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Relationship Between Transportation Availability and Obstetric Access in Predicting United States Maternal Death Rates

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This is to certify that the doctoral dissertation by

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Walden University
2026

Abstract

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by

Veronica Trueblood

MS, Colorado Technical University, 2017

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Services

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Abstract

Maternal mortality remains a significant challenge in the United States with substantial variation across counties reflecting differences in health care delivery systems and access to obstetric services. Fragmented obstetric care networks, hospital closures, and geographic barriers to care contribute to delays in prenatal and emergency obstetric services, increasing the risk of preventable maternal deaths. Guided by the social determinants of health (SDOH) framework, this quantitative cross-sectional health services study examined relationships between transportation availability, obstetric care access, and county-level maternal mortality in the United States. A national scope was required to achieve an adequate analytic sample size, as maternal mortality data were available for 187 counties nationwide, supporting sufficient statistical power and alignment with the study's multivariable regression design. The study focused on structural health care access conditions rather than individual-level risk factors. Secondary data were obtained from the 2020 SDOH County 1.0 data set and were analyzed using descriptive statistics, Pearson correlations, and multiple linear regression while controlling for county-level socioeconomic status, racial composition, and rurality. Greater distance to obstetric care significantly predicted higher county-level maternal mortality ($B = .049$, $p = .002$), whereas transportation availability was not an independent predictor, indicating that disparities were driven by gaps in obstetric service availability (race, income, rurality). The study may contribute to positive social change by informing health services planning, guiding resource allocation, and supporting policies to strengthen obstetric care infrastructure and reduce preventable maternal deaths nationally.

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Dedication

This study is dedicated to my husband, whose unwavering love, support, encouragement, and patience provided constant strength throughout this journey. It is also dedicated to my children and grandchildren, whose lives inspire my commitment to fostering a future in which childbirth is safe, every life is valued, and equity is upheld for all families. I am deeply grateful to my mother and siblings for their love and guidance, which made this achievement possible. Guided by faith, this work reflects my belief in the equal worth and dignity of every mother, child, and human being. These values formed the foundation of this research and motivated the pursuit of a study aimed at addressing disparities in maternal health and advancing equity in health care across communities.

Acknowledgments

I extend my sincere appreciation to the faculty whose guidance and support were instrumental in my academic progress. I am equally thankful to my family and friends, whose encouragement and steadfast support made the completion of this milestone possible.

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Chapter 1: Introduction to the Study

Maternal mortality rates across the United States highlight the critical influence of transportation availability and access to obstetric care in shaping maternal health outcomes. The national maternal mortality rate has exceeded 23 deaths per 100,000 live births, with certain regions reporting higher rates, particularly in rural and underserved counties (Hoyert, 2020). These disparities underline the need to examine county-level differences in health care access and to identify structural barriers that contribute to preventable maternal deaths. Understanding how transportation infrastructure and geographic access to obstetric services shape maternal mortality is essential for informing effective health services planning and policy interventions.

Access to transportation, including household vehicle availability and proximity to obstetric care facilities, is a key determinant of health care utilization. Geographic isolation in many U.S. counties contributes to delays in accessing prenatal, intrapartum, and emergency obstetric services, resulting in reduced continuity of care. Longer travel distances to obstetric facilities were associated with decreased health care utilization, while limited transportation options further exacerbated these challenges (Holcomb et al., 2021). Harrington et al. (2023) demonstrated that women residing in rural areas where transportation barriers and longer travel times are more prevalent experienced significantly higher maternal intensive care unit admission rates and nearly double the risk of maternal mortality compared to women in urban areas. Similarly, Goitia et al. (2023) found that lower neighborhood vehicle ownership was associated with

significantly higher mortality rates, reinforcing the role of transportation availability as a structural social determinant of health.

The current study investigated how transportation availability and access to obstetric care influence maternal mortality rates across U.S. counties. Guided by the social determinants of health (SDOH) framework and using data from the 2020 county-level SDOH data set (County 1.0), the analysis examined the effects of household vehicle availability and travel distance to obstetric services on maternal mortality. Additional structural factors including median household income, racial composition, and rurality were incorporated to provide a comprehensive understanding of how transportation infrastructure and health care accessibility intersect to shape maternal health outcomes nationally.

