality. Mortality for low birth weight infants are highest for those who are very low birth weight (less than 1,500 grams) was 240.44 per 1,000 which is 100 time more than the rate for infants that are more than 2,500 grams or more (2.24 per 1,000). Infants considered to be low birth weight (less than 2,500 grams) were 55.38 per 1,000 in 2006. Infant mortality rates were lowest at birth weights of 3,000 – 4,999 grams. The impact of low birth weight on the infant mortality rate is great, for example, in 2006 0.7 percent of all infant births were less than 1,000 grams but accounted for 48.0 percent of all infant deaths. The disparities also exist in the amount of decline with non-Hispanic Whites experiencing a at 7.3 percent reduction in mortality and non-Hispanic African Americans experiencing a 3.7 percent decline from 2000 to 2006. Non-Hispanic Whites had a 50.10 per 1,000 IMR and non-Hispanic African Americans had a rate of 72.95 per 1,000 for low birth weight infant as compared to normal birth weight IMR's of 2.06 and 3.33 per 1,000.

Maternal characteristics and behaviors have a role in infant mortality, such as, race, ethnicity, age, education, prenatal care and marital status. Often maternal risk factors occur in groups rather than as a single risk factor.

Birth Weight and Morbidity

In addition to infant mortality, low birth weight also shows strong associations to childhood morbidity and is a frequent focus of pregnancy outcome research (Kramer, et al., 2000). Research data suggests, infants who have low birth weight experience difficulties in health throughout their lifetimes (Almond, et al., 2005). Some of the health issues that are experienced include developmental and neurologic disabilities and increased risk for chronic medical conditions (Ricketts, et al., 2005; Russell, et al., 2007).

Despite technological advances in treatment, the incidence of LBW complications and morbidity has not declined in the past decade. Low birth weight infants and very low birth weight infants have a greater risk for growth and developmental problems (Croteau, Marcoux, & Brisson, 2006; Yang, et al., 2006). The risk of these adverse birth outcomes increases continuously as birth weight percentiles decrease (McIntire, et al., 1999). The most often studied complication of prematurity and LBW is Bronchopulmonary Dysplasia and Respiratory Distress Syndrome (RDS) (Eichenwald & Stark, 2008).

Zaw, Gagnon and da Silva (2003), conducted a large sample study of 1267 singleton infants born at less than 34 weeks gestational age, without any congenital anomalies, between 1993 and 2003. Infants who were considered LBW or diagnosed as small for gestational age had an increased risk for RDS, Bronchopulmonary Dysplasia and Intraventricular Hemorrhage (IVH). Morbidity caused by RDS and IVH are among the most significant complications affecting both short and long term outcomes in LBW neonates (Zaw, et al., 2003). Garite, Clark and Thorp (2004), conducted a retrospective review of premature infants born between 1997 and 2001 and compared outcomes for infants with and without intrauterine growth restriction. There were 29,916 singleton infants who were born between 23 and 34 weeks gestational age and 3,708 (12.3%) were classified as having IUGR and LBW. Both IUGR and LBW were independently associated with an increased risk for mortality and the need for respiratory support (Garite, et al., 2004).

There are limitations to the study of morbidity and complications for LBW infants. The terms small for gestational age (SGA) and intrauterine growth restriction (IUGR) can be defined in various ways from obstetric and neonatal perspectives (Garite, et al., 2004; Zaw, et al., 2003). There are also known accuracy issues when determining the gestational age of an infant using the last menstrual period (LMP) of the mother (Phibbs & Schmitt, 2006). Some studies fail to adjust for confounding variables such as gestational age, gender, locations of birth and prenatal care (Bernstein, Horbar, Badger, Ohlsson, & Golan, 2000). These limitations cause difficulties in identifying the specific attributable risk of LBW in the morbidity of infants. Despite these limitations, there are many studies devoted to determining the negative impact of IUGR, SGA and LBW on birth outcomes. Many studies have shown agreement that LBW has a negative impact on birth outcomes.

At birth, respiratory complications are prevalent and a costly outcome for low birth weight infants and are more likely to require more complex and longer hospital care as well as higher hospital readmission rates (Russell, et al., 2007). The costs associated with prematurity and LBW have a high financial burden on the US health care system. It is estimated that the cost associated with complications of LBW run in the excess of $2 billion annually (Gilbert, Nesbitt, & Danielson, 2003). Phibbs and Schmitt (2006), studied the potential cost savings and reductions to hospital length of stay for each additional one-week increase in gestational age for premature infants in California. The cohort included all births with a gestational age of between 24 and 37 weeks in California from 1998 to 2000 with 193,167 infants in the study. Both the cost of hospitalization as well as the length of stay decreased with each one-week increase in gestational age. At 24 weeks gestational age the mean hospital cost for the sample population was $222,563 and the mean length of stay was 78.9 days (Phibbs & Schmitt, 2006). The mean cost and length of stay decreased to $10,535 and 7.4 days for infants who were 34 weeks gestational age. A cost savings of $122,000 per case resulted in delaying deliveries at less than 29 weeks to term at 37 weeks.

As a result of intrauterine growth retardation, low birth weight is related to an increased risk of long term morbidity and chronic disease such as hypertension and dyslipidemia (Dubois

& Girard, 2006; Russell, et al., 2007). Additional research has found social and economic linkages between LBW and low educational attainment, poor self-reported health status, reduced earnings as adults, and for females, an increase in the chance of having a low birth weight infant (Behrman & Rosenzweig, 2004).

Birth Weight as an Important Measure of Health

The infant mortality rate is a common indicator of a population's social development, and low birth weight is an important measure because the IMR is sensitive to birth weight (Conley & Bennett, 2000; Luke, et al., 1993). Increased birth weight is associated with reduced morbidity and mortality and has become a primary measure of infant health and welfare (Almond, et al., 2005; Astone, Misra, & Lynch, 2007; Conley & Bennett, 2000). Birth weight is often measured as an output in studies of maternal behaviors and public health interventions that affect birth outcomes such as infant morbidity and mortality. Birth weight is also seen as an input to studies that have associated longer term implications of poor birth outcomes, such as educational attainment, self-reported health status, and chronic disease (Almond, et al., 2005). There are some criticisms that low birth weight alone is not an adequate measure of perinatal health (Wilcox, 2001). "Analyses of determinants of perinatal health have more value if they focus on the independent issues of gestational age at birth (or preterm birth) and birth weight for gestational age (or IUGR) and, of these, gestational age at birth is the more important measure" (Farley, et al., 2006, p. 786)

Low birth weight also is an indicator of poor maternal health (Kieffer, et al., 2006). Of the health related risk factors for low birth weight and poor birth outcomes, maternal smoking is considered to be the most significant and modifiable factor (Alexander & Korenbrot, 1995; Kramer, 1987). Smoking has been associated with both causes of low birth weight; intrauterine growth retardation and preterm birth. The U.S. federal government and public health officials have attempted to educate women to the dangers of smoking while pregnant and have increased awareness to the negative consequences of maternal smoking (U.S. Department of Health and Human Services, 1990, 2001). Low birth weight has also been associated with maternal stress, anxiety, depression, stressful work environment, abuse and low levels of social support (Baffour, et al., 2009; Kramer, et al., 2000; Ricketts, et al., 2005). Stress is a significant factor for low birth weight in African American mothers which may be attributed to overall lower socioeconomic status and the stress of racism (Hogue & Bremner, 2005). Women who smoke or are living with increased stress levels may be more susceptible to illness and low birth weight births.

Preterm birth and low birth weight are priority public policy health issues in the United States and can be used to determine the effectiveness of social policies (Almond, et al., 2005; Hillemeier, et al., 2007). In the U.S., social programs such as Medicaid and Women, Infants, and Children (WIC) have worked to reduce the incidence of low birth weight and improve infant health. One of the primary goals of the Healthy People 2010 initiative is to reduce the rates of low birth weight and preterm birth (U.S. Department of Health and Human Services, 2000).

Socioeconomic Status

Socioeconomic status (SES) is widely used in research to examine relationships between health and diverse factors such as education, income, employment, and neighborhood factors

(Braveman, et al., 2005; Krieger, Williams, & Moss, 1997). Socioeconomic status is a complex concept and is typically used to measure social and economic disparities among diverse groups (Kramer, et al., 2000). Factors of SES often show an interaction effect with other characteristics such as gender or race that can produce different results across groups (Barbeau, Krieger, & Soobader, 2004; Nicolaidis, Ko, Saha, & Koepsell, 2004; Pearl, Braveman, & Adams, 2001). Despite existing literature showing that SES is complex, many studies that consider SES often use a single variable that is measured at a single time period.

Two variables that are typically used to measure an individual or neighborhood's socioeconomic status within the United States are income and education. Income is often equated to socioeconomic status and education is used as a proxy variable when income is not available (Braveman, et al., 2005). Information concerning education attainment, often measured in years of school completed, is often more easily gathered by the researcher. Some researchers have found that the level of educational attainment is the most consistent predictor of health, especially for women and children (Bloomberg, Meyers, & Baverman, 1994; Kramer, et al., 2000). An individual's access to employment opportunities and other resources can be limited by a low level of education. When both income and education are simultaneously accounted for in the analyses, concerns of collinearity must be addressed; however, research shows that the correlation between them is typically not strong enough to use education as a proxy for income (Braveman, et al., 2005). Income attainment varies across similar education levels and is influenced by social differences within groups. Braveman, et al. (2005) suggest that education should be considered in addition to income and not as a direct proxy.

Another aspect of socioeconomic status that directly influences income is occupation. Research has found linkages between occupational classifications, i.e. manual vs. non-manual labor, and various health outcomes (Mackenbach, et al., 1999; Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). Various aspects of an individual's occupation such as carrying and lifting heavy objects, intense physical effort, work on assembly lines, and industrial work have been associated with negative pregnancy outcomes such as low birth weight (Peoples-Sheps, et al., 1991). Socioeconomic status across the lifespan may also influence adult health outcomes (Galobardes, Lynch, & Smith, 2004; Rahkonen, Lahelma, & Huuhka, 1997; Smith, Hart, Blane, & Hole, 1998). Most studies involving socioeconomic status typically measure current socioeconomic status of the study population. An individual's health may also be influenced by neighborhood socioeconomic characteristics as well (Pickett & Pearl, 2001; Robert, 1999). Unlike individual-based factors, characteristics of the neighborhood may affect health through the physical and social environment via many pathways (Braveman, et al., 2005). As with other factors, both individual level and neighborhood level factors are seldom considered together in studies concerning socioeconomic status.

In 1993, Calle et. al. (1993), analyzed responses from the National Health Interview Survey Cancer Control Supplement concerning mammography and pap smear screening behaviors. Demographic profiles based on certain demographic factors such as, age, income, and educational attainment, were created in order to target interventions at severely underserved groups of women. Another study using demographic profiles was completed in southern Texas to determine at risk populations for hypertension (Patronis Jones, Ricard, Sefcik,

& Miller, 2001). Both studies used multiple factors to group individuals to determine socioeconomic status.

A review of the literature concerning the use of socioeconomic status shows that there are studies using demographic profile variables that combine multiple factors such as education, age, and income (Calle, et al., 1993; Patronis Jones, et al., 2001). However, it is more common that socioeconomic status is defined singularly as a measure of either income or education (Barbeau, et al., 2004; Braveman, et al., 2005; Nicolaidis, et al., 2004; Pearl, et al., 2001; Pickett & Pearl, 2001). Income is typically measured as a categorical variable representing the percent of poverty for either the individual or family. Education is grouped according to the number of years of formal education completed, i.e. less than 9 years, some high school, high school graduate, some college, college graduate, etc. Research suggests that using a more defined measure as compared to a gross categorization is needed in the area of health and public health research (Braveman, et al., 2005).

The Office of Health Information and Policy within the Georgia Division of Public Health created demographic profiles for the State of Georgia using census data variable classes containing: age, income, family structure, housing value and housing type, education and employment type (Office of Health Information and Policy, 2005). Four major categories including, higher, middle, lower middle and lower socioeconomic status, were created and then further subdivided into a total of eighteen distinct demographic clusters. Figure 5 shows the state of Georgia and the color-coded demographic clusters; each cluster is then described in Table 1 (Office of Health Information and Policy, 2005).

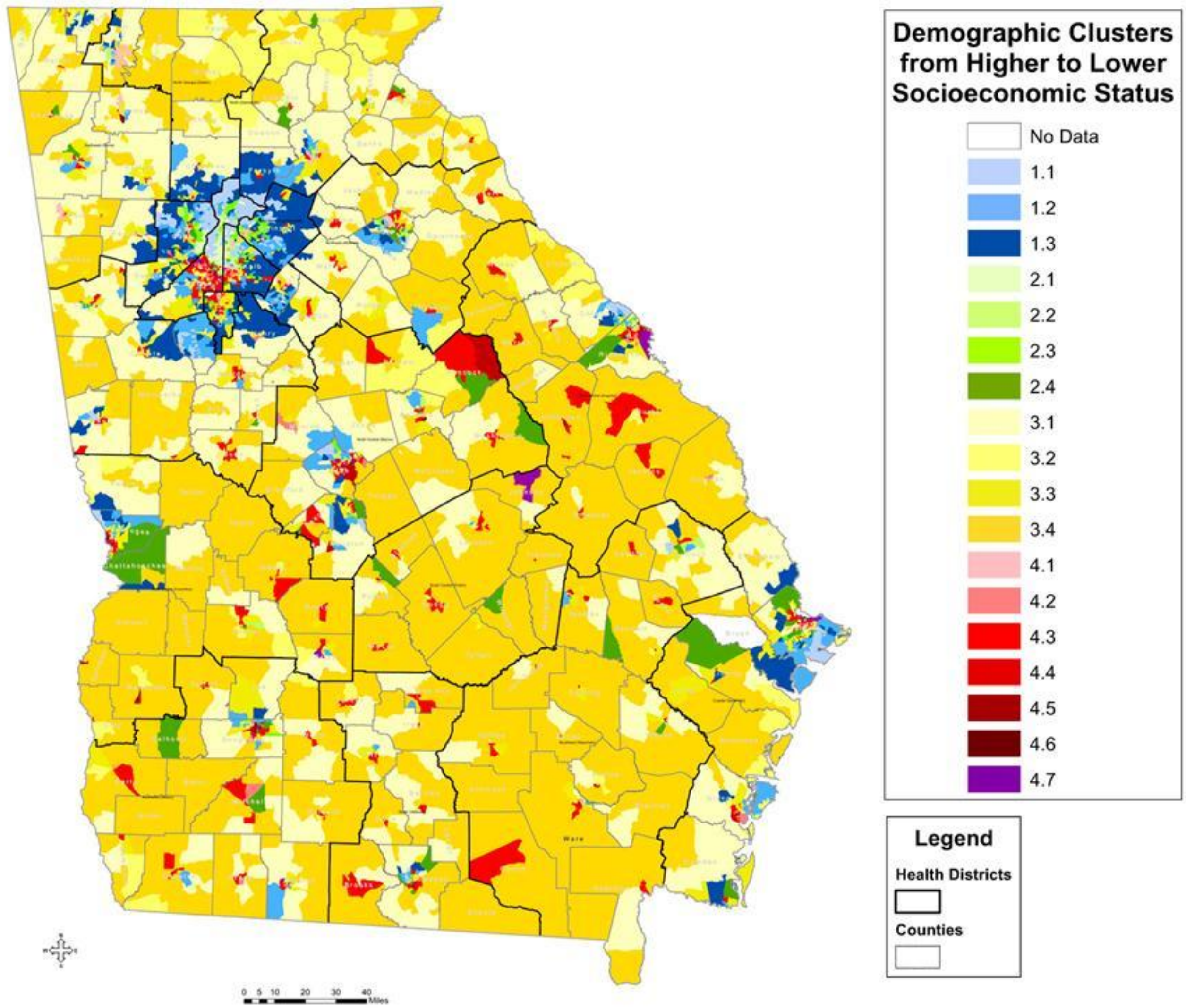

Figure 5. Demographic Profiles of Georgia (Office of Health Information and Policy, 2005)

Table 1

Georgia Demographic Cluster Descriptions (Office of Health Information and Policy, 2005)

Demographic Cluster	Description
1.1	Georgia's wealthiest cluster is primarily populated by "new money" executives and professionals living in tract mansions of metropolitan suburbs and exburbs. Predominantly white with a high index for Asians, this highly educated cluster is composed of married couples in their 40's and early 50's with adolescent children.
1.2	This well-educated, suburban cluster, dominated by professionals and managers has the second highest level of affluence in the state. Mostly white with a high index for Asians, they are older than cluster 1.1 and include married couples with adolescent and grown children.
1.3	Found in the metro suburbs, this mixed-ethnicity, more youthful cluster is populated by married couples in their 30's and early 40's with young children. The majority has some college or are college graduates. Most are employed in managerial and other white collar jobs, while some are high-earning blue collar families. This cluster enjoys a median income well above the state average.
2.1	This cluster is characterized by its high concentration of highly educated young people in their late 20's and 30's renting in upscale urban neighborhoods. Dominated by white and Asian married couples without children, this cluster is positioned to join prosperous families in the next decade.
2.2	This cluster is primarily populated by people in their late 30's and early 40's and older people over 65. A mixed-ethnicity group, they live in rented apartments and condos in the urban areas; and although many are college educated, their median incomes are well below cluster 1.3 and 2.1. Children are not highly represented in this cluster.
2.3	This a very young cluster of mixed ethnicity living in middle-range value apartments in urban/suburban areas. Many are college educated or have some college, and their income is exactly the state average. They have an elevated index for single parent families with children, although the population under 18 is small.
2.4	This mixed-ethnicity cluster represents the college, military and prison populations in Georgia (those populations living in group quarters). They are mostly under 24 years of age and have lower incomes than the state average.
3.1	This cluster is a white, middle class rural cluster dominated by married families with children. They are mainly home owners, but the value of their housing is much lower than in urban areas. Many in this cluster are high school graduates; but they are higher than the state average in population that failed to graduate from high school. The cluster is highly represented in farming and construction and is widespread across the state.
3.2	Although this cluster includes younger populations, it is dominated by the 55+ age group. Found predominantly in N/NE rural counties of Georgia, the cluster is white with some African-American population. As would be expected of a population with many persons living on fixed incomes, this cluster has lower income than families currently working; bur their incomes are still average compared to the state.

3.3	This mixed-ethnicity cluster is average in its age profile, but has a higher percentage of single parent families than the state as a whole. A large percent did not finish high school and they are much less likely to have a 4-year college degree. Approaching the state average in income, these families work in lower paring service, sales and managerial jobs to maintain a lower middle class lifestyle.
3.4	Composed of rural married and single parent families, this cluster is older than cluster 3.1 and less affluent. Predominantly white with some African-American population, this group is much more likely to own low value housing, not to have finished high school, and to work in farming.
4.1	This cluster is composed of newly arrived immigrants to the United States. Primarily Hispanic, the cluster is young and not well educated. Dominated by single households, but with a substantial percentage of married families with children, this urban populations lives in rental housing, is below average in income, and works in service, construction and processing industries.
4.2	An urban cluster, this African-American group has high representation of elderly people and single parent families with children. Not well educated and with lower than average incomes, this group lives in areas with high vacant housing and low housing values. Although poor, this cluster also demonstrates social stability with almost 60% showing home ownership and 30% being married family households.
4.3	This young cluster with a high proportion under 24 years of age. Primarily African-American and with a high index for Hispanics, this cluster is characterized by singles and single parent families with children living in urban/suburban rental units. They work in service jobs and their income is more than 30% below the state average.
4.4	Found in old mill towns in suburban and rural areas, this cluster is composed of predominantly African-American married families and single parents with children. The population is skewed to the very old and very young. They are primarily renters, have high school or less than high school educations and work in service industries – making half the state average in income.
4.5	This African-American cluster is much like cluster 4.4, but is more urban, older, less educated, and lower in income. They are more likely than 4.4 to live in rental units.
4.6	This is a very small and unusual urban cluster. It is dominated by an African-American population with a high percentage of whites. The cluster is more than twice the state average in population over 65 and has very few children. Oddly, this cluster has more males than females for the ages 18-54. The group lives in rental units, is very poorly educated and experiences very low income.
4.7	This is a very young African-American cluster composed of single parent families with children. The population less than 18 is very high, and there is almost no elderly population. The cluster is poorly educated, lives in rental units and has the lowest median income in the state.

Socioeconomic Status and Low Birth Weight

The health of individuals and populations can be profoundly affected by socioeconomic factors of which birth outcomes are particularly susceptible (Joseph, et al., 2007). The association of socioeconomic status and adverse birth outcomes has been documented by many researchers in the United States (Parker, Schoendorf, & Kiely, 1994; Pearl, et al., 2001). In particular, low birth weight has been associated with maternal income and education-level, which are common measurements of socioeconomic status (Hillemeier, et al., 2007; Kramer, et al., 2000; Parker, et al., 1994; Ricketts, et al., 2005). Socioeconomic status affects birth outcomes through lifestyle and behavioral factors. Some of these factors that are influenced by socioeconomic status that are addressed by perinatal research include: maternal age, smoking, marital status, alcohol consumption, obesity, education, and initiation of prenatal care. Research shows that there is a positive relationship between socioeconomic status and birth weight, even when such factors such as gestational age, smoking, and maternal body mass index (BMI) are controlled (Dubois & Girard, 2006).

Socioeconomic factors are often studied in conjunction with other factors such as maternal smoking and obesity. Dubois and Girard (2006), found that in low socioeconomic status families, maternal smoking during pregnancy was a key factor in birth weight and for families of higher socioeconomic status, maternal weight was the key factor. In another study, maternal socioeconomic status was statistically as significant as the effect of smoking during pregnancy (Astone, et al., 2007). The association of socioeconomic status has also been shown to be independent of race and ethnicity (Kramer, et al., 2000). However, some studies suggest that low socioeconomic status is not an adequate explanation for low birth weight disparities, and additional research is required to discover further risk factors (Colen, et al., 2006; Giscombe & Lobel, 2005). Improving socioeconomic conditions may play a vital role in reducing low birth weight.

Income

Joseph, et al. (2007), found that family income and socioeconomic factors were strongly associated with adverse birth outcomes, such as gestational diabetes, intrauterine growth retardation and infant mortality. The study included 92,914 women who delivered a singleton infant in the Nova Scotia province of Canada between 1988 and 1995. The study was carried out in setting where obstetric, neonatal and other health services are widely available and provided at little to no cost to the patient. The rates of LBW, or small for gestational age, were significantly different by income groups. The rate of LBW for women in the lowest income category was 81% higher than in the highest income category. The difference in rates did not diminish even when controlling for certain maternal characteristics such as, maternal age, smoking status, pre-pregnancy weight, and residence in a rural area. Despite universal access to care, socioeconomic characteristics are associated with adverse birth outcomes. The findings highlighted the gaps in health information and social support for those mothers who were socioeconomically disadvantaged in the study population (Joseph, et al., 2007).

In a study conducted in 1994, Parker, Schoendorf, and Kiely (1994) found that lower income had an adverse impact in birth outcomes for both U.S. White and African American mothers. The White mothers with income greater than or equal to 200% of the poverty level experienced a LBW rate of 7.4% and African American mothers experienced a rate of 15.9%

(Parker, et al., 1994). Another study conducted in the U.S. also supported the finding that maternal socioeconomic status is statistically as well as clinically significant with infant birth weight (Astone, et al., 2007).

Education

Educational attainment and income have received the most attention in birth outcomes research and are often both considered within the same study populations (Astone, et al., 2007; Conley & Bennett, 2000). Education level is an important factor is predicting health, especially for women and their children. Research has shown that a low education limits a person's access to employment and other resources and therefore increases the probability of poverty (Kramer, et al., 2000). Many women in the lowest socioeconomic classes experience high levels of unemployment. Of these women who do work during pregnancy, their jobs are typically more physically demanding and may be a great source of stress. Women who have higher levels of education are also more likely to pursue and comply with medical advice concerning healthy pregnancy behaviors (Astone, et al., 2007).

Parker, et al., (1994), found that the highest rates of LBW could be attributed to the groups of women who had a high school diploma or less education. For White women the rates of LBW were 11.6% for those with less than a high school diploma and 10% for those with a diploma but no college. African American women fared worse in that 19.8% of women with less than a high school diploma experienced LBW birth outcomes and 16.7% with a high school diploma but no college (Parker, et al., 1994). In a study conducted in the Canadian province of Quebec for the period of 1991 to 2000, mothers who had not completed high school were significantly more likely to have a LBW infant or other adverse birth outcome (Luo, Wilkins, & Kramer, 2006). Those mothers with less than a high school education had a LBW birth rate of 14.4% and a significant adjusted odds ratio of 1.86 as compared to mothers who had completed community college or had some university.

Place of Residence

Maternal residential environment is an important predictor of low birth weight and preterm birth. The interest in neighborhood-level characteristics has increased in recent years and recent research has shown a direct association between neighborhood socioeconomic deprivation and adverse birth outcomes (Fang, Madhavan, & Alderman, 1999; Hillemeier, et al., 2007; Kramer & Hogue, 2008; O'Campo, Xue, Wang, & Caughy, 1997; Roberts, 1997; Wasserman, Shaw, Selvin, Gould, & Syme, 1998). The residential environment can be described based on rural or urban characteristics and socioeconomic status as a whole. Several studies identify residential or neighborhood-level characteristics that affect birth weight even after individual socioeconomic status is accounted for (Pearl, et al., 2001; Rauh, Andrews, & Garfinkel, 2001). Farley, et al. (2006), found that after controlling for various individual level factors, women living in neighborhoods with lower median incomes were more likely to have low birth weight and preterm infants.

Residential segregation can be defined as the degree to which groups of differing ethnicities live separate from the other in an environment. Studies show that residential segregation exacerbates racial inequalities in health and health outcomes (Acevedo-Garcia, 2000; Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003). In the United States, African

Americans experience higher levels of residential segregation than other minorities (Acevedo-Garcia, 2000). A study completed in New York City found that low birth weight births were unevenly distributed among the borough and health center district levels (Grady, 2006). Women in New York experienced combined and interacting effects of class, income, race, ethnicity, and social differences. Residential segregation further contributes to racial disparities because of the isolation of women from important resources which may result in detrimental conditions affecting birth outcomes (Colen, et al., 2006; Grady, 2006). However , Pearl et. al. (2001) did not find a neighborhood association among White women with birth weight.

Neighborhood or residential access to health care affects not only urban mothers, but also those women living in rural areas. Lack of or reduced access to high quality obstetric and neonatal care increase the risk of preterm birth and low birth weight (Hillemeier, et al., 2007; Joseph, et al., 2007). Partington, Steber, Blair and Cisler (2009), found that neighborhood socioeconomic factors influenced the level of maternal education, particularly among the African American populations.

