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The Association Between Race and Rurality on Maternal and Infant Outcomes in North Carolina

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BY

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A doctoral project submitted to the faculty of the Medical University of South Carolina
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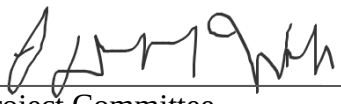
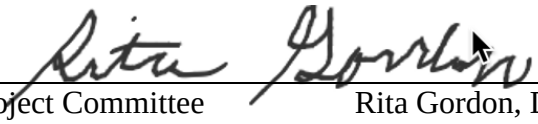
		03/15/2023
Member, Project Committee	Dunc Williams, PhD	Date
		03/15/2023
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Abstract of Dissertation Presented to the
Medical University of South Carolina
In Partial Fulfillment of the Requirements for the
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Chairperson:	Mary Dooley, PhD
Committee:	Dunc Williams, PhD
	Rita Gordon, DHA

Abstract

The closure of rural hospitals and obstetric units have disproportionally impacted expectant mothers on Medicaid, increased travel distances, and accessibility to adequate prenatal care. These closures are affecting communities of color and low-income communities at greater rates than other communities, contributing to access to care barriers. Literature shows lack of rural obstetric access contributes to rural women having higher rates of cesarean sections. This is specifically impactful to North Carolina, one of the top 10 most rural states in the nation.

Using North Carolina HCUP hospital admissions data for 2017, a retrospective cohort analysis was conducted to determine outcomes of Black mothers and infants compared to white mothers and infants in rural and nonrural zip codes. Using this data, cesarian sections and complications during childbirth were assessed for mothers while and mortality complications within the first year of life were examine for infants. Models were assessed using multivariable logistic regression.

Results found confirmed disparities related to infant mortality (OR=2.4), higher odds of delivering via cesarian section for Black mothers vs white mothers in rural zip codes (OR=1.08), and increased odds of experiencing complications for black mothers compared to white mothers (OR=1.11).

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1 INTRODUCTION

1.1 Background and Need

The Centers for Disease Control and Prevention (CDC) defines complications as health problems that occur during pregnancy. Evidence suggests that rural hospital closures and closures of rural obstetric units are affecting communities of color and low-income communities at greater rates than other communities contributing to access to care barriers (Improving access to maternal health care in rural communities ISSUE BRIEF). In poorer countries around the world, when mothers experience complications, they must travel to receive care which is eerily similar to what mothers in rural areas also experience (www.cnn.com). Women are eight to ten times more likely to die due to complications of a cesarean section (c-section) compared to vaginal birth (Improving access to maternal health care in rural communities ISSUE BRIEF). There is a need to understand issues at the local and state level to be able to influence policy and access factors to improve outcomes.

An estimated 700 women die in the United States (US) each year as a result of complications due to pregnancy, leading to the US being one of the only countries in the world where the rate of maternal mortality has heightened over the past 25 years (Noonan, Velasco-Mondragon, & Wagner, 2016). In March 2010, President Obama signed the Patient Protection and Affordable Care Act (ACA) which was intended to increase healthcare protection and expand Medicaid; however, all states did not participate in the expansion. Fortunately, North Carolina was recently included. Though Medicaid covers prenatal care and birth for low-income

uninsured mothers, there are several other contributing factors including access to care that are impacting the population.

With an estimated 2.1 million people (20% of the population) residing in rural areas, North Carolina is one of the top 10 most rural states in the nation (NCDHHS office of rural health, 2020). Traditionally, the areas are older, poorer, and less developed with a healthcare infrastructure that includes minimal doctors and smaller hospitals (Holmes, 2009). Since 2010, North Carolina has had seven rural hospitals close with reasons for closures ranging from industry trends to lack of hospital reimbursements (Holmes, 2009). These closures have disproportionally impacted expectant mothers on Medicaid, increased travel distances, and accessibility to adequate prenatal care (Sullivan et al., 2020).

1.2 Problem Statement

The number of hospital closures in rural areas is a national crisis. With policy changes, programs in place, and advocacy North Carolina can make the needed changes that will positively impact expecting mothers. More research is needed on the maternal and infant morbidity public health challenges and the impact it has had in the United States.

