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Individual and Community Socioeconomic Predictors of High Risk and Low Birthweight in Maternity Deserts in Mississippi

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INDIVIDUAL AND COMMUNITY SOCIOECONOMIC PREDICTORS OF HIGH RISK AND LOW BIRTHWEIGHT IN MATERNITY DESERTS IN MISSISSIPPI

BY

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Approved by:

Chair, Project Committee	Dr. Kit Simpson, DrPH	Date
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Acknowledgments

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Abstract of Dissertation Presented to the
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Chairperson: Kit Simpson, DrPH
Committee: Daniel Brinson, PhD
Michelle Owens, MD

Objective: Performing a retrospective analysis of all live births to Mississippi residents for 2018, using the HCUP SID database; this study examines the relationship between individual and community-level socioeconomic characteristics to high risk and low birth weight outcomes among maternity health care deserts in Mississippi.

Methods: Statistical differences between the subjects and the reference group were examined using Chi-square ($\chi 2$) tests and Fisher's exact test. Logistic regression was used to assess mothers' risk in OB desert county for any adverse event after controlling for race and gender.

Results: On average, babies in OB desert county had a likelihood of neonatal death 29.26% vs. 22.14% *(P*=0.0457). Black, female gender, and delivered by Cesarean Section (*P*=.0001) with a greater likelihood of an adverse event.

Conclusion: There are many consequences associated with limited access to care. Besides low birth weight, prematurity, and maternal morbidity, there are increased risks for Cesarean Section. Findings indicate a need for collaborative efforts to improve access to care and improved advocacy for vaginal birth.

Keywords: health disparities; low birth weight; small for gestational age; prematurity; preterm; racial disparities, access to care; adverse birth outcomes; cesarean section; maternal outcomes, the rural disparity

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INTRODUCTION

Background and Need

The gold standard in the prevention of adverse birth outcomes has been and remains access to care. However, for many women in the United States, this is an eluding reality. As hospital closures and changes in area resources continue nationwide, access to much-needed maternity healthcare has proven to be a struggle for many. Over 10% of rural counties have lost access to local services in the past 15 years (Hung, 2017). Further challenging the many women in rural America is the long-distance traveled for necessary obstetric care. Experts believe these closures contribute significantly to the increased rate of nonindicated induction and Cesarean Section procedures that increase the risks of maternal complications (Lewis, Paxton, and Zephyrin, 2019). According to the Centers for Medicare and Medicaid Services (2019), these access challenges result in several adverse maternal health outcomes, including premature births, low birth weight, maternal morbidity, and severe maternal mortality. Additionally, out-of-hospital births and deliveries in hospitals without Obstetric units increased (Powell, Skinner, Lavender, et al., 2018).

There are many maternity deserts located across the United States with adverse birth outcomes. However, with 40 of its 82 counties with existing maternity deserts, Mississippi has persistently had one of the highest infant mortality rates (Center for Mississippi Health Policy, 2014).

The term *maternity desert* is defined in conjunction with *maternity* as follows:

> **Maternity** care is the health care women get during **pregnancy**, labor

, birth, and the postpartum period after giving birth. A **maternity** care **desert** is an area where there are not enough hospitals, health care providers, or health care services for pregnant and postpartum women (March of Dimes, 2018).

One of the major contributing factors to the high rate of adverse birth outcomes, including infant mortality, is the low use of prenatal and maternal health care services (Fotso, Ezeh, & Essendi, 2009; Bilenko, Hammel, & Belmaker, 2007). The annual toll of losses stemming from poor pregnancy outcomes includes half a million maternal deaths, more than three million stillbirths, of whom at least one million die during labor (Lawn, Kerber, Laryea, et al., 2009). These facts lend themselves to a direct correlation between access to care and adverse birth outcomes.

Problem Statement

While infant mortality rates vary from State to State, Mississippi leads the nation. According to the Center for Mississippi Health Policy (2014), Mississippi has the highest infant mortality rate at 8.8 deaths per 1000 live births compared to the United States average of 6.0 deaths per 1000 live births, with 52% of those death very low birth weight. Low birth weight is associated with a 40-fold increase in the likelihood of death during the first year of life, accounting for two-thirds of all neonatal mortality rates (NMR) (Martin, Fanaroff, & Walsh, 2006). Very low birth weight is associated with a 100 times likelihood of death in the first year of life, accounting for 50% of all NMR (US Department of Health and Human Services, 2011). Their heightened risk of infant mortality, preterm birth, and low birth weight remains high

priority health issue in Mississippi. Access to care contributes to premature birth and low birth weight (Centers for Medicare and Medicaid Services, 2019).

Fewer than half of all rural counties in Mississippi, approximately 48%, have a practicing obstetrician, gynecologist, or maternity care provider. This extreme lack of prenatal care increases the likelihood by three to four times that women residing in the counties with maternity deserts will die a pregnancy-related death, with one-third of maternal deaths occurring one week to a year after giving birth (Lewis, Paxton & Zephyrin, 2019).