The Georgia Office of Rural Health defines a rural county as having a population of 35,000 or less (Georgia Department of Community Health, 2010). Of the 159 counties in Georgia, there are 109 rural counties, see Appendix A for a complete list of rural counties. Approximately 19% of the population in Georgia lives in rural counties (Georgia Rural Health Association, 2009). Education levels differ in rural counties with 68.1% of rural residents having earned at least a high school degree as compared to 76.4% of urban residents. 31% of rural residents in Georgia receive Medicaid as compared to 23.7% of urban residents. Disparities in income and education contribute to poorer health outcomes for rural Georgians

Prenatal Care

Prenatal care is health-related care offered to women during their pregnancy and is one of the most widely used preventive health care services (Alexander & Kotelchuck, 2001; U.S. Department of Health and Human Services, 2009). Prenatal care offered to a mother during her pregnancy generally consists of three types of services: assessment of health risk, risk reduction through treatment, and health education (U.S. Department of Health and Human Services, 2000). Previous studies have shown that prenatal care mitigates the risk of both low birth weight and preterm birth (White, Fraser-Lee, Tough, & Newburn-Cook, 2006). Prenatal care has also been shown to be cost effective because hospital costs due to preterm delivery were reduced (Lu, Lin, Prietto, & Garite, 2000). According to an 18 state 2003 revision of U.S. Certificates of Live Birth, 69.0% of women in these states initiated prenatal care in the first trimester and only 7.9% received late or no prenatal care (Martin, et al., 2009). Disparities exist in the initiation of prenatal care across ethnicities. Among non-Hispanic whites in the 18 states, 5.2% of mothers received late or no prenatal care while non-Hispanic black and Hispanic mothers were at 11.8% and 12.2%, respectively.

Prenatal care has long been recognized as having positive health benefits for both the mother and infant and has been shown to reduce the risk of low birth weight and other adverse outcomes (Alexander & Korenbrot, 1995). However, there is controversy over the effectiveness of prenatal care in preventing low birth weight which may be a result of the difficulty in defining adequate prenatal care. Prenatal care is often used to identify high risk women for the detection and management of pregnancy complications, not primarily for the prevention of low birth weight (Sable & Herman, 1997). However, other researchers believe prenatal care is an important tool to identify women at risk for intrauterine growth retardation and preterm birth which are conditions of low birth weight (Alexander & Korenbrot, 1995). The content of prenatal care differs from provider to provider, but is typically initiated within the first trimester of pregnancy.

In 1985, the Institute of Medicine promoted enrollment of all pregnant women into a system of prenatal care to reduce the risk of low birth weight (Institute of Medicine, 1985). There are many components of prenatal care which may include, clinical care provider visits on a pre-defined schedule, assessment of risk status, clinical screening tests, nutritional support, and social intervention services. In 1989 the Public Health Service Expert Panel on the Content of Prenatal Care issued a report entitled “Caring for Our Future: The Content of Prenatal Care” with specific recommendations concerning the specific procedures and advice to be included in prenatal care (National Institutes of Health, 1989; Sable & Herman, 1997). The panel recommended interventions for pregnant mothers including advice concerning smoking cessation, alcohol avoidance, illicit drug avoidance, proper nutrition, appropriate weight gain, and others. A study based on the panel’s recommendations concluded that women who received all of the recommended interventions had a reduced risk of delivering a low birth weight infant than those who received only some or none of the interventions (Kogan, Alexander, Kotelchuck, Nagey, & Jack, 1994).

Adequacy of Prenatal Care Utilization

A challenge of determining the effect of prenatal care on birth outcomes is measuring the adequacy of prenatal care. The ability to measure the adequacy of prenatal care accurately is critical in the development of programs and interventions to improve prenatal care and ultimately improve birth outcomes. In 1994, Milton Kotelchuck proposed the Adequacy of Prenatal Care Utilization Index (APNCU) to characterize prenatal care into two dimensions: adequacy of initiation of prenatal care and adequacy of services received (Kotelchuck, 1994b). The purpose of the APNCU is to measure the adequacy of utilization of prenatal care not to assess the quality of care received by the mother. The first dimension assesses the adequacy of initiation of prenatal care. Within the APNCU the month the mother initiates prenatal care, which is recorded on the birth certificate, is grouped into four adequacy categories: (1) Adequate Plus: 1st or 2nd month, (2) Adequate: 3rd or 4th month, (3) Intermediate: 5th or 6th month, (4) Inadequate: 7th month or later, or no prenatal care.

The second dimension of the APNCU is the adequacy of services received which describes the adequacy of the number of prenatal visits the mother receives prior to delivery. The expected number of visits is based on the American College of Gynecologists (ACOG) guidelines for prenatal care visitation for uncomplicated pregnancies. The number of visits is adjusted for the gestational age of the infant at delivery. ACOG's recommendation is one visit per month through 28 weeks gestation and one visit every two weeks through 36 weeks gestation and one visit per week thereafter (American College of Obstetricians and Gynecologists, 1985). For example, for a 38-week pregnancy, ACOG recommends 12 visits; if care began in month 4 (three missed visits), then the expected number of visits would be 9.

The measure of the adequacy of services is the ratio of the actual number of visits, which is recorded on the birth certificate, to the expected number of visits. The adequacy of received visits is grouped into four categories: (1) Adequate Plus: greater than or equal to 110%, (2) Adequate: 80% - 109%, (3) Intermediate: 50% - 79%, (4) Inadequate: less than 50% of expected visits.

The two dimensions of adequacy of initiation and adequacy of services received are combined to determine a single utilization index. Table 2 describes the four categories of the APNCU(Kotelchuck, 1994b).

Table 2

Summary of Adequacy of Prenatal Care Utilization Index

Rating	Description
Adequate Plus	Prenatal care begun by the 4th month and 110% or more of recommended visits received
Adequate	Prenatal care begun by the 4th month and 80% - 109% of recommended visits received
Intermediate	Prenatal care begun by the 4th month and 50%-79% of recommended visits received
Inadequate	Prenatal care begun after the 4th month and less than 50% of recommended visits received

There are limitations to the APNCU including that the index is only as accurate as the data on the birth certificate and secondly the index does not make a judgment as to the quality of prenatal care only the utilization.

Prenatal Care and Low Birth Weight

There are currently studies that show empirical evidence that both supports and refutes the connection of prenatal care and low birth weight (Heck, Schoendorf, & Chavez, 2002).

Access to prenatal care has a potential to influence low birth weight as well as underutilization of prenatal programs, such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (Partington, et al., 2009). Previous research has shown that lack of early and consistent prenatal care is linked with low birth weight and preterm births (Alexander & Kotelchuck, 2001; Vintzileos, Ananth, Smulian, Scorza, & Knupple, 2002). In a study that centered on teenage pregnancy outcomes, Partington, et al. (2009) found that teen mothers were less likely to initiate early prenatal care and had an elevated likelihood of receiving no prenatal care during their second pregnancy. However, when an adequate level of prenatal care before the second birth was obtained, the odds of both low birth weight and preterm birth were significantly reduced.

Timing of prenatal care has a significant impact on birth outcomes (Guillory, Samuels, Probst, & Sharp, 2003). Guillory found that certain maternal characteristics such as race and education level affected the timing of prenatal care initiation. White mothers with 12 or more years of education were more likely to initiate prenatal care in their first trimester, while African American mothers with less than 12 years of education started later or not at all. Another study linked poor environmental living conditions and delayed prenatal care with adverse birth outcomes in African American women (Cramer, et al., 2007). When enrolled in a prenatal program, Cramer (2007) found that African American women experienced improved birth outcomes and significant health cost savings. Mothers who participated in the prenatal care program experienced a reduction in low birth weight and increased percentages of those who received prenatal care during the first trimester.

Studies showing positive health outcomes in low birth weight underscore the importance in improving prenatal care programs (Yang, et al., 2006). Nutrition programs and health education programs aimed at higher-risk mothers, such as African American women, teens, and older mothers are important strategies in reducing the burden of low birth weight. The Special Supplemental Nutrition Program from Women, Infants, and Children (WIC) which was authorized in 1974 was created to improve the nutritional status and health outcomes of women and their children. When WIC is utilized in the prenatal period there is a clear reduction in infant mortality and preterm delivery (Khanani, Elam, Hearn, Jones, & Maseru, 2010). WIC provides a number of services to enrolled women including education, counseling, and access to prenatal care and social services. Increasing access to prenatal care and providing case management can also improve birth outcomes (Cramer, et al., 2007).

Previous literature focused on early and consistent prenatal care interventions and the prevention of low birth weight, but the research has not shown that standard prenatal care alone prevents low birth weight (Ricketts, et al., 2005). Ricketts, et al. (2005)found that prenatal interventions did not show success at increasing birth weight for high risk women. Other research also supports that existing prenatal care interventions may not influence the probability of low birth weight or preterm birth (Dunlop, et al., 2008; Lockwood, 2002). Heck, et al. (2002), found no association between local access to prenatal care and the probability of low birth weight even when controlling for other risk factors.

There is little literature regarding birth outcomes for women who receive no prenatal care (Friedman, Heneghan, & Rosenthal, 2009). Some of the reasons that have been identified by researchers accounting for a lack of prenatal care include denial of pregnancy, concealment of pregnancy, substance abuse, multiparity, and lack of financial resources. In a retrospective case review of 211 births at an academic medical center in Ohio, race and education level were significant predictors of lack of prenatal care (Friedman, et al., 2009). Among the women who received no prenatal care, 87% were African American and 78% had a high school diploma or less.

Maternal Characteristics

Much research has been devoted to the study of the causal determinants of pregnancy outcomes such as low birth weight and preterm birth. Demographic, behavioral and medical factors connected with low birth weight have shown the causality to be complex (Kramer, 1987). Many factors connected with low birth weight are not modifiable such as ethnicity, while others such as inadequate diet, lack of prenatal care and smoking are. Addressing modifiable influences through health and clinical related interventions has proven successful in achieving a reduction in low birth weight rates (Alexander & Kotelchuck, 2001).

Age

Extremes in maternal age, those who are under 18 and over 34, are more likely to have an infant who is low birth weight (Conley & Bennett, 2000). More women today are delaying childbirth until relatively later in life (Tough, et al., 2002). Factors that influence this decision include pursuit of advanced education, expanded role of women in their occupations, advances in contraception, delayed marriages, financial issues, and infertility. In 2006, the birth rate for women ages 35-39 increased to 47.3 births per 1,000 which is the highest rate reported in more than four decades (Martin, et al., 2009). The birth rate for women 40–44 years was 9.4 live births per 1,000 in 2006. The rising trend in birth rates for women 35 years of age and older has been linked to the increased usage of fertility-enhancing therapies (Reynolds, et al., 2003).

There is research that supports the association of advanced maternal age and adverse birth outcomes such as low birth weight (Dulitzki, et al., 1998; Prysak, Lorenz, & Kisly, 1995). In a study by Tough et al. (2002), results showed effect of advance maternal age was through pregnancy complications that led to preterm delivery and LBW. Tough suggested that the number of infants needing advanced clinical care will continue to rise if the trend toward delayed childbearing continues. However, other studies do not support an increased risk of low birth weight with increasing maternal age (Berkowitz, Skovron, Lapinski, & Berkowitz, 1990; Bianco, et al., 1996).

The literature shows that the risk of low or very low birth weight is greater for teenagers than for older mothers (Chen, et al., 2007; Gilbert, Jandial, Field, Bigelow, & Danielson, 2004). Factors that have influenced the teenage pregnancy rate within the US include a declining age of first occurrence of menstruation, earlier initiation of sexual activity, and a low rate of contraception use. Contraception usage is often hampered by lack of education and access (Chen, et al., 2007). The Youth Risk Behavior Survey suggests that almost 50% of all high school students in the US have had sexual intercourse (Centers for Disease Control and Prevention, 2008). In 2006, approximately 450,000 births were to mothers ages 15 to 19 a statistic that rose 5% over 2005 (Martin, et al., 2009). The birth rate for White teenagers was 43 per 1,000 and for African Americans, 118 per 1,000. In the United States, African American teenagers are at a greater risk for delivering an infant who is low birth weight than white or Hispanic teenagers (Partington, et al., 2009). According to Partington, et al. (2009), second births to teens were more likely to be low birth weight than the first birth. However, a study by Chen et al. (2007), disagreed concerning which risk factors were associated with low birth weight when other factors are controlled.

Ethnicity and Race

In the United States the rate of low birth weight for non-Hispanic African Americans is twice the rate for non-Hispanic Whites (Colen, et al., 2006; Cramer, et al., 2007; Martin, et al., 2009). In 2003, the rates of LBW for African Americans and White infants were 13.1% and 6.7%, respectively. In 2006 the LBW rates increased and the disparity remained constant at 14.0% for African Americans and 7.3% for Whites. Efforts to reduce the LBW disparity have been unsuccessful thus far and African American women are more likely to have risk factors for low birth weight than White women (Guillory, et al., 2003), including fewer prenatal visits than White women (Kotelchuck, 1994a). Intrauterine growth retardation and preterm births are more frequently seen in women of lower socioeconomic status and African American women, and these disparities are not fully understood (Farley, et al., 2006). Research shows that African American women have not only poorer birth outcomes, but poor health in general (Gilbert, et al., 2004). Factors such as maternal age, poor socioeconomic condition and chronic stress may partly explain these disparities for some ethnic groups, but will not explain poor birth outcomes for other groups.

The disparities in low birth weight are largely attributable to the similar disparity of infant mortality (Giscombe & Lobel, 2005). In the United States, infants who are born to African American mothers are more than twice as likely to die in the first year of life as compared to infants born to White mothers (Howard, Marshall, Kaufman, & Savitz, 2006; Martin, et al., 2006; Matthews, et al., 2002). While there have been improvements in the rate of infant mortality, those improvements are also disparate across ethnicity. Between 1995 and 2001, the infant mortality rate for African Americans improved 8.2% as compared to a 9.5% improvement for Whites (Matthews & MacDorman, 2008). In 2005 infants to African American mothers experience an infant mortality rate of 13.3 per 1000 live births as compared to the White IMR of 5.7 per 1000 which has not changed significantly from 2003 rates (March of Dimes, 2009; Matthews & MacDorman, 2008). Premature delivery accounts for much of the infant mortality in African Americans, therefore it is crucial to determine the causes and take steps to improve and develop interventions for this at risk group.

Marital Status

Marriage is a known protective factor in maternal health and in adverse perinatal outcomes (Barrington, 2010; Luo, Wilkins, & Kramer, 2004; Matthews & Hamilton, 2002). There are several mechanisms through which marriage affects positive health outcomes in women. Married women have higher levels of socioeconomic position, lower smoking rates during pregnancy, more adequate prenatal care, and greater social support and reduced stress (Bennett, 1992; Bennett, Braveman, Egerter, & Kiely, 1994; Ventura, 1995). The relationship between maternal health and birth outcomes varies with maternal age, education and race. As a mother's age increases, the protective factor of marriage also increases (Bennett, 1992;

Bennett, et al., 1994). Marriage has also been shown to provide greater health benefits for White women as opposed to their African American counterparts. Maternal education interacts with a woman's marital status. As education level increases, the protective factor of marriage also will increase for both African American and White women alike (Ventura, 1995). Married women with higher levels of education are less likely to have spouses who are unemployed or underemployed, which leads to a better socioeconomic position.

Using the data from the Panel Study of Income Dynamics (PSID), an ongoing longitudinal study of a representative sample of U.S. individuals and the family units in which they reside, Barrington (2010) examined two groups of African American women who gave birth between 1967 and 2005 to describe the relationship between marital status and low birth weight. After adjusting for certain socioeconomic and demographic factors, the study found an increasing protection of marriage on LBW across the two generational groups. The lowest risk for low birth weight occurred in women who were both married when they gave birth and who had mothers who were married at the time they themselves were born (Barrington, 2010).

CHAPTER THREE METHODS

Data

This study will involve the use of secondary data analysis to examine the relationships between socioeconomic status, adequate prenatal care, gestational age, and birth weight, controlling for certain maternal characteristics such as age, race, marital status, and education, for infants born in the state of Georgia. The data used for this study will be retrieved from the Georgia Department of Community Health, Division of Public Health's standardized health data repository. Specifically the variables used are collected from Georgia Vital Records birth information.

The vital record system in Georgia is well suited for examining the associative connection between socioeconomic strata and birth outcomes. The birth data contains information on all live births in the state of Georgia and corresponding demographic data for the mother and infant. This data is available from 1994 to 2007.

The Division of Public Health’s standard data repository contains an indicator variable that classifies each record into a demographic cluster. Demographic clusters were created from Georgia census information including age, income, family structure, housing value, housing type, education and employment type (Georgia Department of Community Health, 2009b). This combined profile indicator variable provides a detailed classification for socioeconomic status for the residents in Georgia. There are four major groups which are further portioned into 18 distinct profiles. The four major categories include higher, middle, lower middle and lower socioeconomic status (See Figure 5 and Table 1 in Chapter Two of this study).

Variables

The variables included in this study were determined based on peer reviewed literature and availability within the Division of Public Health's standardized health data repository for the years 2000 to 2006. The variables included are described in Table 3 and in additional detail below.

Table 3

Study Variables

Variable	Description	Variable Type
Event County	The county of birth for the infant.	Independent
Public Health District	The Public Health District of the infant.	Independent
Perinatal Region	The perinatal region of the infant	Independent
County Type	Indicates if the county is urban vs. rural	Independent
Demographic Cluster	The demographic cluster, or socioeconomic status, of the infant	Independent
Maternal Age	The age of the mother	Control
Maternal Age Group	The age group of the mother	Control
Maternal Race	The race designation of the mother	Control
Maternal Marital Status	The marital status of the mother	Control
Maternal Education	The last grade of formal education completed by the mother	Control
Kotelchuck Index	Prenatal care designation based on the APNCU	Independent
Birth Weight	A continuous variable for birth weight in grams	Dependent
Low Birth Weight	A categorical variable that classifies the infant as less than 2,500 grams	Dependent

Only births from the state of Georgia were included in the study. There are 159 counties in the state, with 109 being classified as rural. The Georgia Division of Public Health functions via 18 health districts and county public health departments at the local level. Figure 6 provides a map of Georgia's Public Health Districts.

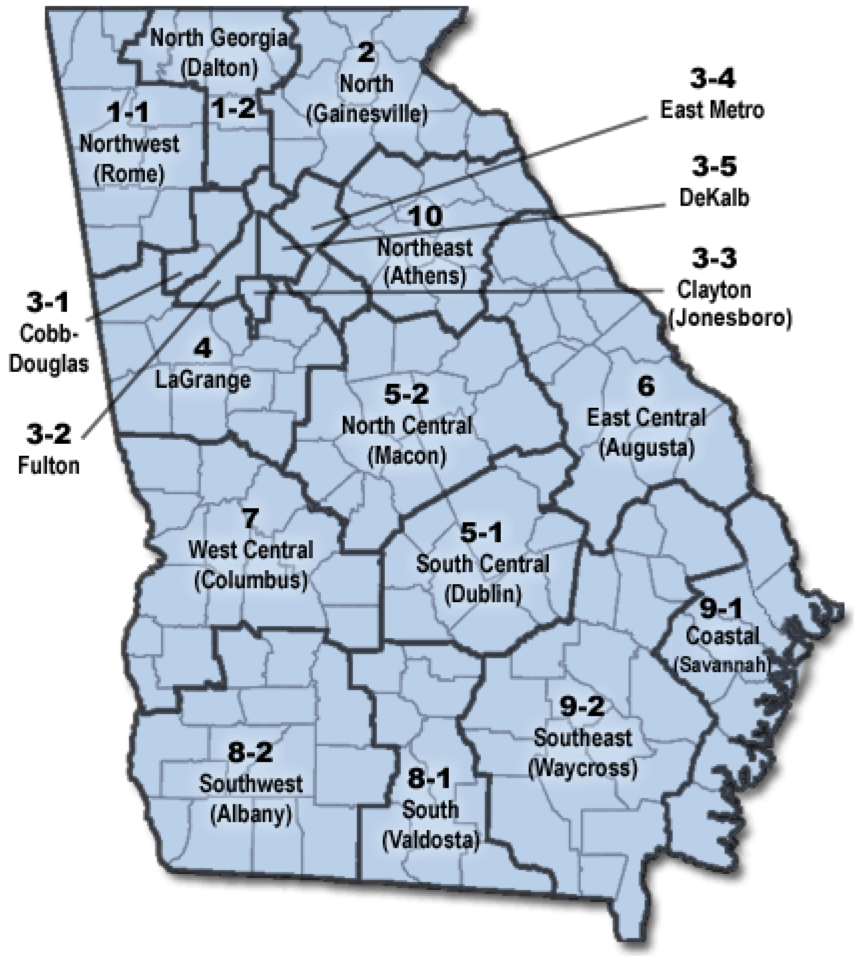

Figure 6. Georgia's Public Health Districts (Georgia Department of Community Health, 2009a)

There are six perinatal regions in the state: Albany, Atlanta, Augusta, Columbus, Macon, and Savannah. In 1974, Georgia created the regional system of perinatal care with the primary goal of establishing a network of perinatal services (Georgia Department of Community Health, 2009c). The infants are also classified with a demographic cluster designation which can serve as a proxy for socioeconomic status. Clusters are arranged from higher SES (1.1) to lower SES (4.7). The demographic cluster variable was created using census data variable classes containing: age, income, family structure, housing value and housing type, education and employment type. Because age and education are also included as separate variables in the analysis this duplication with demographic cluster can cause intercorrelation or mulitcollinearity. Mulitcollinearity is said to exist when predictor variables are correlated amongst themselves (Kutner, Nachtsheim, Neter, & Li, 2004). When the analysis includes the demographic cluster variable the maternal age and education variables will be dropped from the analysis to avoid mulitcollinearity.

The designation of race is described in Table 4.

Table 4

Race Category Descriptions

Race	Description
White	A person having origins in any of the original peoples of Europe, the Middle East or North Africa
African American	A person having origins in any of the black racial groups of Africa
Asian	A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand and Vietnam
American Indian/Alaska Native	A person having origins in any of the original peoples of North and South America (including Central American), and who maintains tribal affiliation or community attachment
Native Hawaiian or Other Pacific Islander	A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands
Multiracial	Two or more of these races

The Adequacy of Prenatal Care Utilization (APNCU) index as proposed by Milton Kotelchuck in 1994 will be used to classify the amount of prenatal care the mother received during her pregnancy (Kotelchuck, 1994b). The index is based upon (1) month of entry into prenatal care, (2) number of prenatal visits and (3) gestational age of the infant at birth. The categories of the index are Adequate Plus, Adequate, Intermediate, and Inadequate.

Procedures

Data Collection

The data that will be analyzed in this study is from a secondary data source, the Georgia Department of Community Health, Division of Public Health's standardized health data repository. Births from years 2000 to 2006 that were present in the repository will be used for the analysis.

Data Analysis

Analysis of the data will be completed using SPSS Statistics version 17 and the Georgia OASIS Mapping Tool. Descriptive statistics will be used to examine the characteristics of the births in the state of Georgia during the years of 2000 to 2006.

Analysis of variance (ANOVA) and χ^2 analysis will be used to determine significant differences in the adequacy of prenatal care, socioeconomic status, county type, birth weight, gestational age, race, maternal age, maternal education and maternal marital status. ANOVA is a statistical test of whether the means of several groups differ. ANOVA is often presented in terms of a linear model and makes three assumptions: (1) The value of the dependent variable is normally distributed, (2) the population variance is the same per group, and (3) the observations are independent.

Logistic regression will be used to determine the influence of socioeconomic status, race, maternal marital status, maternal age, maternal education, county type and adequacy of prenatal care on birth weight. Logistic regression is used to predict the probability of an occurrence of an event based on values of predictor variables. The predictor variables may be either continuous or categorical in nature. Logistic regression is best suited for regression models where the outcome variable is dichotomous.

An ecological analysis will be used to analyze aggregated data for groups of individuals to make inferences about relationships at the individual level. Birth data will be geocoded using geographic information systems (GIS) in order to explore the spatial relationships, patterns and trends in low birth weight. Spatial analysis is the linking of diseases, or event driven data, to geographic areas and has been used by Epidemiologists dating back to John Snow and the London cholera epidemic (Goldhagen, et al., 2005; Gordis, 2000; Lawson, 2001). By displaying geocoded data on a map, GIS technology will give public health practitioners and policy makers an easily understandable visual picture of birth outcomes within the state of Georgia.

CHAPTER FOUR RESULTS

Introduction

The purpose of this study is to examine the relationship of socioeconomic status, county type (rural vs. urban), and adequacy of prenatal care on the adverse birth outcome of low birth weight in the state of Georgia for the years 2000 to 2006. This chapter describes the results of the analysis of the study which was designed to determine the relationship between socioeconomic status, county type, adequacy of prenatal care, and birth weight, controlling for the maternal characteristics of age, race, marital status, and education, for infants in the study population. The four maternal characteristics used for the analysis were the only variables available because of state and federal privacy rules.

Summary statistics were obtained by examining the demographics of the populations using frequency tables and cross tabulations. Then Chi-square analysis, ANOVA, and logistic regression were used to determine potential significant factors associate with low birth weight. The first two sections of the chapter provide a description of the population and the maternal characteristics. The third section provides a description of low birth weight and the association with maternal characteristics. Tables showing frequencies and mean values are presented. In addition, GIS maps are presented to show a county level view of where the populations with certain characteristics reside. The remaining sections discuss logistic regression results from the three major predictors as stated in the study hypotheses.

H_{1o}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{1a}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is positively associated with birth weight (i.e., as socioeconomic status increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status and education.

H_{2o}: County type as defined by the Georgia Office of Rural Health is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{2a}: County type as defined by the Georgia Office of Rural Health is associated with birth weight (i.e., infants born to urban mothers will have a higher birth weight) controlling for the maternal characteristics of age, race, marital status and education.

H_{3o}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{3a}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is positively associated with birth weight (i.e., as the level of prenatal care increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status, and education.

Description of the Population

Between the years of 2000 and 2006 there were 961,792 records of birth in Georgia. Within these records, 7.95% (76,466) contained missing information. For the purposes of the analysis these records were removed (N = 885,326).

The number of births showed a steady increase from 119,793 in 2000 to 132,062 in 2006, a 10.24% increase. Table 5 shows a detailed frequency of births by year.

Table 5

Frequency of Births in Georgia by Year 2000 - 2006

Year	Frequency	Percent
2000	119793	13.5
2001	121239	13.7
2002	124621	14.1
2003	127131	14.4
2004	129792	14.7
2005	130688	14.8
2006	132062	14.9
Total	885326	100.0

Figure 7 is a choropleth map created with the Georgia OASIS mapping tool that depicts total births from 2000 to 2006 at the county aggregation level. A choropleth map shows differences in certain characteristics by using color gradation per mapping unit, which in this case is used to show the density per county of either total births or percentage of births based on maternal characteristics.