There are maternity complications leading to preventable deaths and adverse events experienced by all mothers and infants, however, black individuals experience them at a higher rate. Negative birth outcomes including preterm birth and low birthweight, as well as mortality of infants up to the age one, were also be examined. An analysis provided real world examples of

the areas for improvement as well as opportunities to decrease the number of preventable deaths and complications to understand/improve the experiences of mothers in North Carolina.

1.3 Research Questions and Research Hypotheses

This project explored the associations of demographics and rurality on maternal and infant outcomes. This project will bring awareness to the topic of access to care and healthcare equity. Lastly, it could inform policy makers to get the state closer to accomplishing the 2030 goal of decreasing infant mortality. The hypothesis is the rate of negative maternal and infant outcomes in rural zip codes areas are higher compared to nonrural zip codes considering the potential interaction between race and rurality.

- Are the odds of complications among Black women in rural zip codes higher compared to white women?
- Are the odds of Cesarean Sections (C-Sections) among Black women in rural zip codes higher compared to white women?
- Are the odds of infant mortality among Black infants in rural zip codes higher compared to white infants?
- Are the odds of complications among Black infants in rural zip codes higher compared to white infants?

1.4 Population

By 2030, one of the goals for the state of North Carolina is to decrease infant mortality which will require healthy mothers. The study targets women residing in North Carolina who were admitted and gave birth in hospitals geographically located in North Carolina. Infants under the age of one year who were residing and hospitalized in a North Carolina hospital were also be assessed.

2 SCOPING LITERATURE REVIEW

2.1 Maternal Health

Maternal care includes prenatal, delivery, and postpartum, which is often overlooked (Maternal and obstetric care challenges in rural America policy brief and recommendations to the secretary, 2020). Many people focus only on one specific component of maternal care, not factoring in the impact or importance of a healthy pregnancy from beginning to end. The current administration (President Joe Biden and Vice President Kamala Harris) recognizes the magnitude of the maternal health crisis and the impact it has on many women which has led to The White House Blueprint for Addressing the Maternal Health Crisis. The administration has shared essential steps and goals including closing the Medicaid coverage gap, investing significantly in efforts to reduce maternal mortality and morbidity, expanding maternal health initiatives in rural communities, and implementing implicit bias training for healthcare workers (White House, 2022).

Healthy People 2020 is a prevention agenda intended to build and encourage a healthier nation set in place by the federal government. The national target for cesarean sections is 23.9 percent and North Carolina met the overall target however, targets for first time mothers carrying a single, full-term baby in the head-down position (NTSV) was not met (www.cesareanrates.org). According to the North Carolina Department of Health and Human Services, the total cesarean section rate in NC in 2016 is 29.4 percent resulting in the state ranking 33rd (www.pqcnc.org).

A study examining population level factors and increasing maternal deaths in the United States between 1997 and 2012 found an increased prevalence of obesity, diabetes, and other chronic health problems among expecting mothers (Dagher, R.K.; Linares, D.E, 2022). This finding of study determined maternal mortality was also attributable to SDoH factors occurring across multiple levels, including women of childbearing age who did not complete high school, the proportion of births among Black women, and the proportion of women who attended fewer than ten prenatal visits (Dagher, R.K.; Linares, D.E, 2022).

There are seven leading causal factors connected to the United States maternal mortality consisting of thrombotic pulmonary embolism, hemorrhage, hypertensive disorders of pregnancy, infection, cardiomyopathy, cardiovascular conditions, and non-cardiovascular medical conditions (Dagher, R.K.; Linares, D.E, 2022). The demographic most likely to experience the aforementioned are Black mothers. Trends also frequently include factors such as insurance status, income, and education (Nelson, D.B., Moniz, M.H. & Davis, M.M., 2018).