The findings from this study have important implications for health care system planning and resource allocation. By identifying the structural relationships among transportation infrastructure, access to obstetric care, and maternal mortality, this research provided empirical evidence to inform policies aimed at reducing preventable maternal deaths and improving health equity across U.S. counties (see Tegegne et al., 2018). Prior research showed that women residing in maternity care deserts experienced significantly higher pregnancy-related mortality rates, further emphasizing the importance of geographic access to obstetric services (Wallace et al., 2021). Addressing these structural barriers was critical to strengthening maternal health systems and improving outcomes nationwide.

Background

The relationship between transportation availability, obstetric care access, and maternal mortality is central to understanding health care disparities across U.S. counties. The nation's diverse geographic landscape creates substantial variation in access to essential maternity services, particularly in rural and underserved regions. Limited access to obstetric services including anesthesia coverage, emergency obstetric care, and specialty maternal health services has been linked to adverse maternal outcomes across multiple regions of the United States (Horak & Sanborn, 2022). Lorch et al. (2012) documented a significant increase in neonatal and perinatal mortality following obstetric unit closures, demonstrating how proximity to labor and delivery services directly affects maternal and infant outcomes.

Transportation infrastructure is a critical determinant of health care accessibility. Regions with limited or unreliable transportation systems experience significant barriers to health care utilization, particularly for time-sensitive maternal services such as prenatal care and emergency obstetric interventions. Differences in travel distance and transportation availability disproportionately affect rural populations, where private vehicles often represent the primary mode of transportation and public transit options are scarce (Labban et al., 2023). Nationally, only a small percentage of rural counties offer fixed-route public transportation, further exacerbating access challenges for pregnant individuals (Dagher & Linares, 2022). These transportation barriers intersect with broader structural inequities, compounding disparities in maternal health outcomes. International evidence supported these findings; Musafaah et al. (2023) reported that

longer travel distances and poor geographic access significantly contributed to maternal deaths, underscoring the global relevance of transportation-related barriers.

Research on obstetric care accessibility consistently demonstrated that geographic distance and transportation infrastructure influence maternity service utilization. Longer travel times to obstetric facilities were associated with delayed initiation of care, inconsistent prenatal visits, and reduced access to emergency services, all of which contribute to adverse maternal health outcomes (Sultan, 2024). County-level analyses further revealed disparities in emergency maternal transport systems and obstetric service availability, with variations in health care infrastructure affecting timely access to life-saving interventions (Horak & Sanborn, 2022).

Despite growing awareness of these issues, much of the existing literature examined transportation and health care access as separate constructs rather than evaluating their combined effects on maternal mortality. Transportation metrics such as vehicle availability and proximity to obstetric facilities demonstrated measurable associations with maternal health care utilization (Rossen et al., 2022); however, fewer studies examined how these structural factors jointly influence maternal mortality at the county level in the United States. Addressing these systemic challenges required structural approaches to health care access, including optimizing the geographic distribution of obstetric services and strengthening maternal care networks (Wisner et al., 2024). Health care systems increasingly implemented strategies such as telehealth services and mobile care units to mitigate transportation barriers. However, evidence suggested that sustained investment in transportation infrastructure and strategic

alignment of health care resources with population needs remain essential for reducing maternal mortality disparities (Horak & Sanborn, 2022). Fontenot et al. (2024) further emphasized that extended travel burdens in rural maternity care deserts delay access to emergency obstetric care, particularly in southern and rural regions of the United States.

Problem Statement

Maternal mortality remains a pressing public health issue across the United States, with notable disparities observed across counties and regions (Centers for Disease Control and Prevention [CDC], 2023). Despite advancements in maternal health care, the nation continues to experience high maternal mortality rates, particularly in rural and underserved areas (Harrington et al., 2023). Geographic and systemic barriers contribute to these disparities, making the examination of structural factors that influence maternal health outcomes critical (Kozhimannil et al., 2018). Chaturvedi et al. (2024) identified statistical associations between geographic location and maternal mortality rates, highlighting the need for further investigation into how health care infrastructure and transportation systems interact to impact maternal health.