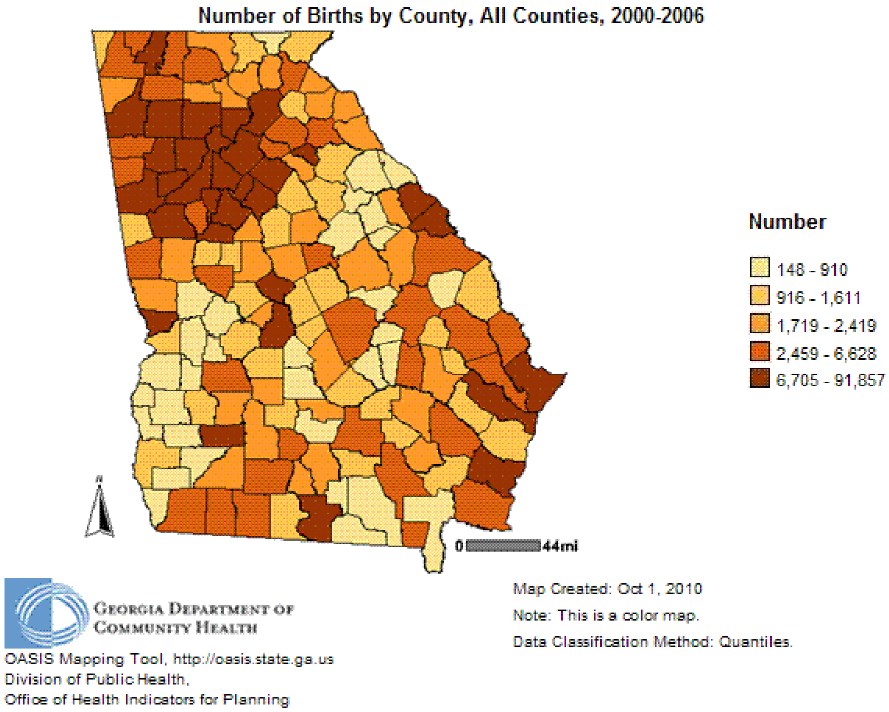

Figure 7. Number of Births by County 2000 - 2006

There are 19 public health districts in Georgia. Six health districts combined account for 50.1% of all births in the state East Metro, 95,221 (10.8%), Fulton, 81,361 (9.2%), Cobb-Douglas, 78,014 (8.8%), Dekalb, 70,879 (8.0%), LaGrange, 63,625 (7.2%), and Coastal, 54,427 (6.1%), see Table 6 and Figure 8. These districts are made up of predominantly urban counties.

Table 6

Frequency of Births by Public Health District

Public Health District	Frequency	Percent
Clayton County Health District (Jonesboro)	28804	3.3
Coastal Health District (Savannah)	54427	6.1
Cobb/Douglas Health District	78014	8.8
DeKalb Health District	70879	8.0
East Central Health District (Augusta)	45333	5.1
East Metro Health District (Lawrenceville)	95221	10.8
Fulton Health District	81361	9.2
LaGrange Health District	63625	7.2
North Central Health District (Macon)	46222	5.2
North Georgia Health District (Dalton)	40741	4.6
North Health District (Gainesville)	51829	5.9
Northeast Health District (Athens)	38009	4.3
Northwest Health District (Rome)	50024	5.7
South Central Health District (Dublin)	12563	1.4
South Health District (Valdosta)	23559	2.7
Southeast Health District (Waycross)	33003	3.7
Southwest Health District (Albany)	35185	4.0
West Central Health District (Columbus)	36527	4.1
Total	885326	100.0

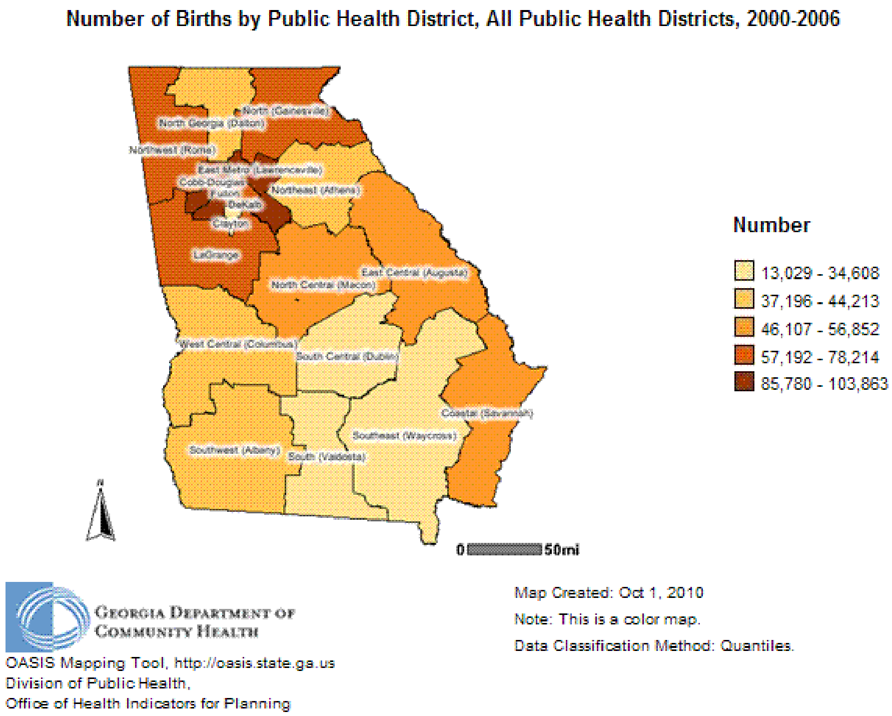

Figure 8. Number of Births by Public Health District, 2000 – 2006

There are six perinatal regions in Georgia: Atlanta, Augusta, Macon, Savannah, Columbus and Albany. The Atlanta perinatal region accounts for the largest total number of births, 517,969 (58.5%), during the study period (Table 7 and Figure 9).

Table 7

Frequency of Births by Perinatal Region

Perinatal Region	Frequency	Percent
ALBANY	51480	5.8
ATLANTA	517969	58.5
AUGUSTA	85148	9.6
COLUMBUS	72562	8.2
MACON	70737	8.0
SAVANNAH	87430	9.9
Total	885326	100.0

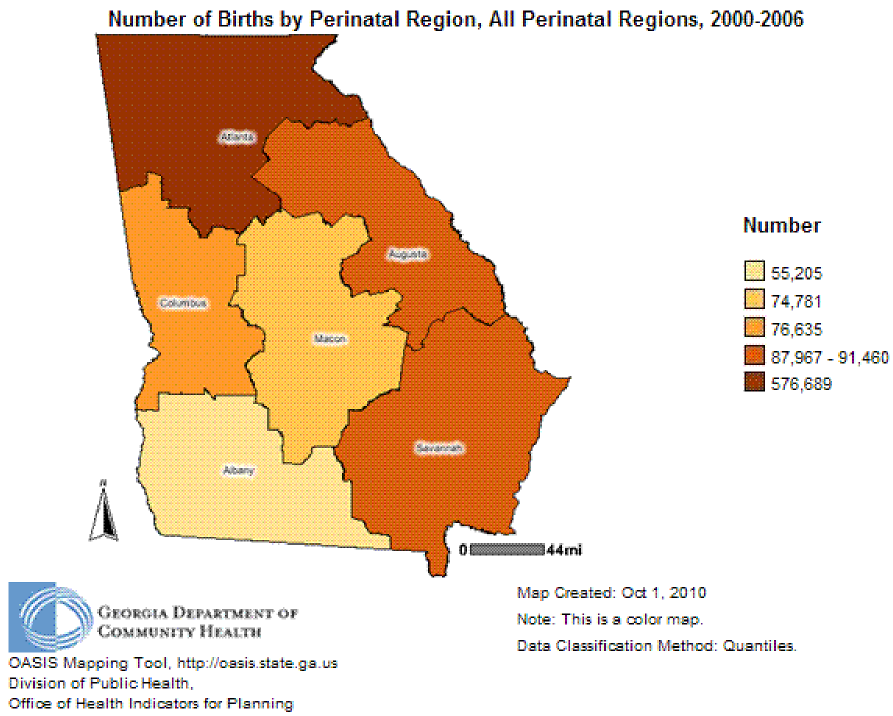

Figure 9. Number of Births by Perinatal Region, 2000 – 2006

Maternal Characteristics

The maternal characteristics in the data analysis include, age, race, marital status and education years completed. Two variables are used to measure maternal age; a continuous variable that describes the mother's age in years and a categorical variable describing the mother's age group. The mean maternal age is 26.7 years; the youngest mother in the study is 10 years old and the oldest mother is 53 years old. Age groups used for analysis are based on the National Center for Health Statistics (NCHS) 5-year age groups. The majority of the mothers are between 20 and 24 (27.8%) and 25 to 29 (26.5%), see Table 8.

Table 8

Frequency of Births by NCHS Maternal Age Group

Age Group	Frequency	Percent	Cumulative Percent
10 – 14	2154	.2	.2
15 – 19	108639	12.3	12.5
20 – 24	246559	27.8	40.4
25 – 29	234735	26.5	66.9
30 – 34	189154	21.4	88.2
35 – 39	86677	9.8	98.0
40 – 44	16626	1.9	99.9
45 – 49	764	.1	100.0
50+	18	.0	100.0
Total	885326	100.0	

There are six racial categories on the birth record. Members of all racial categories are represented in the study population. The majority of the mothers are white (63.5%), followed by African American (32.8%). Table 9 shows the birth frequencies for all races included in the study population.

Table 9

Frequency of Maternal Race

Race	Frequency	Percent
American Indian or Alaska	1811	.2
Asian	27811	3.1
Black or African-American	290012	32.8
Multiracial	2892	.3
Native Hawaiian or Other	569	.1
White	562231	63.5
Total	885326	100.0

From 2000 to 2006 there was an 11.16% increase in the number of births for African Americans and an 8.25% increase for white mothers. Figure 10 depicts the total births to white mothers by county and Figure 11 depicts the total births to African American mothers by county for 2000 to 2006.

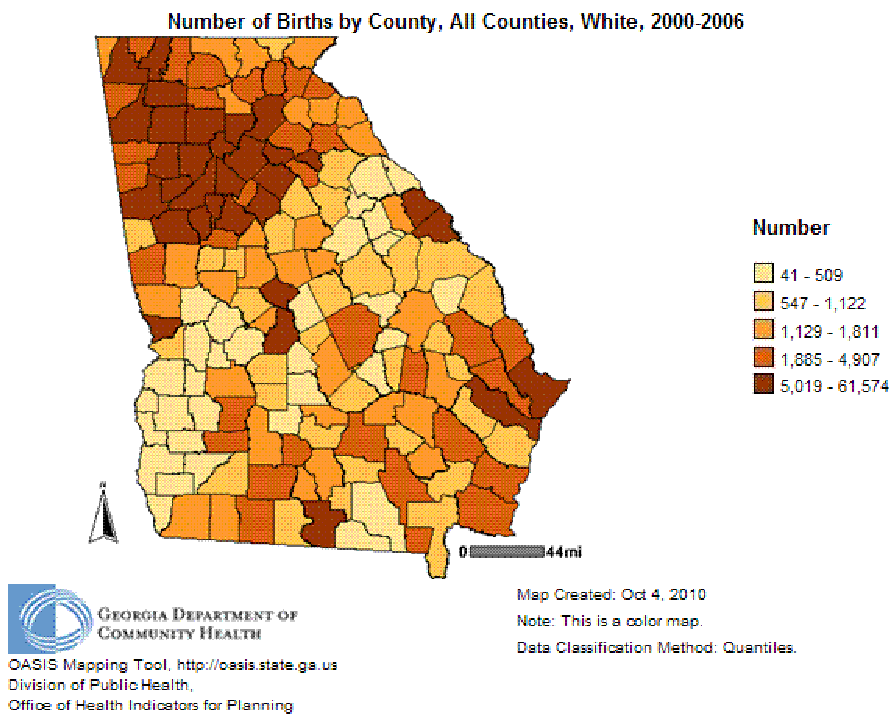

Figure 10. Number of Births to White Mothers, 2000 to 2006

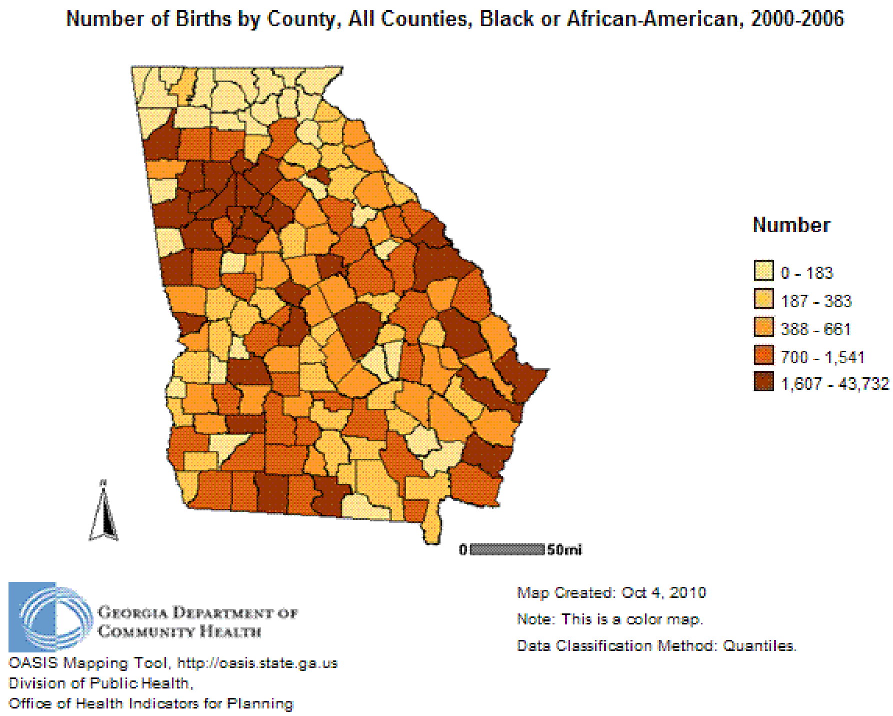

Figure 11. Number of Births to African American Mothers, 2000 to 2006

Maternal education is a continuous variable representing the number of years of education completed. Maternal education years completed range from zero years (no formal education) to 17 or more years (more than five years in college). The mean education years completed is 12.67, indicating some college education, see Table 10. Figure 12 depicts the percentage of births to mothers with less than a high school diploma by county.

Table 10

Frequency of Maternal Education Years Completed

Education Years	Frequency	Percent	Cumulative Percent
0	2763	.3	.3
1	696	.1	.4
2	1571	.2	.6
3	2970	.3	.9
4	2420	.3	1.2
5	3237	.4	1.5
6	25557	2.9	4.4
7	4818	.5	5.0
8	15435	1.7	6.7
9	46437	5.2	12.0
10	51158	5.8	17.7
11	58324	6.6	24.3
12	274061	31.0	55.3
13	59942	6.8	62.1
14	91334	10.3	72.4
15	30518	3.4	75.8
16	143185	16.2	92.0
17	70900	8.0	100.0
Total	885326	100.0	

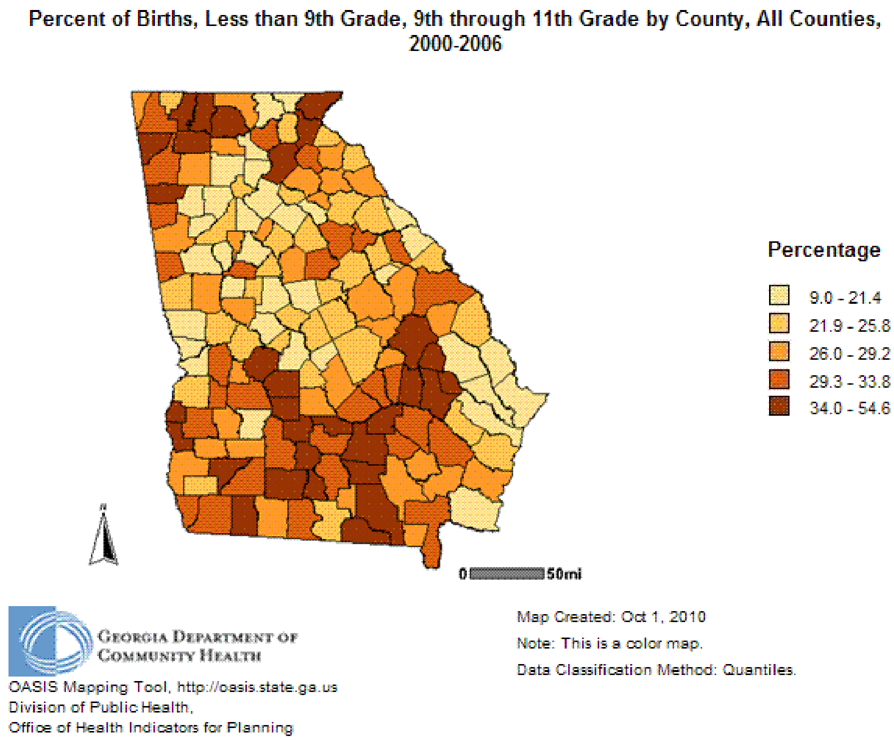

Figure 12. Percentage of Births by Mothers with Less than High School Diploma

Finally, marital status is a categorical variable that describes the mother as being married or unmarried. The majority of the births included in the study were to married mothers (60.9%), see Table 11. Figure 13 depicts the percentage of births to unmarried mothers by county.

Table 11

Frequency of Maternal Marital Status

Marital Status	Frequency	Percent
Married	538866	60.9
Unmarried	346460	39.1
Total	885326	100.0

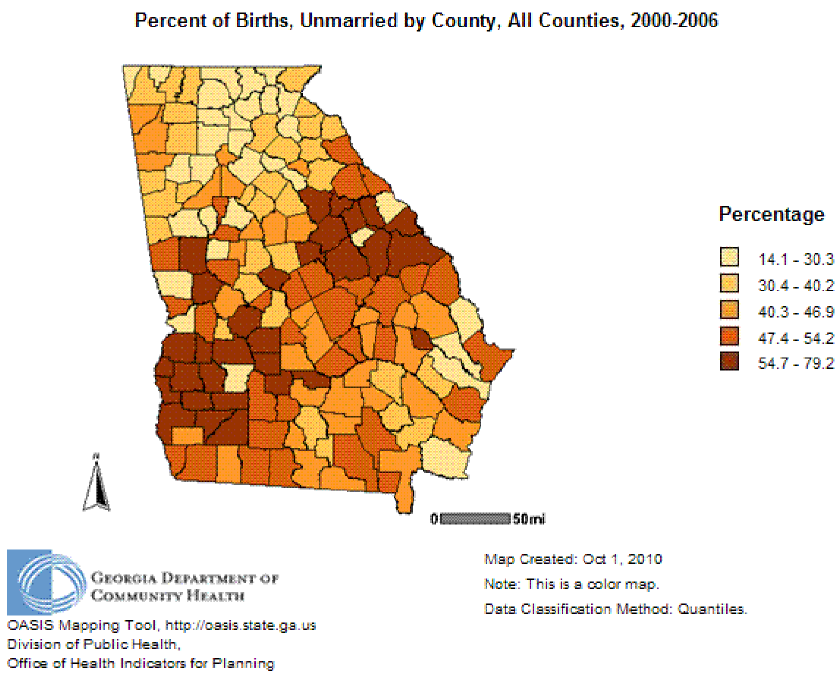

Figure 13. Percentage of Births to Unmarried Mothers by County

Analysis of variance (ANOVA) and Chi-square (χ^2) analysis is used to determine if significant differences exist between groups and their means. ANOVA is a statistical test of whether the means of several groups differ. A Chi-square analysis is used to assess two types of comparison: tests of goodness of fit and tests of independence. Goodness of fit establishes whether or not an observed frequency distribution differs from a theoretical distribution. A test of independence assesses whether paired observations on two variables, expressed in a contingency table, are independent of each other, for example whether mothers who live in either urban or rural counties differ in the frequency of marital status, married versus unmarried. The results of these significance tests for comparing the maternal characteristics of age, race, marital status and education years completed are presented in the remainder of this section.

There is a significant difference in mean maternal age by race (ANOVA, $F = 4752.576$, $p < 0.000$), see Appendix B. The mean age of African American mothers (25.45 years, SD = 6.13 years) is 1.75 years younger than white mothers (27.20 years, SD = 6.013 years) and 4.25 years younger than Asian mothers (29.7 years, SD = 5.098 years), see Table 12.

Table 12

Mean Maternal Age by Maternal Race

Maternal Race	Mean Age	Std. Deviation	N
American Indian or Alaska	26.56	6.027	1811
Asian	29.70	5.098	27811
Black or African-American	25.45	6.130	290012
Multiracial	24.66	6.038	2892
Native Hawaiian or Other	25.91	5.553	569
White	27.20	6.013	562231
Total	26.70	6.105	885326

Because there is a significant difference in the mean maternal age by race, the overall mean age does not appropriately describe the study population and that mean ages by racial groups more appropriately describe the study population.

The association between maternal age and race is further supported since there is a significant difference between maternal age group and race [χ^2 (40 d.f., N = 885,326) = 27074.001, p = <0.000], see Appendix B. The largest percentage of African American mothers is between 20 to 24 years of age (33.1%) and the largest percentage of white mothers is between 25 to 29 years of age (27.5%). The number of infants born to a white mother ages 10 to 19 is higher (59,098) than to African American mothers (50,117). However, the percentage of babies born to African American mothers under the age of 20 is higher (17.3%) than white mothers under the age of 20 (10.5%).

There is a significant difference in mean maternal age by marital status (ANOVA, F = 201855.755, p < 0.000), see Appendix B. The mean maternal age for unmarried mothers was 23.42 years (SD = 5.445 years) as compared to married mothers at 28.81 years (SD = 5.551 years), see Table 13.

Table 13

Mean Maternal Age by Marital Status

Marital Status	Mean Age	Std. Deviation	N
Married	28.81	5.551	538866
Unmarried	23.42	5.445	346460
Total	26.70	6.105	885326

There is a significant association between marital status and age group [χ^2 (8 d.f., N = 885,326) = 179596.968, p = < 0.000], see Appendix B. Of the mothers who are less than 20 years of age, 80.2% were unmarried. Of all married mothers, 30.5% were between the ages of 25 to 29 and 29.2% were between 30 and 34. Figure 14 depicts the percentage of births to unmarried teenage mothers.

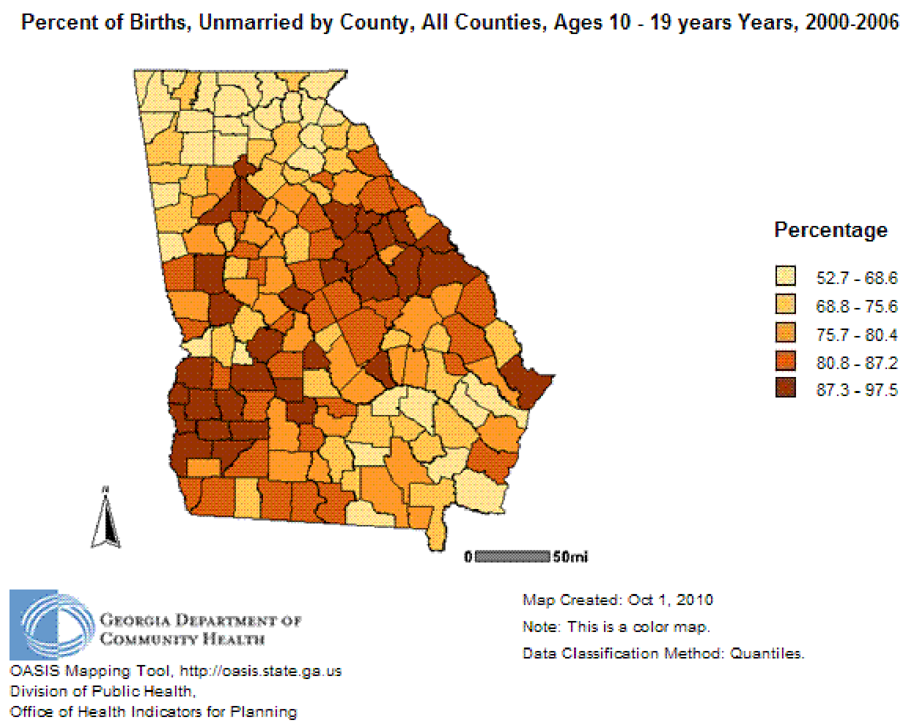

Figure 14. Percentage of Births to Unmarried Mothers Ages 10 – 19

There is a significant difference in mean education years completed by maternal age group (ANOVA, F = 26122.107, p < 0.000), see Appendix B. Mothers between 35 and 39 years old and between 45 and 49 years old had the most completed years of education, on average, with means of 14.19 years (SD = 2.774 years) and 14.16 years (SD = 3.131 years), respectively (Table 14).

Table 14

Mean Education Years by Maternal Age Group

Age Group	Mean Education Years	Std. Deviation	N
10 - 14	7.57	1.122	2154
15 - 19	10.49	1.813	108639
20 - 24	11.67	2.376	246559
25 - 29	13.03	2.926	234735
30 - 34	14.04	2.826	189154
35 - 39	14.19	2.774	86677
40 - 44	13.99	2.886	16626
45 - 49	14.16	3.131	764
50+	12.83	5.238	18
Total	12.67	2.915	885326

There is a significant difference in the mean maternal education years completed and race (ANOVA, $F = 1346.491$, $p < 0.000$), see Appendix B. Asian mothers have a higher level of educational attainment with a mean number of years completed at 14.07. The average years of education years completed are the same for whites and African Americans at 12.63 years (SD = 2.130 for African Americans and SD = 3.237 for whites); there is no significant difference between white and African American mothers ($p > 0.05$).

There is a significant difference in the mean maternal education years completed and marital status (ANOVA, $F = 125756.537$, $p < 0.000$), see Appendix B. Married mothers have a mean education years completed of 13.50 as compared to unmarried mothers at 11.39 years completed, see Table 15.

Table 15

Mean Education Years Completed by Marital Status

Marital Status	Mean Education Years	Std. Deviation	N
Married	13.50	2.898	538866
Unmarried	11.39	2.439	346460
Total	12.67	2.915	885326

There is a significant difference between marital status category and race [χ^2 (5 d.f., N = 885,326) = 140548.660, p = < 0.000], see Appendix B. Of the births to married mothers, 76.9% are white and 17.9% are African American. Of the births to unmarried mothers, 55.8% are to African Americans. Figure 15 depicts the percentage of births to unmarried African American mothers by county.