Severe maternal morbidity (SMM) considers the unexpected outcomes of labor and delivery that result in short- and long-term consequences to a woman's health (cdc.gov). Since 2014, the SMM prevalence has continued to trend upward without a clear explanation. The United States Center for Disease Control and Prevention define SMM as an index of 21 indicators of significant events during delivery hospitalizations, including: acute myocardial infarction, aneurism, acute renal failure, respiratory distress, thrombotic pulmonary embolism, amniotic fluid embolism, cardiac arrest, eclampsia, heart failure, severe anesthesia complications, sepsis, and ventilation, among others (Dagher, R.K.; Linares, D.E, 2022). We

investigated maternal complications during delivery (e.g., lacerations, hemorrhages, infections, traumas).

2.2 Infant Mortality

Infant mortality is defined as a death before the age of one (N C Med J. 2021). In the United States, most infant deaths take place within the first month of life with 40 percent occurring less than 28 days (neonatal period) (healthsystemtracker.org). In 2017, nationally 66 percent of infant deaths transpired during the neonatal period with 40 percent being within the first 24 hours (healthsystemtracker.org).

Adverse birth outcomes result in trauma for both the children and their families for a lifetime. Adverse pregnancy outcomes are those considered anything other than normal live birth which typically include preterm birth, stillbirth and low birth weight which are the major cause of neonatal morbidity, mortality, and long term physical and psychological problems (N C Med J. 2021).

In 2018 and 2019, the overall infant mortality rate (IMR) in North Carolina was at an all-time low with 6.8 deaths per 1,000 live births (N C Med J. 2021). Nationally, racial disparities are in the spotlight with Black infants dying at a rate of 12.5 per 1,000 live births while white infants have a rate of 4.6 per 1,000 births (N C Med J. 2021).

2.3 Healthcare Equity

In 2005, the World Health Organization established the Commission on Social Determinants of Health (CSDH) which generates recommendations based on evidence as it relates to health equity (Bell, Marmot, 2009). In an article, Dr. Ruth Bell and Dr. Michael Marmot, pose the question, “Does the United States have the best Healthcare?” based on the analogy that wealthier countries have better health and medical care leading to improved care. The article compares the United States and SDoH to other countries globally to argue the issue and importance of equity in healthcare and the outcomes. As the climate of the economic crisis shifts, we will continue to also see shifts in the recommendations posed by the CSDH. The article was written in 2009 and mentions the impact the start of the 2007 recession had on job security and healthcare. Now, a decade later, we are likely to experience the same or similar cycle.

A study conducted in New York City found that women living in zip codes with the highest racial and economic division between poor blacks and wealthy whites experienced the highest severe maternal morbidity rates compared to women living in neighborhoods with the lowest. Consequently, there is preliminary evidence showing a potential relationship between neighborhood deprivation and maternal mortality and morbidity (Dagher, R.K.; Linares, D.E, 2022). A zip code can have a greater impact on one’s health than what typically may come to mind initially. According to the Root Causes of Health report, potential health outcomes can be linked to a zip code and determine health outcomes as well as powerful when addressing disparities (himss.org).

SDoH are defined as conditions in which one is born, live, learn and work with and currently account for 80 percent of health outcomes and has become a valuable talking point (Kim, Abrahams, Uwemedimo, & Conigliaro, 2019). In addition, the data continues to show that there is a correlation between health outcomes and SDoH. Along with external factors such as poverty status, neighborhood, and educational attainment, access to prenatal care is a major contributing factor and a root cause of negative birth outcomes in North Carolina.

The Centers for Disease Control and Prevention has developed the Social Vulnerability Index to identify the vulnerability of communities. The integrated tool assesses community resources and preparedness and has 15 factors as the foundation including individual scores in the following 4 themes: socioeconomic status (theme 1), household composition and disability (theme 2), minority status and language (theme 3), and housing type and transportation (theme 4) plus an overall composite score.

2.4 Access to Care

Healthcare is a billion-dollar industry; thus, the payer type is a driving force to continue to produce revenue. The Agency of Healthcare Research and Quality defines "access to care" as, having "the timely use of personal health services to achieve the best health outcomes (ahrq.gov). The United States is one of the only countries in the world where the rate of maternal mortality has heightened over the past 25 years (Noonan, Velasco-Mondragon, & Wagner, 2016). Multiple factors contribute to mortality rates with one being racial and ethnic disparities; specifically access to care (Petersen et al., 2019).