Adverse birth outcomes result in additional health care costs nationwide. The Institute of Medicine (2007) estimated the cost of premature births in the United States to be $26.2 billion. One study examined the cost, causes, and rates of rehospitalization of preterm infants. The researchers found that about 15% of preterm infants required at least one rehospitalization within the first year of life. This rehospitalization resulted in an average cost per admission of $8,468 and an average annual price of over $41 million (Underwood, Danielsen & Gilbert, 2007). Underwood et al. (2007) found that those infants born at 35 weeks gestation had the highest total cost of readmission, $92.9 million. In related studies, prices per infant hospitalized were highest for extremely preterm infants (Russell, Green, Steiner, et al., 2007). Notwithstanding, the researcher found that the more significant number of moderately preterm/low birth weight infants contributed more to the overall costs. They postulated that significant cost savings are possible with preterm birth prevention (Russell, Green, Steiner, et al., 2007).

Objective of Study

This study examines the relationship between individual and community-level socioeconomic characteristics to high risk and low birth weight outcomes among women in the maternity health care deserts in Mississippi. Mississippi has had one of the nation's highest infant mortality rates (Mississippi State Department of Health, 2018). This high infant mortality rate represents one of the most troublesome examples of health disparities associated with geographical location.

Identifying the correlation between access to care and adverse birth outcomes is an essential step in improving the pregnancy-related mortality in Mississippi at the individual, community, clinical, healthcare systems, and health policy levels. Hence, the knowledge gained will provide opportunities for developing strategies to improve health care outcomes for pregnant women who reside in the maternity deserts and promote strategies to improve health care expenditures. Prevention strategies aimed at ensuring that women who live within these maternity deserts have improved access to care before, during, and after pregnancy is essential. Moreover, plans that provide that medical providers and healthcare systems are fully implementing evidence-based strategies to reduce risk and respond adequately to the healthcare needs of many can have global implications.

Research Question

Are there individual and community predictors of high risk and low birth weight among women who reside in maternity healthcare deserts in Mississippi?

Research Hypothesis

Null hypothesis

There is no relationship between individual and community-level socioeconomic characteristics and high risk and low birth weight among women in Mississippi's maternity health care deserts.

Alternative hypothesis

Women who reside in maternity health care deserts in Mississippi have a greater prevalence of high risk and low birth weight relative to individual and community level socioeconomic factors.

Population and Sample

The study sampling frame is the population of women who reside in the maternity care desert counties in Mississippi that gave birth from 2011 to 2017. I further stratified the study sample into racial categories: Black, White, and other. Other confounders, including hospital admissions and discharges, births of high-risk or low birth weight infants between July 1, 2011 – June 30, 2017, and those births resulted in complications. Hence, I will be extract data from multiple delivery related variables to create binary outcomes: emergency cesarean delivery, elective cesarean delivery, major postpartum hemorrhage (>=1000ml estimated blood loss), vaginal lacerations, preterm delivery (< 37 weeks gestation), very preterm delivery (<32 weeks gestation), and low birth weight (<2500g).

1. REVIEW OF THE LITERATURE

Although the reduction in health inequalities is a fundamental goal in the Triple Aim denoted by the Institute for Healthcare Improvement (2012), it is an eluding reality for those who reside in the maternity deserts, particularly in the state of Mississippi. Roberts (2006) stated that Mississippi is one of the poorest states in the nation. More than the poor in other states, the poor in Mississippi have limited access to quality health care (Roberts, 2006). One of the health inequalities undergirding the dismal healthcare for individuals who reside in this region is access to health care related to distance and lack of physicians to provide health care. Maternity patients who live in these geographically disperse areas often find themselves driving great distances to access healthcare, resulting in treatment delays. In some areas, when seeking maternity care, the journey may be greater than 100 miles. Hence, patients in maternity deserts suffer from a range of limited resources: not enough doctors, not enough financial resources, and not enough health care facilities to meet geographic needs. These barriers to accessing health services lead to unmet health needs, delays in receiving appropriate care, inability to get preventive services, financial burdens, and preventable hospitalizations (Healthy People 2020, 2018). Thus, delays in treatment often end in conditions that are progressive and untreatable. These conditions make access to providers, even a general practitioner, a significant concern. This chapter begins by discussing the relevance of access to healthcare providers' provision in maternity care delivery. It will transition to the implications of limited access for those who reside in maternity deserts.

Overview of the Problem

According to the Office of Disease Prevention and Health Promotion (2012), access to comprehensive, quality health care services is vital for promoting and maintaining health, preventing and managing the disease, reducing unnecessary disability and premature death, and achieving health equality for all Americans. I will begin my discussion of the relevance of access by first defining access. The Institute of Medicine (1993) defines it as "the timely use of personal health services to achieve the best health outcomes." This study will test the hypothesis that there is a relationship between individual and community-level socioeconomic characteristics and high risk and low birth weight among women in the maternity health care deserts in Mississippi.

When reviewing the literature, I focused on disparities in critical areas: access to care (rurality), adverse birth and maternal outcomes, and access to resources. I reviewed many articles that addressed barriers to access. The words rural and access are used simultaneously in my search, with the focus gravitated more toward a geographical location where the population densities were lower. The literature results showed that rural access to health care providers was not merely defined by provider-to-population but by access to health care specialists.

According to the literature provided by CMS (2019), many factors contribute to poor access to maternal health services in rural communities. These factors include the closure of rural hospitals, discontinuation of obstetrics, decreased health care providers, and challenges arising from the social determinants of health. Hence, access to maternal health services contributes substantially to health disparities in maternity care for women in rural communities. Thus, the accessibility of health care is a driver in overall physical, social, and mental health status and

helps prevent disease and disability toward an optimum quality of life (Healthy People 2020.gov, 2012).