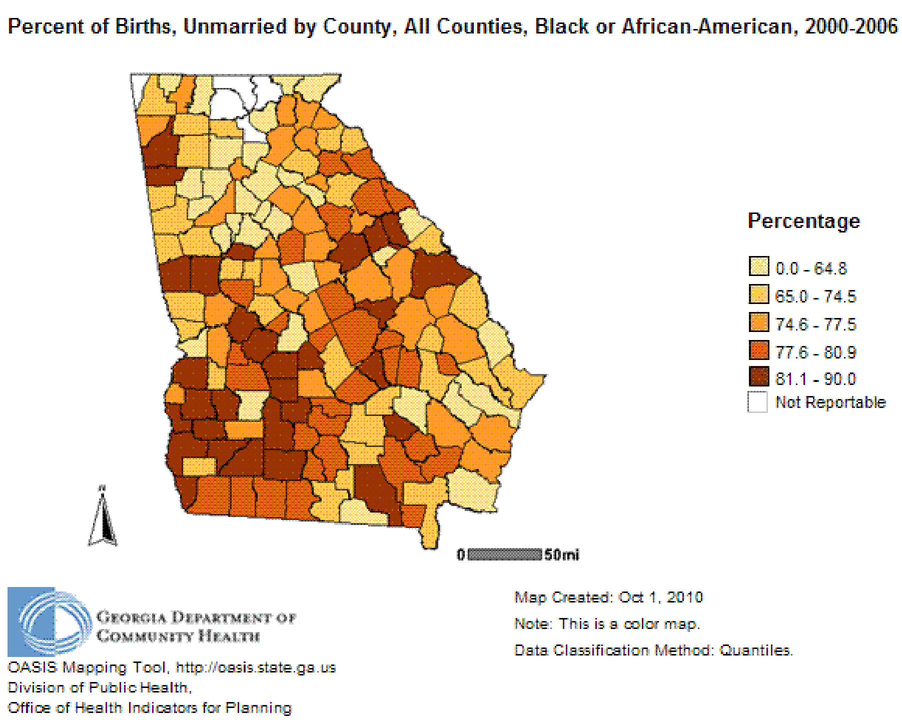

Figure 15. Percentage of Births to Unmarried African American Mothers

Low Birth Weight and Maternal Characteristics

Two variables are used for birth weight; a continuous variable that describes the infant's birth weight in grams at birth and a binary categorical variable indicating if the infant is low birth weight, less than 2,500 grams. Infant birth weights range from 200 grams (7.05 ounces) to 7,270 grams (16 pounds and 0.44 ounces), with a mean birth weight of 3,250 grams (7 pounds and 2.64 ounces). There are 78,085 (8.8%) infants classified as low birth weight, or less than 2,500 grams (Table 16 and Figure 16).

Table 16

Descriptive Statistics for Birth Weight

Low Birth Weight	Frequency	Percent
Normal	807241	91.2
Low Birth Weight	78085	8.8
Total	885326	100.0

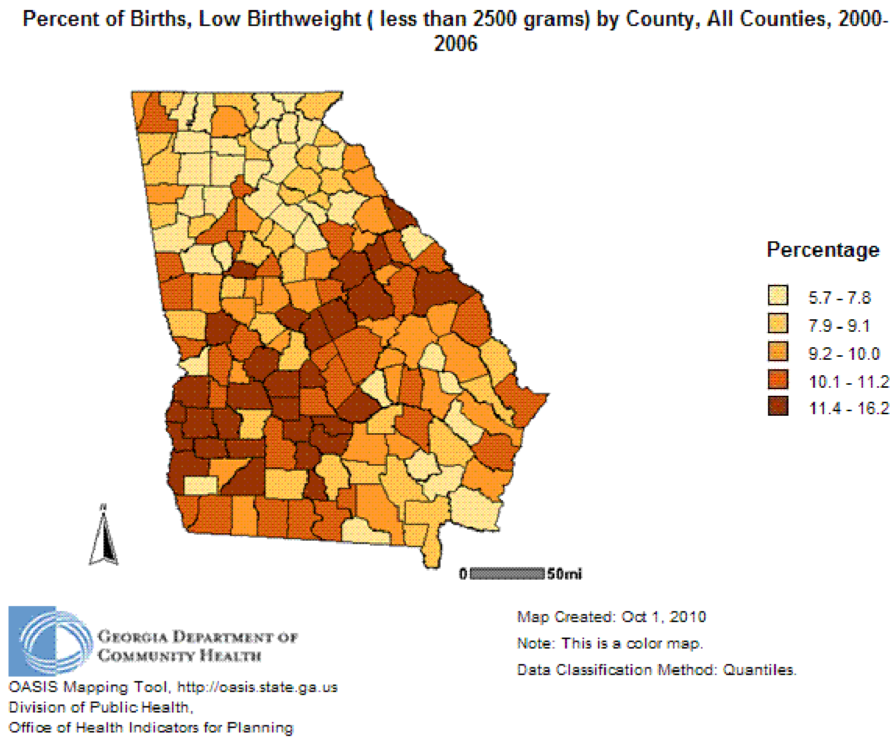

Figure 16. Percentage of Low Birth Weight Births by County

There is a significant difference in mean birth weight and maternal age group (ANOVA, $F = 1187.726$, $p < 0.000$), see Appendix B. The mean birth weight is lowest for those mothers over the age of 50 (2,811.83 grams), see Table 17.

Table 17

Mean Birth Weight by Maternal Age Group

Age Group	Mean Birth Weight	Std. Deviation	N
10 – 14	3009.54	616.084	2154
15 – 19	3128.49	587.210	108639
20 – 24	3207.38	589.354	246559
25 – 29	3285.85	595.823	234735
30 – 34	3314.82	614.207	189154
35 – 39	3295.04	642.800	86677
40 – 44	3233.13	679.969	16626
45 – 49	3173.54	718.303	764
50+	2811.83	595.631	18
Total	3250.01	606.787	885326

The highest mean birth weight is 3,314.82 grams for mothers between 30 and 34. There is not a significant difference between the 10 to 14 age group and the over 50 age group with respect to mean birth weight ($p = 0.166$), nor is there a significant difference between the 20 to 24 and 45 to 49 age groups ($p = 0.122$). All other age groups were significantly different ($p < 0.05$) in mean birth weight.

There is a significant difference in birth weight category (normal vs. low birth weight) by maternal age group [χ^2 (8 d.f., N = 885,326) = 1432.116, p = < 0.000], see Appendix B. The highest percentage of low birth weight infants were born to mothers in the over 50 age group (22.2%) and the 10 to 14 age group (14.1%). The 25 to 29 age group had the lowest percentage (7.8%) of low birth weight infants.

There is a significant difference in mean birth weight and race (ANOVA, $F = 6968.921$, $p < 0.000$), see Appendix B. The difference in mean birth weight for whites and African Americans is significant from all other race groups ($p < 0.000$). African Americans have the lowest mean birth weight at 3,084.76 grams and whites have the highest mean birth weight at 3,337.93 grams, see Table 18. The difference between the two means is 252.87 grams, or 8.91 ounces.

Table 18

Mean Birth Weight by Maternal Race

Race	Mean Birth Weight	Std. Deviation	N
American Indian or Alaska	3248.09	588.180	1811
Asian	3197.64	537.071	27811
Black or African-American	3084.76	639.686	290012
Multiracial	3225.66	604.226	2892
Native Hawaiian or Other	3285.38	576.491	569
White	3337.93	573.719	562231
Total	3250.01	606.787	885326

There is a significant difference between birth weight category and race [χ^2 (5 d.f., N = 885,326) = 10390.079, p = < 0.000], see Appendix B. The percentage of low birth weight infants for African Americans was 13.2%, while the percentage for whites was 6.6%. Figure 17 depicts the percentage of low birth weight births for African Americans by county.

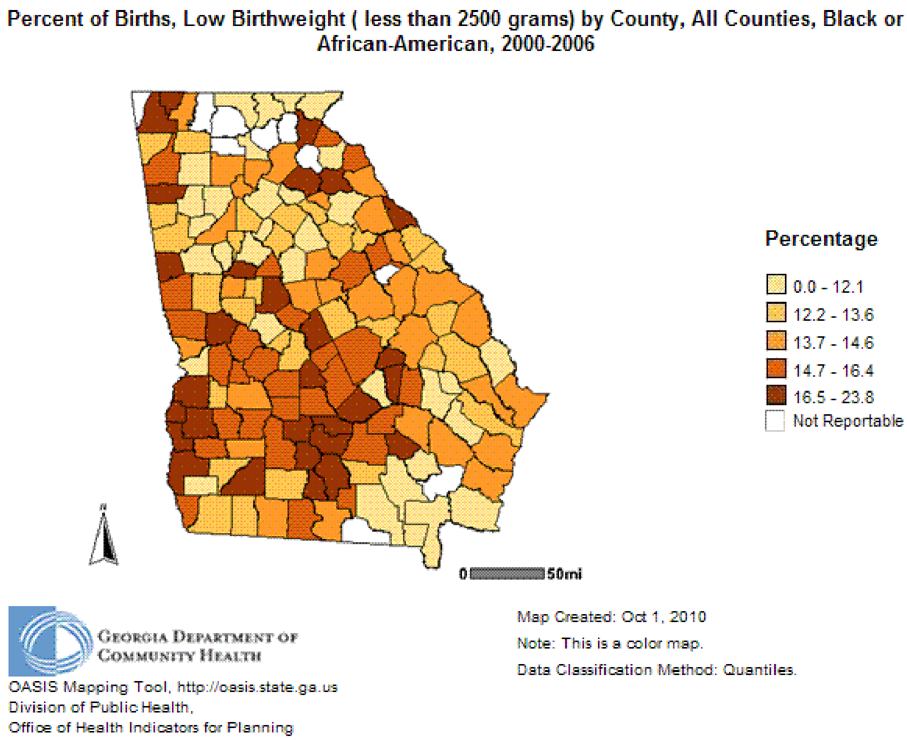

Figure 17. Percentage of Low Birth Weight Births, African American Mothers

The mean birth weight for infants of white mothers was 3,337.93 grams as compared to infants of African American mothers at 3,084.76 grams. The highest percentage of low birth weight infants for African American mothers was between the ages of 45 and 49 (17.4%) and 10 to 14 (17.0%). White mothers between the ages of 10 to 14 and 45 to 49 experienced a lower percentage of low birth weight infants, 8.2% and 15.6% respectively, than African American mothers in those same age categories. The highest percentage of low birth weight infants for white mothers is those over the age of 50 (23.5%).

There is a significant difference between mean birth weight and marital status (ANOVA, $F = 20398.744$, $p < 0.000$), see Appendix B. The mean birth weight for unmarried mothers was 3,136.44 grams as compared to married mothers at 3,323.02 grams, see Table 19.

Table 19

Mean Birth Weight by Maternal Marital Status

Marital Status	Mean Birth Weight	Std. Deviation	N
Married	3323.02	589.453	538866
Unmarried	3136.44	615.834	346460
Total	3250.01	606.787	885326

There is a significant difference between birth weight category (normal vs. low birth weight) and marital status [χ^2 (1 d.f., N = 885,326) = 4821.522, p = < 0.000], see Appendix B. The largest percentage of low birth weight births (11.4%) is to unmarried mothers. Figure 18 depicts the percentage of low birth weight births to unmarried mothers by county.

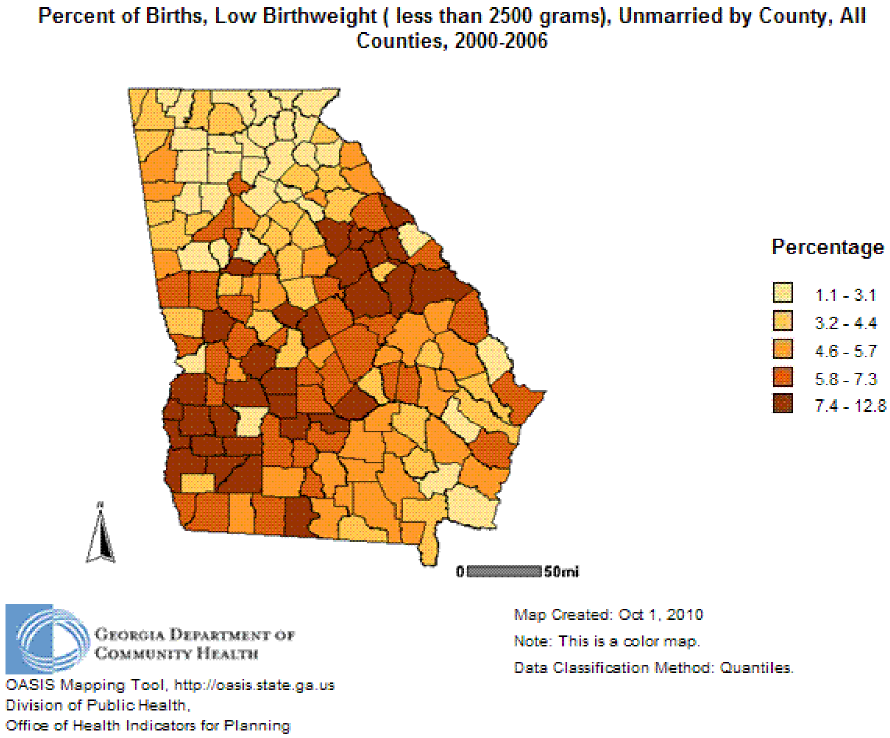

Figure 18. Percentage of Low Birth Weight Births to Unmarried Mothers

Socioeconomic Status

Georgia's Division of Public Health has defined eighteen distinct demographic clusters that represent the varying socioeconomic strata. There are four major categories including, higher, middle, lower middle and lower socioeconomic status. Each of these categories is further subdivided to create eighteen different demographic clusters.

The highest number of births is associated with demographic cluster 1.3, 157,471 (17.8%). This cluster is classified as a higher socioeconomic status. This class of individuals is typically in their 30's and 40's, found in metro area suburbs and is of mixed ethnicity. Most are employed in white collar jobs or are high-earning blue collar families with a median income well above the state average (Office of Health Information and Policy, 2005). The majority of the mothers in the study population in the 1.3 demographic cluster are between the ages of 30 to 34 (29.2%), white (67.8%), married (74.8%) and have a mean education years completed of 13.59 years.

In addition to demographic cluster 1.3, three other clusters make up 55% of the births: 3.4, 114,344 births (12.9%), 3.1, 108,400 births (12.2%), and 3.3, 107,423 births (12.1%). A majority of the births belong to the lower middle class category, i.e. 3.1, 3.3, and 3.4 with 349,780 births (39.4%). The descriptions of the lower middle class demographic profiles are listed in Table 20.

Table 20

Lower Middle Class Demographic Profile Descriptions

Demographic Cluster	**Description**
3.1	This cluster is a white, middle class rural cluster dominated by married families with children. They are mainly home owners, but the value of their housing is much lower than in urban areas. Many in this cluster are high school graduates; but they are higher than the state average in population that failed to graduate from high school. The cluster is highly represented in farming and construction and is widespread across the state.
3.2	Although this cluster includes younger populations, it is dominated by the 55+ age group. Found predominantly in N/NE rural counties of Georgia, the cluster is white with some African-American population. As would be expected of a population with many persons living on fixed incomes, this cluster has lower income than families currently working; bur their incomes are still average compared to the state.
3.3	This mixed-ethnicity cluster is average in its age profile, but has a higher percentage of single parent families than the state as a whole. A large percent did not finish high school and they are much less likely to have a 4-year college degree. Approaching the state average in income, these families work in lower paring service, sales and managerial jobs to maintain a lower middle class lifestyle.
3.4	Composed of rural married and single parent families, this cluster is older than cluster 3.1 and less affluent. Predominantly white with some African-American population, this group is much more likely to own low value housing, not to have finished high school, and to work in farming.

The majority of the mothers in demographic cluster 3.1 are white (88.3%), between the ages of 20 and 29 (57.6%), married (71.6%) and have a mean education years completed of 12.66 years. This is comparable to the description above. The majority of the mothers in demographic cluster 3.3 are white (58.3%), between the ages of 20 and 24 (32.5%), married (55.2%) with a mean education years completed of 12.2 years. This cluster has a higher percentage of unmarried mothers (44.8%) and African American mothers (38.2%) than cluster 3.1. The majority of the mothers in cluster 3.4 are white (72.5%), between the ages of 20 and 24 (35.7%), married (56.3%) and have a mean education years completed of 11.77 years. This group of mothers has the lowest mean education years completed of the three clusters.

Table 21

Frequency of Births by Demographic Cluster

Demographic Cluster	Frequency	Percent	Cumulative Percent
1.1	46329	5.2	5.2
1.2	50701	5.7	11.0
1.3	157471	17.8	28.7
2.1	21220	2.4	31.1
2.2	22020	2.5	33.6
2.3	61601	7.0	40.6
2.4	16085	1.8	42.4
3.1	108400	12.2	54.6
3.2	19613	2.2	56.9
3.3	107423	12.1	69.0
3.4	114344	12.9	81.9
4.1	25680	2.9	84.8
4.2	19920	2.3	87.1
4.3	44861	5.1	92.1
4.4	36262	4.1	96.2
4.5	15461	1.7	98.0
4.6	1779	.2	98.2
4.7	16156	1.8	100.0
Total	885326	100.0	

In addition to analysis of variance (ANOVA) and Chi-square (χ^2)analysis, logistic regression was used to test the hypothesis that socioeconomic status is not associated with birth weight controlling for maternal age, race, education, and marital status. A backward elimination logistic regression was performed with the outcome variable of low birth weight. The attribute variables were: demographic cluster, maternal race, maternal marital status, maternal age group, and maternal education years completed. All attribute variables are categorical with the exception of maternal education years completed, which is continuous. Tables showing the results of the logistic regression analysis are in Appendix C. The results of the significance tests and the logistic regression for socioeconomic status and low birth weight are presented in the remainder of this section.

Birth weight is represented in the study data as both a continuous variable in grams as well as an indicator if the infant is low birth weight, or less than 2,500 grams. There is a significant difference in mean birth weight by demographic cluster (ANOVA, $F = 760.529$, $p < 0.000$), see Appendix B. The lowest mean birth weights are within the lower socioeconomic strata, 4.7 (3,044.81 grams), 4.5 (3,045.98 grams) and 4.4 (3,099.29 grams), see Table 22.

Table 22

Mean Birth Weight by Demographic Cluster

Demographic Cluster	Mean Birth Weight	Std. Deviation	N
1.1	3347.97	575.285	46329
1.2	3308.30	599.701	50701
1.3	3307.74	599.139	157471
2.1	3286.38	578.075	21220
2.2	3287.07	599.884	22020
2.3	3232.43	606.146	61601
2.4	3273.37	604.134	16085
3.1	3303.01	589.684	108400
3.2	3250.33	608.674	19613
3.3	3234.63	612.232	107423
3.4	3223.74	602.137	114344
4.1	3285.77	561.440	25680
4.2	3111.01	640.760	19920
4.3	3148.10	623.420	44861
4.4	3099.29	624.101	36262
4.5	3045.98	632.968	15461
4.6	3133.86	622.636	1779
4.7	3044.81	622.974	16156
Total	3250.01	606.787	885326

There is a significant difference between birth weight category (normal vs. low birth weight) and demographic cluster [χ^2 (17 d.f., N = 885,326) = 3611.723, p = < 0.000], see Appendix B. Within each demographic cluster, the highest percentage of low birth weight is associated with clusters 4.5 (14.6%) and 4.7 (14.5%).

Logistic regression is used to determine associations between a dependent categorical variable, low birth weight, and a set of predictor variables. For the logistic regression analysis for the first study hypothesis, socioeconomic status as defined by the demographic profiles and the maternal characteristics of age group, race, marital status, and education are used.

The demographic cluster variable was created using census data variable classes containing: age, income, family structure, housing value and housing type, education and employment type. Because age and education are also included as separate variables in the analysis this duplication with demographic cluster can cause intercorrelation or mulitcollinearity. To account for mulitcollinearity, the logistic regression analysis was created with and without the maternal characteristics of age and education. The analysis was also run with and without the demographic cluster variable. The different models created show similar regression coefficients that only vary slightly for the variable groupings, significant results are comparable across the models. Because of the similarities, the model with the demographic cluster and all other maternal characteristics including age and education are used for the analysis.

With low birth weight as the outcome, there are 885,326 cases used in the analysis. In the Logistic regression output, see Appendix C, the Omnibus Tests of Model Coefficients tests the null hypothesis that adding the predictor variables to an intercept only model does not significantly increase the ability to predict the outcome of low birth weight. For the analysis the χ^2 statistic is 12169.848 with a p-value < 0.01 which allows the null to be rejected. This indicates that the model with the predictors has greater prediction ability and hence the better model.

All of the predictor variables are included in the model. For analysis of low birth weight, each categorical variable group is compared to the first group as a reference indicator within the variable. The indicator variables for the analysis are listed in Table 23.

Table 23

Indicator Values for Predictor Variables

Predictor Variable	Indicator (Category) for Analysis
Demographic Cluster	1.1
Race	White
Age Group	10 to 14
Marital Status	Married

The logistic regression analysis output provides an odds ratio for each category in comparison to the indicator category. The odds ratio describes the strength of association or non-independence between two binary data values. An odds ratio of 1 implies that the event is equally likely in both groups. An odds ratio greater than one implies that the event is more likely in the first group and an odds ratio less than one implies that the event is less likely in the first group. The odds of low birth weight for the model covariates is represented by Exp(B) (Table 24).

The age categories of 15 to 19, 30 to 34, and 35 to 39 are not significant predictors of low birth weight ($p = 0.172$, $p = 0.398$, $p = 0.052$, respectively) when compared to the reference indicator of age group 10 to 14. The oldest age groups have the highest odds ratios. For mothers over the age of 50, the odds ratio is 3.692 [95% CI (1.195, 11.404)]. In other words, the odds of an infant being low birth weight are 3.692 times higher for infants born to mothers who are over the age of 50 than to mothers who are the age of 10 to 14. Mothers in the age group 45 to 49 had an odds ratio of 2.093 [95% CI (1.661, 2.637)] and mothers ages 40 to 44 had an odds ratio of 1.443 [95% CI (1.264, 1.648)].

White mothers are the indicator category for race. The category of Native Hawaiian/Other was not significantly different than white mothers ($p = 0.924$). African American mothers had the highest odds ratio of 1.914 [95% CI (1.879, 1.948)]. The odds of an infant being low birth weight are 1.914 times higher for infants born to African American mothers than infants of white mothers.

Education years completed is a continuous variable and is significant ($p < 0.000$) for the analysis. The odds ratio for education is 0.990 [95% CI (0.986, 0.993)]. This is interpreted as for a one year increase in education years completed; there is a reduced odds of 0.990 of a low birth weight infant.

For marital status, the reference category is married. The odds ratio for unmarried mothers is 1.301 [95% CI (1.276, 1.325)]. The odds of an infant being low birth weight are 1.301 times higher for infants born to unmarried mothers than infants of married mothers.

Within demographic cluster, 1.3 ($p = 0.618$), 2.1 ($p = 0.118$), 2.2 ($p = 0.305$), 2.3 ($p = 0.702$), and 2.4 ($p = 0.958$), are not significant when compared with the reference indicator of demographic cluster 1.1. All clusters within the lower middle and lower demographic clusters are significant for the analysis. Demographic cluster 4.5 ($p < 0.000$) has an odds ratio of 1.297 [95% CI (1.220, 1.378)].; the odds of an infant being low birth weight are 1.297 times higher for infants born to mothers in demographic cluster 4.5 than to those born in cluster 1.1. Of the demographic clusters, those in the lower socioeconomic strata (4.4, 4.5, 4.6, and 4.7) had the highest odds of low birth weight, see Table 24.

Table 24

Odd Ratios for Lower Middle and Lower Socioeconomic Strata

Demographic Cluster	Significance	Exp(B)	95% CI
3.1	.000	1.129	(1.081, 1.180)
3.2	.013	1.083	(1.017, 1.154)
3.3	.000	1.088	(1.041, 1.136)
3.4	.000	1.176	(1.126, 1.229)
4.1	.001	0.895	(0.841, 0.953)
4.2	.000	1.157	(1.092, 1.227)
4.3	.018	1.062	(1.011, 1.117)
4.4	.000	1.211	(1.151, 1.275)
4.5	.000	1.297	(1.220, 1.378)
4.6	.007	1.223	(1.056, 1.417)
4.7	.000	1.215	(1.144, 1.291)

The hypotheses addressed by these analyses are:

H_{10}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{1a}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is positively (i.e., as socioeconomic status increases infant birth weight also increases) associated with birth weight controlling for the maternal characteristics of age, race, marital status and education.

Based on the results ($p < 0.000$), the null hypothesis can be rejected and therefore the alternative hypothesis is concluded. Socioeconomic status is positively associated with birth weight.

County Type

An urban county is defined as a county that has more than 35,000 in total population (Georgia Rural Health Association, 2009). The majority of the births during 2000 – 2006 were born to mothers living in an urban county, 735,411 (83.1%). Table 25 below shows the frequency of both urban and rural births.

Table 25

Frequency of Births by County Type

County Type	Frequency	Percent
Urban	735411	83.1
Rural	149915	16.9
Total	885326	100.0

Between 2000 and 2006 there was an 11.02% increase in the number of births to mothers living in urban counties and a 6.58% increase for rural mothers.

There is a significant difference in mean maternal age by county type (ANOVA, $F = 11667.637$, $p < 0.000$), see Appendix B. The mean age of mothers in rural counties (25.15 years) is 1.86 years younger than that of urban mothers (27.01 years), see Table 26.

Table 26

Mean Age by County Type

County Type	Mean Maternal Age	Std. Deviation	N
Urban	27.01	6.118	735411
Rural	25.15	5.801	149915
Total	26.70	6.105	885326

Because there is a significant difference in the mean maternal age by county type, the overall mean age of 26.7 years for the study population does not best describe the average age of mothers in each county type, therefore group means are the better measure for indicating the mean age by county type.

There is a significant difference between maternal age group and county type [χ^2 (8 d.f., N = 885,326) = 11507.795, p = <0.000], see Appendix B. Of mothers living in rural counties, the highest percentage is between the ages of 20 to 24.

There is a significant difference between maternal race and county type [χ^2 (5 d.f., N = 885,326) = 4592.499, p = <0.000], see Appendix B. Among African American mothers, 84.0% live in urban counties and 16.0% live in rural counties. Among white mothers, 81.9% live in urban counties and 18.1% live in rural counties.

Among the urban mothers who gave birth during 2000 – 2006, 62.6% were white and 33.1% were African American. There are similar percentages for rural mothers with 68.0% white and 31% African American. Within urban counties, 61.8% of the births were to married women and 38.2% are to unmarried mothers.

In rural counties, the percentage births to married mothers are 56.3% and 43.7% to unmarried mothers. There is a significant difference between marital status category and county type [χ^2 (1 d.f., N = 885,326) = 1584.152, p = < 0.000], see Appendix B.

There is a significant difference in mean maternal education years completed by county type (ANOVA, F = 6298.553, p < 0.000), see Appendix B. The mean education years completed of mothers in rural counties (12.13) is lower than the years completed by urban mothers (12.78), see Table 27.

Table 27

Mean Education Years by County Type

County Type	Mean Education Years	Std. Deviation	N
Urban	12.78	2.976	735411
Rural	12.13	2.527	149915
Total	12.67	2.915	885326

In addition to analysis of variance (ANOVA) and Chi-square (χ^2) analysis, logistic regression was used to test the hypothesis that county type is not associated with birth weight controlling for certain maternal age, race, education, and marital status. A backward elimination logistic regression was performed with the outcome variable of low birth weight. The attribute variables were: county type, maternal race, maternal marital status, maternal age group, and maternal education years completed. All attribute variables are categorical with the exception of maternal education years completed, which is continuous. Tables showing the results of the logistic regression analysis are in Appendix C. The results of the significance tests and the logistic regression for county type and low birth weight are presented in the remainder of this section.

There is a significant difference in mean birth weight by county type (ANOVA, $F = 642.147$, $p < 0.000$), see Appendix B. The lowest mean birth weights are for mothers who live in rural counties, see Table 28.