In rural areas, the prevalence of citizens relying on Medicaid is higher which results in hospital and clinic closures. For quite some time, there have been changes to the inpatient versus outpatient model, and there have been shifts the Medicare reimbursement classifications (Sana & Pink, 2021), a thorough analysis needs to be done to bridge the gap for Medicaid dependent residents.

Programs such as Medicaid, Children's Health Insurance Program (CHIP), and the U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) have improved perinatal and birth outcomes as well as breastfeeding rates (Dagher, R.K.; Linares, D.E, 2022). Medicaid and CHIP are joint state- and federal-based programs providing free medical coverage for low-income pregnant mothers and children. WIC participants receive nutritional assistance, lactation support, immunization screening, connections to Medicaid, and health care referrals using funds from a federal grant given to states to protect the health of women, infants, and children (0–5 years) living in low-income households; to date half of all U.S.-born infants benefit from WIC (Dagher, R.K.; Linares, D.E, 2022).

As of April 2022, North Carolina has become one of the 15 states to extend Medicaid coverage through 12 months postpartum, which will have a monumental impact (politico.com). More studies are needed to evaluate the impact of eligibility expansions for WIC and Medicaid expansions on disparities in infant mortality and morbidity.

2.5 Rural Hospital Closures

High turnover and hospital closures in rural areas are due primarily to the lack of profitability (Han, Nguyen, Drope, & Jemal, 2015). A study conducted in November 2013 through March 2014 spotlighted the struggles clinicians delivering babies have with staffing. Telephone surveys were conducted in nine states, including North Carolina, and the findings primarily indicate a lack of staff for scheduling, training, and recruitment and retention in rural hospitals. There are several family physicians who have been attending deliveries due to the challenges with attaining obstetrics staff (Kozhimannil et al., 2015). The limitations to the study focused on the sample size of nine, though the hospitals surveyed (306) were all comparable size and accreditation, there were variances in the birth volume (Kozhimannil et al., 2015).

A retrospective study spotlighting the five hospital closures in recent years, found that women in rural North Carolina on Medicaid were disproportionately affected and travel times to delivery hospitals was increased to an average of 7-27 miles (Sullivan et al., 2020). Prior to the closures, an overall 66 percent of the mothers were covered by Medicaid at the time of their delivery (Sullivan et al., 2020). The average distances of 11 to 15 miles and 19 to 56 miles ranked the highest with 31 counties a piece.

In May 2021, congress passed the Rural MOMS Act which will expand the initiatives to address rural maternal health through 2025. The bill will foster relationships and relationships to improve the birth outcomes and reduce the maternal morbidities in rural areas (congress.gov). The bill will require the Health Resources and Services Administration (HRSA) to establish rural obstetric networks. In addition, grants will be awarded to medical schools and other health

programs. Though there appears to be an opportunity for extension after 2025, the bill does not seem to be for the entire United States. The list of cosponsors along with their states is listed which leads one to believe only these states will initially be included; North Carolina is not one of them.

3 METHODOLOGY

3.1 Research Design

This retrospective cohort analysis provided a snapshot of opportunities to decrease the number of cesarean sections and complications to understand/improve the experiences of mothers in North Carolina, as well as the impact the outcomes may have on infants. Exclusions assisted in getting the most accurate analysis. Multiple births and mothers age 35 and older were excluded as each has a separate set of complications and challenges that will be ideal for future research. The data assessed Black mothers and infants and white mothers and infants in rural and nonrural areas in the state of North Carolina in 2017.

3.2 Data Set Description

The Healthcare Cost and Utilization Project (HCUP) is a set of healthcare databases developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP data in conjunction with ICD-10 codes was used to explore the associations of demographics, and rurality of maternal and infant outcomes. Zip codes will be used to differentiate rurality. Examining maternal and infant outcomes assisted in preventing complications and improving quality of life which contribute to the impact the study.