When discussing access, it is essential to describe subsequent barriers. The IOM (1993) proposed an access conceptualization based on three distinct types: structural, financial, and subjective, described below (Table 1).

Table 1. Barriers to Access

Barriers	**Examples**
Structural	• Health care plan or refusal of care • Lack of health care providers • Prolonged wait times
Financial	• Uninsured • Underinsured • Absence of coverage for conditions
Personal and Cultural	• Lack of transportation • Communication barriers • Lack of cultural sensitivity

Maternity Care and the Availability of Healthcare Providers

The discussion of maternity care begins with the availability of healthcare providers to provide antenatal care. Joseph and Bantock (1982) published that specializations such as OB/GYNs have encouraged the benefit of size and centralization over the past century. This mindset resulted in the relocation of health care providers to urban areas, thus, lending itself to

the scarcity in care. Rosenblatt and Hart (2000) found the more highly specialized the physician, the less likely the settlement in rural areas. Hence, they felt that nothing impacts the location decision of physicians more than specialty areas. Specialists in urban versus rural areas earn as much as three times more than PCPs annually (Chen et al., 2010). While estimates differ by provider groups, researchers have found that less than 12% of US physicians practice in rural areas. Consequently, the researchers found that specialization was a significant contributor to physicians' geographic undesirable inequality in rural areas (Rosenblatt and Hart, 2000). Hence, inadequate antenatal care was a significant contributor to low birth weight, prematurity, and obstetric complications (Cox et al., 2011).

Several studies described a direct correlation between unattended pregnancies and perinatal mortality. Manjavidze et al. (2020) found that the availability of prenatal care (PNC) and subsequent PNC attendance by pregnant women influence pregnancy outcomes. Utilizing logistic regression to assess the effect of unattended pregnancies, Manjavidze et al. (2020) showed that unattended pregnancies more than doubled PM's risk. They theorized that if a woman has prenatal care, the risk of premature delivery due to medical conditions can be identified and thus is unavoidable. Other researchers highlighted the importance of these variables in prenatal care (Pervin, Moran, & Rahman, 2012; Heanman et al., 2008; Low et al., 2005). These researchers' focus on the maternal factors of age, education, the region of residence, and mode of delivery proved helpful in my study.

An additional search of the literature found studies comparing the effect of reduced prenatal care and standard care with low-risk pregnancies. Dowswell et al. (2010) discovered that women with limited prenatal care had a 14% increase in PM risk than those in the standard

group. This study was in line with other studies that demonstrated the importance of prenatal care related to perinatal mortality and neonatal outcomes.

Rurality and Maternal and Neonatal Outcomes

Radley & Schoen (2012) stated that where a person lives influences their ability to access health care and the quality of that health care received and is significant in Health Professional Shortage Areas. As discussed by HRSA (2012a), Health Professional Shortage Areas (HPSA) have a population-to-full-time-equivalent-primary-care-physician ratio of least 3,500:1. Individuals residing within HPSA were more likely to be uninsured, more likely to have Medicaid or other public insurance, and more likely to have poor health outcomes. Moreover, they are likely to have resulting chronic health conditions (Hoffman, Damico, & Garfield, 2011). Maternity healthcare deserts designated as Health Professional Shortage Areas are critical to improved access to much-needed resources and improved birth outcomes.

Race and Inequalities

I did not summarize extensive literature on racial disparities in adverse birth outcomes, quality of care, and mortality because extensive reviews exist. However, noteworthy from the literature reviewed, African Americans were more adversely affected than other racial/ethnic groups in the United States (Dominguez, 2011; Burris & Hacker, 2017; Collins & David, 2009; Willis et al., 2014). Baskin (2016), with the Division of Preventive Medicine at the University of Alabama at Birmingham (UAB) School of Medicine in an article published by AAMC, stated that these are the disparities you see nationally, with African Americans tending to have higher rates of comorbid conditions.

Unfathomed health disparities in birth outcomes persist among non-Hispanic black populations in the United States. According to the infant mortality statistics of 2013 (Matthews,

MacDorman, & Thomas (2015), the overall infant mortality rate (IMR) in the United States is 5.96 infant deaths per 1000 live births. Yet, the IMR for non-Hispanic blacks is 11.11 infant deaths per 1000 live births. Matthew et al. (2015) cite that the preterm death rate for non-Hispanic black women is 1.6 times higher in Black women than White women. In a similar study, the researcher found that preterm birth is the primary driver of the difference in IMR between non-Hispanic Black and white infants, accounting for 54% of disparity (MacDorman, 2011).

Few studies in the review were inclusive of Hispanic women, with two qualitative studies analyzing the presence of adverse birth outcomes in this patient population (Bediako, Belue, & Hillemeier (2015). They used logistic regression to calculate predicted probabilities of low birth weight (LBW), preterm birth (PTB), or small for gestational age (SGA). They found that Black mothers had the highest incidence and predicted probability of experiencing all three adverse birth outcomes relative to Black-Hispanic and Hispanic (Bediako et al. 2015). Notably, a review of similar studies found Hispanics in the United States gave birth to low-birth-weight infants at rates comparable to non-Hispanic white women despite their socioeconomic disadvantage (Rubin, 2016).