Table 28

Mean Birth Weight by County Type

County Type	Mean Birth Weight	Std. Deviation	N
Urban	3257.38	606.152	735411
Rural	3213.83	608.597	149915
Total	3250.01	606.787	885326

There is a significant difference between low birth weight and county type [χ^2 (1 d.f., N = 885,326) = 129.912, p = < 0.000], see Appendix B. Within rural counties, 9.6% of the births are low birth weight, as opposed to urban counties with 8.7%.

For the logistic regression analysis for the second study hypothesis, county type, rural vs. urban, and the maternal characteristics of age group, race, marital status, and education are used. The outcome being modeled is that the infant is low birth weight. There are 885,326 cases used in the analysis. In the Logistic regression output, see Appendix C, the Omnibus Tests of Model Coefficients tests the null hypothesis that adding the predictor variables to an intercept only model does not significantly increase the ability to predict the outcome of low birth weight. For the analysis the χ^2 statistic is 11936.428 with a p-value < 0.01 which allows the null to be rejected. This indicates that the model with the predictors has greater prediction ability, hence the better model.

As with the logistic regression analysis for hypothesis 1, all of the predictor variables are included in the model. For analysis of low birth weight, each categorical variable group is compared to the first group as a reference indicator within the variable. The indicator variables are the same as with hypothesis 1, see Table 23.

The results of the analysis yield similar results to that of hypothesis 1. The categories that are not significantly different than their reference indicators are the same; Native Hawaiian/Other (p = 0.872) is not significantly different than white and age groups 15 to 19 (p = 0.156), 30 to 34 (p = 0.258), and 35 to 39 (p = 0.105) are not significantly different than age group 10 to 14. The odds ratios are also similar, see Table 29.

Table 29

Odds Ratios for Selected Variables

Variable	Category	Significance	Exp(B)	95% CI
Race	African American	.000	1.956	(1.924, 1.989)
Marital Status	Unmarried	.000	1.382	(1.292, 1.341)
Education		.000	.988	(0.985, 0.991)
Age Group	40 to 44	.000	1.414	(1.238, 1.614)
	45 to 49	.000	2.049	(1.626, 2.581)
	50+	.027	3.574	(1.158, 11.027)

County type is significant ($p < 0.000$) with an odds ratio of 1.135 [95% CI (1.113, 1.157)] for rural mothers. In other words, the odds of an infant being low birth weight are 1.135 times higher for infants born to rural mothers than infants of urban mothers.

The hypotheses addressed by these analyses:

H_{20}: County type as defined by the Georgia Office of Rural Health is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{2a}: County Type as defined by the Georgia Office of Rural Health is associated with birth weight (i.e., infants born to urban mothers will have a higher birth weight) controlling for the maternal characteristics of age, race, marital status and education.

Based on the results, the null hypothesis can be rejected and therefore the alternative hypothesis is concluded. County type is associated with birth weight.

Adequacy of Prenatal Care

Adequacy of prenatal care is based on the Adequacy of Prenatal Care Utilization index, also called the Kotelchuck index. Based on the study data, 75.0% of mothers received adequate or more than adequate prenatal care; only 11.2% received inadequate prenatal care, see Table 30. Figure 19 depicts the percentage of births to women with inadequate prenatal care.

Table 30

Frequency of Births by Adequacy of Prenatal Care Utilization Index

Kotelchuck Index	Frequency	Percent	Cumulative Percent
Inadequate	99511	11.2	11.2
Intermediate	121824	13.8	25.0
Adequate	364596	41.2	66.2
Adequate Plus	299395	33.8	100.0
Total	885326	100.0	

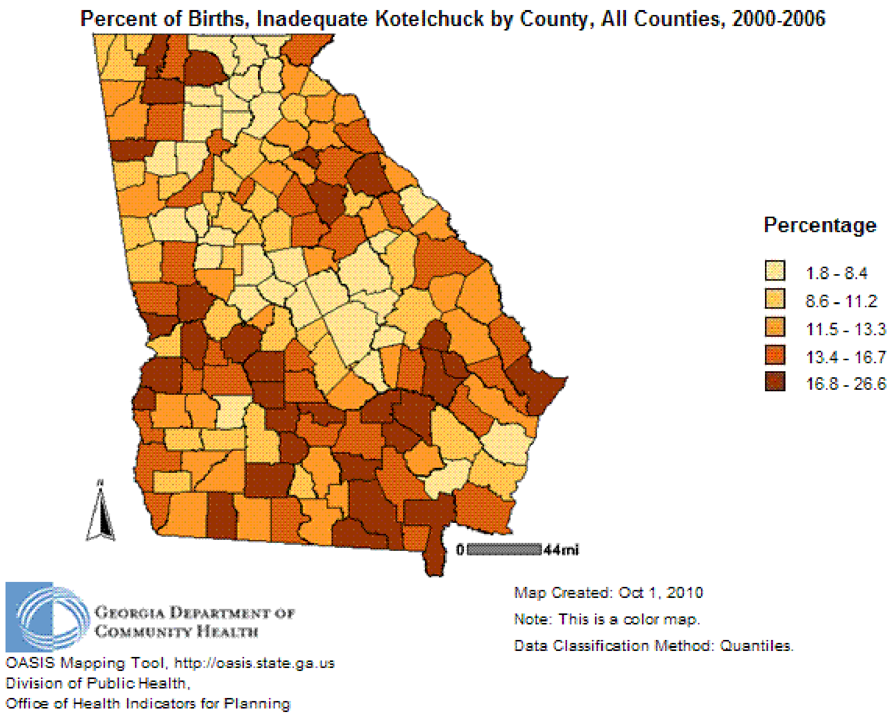

Figure 19. Percentage of Births to Mothers with Inadequate Prenatal Care

There is a significant difference between mean maternal age and each category of the adequacy of prenatal care index (ANOVA, F = 5680.958, p < 0.000), see Appendix B. The mean age for inadequate prenatal care is 24.52 years and 27.03 for adequate prenatal care, see Table 31.

Table 31

Mean Age by Adequacy of Prenatal Care Utilization

Kotelchuck Index	Mean	Std. Deviation	N
Inadequate	24.52	5.986	99511
Intermediate	26.19	5.989	121824
Adequate	27.03	6.002	364596
Adequate Plus	27.22	6.145	299395
Total	26.70	6.105	885326

There is a significant difference between age group and adequacy of prenatal care index [χ^2 (24 d.f., N = 885,326) = 19039.659, p = < 0.000], see Appendix B. Among those classified as having inadequate prenatal care, 21.4% were less than 19 years of age and 35.3% were between 20 and 24 years. Among those classified as having adequate prenatal care, 27.4% were 25 to 29 years of age.

There is a significant difference between race and adequacy of prenatal care [χ^2 (15 d.f., N = 885,326) = 7256.752, p = < 0.000], see Appendix B. For white mothers 9.5% received inadequate prenatal care as compared to 15.0% for African American mothers. White mothers had a higher percentage of adequate prenatal care (42.7%) as opposed to African American mothers (37.5%). Figure 20 depicts the percentage of births to African American mothers with inadequate prenatal care by county.

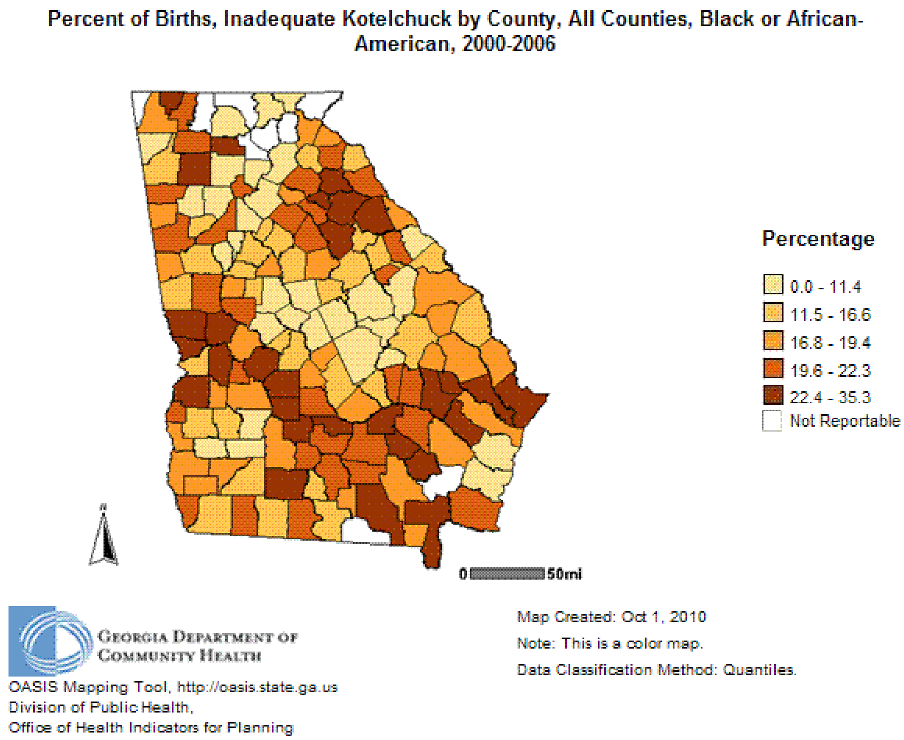

Figure 20. Percentage of Births, African American Mothers with Inadequate Prenatal Care

There is a significant difference in mean maternal education years completed and adequacy of prenatal care (ANOVA, $F = 13939.184$, $p < 0.000$), see Appendix B. The mean education years completed by mothers who received an inadequate level of prenatal care is the lowest at 11.04 years completed, see Table 32.

Table 32

Mean Education Years by Adequacy of Prenatal Care Utilization

Kotelchuck Index	Mean Education Years	Std. Deviation	N
Inadequate	11.04	3.136	99511
Intermediate	12.36	2.943	121824
Adequate	12.96	2.831	364596
Adequate Plus	12.99	2.727	299395
Total	12.67	2.915	885326

There is a significant difference between marital status and adequacy of prenatal care [χ^2 (3 d.f., N = 885,326) = 28262.752, p = < 0.000], see Appendix B. Among married mothers 44.3% received adequate prenatal care and only 6.9% received inadequate care. Among unmarried mothers 36.4% received adequate prenatal care and 18.0% received inadequate care. Figure 21 depicts the percentage of births to unmarried mothers with inadequate prenatal care by county.

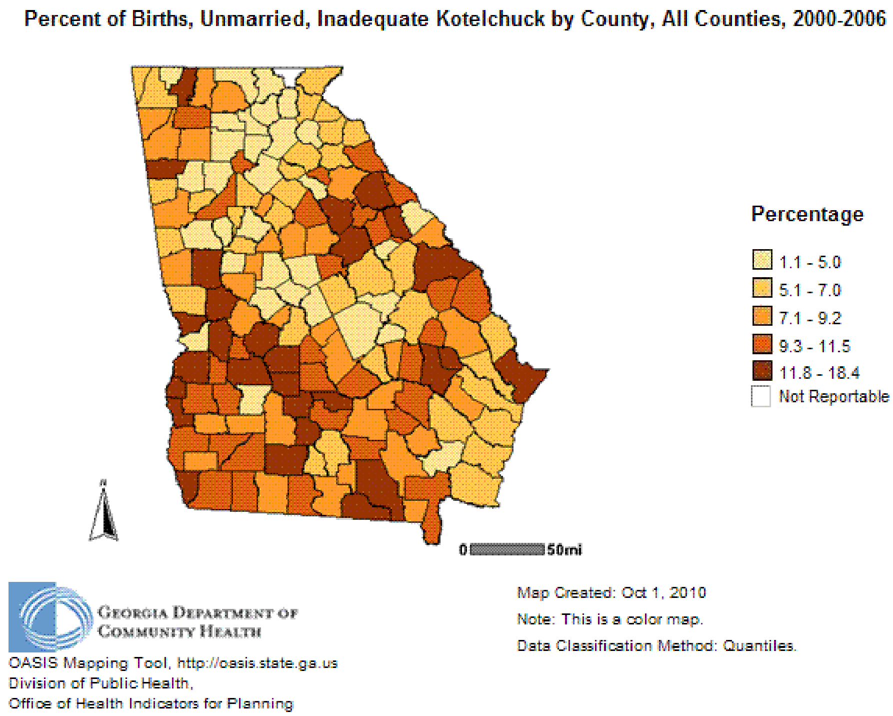

Figure 21. Percentage of Births, Unmarried Mothers with Inadequate Prenatal Care

In addition to analysis of variance (ANOVA) and Chi-square (χ^2) analysis, logistic regression was used to test the hypothesis that adequacy of prenatal care is not associated with birth weight controlling for maternal age, race, education, and marital status. A backward elimination logistic regression was performed with the outcome variable of low birth weight. The attribute variables were: adequacy of prenatal care (Kotelchuck index), maternal race, maternal marital status, maternal age group, and maternal education years completed. All attribute variables are categorical with the exception of maternal education years completed, which is continuous. Tables showing the results of the logistic regression analysis are in

Appendix C. The results of the significance tests and the logistic regression for adequacy of prenatal care and low birth weight are presented in the remainder of this section.

There is a significant difference between the mean birth weight and the adequacy of prenatal care index groups (ANOVA, $F = 10662.95$, $p < 0.05$), see Appendix B. The highest mean infant birth weight was for the group of women who received an adequate level of prenatal care (3,351.67 grams). The lowest mean infant birth weight was for the adequate plus level of prenatal care (3,109.93), see Table 33. There is no significant difference between the adequate and intermediate level of prenatal care ($p = 0.226$) with respect to mean birth weight.

Table 33

Mean Birth Weight by Adequacy of Prenatal Care Utilization Index

Kotelchuck Index	Mean Birth Weight	Std. Deviation	N
Inadequate	3177.43	600.317	99511
Intermediate	3349.28	533.982	121824
Adequate	3351.67	529.139	364596
Adequate Plus	3109.93	688.495	299395
Total	3250.01	606.787	885326

There is a significant difference between low birth weight and the adequacy of prenatal care index [χ^2 (3 d.f., N = 885,326) = 25422.063, p = < 0.000], see Appendix B. The mothers who received the level of adequate plus prenatal care had the highest percentage of low birth weight infants (15.1%) and the lowest percentage is for those who receive adequate prenatal care (4.6%). Figure 22 depicts the percentage of low birth weight births of mothers with adequate plus prenatal care by county.

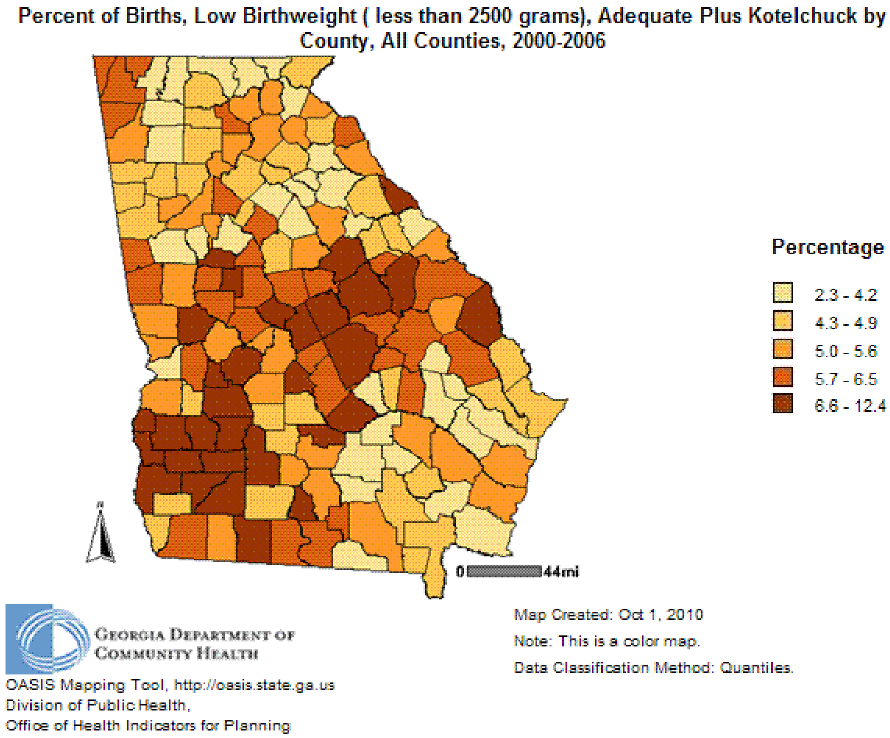

Figure 22. Percent of Low Birth Weight Births, Adequate plus Prenatal Care

For the logistic regression analysis for the third study hypothesis, adequacy of prenatal care utilization, and the maternal characteristics of age group, race, marital status, and education are used. With low birth weight as the outcome, there are 885,326 cases used in the analysis. In the logistic regression output, see Appendix C, the Omnibus Tests of Model Coefficients tests the null hypothesis that adding the predictor variables to an intercept only model does not significantly increase the ability to predict the outcome of low birth weight. For the analysis the χ^2 statistic is 36231.230 with a p-value < 0.01 which allows the null to be rejected. This indicates that the model with the predictors has greater prediction ability, hence the better model.

As with the logistic regression analysis for hypotheses 1 and 2, all of the predictor variables are included in the model. For analysis of low birth weight, each categorical variable group is compared to the first group as a reference indicator within the variable. The indicator variables are the same as with hypotheses 1 and 2, see Table 23.

The results of the analysis yield similar results to that of hypotheses 1 and 2. The categories that are not significantly different than their reference indicators are the same; Native Hawaiian/Other (p = 0.563) is not significantly different than whites and age groups 15 to 19 (p = 0.355), 30 to 34 (p = 0.242), and 35 to 39 (p = 0.280) are not significantly different than age group 10 to 14. One additional age group, over 50 (p = 0.09), was also not significantly different than age group 10 to 14 for this analysis. The odds ratios are also similar, see Table 34.

Table 34

Odds Ratios for Selected Variables

Variable	Category	Significance	Exp(B)	95% CI
Race	African American	.000	1.926	(1.894, 1.959)
Marital Status	Unmarried	.000	1.331	(1.306, 1.356)
Education		.000	.982	(0.979, 0.985)
Age Group	40 to 44	.000	1.348	(1.178, 1.543)
	45 to 49	.000	1.888	(1.492, 2.390)

Within the adequacy of prenatal care utilization index, all of the categories are significant when compared with the reference indicator of inadequate prenatal care. The intermediate and adequate categories both have odds ratios less than 1 indicating a reduction of the odds of low birth weight. The intermediate category has an odds ratio of 0.536 [95% CI

(0.518, 0.554)] and the adequate category has an odds ratio of 0.515 [95% CI (0.501, 0.528)]. The adequate plus category has an odds ratio of 1.894 [95% CI (1.850, 1.940)]. The odds of an infant being low birth weight are 1.894 times higher for infants born to mothers with adequate plus prenatal care than to those born with inadequate prenatal care.

The hypotheses addressed by these analyses:

H_{30}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{3a}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is positively associated with birth weight (i.e., as the level of prenatal care increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status, and education.

Based on the results, the null hypothesis can be rejected and therefore the alternative hypothesis is concluded. Adequacy of prenatal care is positively associated with birth weight and that as one's adequacy of prenatal care increases, the infants birth weight becomes normal.

Summary

The infants in the study were born to predominantly white mothers who are married and had a high school or better education. The mothers live in urban counties and experienced an adequate level of prenatal care. The average birth weight for the majority of the infants is considered to be normal, above 2,500 grams. Overall the number of births is greatest in the north central area of the state where the capital city of Atlanta and a majority of the large cities are located.

The results of the data analysis reject the null for the three hypotheses in the study (Table 35).

Table 35

Summary of Hypothesis Testing

Null Hypothesis	**Result**	**Reasoning**
H_{10}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.	Reject	There is a statistically significant association between socioeconomic status and birth weight. As socioeconomic status increased birth weight also increased.
H_{20}: County type as defined by the Georgia Office of Rural Health is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.	Reject	There is a statistically significant association between county type and birth weight. Mothers in urban counties have increased birth weight over mothers in rural counties.
H_{30}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Utilization Index (Kotelchuck, 1994b) is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.	Reject	There is a statistically significant association between adequacy of prenatal care and birth weight. Mothers with increased prenatal care, both intermediate and adequate, have increased birth weight.

Based on the results of the analyses for socioeconomic status, the null hypothesis was rejected indicating that as the level of socioeconomic status increased the birth weight of the infant also increased controlling for the maternal characteristics of age, race, education and marital status. The demographic profiles created by the Georgia Division of Public Health serve as a proxy for socioeconomic status in the study. The descriptions of the demographic profiles matched the study population's demographic characteristics. Mothers in the lower middle and lower socioeconomic strata experienced the lowest mean birth weight and had higher odds of having low birth weight infants. Mothers who are African American, unmarried, or in older maternal age groups have greater odds of having a low birth weight infant. The mothers in the lower socioeconomic classes have a higher percentage of unmarried mothers and a lower educational attainment than their counterparts in the higher socioeconomic strata.

The second set of hypotheses dealt with place of residence; if the mother lives in an urban or rural county. Based on the results of the analyses, the null hypothesis was rejected indicating that the infants of mothers living in urban counties have increased birth weight controlling for the maternal characteristics of age, race, education and marital status. This analysis also found that mothers who are African American, unmarried and of advanced maternal age had the worst outcomes with regards to birth weight. Mothers in rural counties have higher odds of having low birth weight infants than those mothers living in urban counties.

The third set of hypotheses test the effect of the adequacy of prenatal care utilization. Based on the results of the analyses, the null hypothesis was rejected indicating that the infants of mothers increased prenatal care experienced increased infant birth weight controlling for the maternal characteristics of age, race, education and marital status. This analysis found similar results as the two previous. However, it is surprising that infants of mothers with more than adequate prenatal care experienced higher odds of low birth weight and a lower mean birth weight. Those mothers with either intermediate or adequate levels of prenatal care have the highest mean infant birth weight and the lowest odds of low birth weight. The percentage of low birth weight births to mothers with more than adequate prenatal care are clustered in the south western counties of the state.

Based on the statistical analyses, the mothers with the highest odds of having a low birth weight infant were found to have the following characteristics: African American, unmarried, advanced maternal age (over 45 years of age), rural county, adequate plus prenatal care, and lower socioeconomic strata. The ecological analyses found that these mothers are primarily located in southwestern counties of Georgia (Figures 23 – 26).

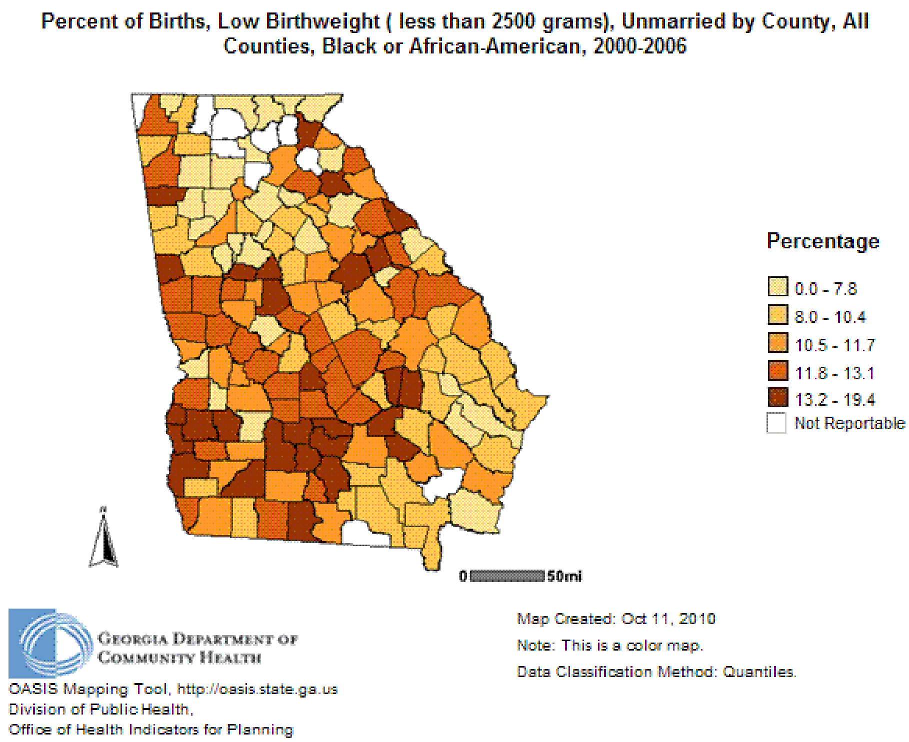

Figure 23. Percentage of Low Birth Weight Births to Unmarried African American Mothers

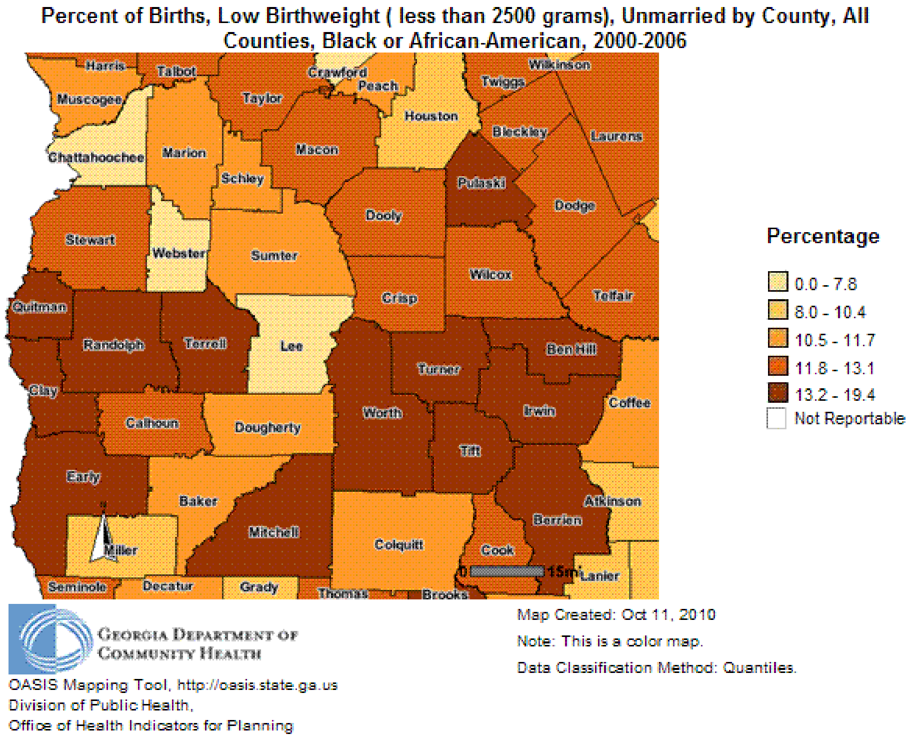

Figure 24. Percentage of Low Birth Weight Births to Unmarried African American Mothers in Southwestern Counties