One major challenge in addressing maternal mortality is limited transportation accessibility. Previous studies established links between transportation infrastructure and health care access. Horak and Sanborn (2022) found that limited transportation options directly affect obstetric care utilization, while Hung et al. (2023) demonstrated how geographic distance and system connectivity influence access to maternal health care. Goitia et al. (2023) confirmed that neighborhoods with lower vehicle ownership have significantly higher all-cause mortality, reinforcing that transportation access predicts

health risk. The distribution of health care resources across counties further compounds these challenges. Labban et al. (2023) and Meyer et al. (2016) demonstrated that travel time, transportation infrastructure, and health care accessibility significantly impact care utilization and the timing of maternal health services. These findings suggest that transportation-related barriers can delay essential maternal care, increasing health risks for pregnant individuals. Harrington et al. (2023) emphasized that maternal mortality risk nearly doubles in rural areas, even after adjusting to individual characteristics.

Despite existing research on maternal health disparities, gaps remain in understanding the combined effects of transportation infrastructure and health care accessibility on maternal mortality rates. Sultan (2024) examined the relationship between transportation availability and maternal health outcomes, while Richardson et al. (2023) developed analytical frameworks to assess the structural components of health care delivery. Additionally, Rossen et al. (2022) provided long-term data on maternal health trends, revealing how disparities in care access persist over time. However, these studies did not fully capture how transportation and health care system limitations intersect to influence maternal mortality rates at a county level.

This study sought to address this gap by conducting a comprehensive county-level analysis of the relationships among transportation availability, access to obstetric care, and maternal mortality rates across 187 U.S. counties using the SDOH 2020 County 1.0 Data set. By integrating insights from prior research and examining these structural factors in greater detail, this study aimed to provide a more nuanced understanding of the

barriers to maternal health care access and inform policy interventions to improve maternal health outcomes nationally.

Purpose of the Study

This study investigated the relationship between transportation availability, access to obstetric care, and maternal mortality rates across U.S. counties. Using data from the Social Determinants of Health (SDOH) 2020 County 1.0 Dataset, the analysis focused on three key factors: transportation availability, access to obstetric care, and maternal mortality. These measures align with the methods established by Richardson et al. (2023) for evaluating health care system components, providing a structured approach to understanding how health care access influences maternal health outcomes.

Existing research establishes clear connections between health care access and maternal health disparities. Chaturvedi et al. (2024) found geographic differences in maternal mortality rates, while Horak and Sanborn (2022) examined how transportation infrastructure affects access to maternity care. Hung et al. (2023) further demonstrated that travel distance and system connectivity play a role in health care utilization. Longitudinal studies by Rossen et al. (2022) offer insights into how these geographic variations persist over time, complementing Meyer et al.'s (2016) findings on the role of transportation networks in health care access.

To build on this foundation, the study applied methodologies from Sultan (2024) for evaluating transportation infrastructure and Labban et al. (2023) for assessing health care accessibility. This approach allowed a more comprehensive analysis of how transportation barriers and health care facility distribution shape maternal health

outcomes. Additionally, the study built upon Wisner et al.'s (2024) research by incorporating factors such as vehicle availability, travel distances to health care facilities, and disparities in health care service locations.

A multiple linear regression analysis, based on Kim and Rosenberg (2024), assessed these relationships while controlling demographic and geographic variables. This statistical approach helped determine the individual and combined effects of transportation access and health care availability on maternal mortality, addressing gaps identified by Dagher and Linares (2022) in health care system evaluations.

By systematically examining these factors, this study aimed to contribute new evidence on the role of transportation infrastructure and health care accessibility in maternal mortality rates. The findings provided insights for policymakers and health care planners, supporting efforts to improve maternal health outcomes through better resource allocation and infrastructure planning. This research builds on previous studies (Horak & Sanborn, 2022) while addressing critical gaps in understanding the intersection of transportation and health care access at the county level.

A priori power analysis conducted in G*Power (version 3.1) indicated that a minimum of 92 data points was required to detect a medium effect size ($f^2 = 0.15$) with five predictors, $\alpha = 0.05$, and statistical power = 0.80. The final analytic sample of 187 counties exceeded this threshold, confirming adequate statistical power for the planned analyses. This ensures that the study's results are based on a sufficiently large sample to detect meaningful relationships between transportation availability, obstetric care access, and maternal mortality at the national level.

Research Questions and Hypotheses

RQ1: What is the relationship between obstetric care access and maternal mortality rates among U.S. counties?