Access to Care and Maternal Outcomes

There are many consequences associated with limited access to care. Besides low birth weight, prematurity, and maternal morbidity, there are increased risks for Cesarean Section and postpartum hemorrhage. Kozhimannil et al. (2019) found that poor access to appropriate obstetric services for women living in rural areas led to documented increases in out-of-hospital births, including births in hospitals without obstetric services and less than optimum birth outcomes. Martinet al. (2007) discovered that many rural women and their obstetricians, for fear

of untimely arrival to the hospital during labor related to long-distance, had a substantial increase in early elective delivery through labor induction increase in low-risk cesarean delivery. Several studies (Ellison, 2017; Singh, 2010; Curtis, 2015) reported adverse maternal outcomes associated with these procedures. Furthermore, they reported that women were more likely to die from complications associated with cesarean section than vaginal birth. Moreover, elective inductions that occurred before the term was high-risk for newborns and led to more prolonged labor and increased risk for postpartum hemorrhage (Ellison, 2017).

A retrospective analysis using data from the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project (AHRQ-HCUP) and the National Inpatient Sample (NIS) looked at adverse outcomes associated with cesarean section. The results showed increased adverse maternal outcomes of hematoma, blood transfusion, cardiac arrest, and ventricular fibrillation in minority groups, particularly with epidural placement. These adverse outcomes suggest population-based studies' development to determine the correlation between the individual or community-based predictors of these disparities.

One of the leading causing of maternal mortality is maternal sepsis. A study whose aim was to estimate the incidence and mortality rate of sepsis and the associated risk for its development during pregnancy, labor, delivery, and postpartum period collaborated this fact. Al-Ostad et al. (2015) utilized data obtained from the Healthcare Cost and Utilization Project-Nationwide Inpatient Sample (HCUP-NIS) database from 1998-2008. They found a relationship between maternal sepsis and adverse birth outcomes: preterm birth, hysterectomy, postpartum hemorrhage, puerperal infection, transfusion, and chorioamnionitis. Thus, interventions whose aim is early recognition and management would prove critical in its reduction.

Literature Search

Search terms and inclusion/exclusion criteria designed to identify population-based studies for effect modifications of race/ethnicity and SES on birth outcomes. Literature searches were epidemiological studies including non-randomized designs (i.e., cohort study, cross-sectional study, a case-control study) that examined the impact of access to care on birth outcomes published from 2006 to 2019. I limited my search to papers published in English, and I utilized databases: PubMed, Scopus, CINAHL, PsycINFO, and Medline. The search terms were divided into the following categories using the Boolean and positional operators and to narrow search results: 1) "access to care," including searches for "physician shortage," "rural," "Mississippi," "maternity deserts." "hospital closures,": 2) "adverse birth outcome" which included "preterm birth," "low birth weight," "prematurity," " infant mortality," "African Americans," "Hispanics," and 3) "maternal outcomes," which included " hemorrhage," " Cesarean Section," including critical words: health disparities; low birth weight; small for gestational age; prematurity; preterm; racial disparities.

Inclusion and exclusion criteria

I screened the titles and abstracts to exclude studies that were not related to my research question. The included studies: 1) examined access to care and at least one of the birth outcomes of PTB, LBW, SGA, and stillbirths, or 2) had provisions of risk estimation of access to care and birth outcomes, modified by maternal race/ethnicity and SES. Exclusions were: 1) those articles referencing adverse birth outcomes and multiple births as they are inherently high risk, 2) studies not addressing a direct correlation between access to care and adverse prenatal outcomes, 3) studies not reporting effect modifications, and 4) brief research papers without study details, review, or commentaries.

Chapter 3. METHODOLOGY

Study Design and Hypothesis

Design

A descriptive analysis summarizes statistics that quantitatively describe features from collecting information (Mann, 1995). Hence, for this quantitative study, a descriptive analysis of county-level data from the MUSC Comparative Effectiveness Data Analysis Resource (CEDARS) core will be used. CEDARS is a repository for 7+terra-bytes of archival health service data. The resource includes data from the Healthcare Cost and Utilization Project (HCUP) and the Nationwide Inpatient Sample (NIS), a nationally representative database of hospital stays in the US from 2011 to 2017. Singleton newborns with small for gestational age (SGA), low birth weight (LBW), and very low birth weight (VLBW) codes were identified and examined over the study period. This data was inclusive of only those counties in Mississippi designated as maternity deserts.

Statewide Databases

The Cedar Data Inventory (2019, August 9) provides access to the State Inpatient Databases (SID), including inpatient discharge records from community hospitals in Mississippi and several other states. The SID files encompass all patients, regardless of payer, providing a unique view of inpatient care in a defined market or state over time. The SID contains the

universe of the inpatient discharge abstracts from participating states translated into a uniform format to facilitate multi-state comparisons and analyses. Besides, the SID contains a core set of clinical and nonclinical information on all patients. SID is inclusive of insurance information: Medicare, Medicaid, and private insurers, as well as uninsured.

The data elements of the 2019 SID file for Mississippi contain clinical and resource-use information included in a typical discharge summary. It contains more than 100 clinic and nonclinical variables included in a hospital discharge summary. These clinical and nonclinical variables include principal and secondary diagnoses and procedures, admission and discharge status, patient demographics characteristics, expected payment source, total charges, and length of stay.