3.3 Independent and Dependent Variables

To research the hypothesis, independent and dependent variables were considered. The independent variables for mothers include: 1) Race, 2) Age (ranging 12-34), 3) Charlson

Comorbidity Index (CCI) Score, 4) Length of Stay (LOS), and 5) C-Section vs Vaginal birth. The independent variables for infants will include: 1) Race, 2) Gender, 3) Age (days), 4) Length of Stay. Additional independent variables for both mothers and infants were 1) Insurance Status and 2) Rurality. Dependent variables were the outcomes. The outcomes for infants include: 1) complications including preterm birth with and without complications, extreme immaturity or respiratory distress syndrome, and full-term birth with major problems, and 2) mortality of infants up to the age one. For mothers the outcomes include: 1) presence of any delivery complications (using ICD 10 codes) including preterm labor and 2) was the baby delivered via C-Section.

3.4 Data Analysis

The use of logistic regressions, Chi Squares, and T-tests were the statistical approaches used to analyze the data. The binary outcomes focusing on the research questions were assessed using multivariable logistic regressions to evaluate the relationship between outcomes with rurality and race while controlling for confounders. The descriptive statistics are reported as mean (standard deviation) for continuous and frequency (percentage) for categorical variables. Differences in characteristics between groups was assessed using Chi squares and T-tests for categorical and continuous variables, respectively. All analyses were conducted using SAS 9.4 (Cary, NC). Statistical significance was assessed using p-value of 0.05 with two-tailed tests.

3.5 Protection of Human Subjects

Exempt due to non-human subjects.

4 RESULTS

4.1 Outcomes of Mothers

Table 1 provides a descriptive comparison of mothers included in the analysis who gave birth in a hospital in North Carolina in rural and non-rural areas. A total of 69,295 mothers were assessed. There was a total of 18,669 mothers living in areas with zip codes classified as rural with a median age of 25.7 and 50,626 living in non-rural areas with a median age of 27.0. There was a slight difference in distribution of races analyzed, which solely included Black and White. The insurance statuses studied were Medicaid, Private Insurance, and other which encompassed self-pay, no charge and other. Significant differences in distribution of Medicaid (58.6% vs. 44.6%), as well as private insurance (37.7% vs. 50.8%), were found between rural and non-rural zip codes, respectively (p=<.0001).

Table 1: Characteristics of Mothers			
	Rural	**Non- Rural**	**P- Value**
N	18669	50626	
Age (in years)	25.7 ± 4.5	27 ± 4.5	<.0001
Race: Black White	 5,516 (29.6%) 13,153 (70.5%)	 16,943 (33.7%) 33,319 (66.3%)	<.0001
Insurance Status: Medicaid Private Insurance Other	 22,394 (58.6%) 7,029 (37.7%) 693 (3.71%)	 10947 (44.6%) 25,534 (50.8%) 2334 (4.64%)	<.0001
Complications:	4,910 (10.0%)	1,929 (10.3%)	0.0278
C-Section:	5,466 (29.3%)	13,974 (27.8%)	0.0001
Charlson Score	0.1 ± 0.3	0.1 ± 0.3	<.0001
Length of Stay (days)	2.0 (2.0 - 3.0)	2.0 (2.0 - 3.0)	<.0001

****Due to rounding, percentages may not sum to 100%**

The unadjusted percentage of mothers receiving cesarean sections were similar between nonrural and rural zip codes (27.8% vs. 29.3%, respectively). However, when adjusted to assess the differences in race by rurality, there were significant differences found for Black mothers compared to white mothers in rural zip codes (OR=1.08, 95% CI 1.00-1.16); however, there were no significant differences for Black mothers compared to white mothers in non-rural zip codes (OR=0.98, 95% CI 0.94-1.03); controlling for insurance status, CCI, and age. Overall, the findings show that mothers with private insurance or other insurances have lower odds of delivering via c-section than mothers receiving Medicaid (OR=0.89, 95% CI (0.86-0.93) and OR=0.82, 95% CI (0.75-0.90); respectively); controlling for race, rurality, CCI, and age.