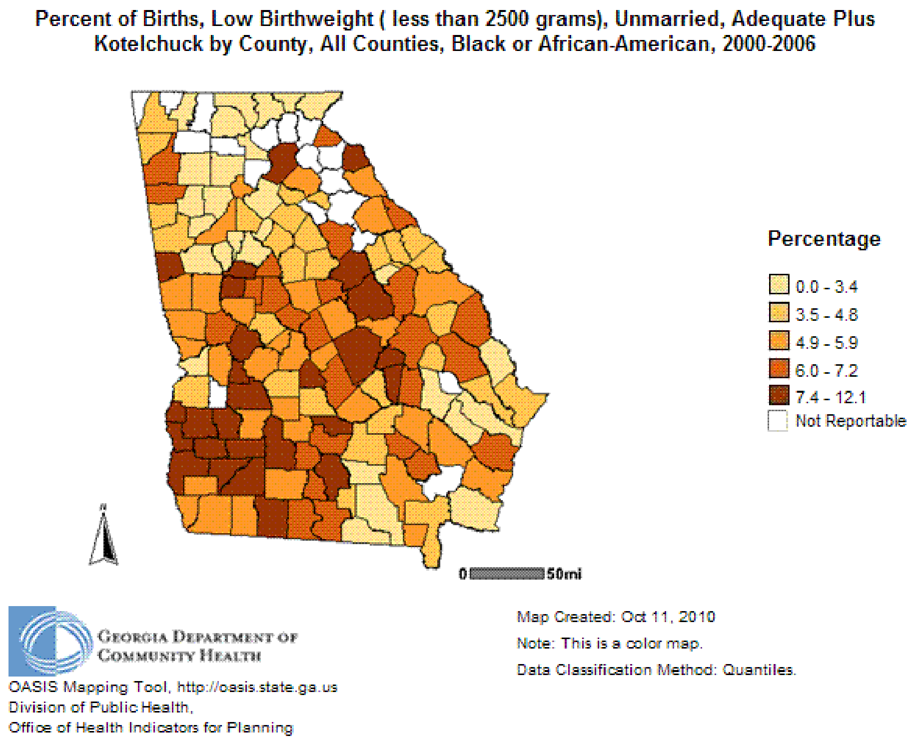

Figure 25. Percentage of Low Birth Weight Births to Unmarried African American Mothers with Adequate Plus Prenatal Care

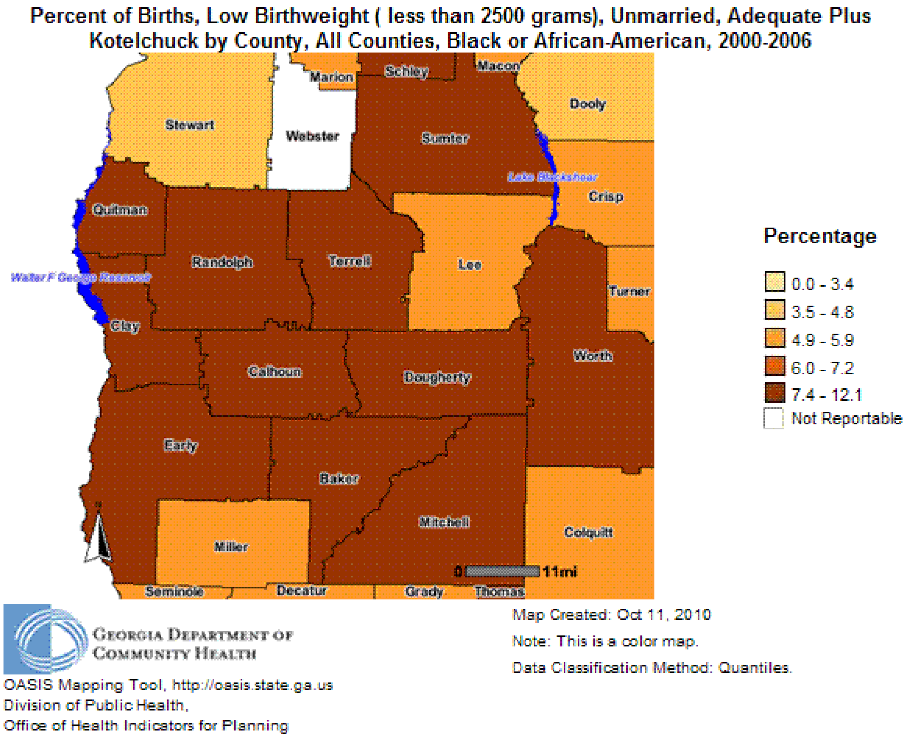

Figure 26. Percentage of Low Birth Weight Births to Unmarried African American Mothers with Adequate Plus Prenatal Care in Southwestern Counties

CHAPTER FIVE DISCUSSION

Introduction

The purpose of this study is to examine the relationship of socioeconomic status, county type (rural vs. urban), and adequacy of prenatal care on low birth weight in the state of Georgia for the years 2000 to 2006. The study addresses the following research question:

> What is the relationship between socioeconomic status, county type, adequacy of prenatal care, and birth weight, controlling for certain maternal characteristics, for infants born in the state of Georgia between the years 2000 and 2006?

The study provides an ecological analysis of low birth weight at the county level in Georgia using geographic information systems (GIS) and spatial analysis.

In order to answer the research question, secondary data is used to examine the relationships between socioeconomic status, adequate prenatal care, county type, and birth weight, controlling for certain maternal characteristics such as age, race, marital status, and education. The data used for this study is from the Georgia Department of Community Health, Division of Public Health's standardized health data repository. Specifically, the variables are from Georgia Vital Records birth information.

Statistical methods including Analysis of variance (ANOVA) and χ^2 analysis determine significant differences in the adequacy of prenatal care, socioeconomic status, birth weight, race, maternal age, maternal education and maternal marital status. Logistic regression is also used to determine the influence of socioeconomic status, race, maternal marital status, maternal age, maternal education, and adequacy of prenatal care on low birth weight. Finally, an ecological analysis using the Georgia OASIS GIS mapping tool analyzes aggregated data for groups of individuals to make inferences about relationships at the individual level.

The descriptive results of the study show that most infants in the study are born to white mothers living in urban counties who are married and have a high school or better education. Mothers in the study have an adequate level of prenatal care and the average birth weight of the infants is considered to be normal, above 2,500 grams. Overall the largest number of births is primarily located in the north central area of the state where the capital city of Atlanta and a majority of the large cities are located.

The statistical analyses showed that the predictors of socioeconomic status, county type, and adequacy of prenatal care utilization also play a significant role in birth weight. Mothers who are African American, unmarried or in older maternal age groups have a greater chance of having a low birth weight infant. Infants of mothers in the lower middle and lower socioeconomic strata experience a lower mean birth weight as well as more instances of low birth weight infants. Similar results are found for those mothers who live in rural counties. Finally, mothers who experience either inadequate or the adequate plus classification of prenatal care also have more adverse birth outcomes than those mothers with intermediate or adequate care.

Discussion of Results

Population and Maternal Characteristics

There was a steady increase in the number of births between 2000 and 2006 for the study population. Overall the 10.24% increase over the study period for Georgia is higher than the 5.09% increase across the United States during the same time period (Martin, et al., 2009). The majority of the births in the study occur in urban counties. More than half of the counties in Georgia are considered to be rural, 109 rural counties as opposed to 50 urban. Less than 20% of the population in the state lives in rural counties (Georgia Department of Community Health, 2010). Six of the health districts with the highest number of births and percentage are predominantly urban. However, one of the fastest growing public health districts in percentage of births is the North Georgia health district (31.81%), which is primarily made up of rural counties.

The mean maternal age of the mothers in the study is 26.7 years. Over the study period there is a small overall decrease (0.86%) in the percentage of births to mothers less than the age of 19. There is a 7.59% decrease in the number of births to teenage mothers from 2000 to 2003, however there is an increase of 7.29% in the number of births from 2003 to 2006 (Figure 27). Although the study population shows a slight decrease in the number of teenage births, the teen birth rate, ages 15 to 19, in Georgia of 54.2 per 1,000 is higher than the U.S. rate of 41.9 per 1,000.

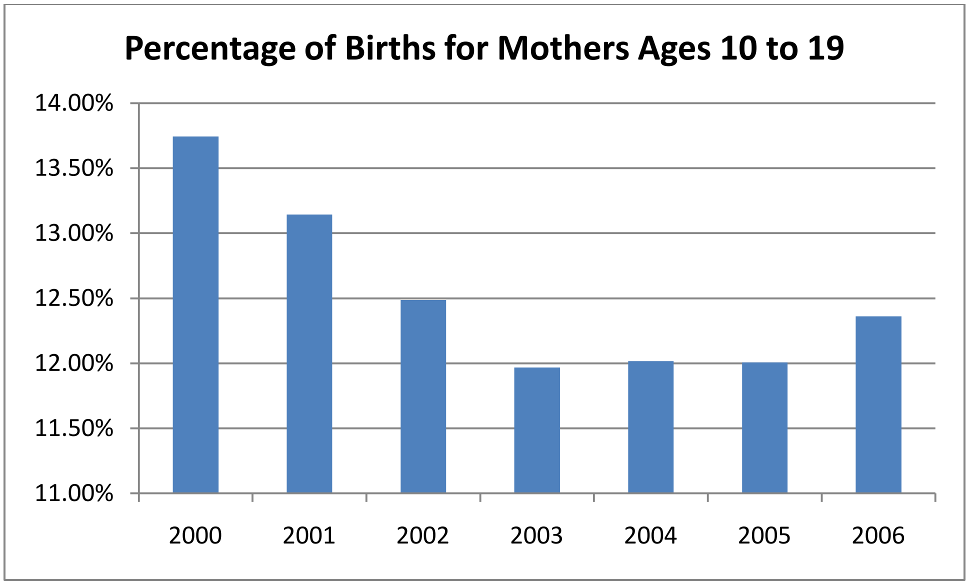

Figure 27. Percentage of Births for Mothers Ages 10 to 19

The highest overall percentage increase (23.74%) in the number of births in the study occurred in those mothers who are over the age of 40 (Figure 28). In the U.S. there is also a trend of increasing births for women between the ages of 40 and 44 (Martin, et al., 2009; Tough, et al., 2002). The rise in the trend of older mothers can be attributed to many factors including pursuit of advanced education, expanded career opportunities, delayed marriages, financial issues, and fertility-enhancing therapies (Reynolds, et al., 2003).

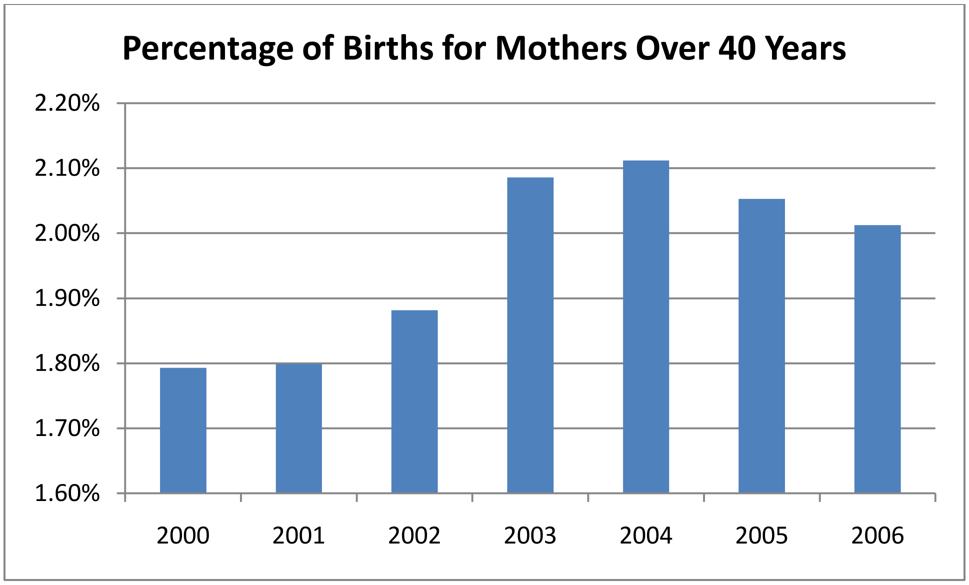

Figure 28. Percentage of Births for Mothers Over 40 Years of Age

The mean age differs among the racial classes in the study; African Americans 25.45 years, white 27.2 years, and Asian 29.7 years. Based on the descriptive results, African American mothers are having infants at a younger age than their counterparts and most births occurred to these women in their 20's and early 30's (Figure 29). There is also a difference in the percentage increase in the number of births among the races. For mothers in the study population, there was an overall 11.16% increase for African American mothers and an overall 8.25% increase for white mothers (Figures 30 and 31). African American mothers in the study have a steady increase in the number of births from 2001 to 2006. Births to white mothers increase until 2004 then show a slow decline until 2006. Compared to nation-wide statistics of 7.04% increase for African Americans and 3.64% increase for whites, the growth in Georgia is happening at a higher percentage (Martin, et al., 2009).

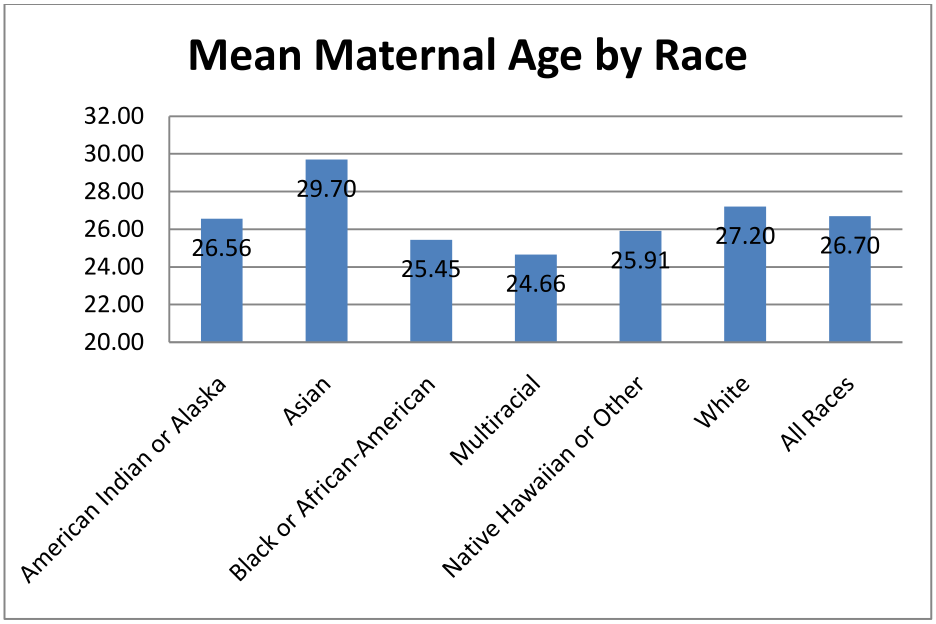

Figure 29. Mean Maternal Age by Race

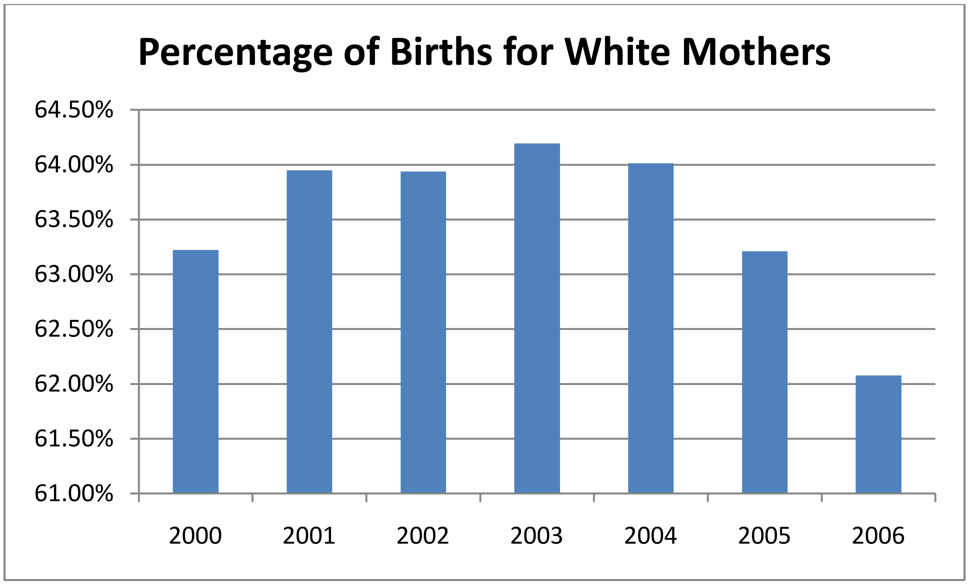

Figure 30. Percentage of Births for White Mothers, 2000 – 2006

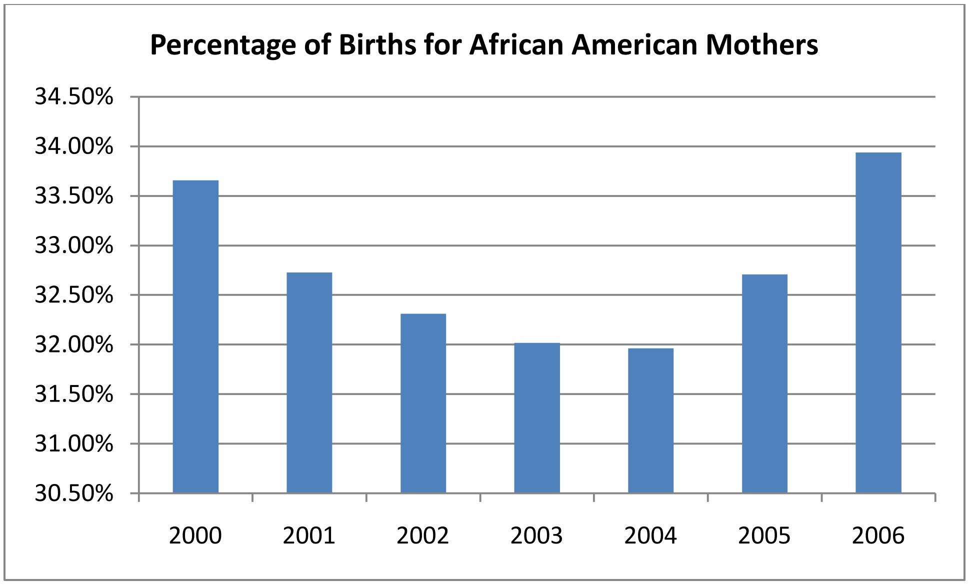

Figure 31. Percentage of Births for African American Mothers, 2000 – 2006

The mean education level of the study population is slightly higher than the high school diploma level (12.67 years). Approximately 75% of the mothers in the study have a high school diploma or more, which is similar to the trend in the U.S. at 73.6%. In the study population, the mean educational years completed by race are the same for African American and white mothers (12.63 years) and is not statistically significant. Asian mothers in the study have the highest mean educational years completed (14.07 years). According to the literature, lower educational attainment limits a person's access to employment and therefore can increase the probability of living at or below the poverty level (Kramer, et al., 2000). Based on the ecological analysis, the highest percentage of births of mothers with less than a high school diploma occur in southern central and extreme northern Georgia.

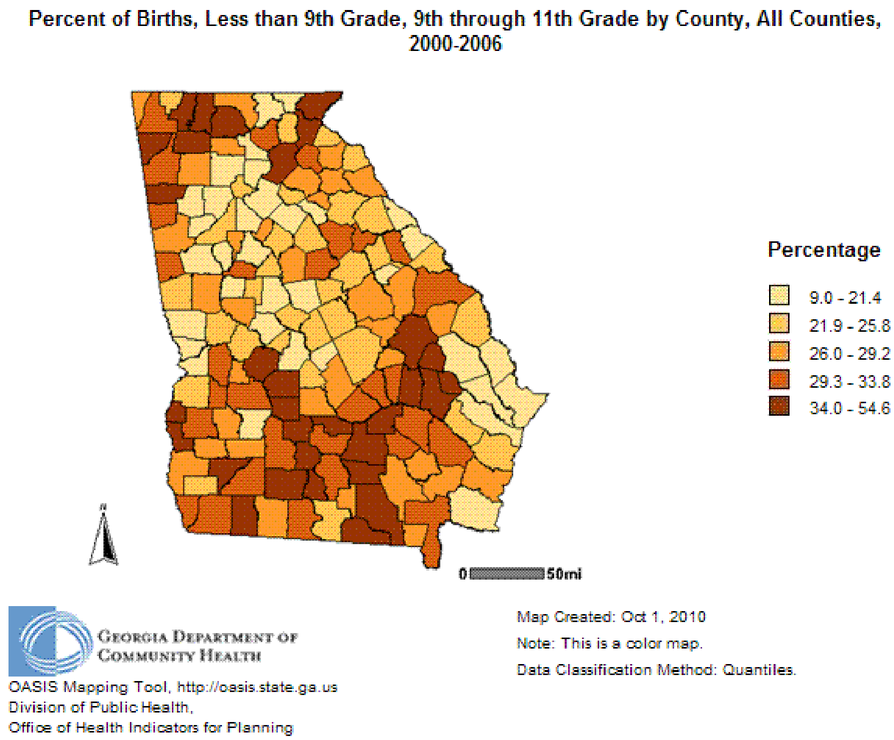

Figure 32. Percent of Births to Mothers with Less than High School Diploma

The majority of the births in the study are to married mothers (60.9%). However, there is a 29.6% increase in the number of births to unmarried women over the study period. This increase is higher than the increase over the same time period in the U.S. (21.9%). Race plays a significant role for unmarried mothers, of the unmarried mothers 55.8% were African American. When looking at birth percentages to unmarried mothers, the southwestern counties of Georgia appear to have the largest percentage. When further refining and looking at unmarried African American mothers, similar counties appear, however, there are two counties in Northern Georgia that also appear. This supports the finding from the descriptive analysis that there were more unmarried mothers in rural counties as opposed to urban counties. Age and educational attainment are also significant for marital status. Approximately 80% of the mothers less than 20 years of age are unmarried. Married mothers in the study population have a higher level of educational attainment.

Low Birth Weight

The mean birthweight of the infants in the study, 3,250 grams or 7 pounds 2.64 ounces, is well above the threshold of low birth weight at 2,500 grams or 5 pounds 8 ounces. 8.8% of the infants in the study are considered low birth weight. The percentage of low birth weight increased each year of the study from 8.27% in 2000 to 9.35% in 2006 (Figure 33). This is a similar trend to the U.S., however the percentage in 2006 was 8.3% which is less than Georgia (Martin, et al., 2009). Looking at a map of Georgia, counties in central east and south west experience the highest percentage of low birth weight births (Figure 34).

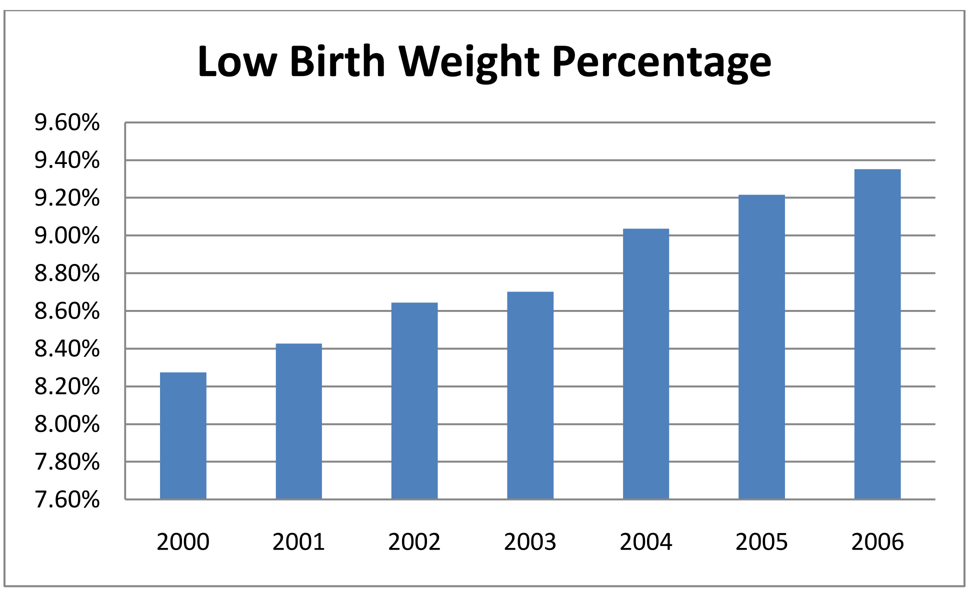

Figure 33. Percentage of Low Birth Weight Births

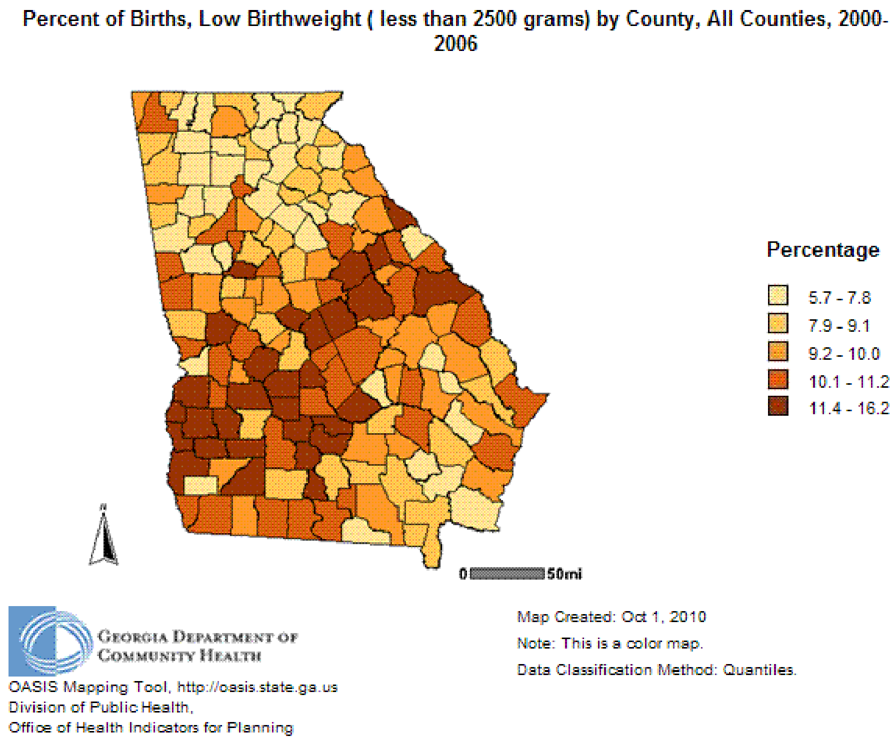

Figure 34. Percent Low Birth Weight Births by County

Mothers in the study over the age 45 and under the age of 19 have the lowest mean birth weight as well as the highest percentage of low birth weight births. Two groups, those age 10 to 14 and those over 50, are very similar and have no significant difference between them for the odds of low birth weight. According to the literature, extremes in maternal age contribute to adverse birth outcomes such as low birth weight, which is supported by the study data (Conley & Bennett, 2000). There literature also supports a higher low birth weight percentage for teenage mothers over mothers of advanced maternal age (Chen, et al., 2007; Gilbert, et al., 2004; Martin, et al., 2009). For the study population, the low birth weight percentages are only slightly higher for the mothers who are over the age of 40 (10.92%) than for the teenage mothers (12.14%). Because the 10 to 14 and over 50 age groups are not significantly different with regards to low birth weight births, the study data supports that extremes in maternal age lead to adverse birth outcomes.