Specifications of Variables

Key variables to be reviewed in the analysis of data from these resources will include hospital admissions and discharges between 2011-2017, births to African Americans or other minorities, births of high risk or low birth weight infants between July 1, 2011 – June 30, 2017, and those births that resulted in complications. Hence, I will extract data from multiple delivery related variables to create binary outcomes: emergency cesarean delivery, elective cesarean delivery, major postpartum hemorrhage (>=1000ml estimated blood loss), vaginal lacerations, preterm delivery (< 37 weeks gestation), very preterm delivery (<32 weeks gestation), and low birth weight (<2500g). Moreover, as stated above, variables to be included as confounders will include the mother's ethnicity (White, Black, or Other), marital status, education, employment, and payor source.

Statistical Analysis

Poisson regression usage in quantitative studies is essential. It assists in modeling count data and guides which explanatory variable has a statistically significant effect on the response variable. Hence, a modified Poisson regression to estimate risk ratios for the association between individual and community-level socioeconomic characteristics along with obstetric and neonatal outcomes is essential. This linear model will include a series of multivariable models for each outcome. A p-value <0.05 will provide evidence of possible interactions or associations. Glenn (2016) describes the assumptions for Poisson regression:

- **Y-values are counts.**
- **Counts must be positive integers**. Because the Poisson distribution is discrete, this technique will not work with fractions or negative numbers.
- **Because counts must follow a Poisson distribution,** the mean and variance should be the same.
- **Explanatory variables must be continuous, dichotomous, or ordinal.**
- **Observations must be** independent.

Hypotheses

Research Question

Are there individual and community predictors of high risk and low birth weight among women who reside in maternity healthcare deserts in Mississippi?

Null hypothesis

There is no relationship between individual and community-level socioeconomic characteristics and high risk and low birth weight among women in Mississippi's maternity health care deserts.

Alternative hypothesis

Women who reside in maternity health care deserts in Mississippi have a greater prevalence of high risk and low birth weight relative to individual and community level socioeconomic factors.

Definition of Variables

Each variable in the study was defined and values assigned utilizing information from the HCUP webpage, "Central Distributor SID: Description of Data Elements (ARHQ HCUP Website, 2016, July 15). Covariates considered are those of age, marital status, payor, race, education, and employment. This study's covariates will include data elements such as AGE, MARITALSTATUS, PAY1, and RACE.

Definitions and values are as follows:

- AGE (AGE is from the birth date (DOB) and the admission date (ADATE). Values are "0-124" for AGE in years. "." for Missing, "A" for Invalid, "B" for Unavailable from source, and "C' for Inconsistent.
- MARITALSTATUSUB04 (MARITALSTATUS, UB-04 indicates the patient's marital status and uses the same coding as the MARITALSTATUS data element on the UB-04 claim form). "I" for Single, "M" for married, "A" for Common Law, "B" for Registered Domestic Partner, "S" for Separated, "D" for Divorced, "W" for Widowed, "U" for Unmarried, and "Blank" for unknown, not applicable, missing, or invalid.

- PAY1 (PAY1 indicates the expected primary payer-Medicare, Medicaid, private insurance, etc.) "1" for Medicare, "2" Medicaid, "3" for Private Insurance, "4" for Self-Pay, "5" for no charge, "6" for Other," for Missing, "A" for Invalid, and. "B" for unavailable from the source.
- RACE (RACE retains information on the race of the patient as provided by the data source. “1” for White, “2” for Black, “3” for Hispanic, “4” for Asians, “5” for Native American, "6" for Other," for Missing, "A" for Invalid, and. "B" for Unavailable from sources.

The outcome variables of interest were the neonatal outcomes of small for gestational age (SGA), low birth weight (LBW), very low birth weight (VLBW), and NICU admissions. The term low birth weight (LBW) is defined as a birth weight of less than 2500 g, regardless of gestational age at the time of birth. Additionally, very low birth weight (VLBW) refers to birth weight less than 1500 g, and extremely low birth weight (ELBW) refers to birth weight less than 1000 g (Easter et al. 2016; & Cutland et al., 2017). Noteworthy, SGA is not synonymous with LBW, VLBW, or ELBW. The maternal outcomes of interest were delivery type, stillbirth, postpartum hemorrhage, vaginal laceration, infection, and hysterectomy. The maternal outcomes use the data elements: I10-NEOMAT and I10_DXN.

Chapter 4. RESULTS/FINDINGS

Description of the Study Population

We performed a retrospective analysis of all live births to Mississippi residents for 2018 using the HCUP SID database. This database contains all hospital admission for deliveries with separate (non-linkable records) for mothers and babies. We examined the variable race, which included categories for women or babies grouped by non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and Hispanic. We collapsed those categories into dichotomous variables: Black=1 includes non-Hispanic Black, Black=0 is all other groups. We examined statistical differences between the subjects and the reference group using Chi-square tests. Fisher's exact test was applied if the minimal estimated expected value was less than five. A value of $p < 0.05$ was considered statistically significant. We could not control for effects of Maternal education level and other potential confounders because these indicators were not available in the data set.