Table 3: Mothers Delivering via C-Section	
Variable	**OR (95% CI)**
Fixed	
Black vs White (NonRural)	**0.98 (0.94 – 1.03)**
Black vs White (Rural)	**1.08 (1.00 -1.16)**
Covariants	
Insurance (Private vs Medicaid)	**0.89 (0.86 – 0.93)**
Insurance (Other vs Medicaid)	**0.82 (0.75 – 0.90)**
Charlson Score	**1.12 (1.06 – 1.18)**
LOS	**1.71 (1.70 – 1.74)**
Age (5-year increment)	**1.36 (1.33 – 1.39)**

Table 4 reports Black mothers have increased odds of complications from childbirth compared to white mothers (OR=1.11, 95% CI (1.05-1.17)); controlling for delivery type, age, insurance, and CCI. The odds of having a complication from childbirth by delivering via c-section was 26% higher compared to delivering vaginally (OR=1.26, 95% CI (1.19-1.33); controlling for race, insurance status, CCI, and age.

Table 4: Mothers Experiencing Complications During Childbirth	
Variable	**OR (95% CI)**
Fixed	
Black vs White	**1.11 (1.05 -1.17)**
C-Section vs Vaginal Birth	**1.26 (1.19 – 1.33)**
Covariants	
Insurance (Private vs Medicaid)	**0.88 (0.83 – 0.93)**
Insurance (Other vs Medicaid)	**1.00 (0.88 – 1.13)**
Charlson Score	**1.53 (1.44 – 1.62)**
Age (5-year increment)	**0.92 (0.89 – 0.94)**

4.2 Outcomes of Infants

Table 2 provides a descriptive comparison of infants included in the analysis born in North Carolina in rural and non-rural areas. A total number of 82,719 infants with analyzed. There were 59,841 infants in rural areas with a median age of 9.0 days and 22,878 in non-rural areas with a median age of 8.1 days. Of note, infants up to 365 days old were considered eligible and approximately 52 percent of infants from both areas were males. In parallel to the mothers analyzed, insurance statuses of the infants presented significant differences in Medicaid and private insurance statuses. The insurance statuses studied were Medicaid, Medicare, Private Insurance, and other which encompassed self-pay, no charge and other. Significant differences in distribution of Medicaid (61.7% vs. 45.8%), as well as private insurance (30.9% vs. 46.5%),

were found between rural and non-rural zip codes, respectively (p=<.0001). Similarly, to the cohort of mothers, there was a slight difference in distribution of races analyzed, which solely included Black and white.

Table 2: Characteristics of Infants			
	Rural	**Non- Rural**	**P- Value**
N	59841	22878	
Age (in days)	9.0 ± 43	8.1 ± 41	<.0001
Gender: Female Male	 11,122 (48.6%) 11,756 (51.4%)	 28,973 (48.4%) 30,868 (51.6%)	0.6107
Race: Black White	 6,868 (30.0%) 16,010 (70.0%)	 19,500 (32.7%) 40,251 (67.3%)	<.0001
Insurance Status: Medicaid Private Insurance Other	 14,126 (61.7%) 7067 (30.9%) 1,685 (7.4%)	 27,396 (45.8%) 27,821 (46.5%) 4,624 (7.7%)	<.0001
Complications:	8,739 (38.2%)	24558 (41.0%)	<.0001
Deceased:	107 (0.47%)	221 (0.37%)	0.0440
Length of Stay (days)[1]	2.0 (2.0-4.0)	2.0 (2.0-4.0)	<.0001

[1] Median (IQR)

The unadjusted percentages for infant mortality in rural and nonrural zip codes were similar (0.47% and 0.37%, respectively). Once adjusted to assess race, rurality, LOS, and insurance status, the odds of Blacks infants dying was 2.4 times that of white infants (OR=2.40, 95% CI (1.90-3.03) when controlling for rurality, insurance, LOS, and age. There were also

significant increase in odds of infant deaths in rural zip codes compared to non-rural zip codes (OR=1.29, 95% CI=1.02-1.63) when controlling for race, insurance, LOS, and age.