H_o1: There is no significant relationship between obstetric care access and maternal mortality rates among U.S. counties.

H_a1: There is a significant relationship between obstetric care access and maternal mortality rates among U.S. counties.

RQ2: What is the relationship between transportation availability and maternal mortality rates among U.S. counties?

H_o2: There is no significant relationship between transportation availability and maternal mortality rates among U.S. counties.

H_a2: There is a significant relationship between transportation availability and maternal mortality rates among U.S. counties.

Theoretical/Conceptual Framework

This study was grounded in the Social Determinants of Health (SDOH) framework, which provides a structured approach to examining the relationships between transportation availability, access to obstetric care, and maternal mortality rates at the county level in the U.S. The SDOH framework, as conceptualized by the World Health Organization (WHO) and various public health scholars, identifies the social, economic, and environmental factors that influence individual and population health outcomes (Dagher & Linares, 2022). Key elements of the framework include economic stability, access to and quality of education, access to and quality of health care, neighborhood and

built environment, and social and community context (Wisner et al., 2024). These determinants collectively shape health outcomes by influencing individuals' ability to access essential health care services, including maternal care.

Within this framework, transportation infrastructure and geographic access to health care facilities are central components of the neighborhood and building environment determinant. These factors directly affect health care access and utilization, particularly for pregnant individuals in rural or underserved areas. By applying this framework, the study systematically examined the interaction between geographic distance to healthcare facilities, transportation accessibility, and maternal health outcomes. The first research question, which investigates the relationship between access to obstetric care and maternal mortality rates, aligns with the SDOH framework's emphasis on health care facility distribution patterns. The second research question, which examines how transportation availability influences maternal mortality, corresponds with the framework's focus on the infrastructure-related determinants of health care access (Labban et al., 2023).

Transportation infrastructure is a key determinant of health care utilization within the SDOH framework. This study assessed specific factors, including proximity to obstetric care facilities, public transit availability, and household vehicle access, to determine how transportation barriers impact maternal health outcomes (Rossen et al., 2022). These variables are examined in relation to health care access and service utilization patterns across different geographic contexts (Sultan, 2024). By incorporating these measurable elements, the research provides a data-driven analysis of how

disparities in transportation infrastructure contribute to variations in maternal health care access.

The SDOH framework also supports a broader investigation into how transportation systems interact with health care infrastructure to shape maternal health outcomes. The study considered population distribution, county and regional health care system capacity, and geographic barriers to comprehensively understand the systemic challenges associated with maternal health care access (Dagher & Linares, 2022). This perspective ensures that the study moves beyond isolated transportation or health care variables and examines how these factors interact within a larger structural framework.

Beyond guiding the selection of variables, the SDOH framework also informs the study's methodological approach. The research employed correlation analysis and multiple regression, following the methods established by Kim and Rosenberg (2024), to analyze the impact of transportation infrastructure and health care facility distribution on maternal mortality rates. These statistical techniques allow for a rigorous examination of the direct and combined effects of transportation and health care access, while accounting for demographic and geographic differences (Horak & Sanborn, 2022).

By anchoring this study in the SDOH framework, the research systematically explores the structural barriers affecting maternal health care delivery. This theoretical foundation justifies the investigation of transportation and health care access as interconnected factors and supports the development of evidence-based strategies for improving maternal health outcomes across U.S. counties. Through this approach, the study contributes to existing literature (Wisner et al., 2024) while addressing critical gaps

in understanding how transportation infrastructure and health care accessibility jointly influence maternal mortality rates.

Nature of the Study

This study employed a quantitative, cross-sectional design to examine the relationship between transportation availability, access to obstetric care, and maternal mortality rates across U.S. counties. Guided by the social determinants of health (SDOH) framework, the research investigated how structural factors such as transportation infrastructure and health care facility distribution shape maternal health outcomes (Dagher & Linares, 2022). Using national-level analysis**,** the study systematically evaluated health care access and maternal mortality disparities**,** providing insights into how transportation barriers contribute to health care inequities**.**

The study relied on secondary data from the Social Determinants of Health (SDOH) 2020 County 1.0 Dataset**,** which includes measures of transportation infrastructure, such as vehicle access and travel distances to obstetric care, as well as health care facility proximity and maternal mortality rates**.** These data points allow for a structured investigation of the relationships between geographic accessibility and maternal health outcomes, aligning with the SDOH framework's emphasis on systemic factors influencing health care utilization (Wisner et al., 2024).