. We compared groups of women stratified into two categories by a residence count: those in OB service county versus non-OB Service. The characteristics of the two groups are shown in Table 2.

We performed a statistical test to determine the predominant racial presence among mothers residing in OB service county relative to non-OB service county. The racial distribution showed no statistical difference (P=0.006). White mothers in OB service county comprised (49.3%), Black (44%), and Hispanic/Other (7%). These numbers were comparable to non-OB service county with White (49%), Black (44%), and Hispanic/Other (7%). Furthermore, we wanted to determine if there was a difference in the total number of Black in both counties. We found Black OB desert counties (44.1%) and Black in non-OB desert counties (43.6%) when

combining White with Hispanic/Other in both OB desert counties and non-OB desert counties, both 56% and 56.4%, respectively. Hence, there remains no statistical difference concerning the racial mix of mothers residing in OB deserts vs. non-OB deserts (P=0.5009) (Table 2).

Patients in maternity deserts suffer from a range of limited resources. One disparity is often a lack of financial resources to meet geographic needs. Table 2 details the various insurers for mothers in OB desert county versus non-OB desert county. We found payment sources: Medicaid 51.6%, Private Insurance 41.1%, Uninsured 2.7%, and Other 4.6%. These numbers are comparable to non-OB desert county: Medicaid 56.7%, Private Insurance 36.8%, Uninsured 2.8%, and Other 3.7%. Hence, insurability proves not to be an overwhelming concern for mothers who reside in OB desert counties.

Obstetric Outcomes

We explored evidence that suggests a correlation between mothers who reside in OB deserts and an increase in the prevalence of cesarean section. Literature suggests that limited access to prenatal care and rurality results in a substantial increase in early elective delivery through labor induction and increased cesarean delivery (Martinet al. 2007). Table 2 represents a statistical analysis of the total number of mothers that gave birth in 2018 in Mississippi by vaginal delivery and cesarean section. There was no difference in total vaginal deliveries by mothers in OB desert (61.4%) and non-OB desert (61.7%). Moreover, there was no statistical difference in the rate of cesarean section for mothers that reside in OB deserts (38.6%) comparable to the non-OB desert (38.4%) (P=0.7344). Of interest, the cesarean section rate for the United States is 31.2% (WHO, 2019).

The WHO (2019) stated cesarean rates should be between 10% and 15%, with research showing that maternal and newborn deaths decrease when the rate approaches 10%. While there

is no evidence that mortality rates improve or worsen above 15%, the data we obtained in Table 2 was used to determine if the rates of maternal deaths differed between mothers residing in OB desert versus non-OB desert. We assumed that the maternal factor of a region of residence and the availability of prenatal care attendance increases the risk of maternal morbidity, particularly given the high rate of cesarean section. No statistical difference was identified *(P*=0.0605). Hence, there is no evidence of a direct effect of maternal morbidity and prenatal care attendance, or vice versa.

Guidelines published by the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists suggest that the length of postpartum hospital stay averages 48 hours for vaginal delivery to 96 hours for cesarean births. Table 2 depicts the difference in the mean length of stay when comparing OB desert county to non-OB desert county, revealing no statistical difference (*P*=0.8831). The mean length of stay OB desert county 2.6 days with non-OB desert 2.6 days. The mean age of individuals in OB desert county 26.1 years of age, non-OB desert 27 years of age. The total mean charges for mothers giving birth in OB desert county were $18,916 and non-OB county $21,776; however, it was not statistically significant (*P*=<.0001).

We assumed that prenatal care attendance affects the prevalence of adverse events. Thus, if a mother has an unattended or poorly attended pregnancy, the risk of an adverse event would increase significantly. However, there was no statistical difference in adverse events (P=0.0743) between mothers in OB desert county (34.8%) when compared to non-OB desert county (35.9%) (Table 2).

Table 2: *Demographic and risk characteristics of 33,473 women in MS in 2018 who resided in counties without obstetrical services (OB Deserts) compared to women residing in counties with obstetrical services (Controls)*

Variable Name	OB Desert County of Residence N=7,378	Control County of Residence N=26,075	Statistic
Age Mean (SD)	26.1 (5.4)	27.0 (5.6)	<.0001
Race: N (%)			.0006
White	3,628 (49.0)	12,862 (49.3)	
Black	3,259 (44.1)	11,372 (43.6)	
Hispanic	286 (3.8)	840 (3.2)	
Other	225 (3.0)	1,001 (3.8)	
Cesarean section	2,853 (38.6)	9,999 (38.4)	.7344
Vaginal delivery	4,545 (61.44)	16,076 (61.7)	
Any Adverse Event	2,574 (34.8)	9366 (35.9)	.0743
Mean Total Adverse Events (SD)	0.47 (0.75)	0.49 (0.77)	.0234
LOS Mean (SD)	2.6 (2.0)	2.6 (1.5)	.8831
LOS > 5 Days	141	435	.1653
Total Charges mean (SD)	$18,916 (16,845)	$21, 776 (19,574)	<.0001
Insurance: N (%)			<.0001
Medicaid	4,193 (56.7)	13,453 (51.6)	
Private	2,720 (36.8)	10,704 (41.1)	

Uninsured	205 (2.8)	698 (2.7)	
Other	280 (3.7)	1,220 (4.6)	

Neonatal Outcomes

We examined 34.883 births to mothers within OB desert county versus non-OB desert county, comparing the incidence of LBW, prematurity, death, and hospice for Mississippi in the year 2017. The assumption was that prenatal care attendance affected gestational age at the time of birth; thus, there is a causal effect of PNC on prematurity, LBW, and neonatal mortality. Table 3 shows LBW rates for infants born to mothers in OB desert county to be 13.17% versus that of the non-OB desert county at 12.43%; hence no statistical difference was found (*P*=0.0830). Only singleton births were included in the study as twin or multiple gestations have inherent associative risks.