Table 5: Infant Mortality	
Variable	**OR (95% CI)**
Fixed	
Rural vs Nonrural	**1.29 (1.02– 1.63)**
Black vs White	**2.40 (1.90 -3.03)**
Covariants	
Insurance (Private vs Medicaid)	**0.80 (0.61 – 1.05)**
Insurance (Other vs Medicaid)	**1.74 (1.24 – 2.45)**
LOS	**1.01 (1.01 – 1.02)**
Age	**1.00 (1.00 – 1.00)**

Table 6 details the comparison of infants experiencing complications from birth. The unadjusted percentages for complications were not significant with 38.2% infants in rural zip codes experiencing complications and 41.0% in nonrural zip codes (p=<.0001). When adjusted, the odds of Black infants in nonrural zip codes having complications were 7% greater than white infants (OR=1.07, 95% CI=1.03-1.12) however, in rural zip codes the odds for Black infants were 10% lower than white infants (OR=0.90, 95% CI=0.85-0.95), controlling for insurance, LOS, and age. Interestingly, infants with private and other insurance had significantly lower odds

of complications compared to infants with Medicaid (OR = 0.80 and OR = 0.84, respectively), when controlling for race, rurality, LOS, and age.

Table 6: Infants Experiencing Complications Up To 1 Year of Age	
Variable	**OR (95% CI)**
Fixed	
Black vs White (Nonrural)	**1.07 (1.03– 1.12)**
Black vs White (Rural)	**0.90 (0.84 -0.95)**
Covariants	
Insurance (Private vs Medicaid)	**0.80 (0.77 – 0.83)**
Insurance (Other vs Medicaid)	**0.84 (0.79 – 0.88)**
LOS	**1.20 (1.19 – 1.21)**
Age	**0.95 (0.95 – 0.95)**

5 DISCUSSION

5.1 Discussion of Results

Various studies have shown rural women are affected by the lack of access to care, often disproportionately affecting Black women (Sullivan et all, 2020). The current study assessed the effects of rurality on the maternal outcomes of women and outcomes of infants in the state of North Carolina. Results showed that Black mothers had higher odds of delivering via c-section in rural areas than white mothers, whereas the odds of delivering via c-section in non-rural areas were similar for Black mothers and white mothers. While an increase in scheduled deliveries and c-sections is expected in rural mothers, Black women in rural areas were disproportionately affected. Furthermore, the odds of having complications from childbirth when delivering via c-section was 26% higher compared to delivering vaginally when controlling for race, insurance status, CCI, and age. Of note, Black mothers had increased odds of complications, compared to white mothers, when controlling for the aforementioned. Among the models assessing c-sections, there is an interaction between race, rurality, LOS that is beyond the scope of this project and will need to be investigated further.

Nationally, racial disparities are in the spotlight with Black infants dying at a rate of 12.5 per 1,000 live births while white infants have a rate of 4.6 per 1,000 births (N C Med J. 2021). Similarly in our current study of infants living in North Carolina, we found that Black infants had 2.4 times the odds of death compared to white infants. Contrary to what is found in the literature, our study found Black infants had lower odds of complications than white infants in rural areas. While the scheduling of c-sections is often performed to optimize fetal health,

therefore may explain some of the infants born in rural zip codes having less complications, this does not explain the conflicting finding. Furthermore, interviews with clinical experts in maternal care have confirmed the data is not consistent with what they have observed. Further investigation will need to be conducted concerning infant complications and outcomes. Caution should be taken against any implications this result may have on clinical care.

5.2 Limitations

The limitations for this study were extensive. Mothers and infants were not analyzed as dyads which made determining associations between the outcomes impossible. Additionally, inductions were not able to be identified in the data set. Race was also subjective as confirmation of one or more races is not considered for mother or infants. Lastly, infant death certificates were not attainable; only deaths taking place in hospitals were considered.

5.3 Future Research

Future research will include a greater analysis of hospital closures in rural North Carolina as well as comparing the impact of individual and community factors on maternal and infant outcomes in other southern states (i.e. South Carolina and Mississippi). Exploring transportation barriers, primarily the mileage expecting mothers must travel to receive pre- and post-natal care and determining outcomes should also be assessed.