To analyze these relationships, the study applied multiple statistical methods**.** Regression analysis examined the impact of transportation infrastructure and health care access on maternal mortality while controlling demographic and geographic variables**.** Correlation analysis identified the strength and direction of associations among the study

variables, highlighting interrelationships between transportation availability, obstetric care access, and maternal mortality. Additionally, descriptive statistics provided an overview of key variables, offering insight into patterns of health care access, geographic disparities, and maternal health outcomes (Sultan, 2024).

Prior research demonstrated the role of transportation and health care infrastructure in shaping maternal health outcomes**.** Rossen et al. (2022) found strong correlations between transportation access and maternal mortality rates**,** while Horak and Sanborn (2022) explored how health care infrastructure distribution affects maternity care accessibility**.** Additionally, Chaturvedi et al. (2024) documented the effects of geographic isolation on maternal mortality**,** highlighting disparities in access to obstetric services.

By examining systemic factors through the lens of the SDOH framework, this study aimed to provide empirical evidence on how transportation infrastructure and health care accessibility influence maternal mortality**.** The findings contributed to evidence-based strategies for improving maternal health care access, resource distribution, and infrastructure development nationally (Labban et al., 2023).

Definitions

Geographic access: The measurable distance and systematic barriers between population centers and health care facilities, quantified through travel time and physical distance metrics (Hung et al., 2023).

Maternal mortality rate: A standardized health care outcome measure representing the number of maternal deaths per 100,000 live births within defined geographic parameters (Chaturvedi et al., 2024).

Obstetric care: The availability, accessibility, and utilization of medical services specifically related to pregnancy, childbirth, and postpartum care. This includes prenatal care, skilled birth attendance, emergency obstetric interventions, and postpartum follow-up services (Rossen et al., 2022). Obstetric care is assessed through key indicators such as the distribution of obstetric health care providers, proximity to health care facilities with obstetric services, and the adequacy of maternal health care resources within U.S. counties. This variable is critical for evaluating disparities in maternal health outcomes and identifying geographic barriers to essential maternal care.

Social determinants of health (SDOH): Measurable structural components of healthcare delivery systems, including transportation infrastructure, health care facility distribution, and systematic factors affecting health care access patterns (Horak & Sanborn, 2022).

Transportation availability: The quantifiable measure of transportation infrastructure and options available within defined geographic areas that facilitate health care facility access (Richardson et al., 2023).

Assumptions

This analysis operates under several key assumptions related to health care delivery patterns across U.S. counties. The Social Determinants of Health (SDOH) 2020 County 1.0 Dataset is assumed to accurately represent the study variables, including transportation infrastructure indicators, geographic accessibility to health care facilities, and maternal mortality rates. The dataset provides standardized county-level data

appropriate for systematically examining relationships among structural determinants of health care delivery (Dagher & Linares, 2022).

A central assumption of this study is that county-level reporting of transportation infrastructure and geographic accessibility measures is sufficiently consistent to allow meaningful comparison across geographic contexts. Although minor variations in data collection procedures or reporting practices may exist between counties, these differences are not expected to materially compromise the reliability or comparability of the dataset. This level of consistency supports the examination of relationships between transportation infrastructure and maternal health outcomes at the national level (Labban et al., 2023).

The selected statistical techniques, including correlation analysis and multiple linear regression, are assumed to be appropriate for identifying associations among transportation availability, obstetric care access, and maternal mortality within complex health care delivery systems. While acknowledging that not all potentially relevant variables can be captured in secondary datasets, these analytical methods are expected to detect meaningful patterns and relationships within the available data (Rossen et al., 2022).

Another assumption underlying this study is that county-level health care infrastructure indicators reflect access conditions experienced by populations within those counties. Although intra-county variation may exist, county-level aggregation is assumed to provide a valid structural representation of health care access and transportation conditions relevant to maternal health outcomes. This assumption aligns

with prior health services research using county-level analyses to examine systemic disparities (Horak & Sanborn, 2022).