African Americans in the study have the lowest mean birth weight of all the race groups (Figure 35). The low birth weight percentage for African American mothers is 13.2% as compared to white mothers at 6.6%. In looking at the map of Georgia, African Americans in southwest Georgia and northwestern Georgia have the highest percentage of low birth weight births. Mothers in Georgia fare worse than their counterparts across the country with the low birth weight percentage for African American mothers at 11.85% and for white mothers at 5.37% nationwide (Martin, et al., 2009). The highest percentage of low birth weight births in the study population for African American mothers is for maternal age groups 10 to 14 and 45 to 49 years. For white mothers the highest percentage of low birth weight is to those over the age of 50.

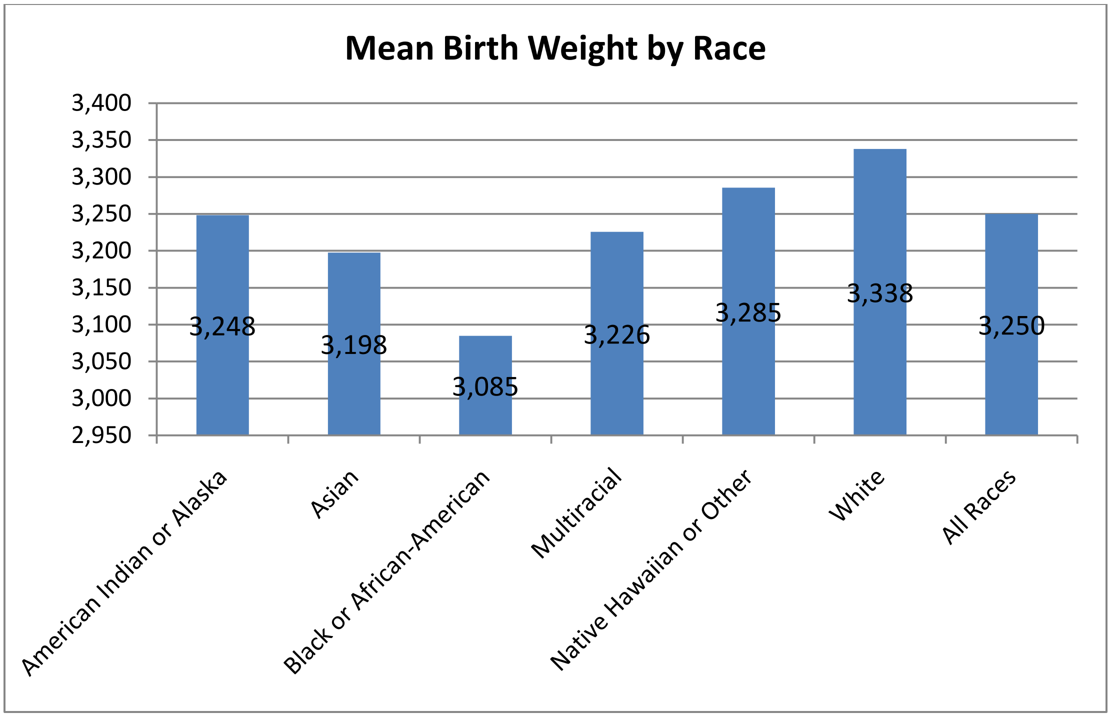

Figure 35. Mean Birth Weight by Race

Unmarried mothers have a higher percentage of low birth weight infants and a lower mean birth weight than married mothers. Marriage is a protective factor for adverse birth outcomes, which is supported by the study data (Barrington, 2010; Luo, et al., 2004; Matthews & Hamilton, 2002). Looking at a GIS map the disparities exist in southwestern Georgia and some central eastern counties.

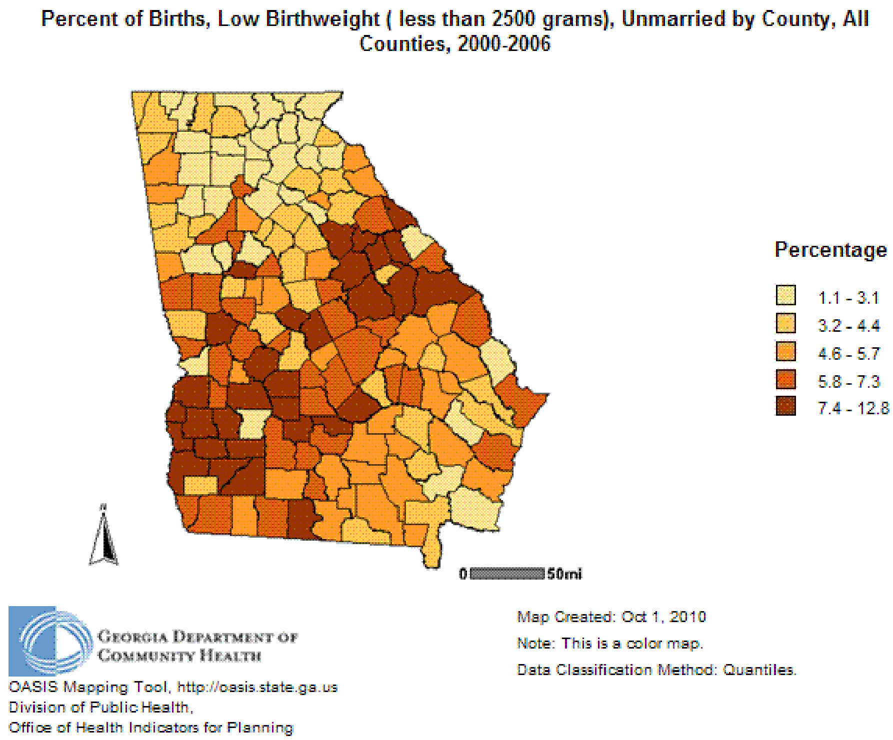

Figure 36. Percent Low Birth Weight Births to Unmarried Mothers

Hypothesis 1: Socioeconomic Status

H_{10}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{1a}: Socioeconomic status as defined by the Georgia Division of Public Health's demographic profiles is positively associated with birth weight (i.e., as socioeconomic status increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status and education.

The majority of the births in the study are to mothers in one of the highest classes of SES (1.3) or in the lower middle clusters (3.1, 3.3, 3.4). When compared to the descriptive statistics for the study population, the description of the cluster as defined by Georgia Division of Public Health is similar, which indicates that for the study population the demographic cluster is an appropriate measure of socioeconomic status. From the logistic regression analysis, there are several clusters that are not significantly different from the reference cluster of 1.1, the highest socioeconomic status. Those that are significantly different showed an increase in the odds of low birth weight, with the lowest socioeconomic strata having the highest odds. As the level of socioeconomic status decreased, from higher to lower, the odds of low birth weight increased.

Socioeconomic status is known to affect the health of individuals, including infants. Low birth weight is associated with lower socioeconomic status (Joseph, et al., 2007; Parker, et al., 1994; Pearl, et al., 2001). However, much of the literature defines socioeconomic status using single proxy indicators, such as income or education, and not in great detail (Barbeau, et al., 2004; Braveman, et al., 2005; Nicolaidis, et al., 2004; Pearl, et al., 2001; Pickett & Pearl, 2001). The study supports a detailed definition of socioeconomic status by using the demographic clusters. With a greater amount of detail it is possible to further refine target populations for health interventions (Calle, et al., 1993).

Hypothesis 2: County Type

H_{20}: County type as defined by the Georgia Office of Rural Health is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{2a}: County Type as defined by the Georgia Office of Rural Health is associated with birth weight (i.e., infants born to urban mothers will have a higher birth weight) controlling for the maternal characteristics of age, race, marital status and education.

The Georgia Office of Rural Health defines a rural county as having a population of 35,000 or less (Georgia Department of Community Health, 2010). There are 159 counties in Georgia, of which, 109 are considered to be rural. Only 20% of the population in the state lives in rural counties which support the finding that there are more births in the study population to mothers living in urban counties. Rural mothers are typically younger than their urban counter parts in the study and have a higher percentage of unmarried mothers. The mean number of years of education completed is also lower for rural residents. The mean birth weight is lower and rural mothers have a higher percentage of low birth weight infants.

Based on the statistical analyses, county type is significant for low birth weight. There is an increased chance of low birth weight for mothers living in rural counties as opposed to mothers living in urban counties. Based on the literature, the environment in which an individual lives is often measured with several characteristics including rural or urban, as well as socioeconomic characteristics (Pearl, et al., 2001; Rauh, et al., 2001). Women living in rural counties often experience a lack of or reduced access to health care and this increases the risk of adverse birth outcomes (Hillemeier, et al., 2007; Joseph, et al., 2007).

Hypothesis 3: Adequacy of Prenatal Care

H_{30}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is not associated with birth weight controlling for the maternal characteristics of age, race, marital status, and education.

H_{3a}: Adequacy of prenatal care as measured by the Adequacy of Prenatal Care Index (Kotelchuck, 1994b) is positively associated with birth weight (i.e., as the level of prenatal care increases infant birth weight also increases) controlling for the maternal characteristics of age, race, marital status, and education.

A large percentage of mothers in the study (75%) receive adequate prenatal care. Adequate prenatal care is described as prenatal care begun by the 4th month and 80% to 109% of the recommended visits to a health care provider completed (Kotelchuck, 1994b). A higher percentage of women in Georgia receive inadequate care, 11.2%, as opposed to the nationwide percentage of 7.9% (Martin, et al., 2009).

As mean maternal age increases so does the level of prenatal care. A higher percentage of African American mothers (15.0%) receive inadequate prenatal care than white mothers (9.5%). African Americans in Georgia experience a higher percentage of inadequate care than the rest of the nation, 15.0% for the study population as opposed to 11.8% of African American mothers nationwide (Martin, et al., 2009). White mothers show a similar trend, 9.5% of the study population receives inadequate care and 5.2% of white mothers nationwide. Looking at a map, African American mothers with high percentages of inadequate prenatal care reside in southern Georgia and counties in the north east corner of the state. Unmarried mothers and rural county residents have a higher percentage of inadequate prenatal care. The south west counties have the poorest birth outcomes even though they seem to have the highest level of prenatal care.

The highest mean birth weight for the infants in the study is to women who received adequate prenatal care and the lowest to those with adequate plus. It appears that women who receive either intermediate or adequate levels of prenatal care have the best outcomes. The literature supports that adequate plus levels of care are most likely provided to women who are considered high risk and will more likely to have poor birth outcomes regardless (Alexander & Korenbrot, 1995; Sable & Herman, 1997). Extra prenatal care visits can be the result of either a detected or anticipated problem with pregnancy (Lauderdale, VanderWeele, Siddique, & Lantos, 2010). Mothers also often self-select more than adequate prenatal care to improve their own satisfaction with their medical care. Based on literature, it is unclear if adequate plus prenatal care creates better outcomes with regard to birth weight.

Ecological Analyses

Based on the statistical analyses, it appears that the women in the study population with the following traits have the worst birth outcomes:

- Women of advanced maternal age (over 40 years of age)
- Unmarried women
- African American women
- Women with adequate plus level of prenatal care
- Lower middle and lower socioeconomic strata

- Women living in rural counties

Choropleth maps show where these of mothers live in the state in order to create a picture of at-risk populations (Figure 37). Based on the results, the women who are most at-risk can be found primarily in southwestern counties of Georgia, for example Baker, Calhoun, Dougherty, Mitchell, Terrell, Sumter and Worth.

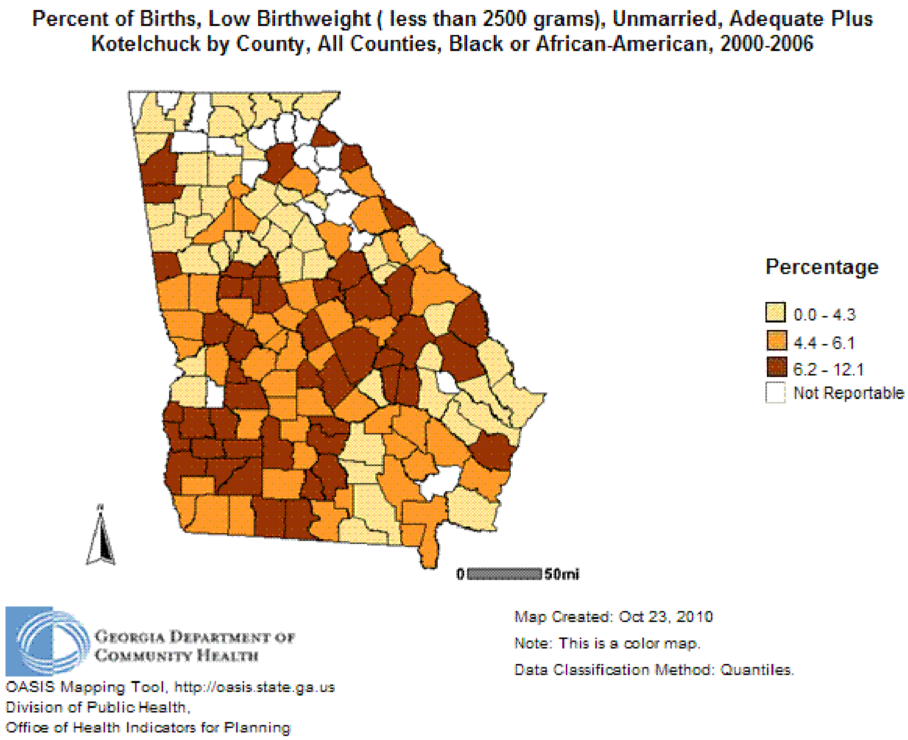

Figure 37. Percent Low Birth Weight Births to Unmarried, African American Mothers with Adequate plus Prenatal Care

Based on the ecological analyses of those women in the study with high risk characteristics, three categories of need can be identified in order to classify the level of need for maternal health interventions. The counties in the state are classified based on the percentage of low birth weight births with the maternal characteristics of unmarried, African American and adequate plus prenatal care. The categories of need are high, moderate and low. A fourth category represents counties that have incomplete information (Table 36).

Table 36

Categories of Need by County

Category	County Type	Counties
High	Rural	Baker, Ben Hill, Berrien, Brooks, Butts, Calhoun, Clay, Cook, Dodge, Early, Emanuel, Hancock, Hart, Heard, Irwin, Jefferson, Lamar, Lincoln, McIntosh, Mitchell, Monroe, Montgomery, Pike, Pulaski, Quitman, Randolph, Schley, Screven, Stephens, Sumter, Talbot, Taylor, Terrell, Toombs, Treutlen, Twiggs, Washington, Worth
	Urban	Baldwin, Bulloch, Dougherty, Floyd, Hall, Laurens, Polk, Spalding, Thomas
Moderate	Rural	Appling, Bacon, Bleckley, Burke, Charlton, Crawford, Crisp, Decatur, Dooly, Elbert, Grady, Greene, Harris, Jeff Davis, Johnson, Jones, Lanier, Lee, Macon, Marion, McDuffie, Meriwether, Miller, Peach, Pierce, Seminole, Telfair, Turner, Upson, Wayne, Wilcox, Wilkes, Wilkinson
	Urban	Bibb, Colquitt, DeKalb, Fulton, Glynn, Houston, Jackson, Lowndes, Muscogee, Richmond, Tift, Troup, Ware
Low	Rural	Atkinson, Bryan, Candler, Chattahoochee, Chattooga, Clinch, Dawson, Echols, Fannin, Gilmer, Glascock, Haralson, Jasper, Jenkins, Long, Morgan, Putnam, Rabun, Stewart, Tattnall, Towns, Union, Warren, Wheeler
	Urban	Bartow, Camden, Carroll, Chatham, Cherokee, Clarke, Clayton, Cobb, Coffee, Columbia, Coweta, Douglas, Effingham, Fayette, Gwinnett, Henry, Liberty, Newton, Paulding, Rockdale, Walker, Walton, Whitfield
Not Enough Information	Rural	Banks, Brantley, Dade, Evans, Franklin, Lumpkin, Madison, Oconee, Oglethorpe, Pickens, Taliaferro, Webster, White
	Urban	Barrow, Catoosa, Forsyth, Gordon, Habersham, Murray

Women living in the lower middle and lower income socioeconomic strata are represented by the demographic cluster 3.1 – 3.4 and 4.1 – 4.7 (Figure 38). While this population is mainly urban, there are a larger percentage of rural mothers in these socioeconomic classes (27.7%) than the population as a whole (16.9%). Together the lower middle and lower classes have a higher low birth weight percentage as well, 9.6% as opposed to 8.8%. The lower middle class has the highest number of births and higher odds of having a low birth weight infant than those classes that are higher. These strata are found mainly in rural counties in Georgia, while the lowest classes are found in predominantly urban counties. The worst outcomes with regards to low birth weight are for those mothers in the lowest socioeconomic classes (4.4 – 4.7). The lowest classes make up a smaller percentage of total births than the lower middle classes.

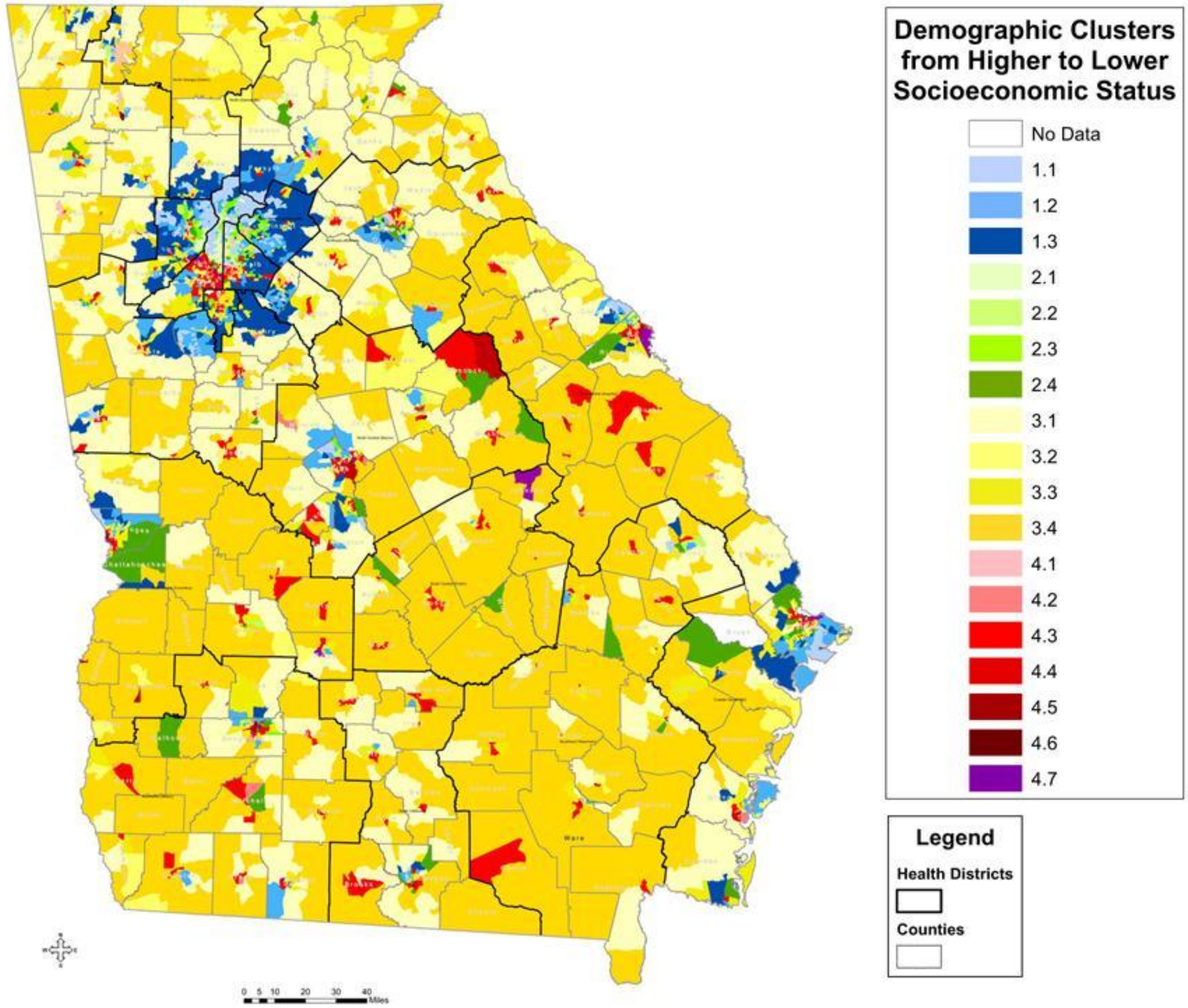

Figure 38. Demographic Profiles of Georgia (Office of Health Information and Policy, 2005)

Limitations

Although the data for this study is rich in content, there are several important limitations. This study does not provide causal evidence for low birth weight in the state of Georgia; however it does provide an analysis of significant factors and an estimation of the odds of low birth weight for mothers during the study period. Certain demographic and other health related information is not available to the researcher because of the privacy rules of the

Health Insurance Portability and Accountability Act (HIPAA) or a lack of availability. These uncollected data may have provided additional insight to a more defined statistical analysis, as well as, an ecological analysis that could have been geocoded to the neighborhood level.

There are known limitations with the use of vital records data in research studies. The standard U.S. certificate of live birth has been expanded over the previous decades to include questions concerning the reproductive health history, additional infant characteristics, maternal tobacco and alcohol use during pregnancy and other clinical risk factors (Hetzel, 1997). However, the expansion of the data elements collected has not led to increased quality and completeness of birth certificate data. Studies using vital records data are typically not generalizable to a larger population and the range of data elements are often narrow in focus (Watkins, et al., 1996).

There are also limitations to having a large sample size and the trend towards significance. Typically, a larger sample sizes improves the precision of the estimates of various population characteristics. However, as the sample size increases there is a trend towards statistical significance that is neither practically nor clinically significant. Also, if there is a systematic error in the data, a large sample size magnifies the problem. Because of the large sample size, three random samples were created using the Select Cases function in SPSS. Random sample sizes of approximately 40%, 20%, and 5% of all records were selected and then the binary logistic regression models were recreated for each new data set. The results of the analyses showed similar results as found with the entire data set as described in the chapter four.

Policy Implications and Recommendations for Future Research

In general, the state of Georgia has poorer birth outcomes than most states in the country combined. In 2006, Georgia ranks overall at 41st in the state health rankings (United Health Foundation, 2006). In infant mortality and prenatal care, Georgia ranks 41st and 31st, respectively. This study shows that there are disparities that exist with regards to birth outcomes in Georgia. African American, rural, unmarried, lower socioeconomic status mothers have poorer outcomes with regard to birth weight. The study population's low birth weight percentage of 8.8% overall does not meet the Healthy People 2010 objective for the low birth weight goal of 5.0%. Based on the study results, the percentage of low birth weight in the state continues to rise.

Although infant mortality is decreasing both across the U.S. and in Georgia, complications from low birth weight are still the second leading cause of infant death. Other implications of low birth weight include increased health care costs for infants at birth and throughout childhood because of increased morbidity. Because Georgia's low birth weight percentage is in an upward trend, adverse outcomes from low birth weight will persist for at-risk mothers and their infants. In order to meet the Healthy People goals going forward to 2020, it is important to implement targeted interventions and conduct further study around birth outcomes in the state.

With regards to prenatal care, the mothers in the study with the worst outcomes are those who receive inadequate and adequate plus care. It is surprising that the adequate plus group have the poorest outcomes although there is limited literature that supports this.

Measuring the adequacy of prenatal care can be problematic even with an evidence based index. It is possible that the women in the study who received an adequate plus level of prenatal care may still have not received high quality care. Another reason for additional prenatal care could result from a perceived or actual risk to the pregnancy. Physicians may suggest additional prenatal visits if problems are known a priori. Some women also self-select to receive additional care for satisfaction purposes or the perception of a problem. There is a potential inverse or reverse association for adequate plus prenatal care and birth weight, for example these extra visits increase costs and may not positively influence outcomes that justify the cost. As maternal population ages and women wait longer to have children, costs and adverse birth outcomes will continue to rise.

It is also important to focus on those mothers who receive inadequate or no prenatal care. The women in the study with this level of care are largely in the lower middle socioeconomic strata and African American. They also experience a very high level of low birth weight (10.1%) and are unmarried (62.7%). Like the mothers with adequate plus levels of prenatal care, these women likely have high cost deliveries with complications. As well, their infants will most likely have more morbidity that will follow them through childhood. Further investigation into both groups is needed; however, as of 2007, the state of Georgia no longer collects prenatal care utilization information on the birth certificate. Other avenues of exploration are needed and where these women reside down to the neighborhood level in order to create targeted public health initiatives.

The rural women in this study are younger and have a lower educational attainment than the urban mothers. Approximately 45% of these mothers are unmarried. The literature shows that married women have higher birth weight infants and better maternal health outcomes in general. Lower educational attainment also plays a significant role in maternal and infant health. Unmarried mothers and those with low educational levels are more likely to live at or below the poverty line. The implications of these issues are exacerbated by the reduced access to care in rural areas. Additional research and more detailed studies that account for more maternal risk factors are needed for these rural populations to better determine the relationships of these risk factors to low birth weight.

Additional quantitative analyses should be performed using more advanced statistical techniques to validate the results of this study. An analysis including all possible two-way interactions and a multilevel model with a random effect for the demographic cluster could provide different results. Models with more than two-way interactions, i.e. three-way or more interactions, are not reasonable to interpret. The demographic cluster variable in this study represents more than just an individual-level factor and can be accounted for using a random effects model, which would allow for a multi-level structure.

Through ecological analyses and geographic information systems, this study identifies groups in Georgia at the county level who need interventions to improve birth outcomes. The counties most in need are located in the southwestern area of the state. These counties are typically classified as rural and have high percentages of mothers with adequate plus levels of prenatal care. The counties are identified in Table 36. These high need counties experience the worst birth outcomes for the state and have high percentages of women with all of the higher risk maternal characteristics. It is likely that the adverse outcomes, such as higher costs, higher infant mortality and higher childhood morbidity, are the worst in these areas than other places in the state. Targeted interventions for the southwestern counties of Georgia are needed as well as additional research to determine why the outcomes are clustered in this sector of the state.

Studies and evaluations of existing perinatal programs throughout Georgia may provide additional important pieces of data that are needed to confirm the results of this study. The use of GIS analyses in conjunction with further study will show decision makers and legislators those women who are specifically being targeted and if these programs are showing positive results. Future research with expanded criteria, which could include environmental factors, biological and behavioral risk factors, is also suggested to determine more specifically which characteristics are associated with low birth weight in the state. Reducing the low birth weight percentage in the state of Georgia can have a significant impact on the short and long term health of infants and children in the state. This study provides a picture of the maternal characteristics of those mothers who can most benefit from public health interventions in order to meet the goal of healthy people in healthy communities.