Further investigating into the findings of infant complications as well as mothers delivering via c-sections in rural and non-rural zip codes in North Carolina. In addition, outcomes of mothers over the age of 35 and multiple births would be of interest as these were exclusions for this study.

5.4 Conclusion

While some of the data conflicts with the findings in the literature and results from other southern states, the study found there is a disparity in maternal and infant outcomes as it pertains to race. The odds of Black infants dying prior to the age of one is 2.4 times greater than those of white infants and the odds of rural mothers delivering via c-section are greater than white mothers. The analysis did find there were significant differences in the odds for Black mothers compared to white mothers in rural zip codes delivering via c-section; however, there were no significant differences for Black mothers compared to white mothers in non-rural zip codes when controlling for insurance status, CCI, and age.

Lastly, the odds of Black infants in nonrural zip codes having complications were greater than white infants whereas, in rural zip codes the odds for Black infants were lower than white infants. Further investigating will be necessary to expound on the findings of infant complications as well as mothers delivering via c-sections in rural and non-rural zip codes in North Carolina. Caution should be taken against the clinical implications of data.

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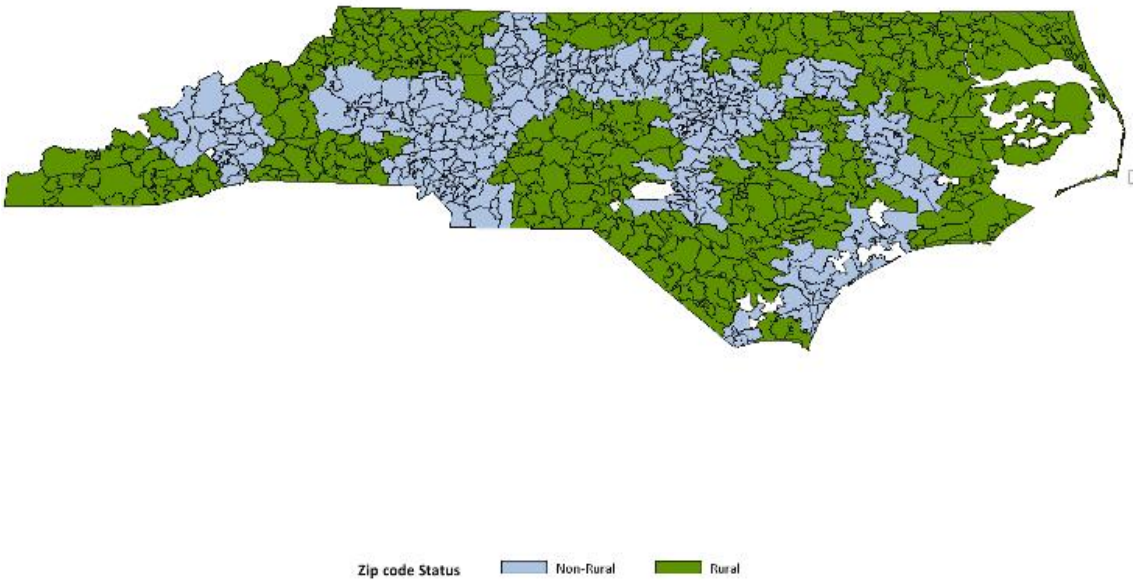
Appendices

Appendix A: North Carolina Rurality Map



APPENDIX B: DRG & ICD-10 CODES FOR OUTCOMES OF MOTHERS	
CODE	**DESCRIPTION**
765	Cesarean Section with complication or comorbidity (CC)/major complication or comorbidity (MCC)
766	Cesarean Section Without complication or comorbidity (CC)/Major complication or comorbidity (MCC)
060	Preterm Labor
075	Other complications of labor and delivery, not elsewhere classified

APPENDIX C: DRG & ICD-10 CODES FOR OUTCOMES OF INFANTS	
CODE	**DESCRIPTION**
1	Mortality; died in hospital
789	Neonates, Died or transferred to another acute care facility
790	Extreme immaturity or respiratory distress syndrome, Neonates
791	With Major Problems
792	Without Major Problems
793	Full Term Neonate with Major Problems