Assuming a causal effect of non-OB Service on prematurity, we examined the association between access to care and premature birth. We explored how living in a rural county contributes to the increased incidence of prematurity in Mississippi. Table 3 shows no statistical difference in prematurity with problems (*P*=0.7358) with OB desert county (3.88%) compared to OB service county (3.8%). We further examined any adverse obstetric event that combined with any adverse baby event for both OB desert county and the control group, 979 (12.6%) and 3337 (12.3%) respectively and found no statistical difference (*P*=.3792).

Earlier research suggested that missing attendance or lack of prenatal care substantially impacted the risk of stillbirth and early neonatal death (Roy, S.& Haque, M.A., 2018). To

estimate the burden of infant mortality attributable to access to Obstetric care, we examine the incidence of infant death in Mississippi for the year 2017 (Table 3). The percentage of babies who died/hospice for non-OB service county 29.46% and OB service county 22.14%. While statistically significant (*P*=0.0457), all infant death is significant because none we expected.

LOS is an important indicator of health care delivery efficiency. Understanding its associated factors could provide valuable information to reduce healthcare costs, improve OB services delivery, and improve comorbidities and complications that often require readmission (Otterlo et al., 2018). Table 3 shows the mean length of stay (LOS), in days, after childbirth, total charge (TOTCHG), and standard deviation (SD). The mean LOS by mothers in OB desert county after delivery was 3.67 days compared to the control group of 3.70 days. However, this is not statistically significant (*P*=.8831). Total hospital payment was lower for OB desert county with a mean cost of $11,590 compared to the non-OB desert county with a mean cost of $12,961 (*P*<.0001).

At the onset of this study, we assumed that mothers who reside in OB desert county are more likely to be shipped to larger hospitals for delivery. Thus, we included hospitals with >1000 births per year in the data mix. Mothers who resided in OB desert county that gave birth in a large hospital were 12,956 (47.7%) versus non-OB desert county births of 3,844 (49.7%), a difference of 9,112 (*P*=0.0018).

Table 3: *Demographic and risk characteristics of 34,883 Births to Mothers in MS in 2017 who resided in counties without obstetrical services (OB Deserts) compared to women residing in counties with obstetrical services (Controls)*

Variable Name	OB Desert County of Residence N=7731	Control County of Residence N=27,152	Statistic
LBW	1018 (13.17)	3374 (12.43)	.0830
Race: N (%)			
Minority	3975 (51.42)	13,720 (50.5)	.1692
PremieProb	300 (3.88)	1031 (3.8)	.7358
DIED/Hospice	38 (29.5)	7693 (22.1)	.0457
Female	3800 (49.2)	13,349 (49.2)	.9642
Any Adverse Event	979(12.7)	3337 (12.3)	.3792
Mean Total Adverse Events (SD)	0.47 (0.75)	0.49 (0.77)	
Cesarean Section	2696 (34.87)	9599 (35.35)	.4355
LOS Mean (SD)	3.7 (9.4)	3.7 (9.0)	.8831
Total Charges mean (SD)	$12,961 (54,764)	$11,590 (53,114)	<.0001
Birth>1000	3844 (49.7)	12,956 (47.7)	.0018
DIED/Hospice (Hosp.>1000births)	38 (0.49)	91 (0.34)	0.0457

We used logistic regression analysis to assess the effect of race and gender on the risk of a mother who resides in OB desert county for any adverse event. We assumed that the residence region had a significant effect on the maternal and neonatal outcomes and the presence of an adverse event. This multivariable model shows that, overall, mothers living in the non-OB desert are inversely related to the odds of an adverse event after controlling for the effect of other variables in the dataset (Table 4). Mothers who reside in OB desert county had more than 65% higher odds of suffering an adverse event, more than 30% higher odds of and adverse event if Black, and 15% lower odds of having a female baby with an adverse event than women who lived in the non-OB desert county (Table 3). Moreover, the likelihood of mothers in OB desert county who delivered by Cesarean Section having an adverse event is 65% and significant (*P*=.0001)

Table 4. *Odds Ratio and 95% Confidence Intervals for the Association Between Residence in OB Desert County and Maternal Characteristics*

Variable	**β**	**P-value**	**Odds Ratio (OR)**	**95% Confidence Interval**
Constant	-2.2050	<.0001		
OB_Desert	-0.0328	0.5406	9.968	(0.87-1.08)
C Section	0.5007	<.0001	1.65	(1.53-1.78)
Black	0.2637	<.0001	1.30	(1.22-1.39)
FEMALE	-0.1683	<.0001	0.85	(0.79-0.90)
OB_Desert by C Section	0.1408	0.0759	1.151	(0.98-1.35)

Chapter 5: DISCUSSION

We performed a retrospective analysis of all live births to Mississippi residents for 2018 using the HCUP SID database for this project. The population consisted of 33,473 women who were Mississippi residents when they gave birth during the year 2018. We compared groups of women stratified into two categories by the residence count: those in OB service county versus non-OB Service. A county was classified as a maternity desert if there was no hospital providing obstetric care, no gynecologist, or no midwife. Using logistic regression analysis, we assessed the effect of race and gender on the risk of a mother who resides in OB desert county for any adverse event.