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APPENDIX A RURAL COUNTIES IN GEORGIA

1. Appling County
2. Atkinson County
3. Bacon County
4. Baker County
5. Banks County
6. Ben Hill County
7. Berrien County
8. Bleckley County
9. Brantley County
10. Brooks County
11. Bryan County
12. Burke County
13. Butts County
14. Calhoun County
15. Candler County
16. Charlton County
17. Chattahoochee County
18. Chattooga County
19. Clay County
20. Clinch County
21. Cook County
22. Crawford County
23. Crisp County
24. Dade County
25. Dawson County
26. Decatur County
27. Dodge County
28. Dooly County
29. Early County
30. Echols County
31. Elbert County
32. Emanuel County
33. Evans County
34. Fannin County
35. Franklin County
36. Gilmer County
37. Glascock County
38. Grady County
39. Greene County
40. Hancock County
41. Haralson County
42. Harris County
43. Hart County
44. Heard County
45. Irwin County
46. Jasper County
47. Jeff Davis County
48. Jefferson County
49. Jenkins County
50. Johnson County
51. Jones County
52. Lamar County
53. Lanier County
54. Lee County
55. Liberty County*
56. Lincoln County
57. Long County
58. Lumpkin County
59. McDuffie County
60. McIntosh County
61. Macon County
62. Madison County
63. Marion County
64. Meriwether County
65. Miller County
66. Mitchell County

67. Monroe County
68. Montgomery County
69. Morgan County
70. Oconee County
71. Oglethorpe County
72. Peach County
73. Pickens County
74. Pierce County
75. Pike County
76. Pulaski County
77. Putnam County
78. Quitman County
79. Rabun County
80. Randolph County
81. Schley County
82. Screven County
83. Seminole County
84. Stephens County
85. Stewart County
86. Sumter County
87. Talbot County
88. Taliaferro County
89. Tattnall County
90. Taylor County
91. Telfair County
92. Terrell County
93. Toombs County
94. Towns County
95. Treutlen County
96. Turner County
97. Twiggs County
98. Union County
99. Upson County
100. Warren County
101. Washington County
102. Wayne County
103. Webster County
104. Wheeler County
105. White County
106. Wilcox County
107. Wilkes County
108. Wilkinson County
109. Worth County

APPENDIX B SELECTED STATISTICAL RESULTS

ANOVA: Maternal Age and Maternal Race

Dependent Variable: Maternal Age

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	862568.724[a]	5	172513.745	4752.576	.000
Intercept	9433057.311	1	9433057.311	259871.006	.000
Maternal Race	862568.724	5	172513.745	4752.576	.000
Error	3.214E7	885320	36.299		
Total	6.640E8	885326			
Corrected Total	3.300E7	885325			

a. R Squared = .026 (Adjusted R Squared = .026)

Cross-Tab and Chi-Square: Maternal Age Group by Maternal Race

	RACE						
Age Group	American Indian or Alaska	Asian	Black or African-American	Multiracial	Native Hawaiian or Other	White	Total
10 - 14	6	9	1433	19	0	687	2154
15 - 19	210	662	48684	612	60	58411	108639
20 - 24	530	3702	95983	976	206	145162	246559
25 - 29	501	8982	69749	655	172	154676	234735
30 - 34	363	9742	46418	412	78	132141	189154
35 - 39	165	3926	22647	184	42	59713	86677
40 - 44	31	751	4890	32	11	10911	16626
45 - 49	5	37	207	2	0	513	764
50+	0	0	1	0	0	17	18
Total	1811	27811	290012	2892	569	562231	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27074.001[a]	40	.000
Likelihood Ratio	27987.566	40	.000
N of Valid Cases	885326		

a. 9 cells (16.7%) have expected count less than 5. The minimum expected count is .01.

ANOVA: Maternal Age and Marital Status

Dependent Variable: Maternal Age

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.127E6	1	6126859.237	201855.755	.000
Intercept	5.751E8	1	5.751E8	1.895E7	.000
Marital Status	6126859.237	1	6126859.237	201855.755	.000
Error	2.687E7	885324	30.353		
Total	6.640E8	885326			
Corrected Total	3.300E7	885325			

a. R Squared = .186 (Adjusted R Squared = .186)

Cross-Tab and Chi-Square: Marital Status by Maternal Age Group

	Marital Status		
Age Group	Married	Unmarried	Total
10 - 14	87	2067	2154
15 - 19	21855	86784	108639
20 - 24	107984	138575	246559
25 - 29	164427	70308	234735
30 - 34	157350	31804	189154
35 - 39	72969	13708	86677
40 - 44	13545	3081	16626
45 - 49	634	130	764
50+	15	3	18
Total	538866	346460	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	179596.968[a]	8	.000
Likelihood Ratio	187093.880	8	.000
Linear-by-Linear Association	156296.982	1	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.04.

ANOVA: Maternal Education and Maternal Age Group

Dependent Variable: Maternal Education Years Completed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.437E6	8	179569.064	26122.107	.000
Intercept	218360.032	1	218360.032	31765.071	.000
Maternal Age Group	1436552.511	8	179569.064	26122.107	.000
Error	6085862.261	885317	6.874		
Total	1.497E8	885326			
Corrected Total	7522414.772	885325			

a. R Squared = .191 (Adjusted R Squared = .191)

Mean Maternal Education Years Completed by Maternal Race

Maternal Race	Mean Education Years	Std. Deviation	N
American Indian or Alaska	12.34	3.159	1811
Asian	14.07	2.825	27811
Black or African-American	12.63	2.130	290012
Multiracial	12.92	2.259	2892
Native Hawaiian or Other	11.98	3.035	569
White	12.63	3.237	562231
Total	12.67	2.915	885326

ANOVA: Maternal Education Years Completed and Maternal Race

Dependent Variable: Maternal Education Years Completed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56772.788[a]	5	11354.558	1346.491	.000
Intercept	2174079.019	1	2174079.019	257815.154	.000
Maternal Race	56772.788	5	11354.558	1346.491	.000
Error	7465641.984	885320	8.433		
Total	1.497E8	885326			
Corrected Total	7522414.772	885325			

a. R Squared = .008 (Adjusted R Squared = .008)

ANOVA: Maternal Education Years Completed and Marital Status

Dependent Variable: Maternal Education Years Completed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	935625.600[a]	1	935625.600	125756.537	.000
Intercept	1.307E8	1	1.307E8	1.756E7	.000
Marital Status	935625.600	1	935625.600	125756.537	.000
Error	6586789.172	885324	7.440		
Total	1.497E8	885326			
Corrected Total	7522414.772	885325			

a. R Squared = .124 (Adjusted R Squared = .124)

Cross-Tab and Chi-Square: Marital Status by Maternal Race

	Marital Status		
Race	**Married**	**Unmarried**	**Total**
American Indian or Alaska	1231	580	1811
Asian	24692	3119	27811
Black or African-American	96682	193330	290012
Multiracial	1444	1448	2892
Native Hawaiian or Other	346	223	569
White	414471	147760	562231
Total	538866	346460	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	140548.660[a]	5	.000
Likelihood Ratio	141734.684	5	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 222.67.

ANOVA: Birth Weight and Maternal Age Group

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.461E9	8	4.327E8	1187.726	.000
Intercept	1.410E10	1	1.410E10	38719.644	.000
Maternal Age Group	3.461E9	8	4.327E8	1187.726	.000
Error	3.225E11	885317	364283.492		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .011 (Adjusted R Squared = .011)

Cross-Tab and Chi-Square: Birth Weight Category by Maternal Age Group

	Birth Weight Category		
Age Group	**Normal**	**Low Birth Weight**	**Total**
10 - 14	1851	303	2154
15 - 19	96841	11798	108639
20 - 24	224139	22420	246559
25 - 29	216459	18276	234735
30 - 34	174094	15060	189154
35 - 39	78562	8115	86677
40 - 44	14640	1986	16626
45 - 49	641	123	764
50+	14	4	18
Total	807241	78085	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1432.116[a]	8	.000
Likelihood Ratio	1374.612	8	.000
Linear-by-Linear Association	167.444	1	.000
N of Valid Cases	885326		

a. 1 cells (5.6%) have expected count less than 5. The minimum expected count is 1.59.

<u>ANOVA: Birth Weight and Maternal Race</u>

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.234E10	5	2.469E9	6968.921	.000
Intercept	1.393E11	1	1.393E11	393147.633	.000
RACE	1.234E10	5	2.469E9	6968.921	.000
Error	3.136E11	885320	354249.360		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .038 (Adjusted R Squared = .038)

Cross-Tab and Chi-Square: Birth Weight Category by Maternal Race

	Birth Weight Category		
Maternal Race	**Normal**	**Low Birth Weight**	**Total**
American Indian or Alaska	1654	157	1811
Asian	25601	2210	27811
Black or African-American	251724	38288	290012
Multiracial	2627	265	2892
Native Hawaiian or Other	530	39	569
White	525105	37126	562231
Total	807241	78085	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10390.079[a]	5	.000
Likelihood Ratio	9855.556	5	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 50.19.

ANOVA: Birth Weight and Maternal Marital Status

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.341E9	1	7.341E9	20398.744	.000
Intercept	8.799E12	1	8.799E12	2.445E7	.000
Marital Status	7.341E9	1	7.341E9	20398.744	.000
Error	3.186E11	885324	359897.909		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .023 (Adjusted R Squared = .023)

Cross-Tab and Chi-Square: Birth Weight Category by Maternal Marital Status

	Birth Weight Category		
Marital Status	**Normal**	**Low Birth Weight**	**Total**
Married	500381	38485	538866
Unmarried	306860	39600	346460
Total	807241	78085	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4821.522[a]	1	.000		
Continuity Correction[b]	4820.989	1	.000		
Likelihood Ratio	4713.168	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	4821.517	1	.000		
N of Valid Cases	885326				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 30557.48.

b. Computed only for a 2x2 table

ANOVA: Birth Weight and Demographic Cluster

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.692E9	17	2.760E8	760.529	.000
Intercept	2.984E12	1	2.984E12	8221397.512	.000
Demographic Cluster	4.692E9	17	2.760E8	760.529	.000
Error	3.213E11	885308	362897.234		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .014 (Adjusted R Squared = .014)

Cross-Tab and Chi-Square: Birth Weight Category by Demographic Cluster

	Birth Weight Category		
Demographic Cluster	Normal	Low Birth Weight	Total
1.1	43209	3120	46329
1.2	46724	3977	50701
1.3	145417	12054	157471
2.1	19602	1618	21220
2.2	20279	1741	22020
2.3	56088	5513	61601
2.4	14792	1293	16085
3.1	100224	8176	108400
3.2	17904	1709	19613
3.3	97550	9873	107423
3.4	103932	10412	114344
4.1	23938	1742	25680
4.2	17438	2482	19920
4.3	39863	4998	44861
4.4	31704	4558	36262
4.5	13207	2254	15461
4.6	1557	222	1779
4.7	13813	2343	16156
	807241	78085	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3611.723[a]	17	.000
Likelihood Ratio	3352.085	17	.000
Linear-by-Linear Association	1856.403	1	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 156.91.

ANOVA: Maternal Age and County Type

Dependent Variable: Maternal Age

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	429232.554[a]	1	429232.554	11667.637	.000
Intercept	3.389E8	1	3.389E8	9211570.686	.000
County Type	429232.554	1	429232.554	11667.637	.000
Error	3.257E7	885324	36.788		
Total	6.640E8	885326			
Corrected Total	3.300E7	885325			

a. R Squared = .013 (Adjusted R Squared = .013)

Cross-Tab and Chi-Square: Maternal Age Group by County Type

	County Type		
Age Group	**Urban**	**Rural**	**Total**
10 - 14	1678	476	2154
15 - 19	83457	25182	108639
20 - 24	195086	51473	246559
25 - 29	196453	38282	234735
30 - 34	165959	23195	189154
35 - 39	77253	9424	86677
40 - 44	14839	1787	16626
45 - 49	672	92	764
50+	14	4	18
Total	735411	149915	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11507.795[a]	8	.000
Likelihood Ratio	11682.412	8	.000
Linear-by-Linear Association	10875.171	1	.000
N of Valid Cases	885326		

a. 1 cells (5.6%) have expected count less than 5. The minimum expected count is 3.05.

Cross-Tab and Chi-Square: Maternal Race by County Type

	County Type		
Maternal Race	**Urban**	**Rural**	**Total**
American Indian or Alaska	1537	274	1811
Asian	26863	948	27811
Black or African-American	243542	46470	290012
Multiracial	2691	201	2892
Native Hawaiian or Other	511	58	569
White	460267	101964	562231
	735411	149915	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4592.499[a]	5	.000
Likelihood Ratio	6083.562	5	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 96.35.

Cross-Tab and Chi-Square: Marital Status by County Type

	County Type		
Marital Status	**Urban**	**Rural**	**Total**
Married	454473	84393	538866
Unmarried	280938	65522	346460
Total	735411	149915	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1584.152[a]	1	.000		
Continuity Correction[b]	1583.921	1	.000		
Likelihood Ratio	1568.844	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	1584.150	1	.000		
N of Valid Cases	885326				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 58667.15.

b. Computed only for a 2x2 table

<u>ANOVA: Maternal Education Years Completed and County Type</u>

Dependent Variable: Maternal Education Years Completed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	53139.447[a]	1	53139.447	6298.553	.000
Intercept	7.731E7	1	7.731E7	9163802.567	.000
County Type	53139.447	1	53139.447	6298.553	.000
Error	7469275.325	885324	8.437		
Total	1.497E8	885326			
Corrected Total	7522414.772	885325			

a. R Squared = .007 (Adjusted R Squared = .007)

ANOVA: Birth Weight and County Type

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.363E8	1	2.363E8	642.127	.000
Intercept	5.215E12	1	5.215E12	1.417E7	.000
COUNTY_TYPE	2.363E8	1	2.363E8	642.127	.000
Error	3.257E11	885324	367923.459		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .001 (Adjusted R Squared = .001)

Cross-Tab and Chi-Square: Birth Weight Category by County Type

	County Type		
Birth Weight Category	Urban	Rural	Total
Normal	671689	135552	807241
Low Birth Weight	63722	14363	78085
Total	735411	149915	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	129.912[a]	1	.000		
Continuity Correction[b]	129.798	1	.000		
Likelihood Ratio	127.343	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	129.912	1	.000		
N of Valid Cases	885326				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13222.38.

b. Computed only for a 2x2 table

ANOVA: Adequacy of Prenatal Care and Maternal Age

Dependent Variable: Maternal Age

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	623244.921[a]	3	207748.307	5680.958	.000
Intercept	4.527E8	1	4.527E8	1.238E7	.000
Kotelchuck Index	623244.921	3	207748.307	5680.958	.000
Error	3.238E7	885322	36.569		
Total	6.640E8	885326			
Corrected Total	3.300E7	885325			

a. R Squared = .019 (Adjusted R Squared = .019)

Cross-Tab and Chi-Square: Adequacy of Prenatal Care by Maternal Age Group

	Adequacy of Prenatal Care Index (Kotelchuck Index)				
Age Group	Inadequate	Intermediate	Adequate	Adequate Plus	Total
10 - 14	829	278	549	498	2154
15 - 19	20547	16512	39750	31830	108639
20 - 24	35085	36446	96479	78549	246559
25 - 29	22729	32482	99814	79710	234735
30 - 34	12921	23887	84108	68238	189154
35 - 39	5945	10172	37039	33521	86677
40 - 44	1380	1954	6590	6702	16626
45 - 49	73	91	264	336	764
50+	2	2	3	11	18
Total	99511	121824	364596	299395	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19039.659[a]	24	.000
Likelihood Ratio	18213.561	24	.000
Linear-by-Linear Association	13181.593	1	.000
N of Valid Cases	885326		

a. 2 cells (5.6%) have expected count less than 5. The minimum expected count is 2.02.

Cross-Tab and Chi-Square: Adequacy of Prenatal Care Utilization by Maternal Race

	Adequacy of Prenatal Care Index (Kotelchuck Index)				
Maternal Race	**Inadequate**	**Intermediate**	**Adequate**	**Adequate Plus**	**Total**
American Indian or Alaska	262	259	706	584	1811
Asian	2097	3879	13329	8506	27811
Black or African-American	43411	39282	108833	98486	290012
Multiracial	345	394	1234	919	2892
Native Hawaiian or Other	117	96	222	134	569
White	53279	77914	240272	190766	562231
Total	99511	121824	364596	299395	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7256.752[a]	15	.000
Likelihood Ratio	7052.671	15	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 63.96.

ANOVA: Maternal Education Years Completed and Adequacy of Prenatal Care

Dependent Variable: Maternal Education Years Completed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	339289.765[a]	3	113096.588	13939.184	.000
Intercept	1.001E8	1	1.001E8	1.234E7	.000
Kotelchuck Index	339289.765	3	113096.588	13939.184	.000
Error	7183125.007	885322	8.114		
Total	1.497E8	885326			
Corrected Total	7522414.772	885325			

a. R Squared = .045 (Adjusted R Squared = .045)

Cross-Tab and Chi-Square: Adequacy of Prenatal Care Utilization by Marital Status

	Adequacy of Prenatal Care Index (Kotelchuck Index)				
Marital Status	**Inadequate**	**Intermediate**	**Adequate**	**Adequate Plus**	**Total**
Married	37147	70606	238582	192531	538866
Unmarried	62364	51218	126014	106864	346460
Total	99511	121824	364596	299395	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28262.752[a]	3	.000
Likelihood Ratio	27595.995	3	.000
Linear-by-Linear Association	18885.223	1	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 38942.24.

ANOVA: Birth Weight and Adequacy of Prenatal Care Utilization Index

Dependent Variable: Birth Weight

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.137E10	3	3.789E9	10662.950	.000
Intercept	6.931E12	1	6.931E12	1.950E7	.000
KOTELCHUCK_INDEX	1.137E10	3	3.789E9	10662.950	.000
Error	3.146E11	885322	355351.429		
Total	9.677E12	885326			
Corrected Total	3.260E11	885325			

a. R Squared = .035 (Adjusted R Squared = .035)

Cross-Tab and Chi-Square: Low Birth Weight by Adequacy of Prenatal Care

	Adequacy of Prenatal Care Index (Kotelchuck Index)				
Birth Weight Category	**Inadequate**	**Intermediate**	**Adequate**	**Adequate Plus**	**Total**
Normal	89479	115785	347884	254093	807241
Low Birth Weight	10032	6039	16712	45302	78085
Total	99511	121824	364596	299395	885326

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25422.063[a]	3	.000
Likelihood Ratio	25009.687	3	.000
Linear-by-Linear Association	6755.851	1	.000
N of Valid Cases	885326		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8776.79.

APPENDIX C LOGISTIC REGRESSION RESULTS

Results of Logistic Regression Analysis for Hypothesis 1 (Socioeconomic Status)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12169.848	32	.000
	Block	12169.848	32	.000
	Model	12169.848	32	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	516106.643[a]	.014	.030

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			Birth Weight Category		
	Observed		Normal	Low Birth Weight	Percentage Correct
Step 1	Birth Weight Category	Normal	807241	0	100.0
		Low Birth Weight	78085	0	.0
	Overall Percentage				91.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Demographic Cluster 1.1			392.901	17	.000			
	Demographic Cluster 1.2	.063	.025	6.211	1	.013	1.065	1.013	1.118
	Demographic Cluster 1.3	-.011	.021	.248	1	.618	.989	.949	1.032
	Demographic Cluster 2.1	.050	.032	2.438	1	.118	1.051	.987	1.119
	Demographic Cluster 2.2	.032	.032	1.054	1	.305	1.033	.971	1.099
	Demographic Cluster 2.3	.009	.024	.146	1	.702	1.009	.962	1.059
	Demographic Cluster 2.4	.002	.035	.003	1	.958	1.002	.935	1.073
	Demographic Cluster 3.1	.122	.022	29.228	1	.000	1.129	1.081	1.180
	Demographic Cluster 3.2	.080	.032	6.237	1	.013	1.083	1.017	1.154
	Demographic Cluster 3.3	.084	.022	14.031	1	.000	1.088	1.041	1.136
	Demographic Cluster 3.4	.162	.022	52.621	1	.000	1.176	1.126	1.229
	Demographic Cluster 4.1	-.111	.032	11.864	1	.001	.895	.840	.953
	Demographic Cluster 4.2	.146	.030	23.982	1	.000	1.157	1.092	1.227
	Demographic Cluster 4.3	.060	.025	5.628	1	.018	1.062	1.011	1.117
	Demographic Cluster 4.4	.192	.026	53.654	1	.000	1.211	1.151	1.275
	Demographic Cluster 4.5	.260	.031	69.927	1	.000	1.297	1.220	1.378
	Demographic Cluster 4.6	.202	.075	7.214	1	.007	1.223	1.056	1.417
	Demographic Cluster 4.7	.195	.031	39.700	1	.000	1.215	1.144	1.291
	Race – White			4987.660	5	.000			
	Race – African American	.649	.009	4980.836	1	.000	1.914	1.879	1.948
	Race – Asian	.272	.023	138.687	1	.000	1.313	1.255	1.374
	Race – American Indian/Alaska	.287	.084	11.688	1	.001	1.332	1.130	1.570
	Race – Native Hawaiian/Other	.016	.166	.009	1	.924	1.016	.734	1.407
	Race – Multiracial	.327	.065	25.373	1	.000	1.387	1.221	1.575
	Marital Status – Unmarried	.263	.010	750.912	1	.000	1.301	1.276	1.325

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
Age – 10 to 14			966.766	8	.000			
Age – 15 to 19	-.087	.063	1.868	1	.172	.917	.810	1.038
Age – 20 to 24	-.170	.063	7.268	1	.007	.843	.745	.955
Age – 25 to 29	-.180	.063	8.016	1	.005	.835	.738	.946
Age – 30 to 34	-.054	.064	.715	1	.398	.947	.836	1.074
Age – 35 to 39	.125	.064	3.767	1	.052	1.133	.999	1.286
Age – 40 to 44	.367	.068	29.333	1	.000	1.443	1.264	1.648
Age – 45 to 49	.738	.118	39.241	1	.000	2.093	1.661	2.637
Age – 50 +	1.306	.575	5.152	1	.023	3.692	1.195	11.404
Education Years Completed	-.011	.002	41.613	1	.000	.990	.986	.993
Constant	-2.570	.068	1439.218	1	.000	.077		

a. Variable(s) entered on step 1: DEMOGRAPHIC CLUSTER, RACE_CODE, M_MARITAL_STATUS, M_AGE_GROUP, M_EDUCATION_YEARS.

Results of Logistic Regression Analysis for Hypothesis 2 (County Type)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11936.428	16	.000
	Block	11936.428	16	.000
	Model	11936.428	16	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	516340.062[a]	.013	.030

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Birth Weight Category		Percentage Correct
			Normal	Low Birth Weight	
Step 1	Birth Weight Category	Normal	807241	0	100.0
		Low Birth Weight	78085	0	.0
	Overall Percentage				91.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Race – White			6232.409	5	.000			
	Race – African American	.671	.009	6229.147	1	.000	1.956	1.924	1.989
	Race – Asian	.261	.023	128.964	1	.000	1.298	1.241	1.358
	Race – American Indian/Alaska	.284	.084	11.472	1	.001	1.328	1.127	1.565
	Race – Native Hawaiian/Other	.027	.166	.026	1	.872	1.027	.742	1.423
	Race – Multiracial	.324	.065	24.900	1	.000	1.382	1.217	1.569
	Marital Status - Unmarried	.275	.009	838.751	1	.000	1.317	1.292	1.341
	Age – 10 to 14			936.468	8	.000			
	Age – 15 to 19	-.090	.063	2.017	1	.156	.914	.807	1.035
	Age – 20 to 24	-.176	.063	7.782	1	.005	.839	.741	.949
	Age – 25 to 29	-.192	.063	9.119	1	.003	.826	.729	.935
	Age – 30 to 34	-.072	.064	1.281	1	.258	.930	.821	1.054
	Age – 35 to 39	.104	.064	2.631	1	.105	1.110	.978	1.259
	Age – 40 to 44	.346	.068	26.179	1	.000	1.414	1.238	1.614
	Age – 45 to 49	.717	.118	37.032	1	.000	2.049	1.626	2.581
	Age – 50 +	1.274	.575	4.910	1	.027	3.574	1.158	11.027
	Education Years Completed	-.012	.002	58.791	1	.000	.988	.985	.991
	County Type – Rural	.127	.010	164.167	1	.000	1.135	1.113	1.157
	Constant	-2.501	.064	1511.663	1	.000	.082		

a. Variable(s) entered on step 1: RACE_CODE, M_MARITAL_STATUS, M_AGE_GROUP, M_EDUCATION_YEARS, COUNTY_TYPE.

Results of Logistic Regression Analysis for Hypothesis 3 (Adequacy of Prenatal Care Utilization)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	36231.230	18	.000
	Block	36231.230	18	.000
	Model	36231.230	18	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	492045.261[a]	.040	.089

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			Birth Weight Category		Percentage Correct
	Observed		Normal	Low Birth Weight	
Step 1	Birth Weight Category	Normal	807241	0	100.0
		Low Birth Weight	78085	0	.0
	Overall Percentage				91.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Race – White			5765.230	5	.000			
	Race – African American	.655	.009	5751.687	1	.000	1.926	1.894	1.959
	Race – Asian	.320	.023	188.834	1	.000	1.377	1.316	1.442
	Race – American Indian/Alaska	.282	.085	11.040	1	.001	1.326	1.123	1.567
	Race – Native Hawaiian/Other	.097	.168	.335	1	.563	1.102	.793	1.532
	Race – Multiracial	.330	.066	25.174	1	.000	1.391	1.223	1.583
	Marital Status - Unmarried	.286	.010	872.675	1	.000	1.331	1.306	1.356
	Age – 10 to 14			705.357	8	.000			
	Age – 15 to 19	-.059	.064	.857	1	.355	.942	.831	1.069
	Age – 20 to 24	-.158	.064	6.071	1	.014	.854	.753	.968
	Age – 25 to 29	-.183	.064	8.070	1	.005	.833	.734	.945
	Age – 30 to 34	-.076	.065	1.370	1	.242	.927	.816	1.053
	Age – 35 to 39	.071	.065	1.165	1	.280	1.073	.944	1.220
	Age – 40 to 44	.299	.069	18.879	1	.000	1.348	1.178	1.543
	Age – 45 to 49	.636	.120	27.964	1	.000	1.888	1.492	2.390
	Age – 50 +	.992	.585	2.879	1	.090	2.696	.857	8.477
	Education Years Completed	-.018	.002	124.823	1	.000	.982	.979	.985
	Inadequate Prenatal Care			22965.716	3	.000			
	Intermediate Prenatal Care	-.624	.017	1336.245	1	.000	.536	.518	.554
	Adequate Prenatal Care	-.664	.014	2410.224	1	.000	.515	.501	.528
	Adequate Plus Prenatal Care	.639	.012	2767.524	1	.000	1.894	1.850	1.940
	Constant	-2.416	.066	1358.509	1	.000	.089		

a. Variable(s) entered on step 1: RACE_CODE, M_MARITAL_STATUS, M_AGE_GROUP, M_EDUCATION_YEARS, KOTELCHUCK_INDEX.