For several of the maternal outcomes of interest in this study, there was an apparent increase in risks found in women ages >25. The trend was significant for the incidence of cesarean delivery in Mississippi OB desert county. Thus, we found an apparent correlation between access to care and the risk of elective cesarean delivery. The presence of adverse events was significant 15.1% compared to women who lived in the non-OB desert county. Moreover, the likelihood of mothers in OB desert county being Black, with female babies, and delivering by Cesarean Section is significant (P=.0001). While there was no evidence for an association between PTB and LBW in OB desert county compared to non-OB desert county, there was a significantly elevated risk of neonatal mortality (P=0.0457).

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Limitations

This analysis includes data obtained in a single year with information on cofounding factors, including parity, BMI, and area deprivation not available in the data set. We could not control the effects of maternal education level and other potential confounders because these indicators were not available in the data set.

The MUSC Comparative Effectiveness Data Analysis Resource (CEDARS) core was the primary data source for this study. Data from this source comes from a variety of data sources reported in by county. Suppression criteria, other analytic decisions, and data sources limitation are unknown for every data source represented in the CEDARS. Hence, estimates may be skewed. Furthermore, all data for hospital delivery, while reportable, is often omitted or underreported. Hence, human error may skew findings.

Strengths and Weaknesses

There was evidence of an association between increased adverse events in OB desert county while modifying for race and gender. However, there was plausible evidence, while weak, suggestive of an association between rurality and LBW as well as PTB.

The strength of the association between cesarean delivery and access to care strongly suggests that the high risk of elective cesarean delivery among mothers in OB desert county is partially attributable to the difference in maternal care obtained and preference. Hence, it is noteworthy that there is currently no policy in place recommending elective cesarean as a cost-effective measure accounting for rurality. Your most significant cesarean section risk may be the hospital chosen for delivery.

Recommendations

Policy Options

Maternity care providers are unevenly distributed across Mississippi, leading to access inequalities, particularly in rural areas. Efforts to integrate other health care professionals into OB desert county could significantly improve access issues. Studies have found this integration results in significantly higher rates of positive birth outcomes, such as vaginal delivery, vaginal birth after cesarean, as well as lower incidences of cesarean section, PTB, LBW, and neonatal death (Vedam, Stoll, MacDorman, et al., 2018). A strategy to overcome staffing issues is tapping into non-physician clinicians such as the Physician Assistant, Nurse Midwife, and Nurse Practitioner. Hence, steps to broaden the scope of practice for these clinicians would allow clinicians to deliver care within the underserved area.

While rural hospital closure plague counties with access issues. The incorporation of telemedicine can be instrumental in improving access. The development of policies in patients' access to care in OB desert county is an essential vehicle for positive change. However, many rural communities do not currently have access to internet connection speed that supports the effective and efficient transmission of data to provide telehealth services. Hence, policies aimed at improving broadband access are essential.

Another policy option is to show that physicians who grow up in rural areas are more likely to pursue careers there. Various state legislatures have created programs to recruit and encourage high school students to pursue rural medicine careers. An example of this in Mississippi is the Rural Physician Scholarship Program. Created by the Legislature in 2007, the Mississippi Rural Physician Scholarship Program provides rural students who wish to practice

medicine in their hometowns with financial support and mentoring opportunities with faculty and physicians to develop a robust rural workforce (Mississippi Academy of Family Physician, 2017). However, additional financial incentives to work in the underserved area may prove helpful.

Fourth, the policy option for the state is the expansion of medical residency programs. There is good evidence that the more time spent training in a rural place, the greater the likelihood of graduate placement in rural community practice (Bowman & Penrod, 1998; Patterson, Schmitz & Longenecker, 2017). There are nine schools of medicine located in rural communities and 39 medical schools with rural programs. There are none located in the state of Mississippi.

Fifth, policy option is that policy development in public health become cross-sectoral. Cross-sectoral work would examine income, economic development, education, housing, social and political climate, environment, and practitioners when studying health and medicine (Probst et al., 2004).

Finally, policy option in the provision of logistical support and financial assistance for mothers in OB desert county to travel is essential. While it may seem trivial to some, many mothers in OB desert county have limited access to care because of distance and financial resources to travel for obstetric care.

Conclusion

There are many consequences associated with limited access to care. Besides low birth weight, prematurity, and maternal morbidity, there are increased risks for Cesarean Section. While cesarean section can be a life-saving and necessary procedure, its over usage, directly and indirectly, affects many health implications regarding maternal health. Hence, we should advocate for vaginal birth should be promoted if we are to trend toward being in sync with the Triple Aim of Population health. Recommendations are for future studies that would examine the impact that education, parity, and marital status would have on maternal and neonatal outcomes. Additional studies aimed at assessing the impact of group prenatal care on maternal outcomes in Mississippi would be equally valuable with group prenatal care a proven healthcare model.

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