Finally, the study assumes that the combined effects of transportation availability and geographic access to obstetric care can be meaningfully examined despite the presence of unmeasured confounding factors. While residual confounding may influence observed relationships, the selected variables and analytical approach are expected to yield reliable insights into the structural factors associated with maternal mortality disparities. Articulating these assumptions clarifies the analytical boundaries of the study and supports cautious interpretation of findings within the broader context of health care delivery research.

Scope and Delimitations

This study examined the county-level relationships between transportation infrastructure, health care accessibility, and maternal mortality rates across the United States, addressing specific aspects of the research problem related to disparities in maternal health outcomes. The study focused on how geographic barriers, transportation availability, and obstetric care access interacted to influence maternal mortality, aligning with the social determinants of health (SDOH) framework (Dagher & Linares, 2022).

The research utilized secondary data from the Social Determinants of Health (SDOH) 2020 County 1.0 Dataset, which systematically measures health care infrastructure, transportation resources, and demographic patterns across U.S. counties. The study focused on county-level data across the United States, incorporating all available counties in the SDOH dataset with complete records on maternal mortality and

predictor variables (N = 187). However, the dataset did not capture individual-level factors such as variations in clinical care delivery, maternal health behaviors, or localized health care system characteristics. The study is limited to county-level structural determinants, meaning it does not directly account for patient-specific variables such as socioeconomic status, education, or personal health care-seeking behaviors. The findings therefore reflect structural rather than individual contributors to maternal mortality.

The study's boundaries are defined by national health care infrastructure, population distributions, and transportation systems, making the findings most applicable to regions with comparable health care delivery structures. While the study provides critical insights into health care access patterns at the national level, its generalizability to all states or regions was limited due to differences in health care facility distribution, transportation infrastructure, and regional health care policies (Richardson et al., 2023). Areas with varying levels of urbanization, health care resource allocation, or systemic health care disparities may have exhibited distinct relationships between transportation access and maternal health outcomes.

By framing the research within the SDOH framework, the study highlights structural barriers to maternal health care access, emphasizing systemic factors rather than individual-level determinants. This approach enabled a comprehensive analysis of how transportation infrastructure and access to obstetric care shape maternal mortality rates, offering evidence-based insights into improving maternal health services at a policy level (Labban et al., 2023). However, applying these findings to different geographic

contexts required careful consideration of regional variations in health care delivery systems, transportation policies, and demographic distributions.

Limitations

The study faced several methodological and data-related limitations that warrant acknowledgment. The reliance on secondary data from the Social Determinants of Health (SDOH) 2020 County 1.0 Dataset restricts the ability to account for unmeasured variables that may have influenced maternal mortality rates. The cross-sectional design captured data simultaneously, limiting the capacity to establish causal relationships between transportation barriers and maternal mortality outcomes.

The county-level data aggregation may have masked individual-level variations and nuances critical to understanding the full impact of transportation barriers on health services access. This aggregation could obscure important patterns or relationships at more granular geographic levels. Additionally, the dataset may not capture all relevant aspects of transportation barriers or healthcare accessibility, including informal transportation networks or variations in clinical service availability, which could influence maternal mortality rates.

Potential measurement errors or inconsistencies in how counties report and record maternal mortality data may have affected the study's internal validity. Differences in reporting practices, case identification, or data completeness across counties may have introduced variability that cannot be fully controlled. External validity considerations include the generalizability of findings to counties or regions not represented in the

dataset, particularly areas with distinct demographic compositions, healthcare infrastructures, or geographic characteristics.

Statistical analyses were further limited by missing data, potential outliers, or violations of statistical assumptions inherent in secondary data analysis. The available data fields within the SDOH dataset constrain the study's ability to control all possible confounding variables that may influence maternal mortality. These limitations inform the interpretation of the findings and highlighted opportunities for future research to incorporate longitudinal designs, finer geographic resolution, or additional contextual variables to further examine structural determinants of maternal health outcomes.

Significance

This study contributed to the health services and health care administration literature by addressing analytical gaps in understanding the structural relationships between transportation infrastructure, geographic accessibility, and maternal health outcomes in the United States. Through systematic analysis of county-level data, the research advanced health care delivery systems scholarship by identifying patterns in transportation accessibility and their association with maternal mortality rates (Sultan, 2024). The findings added to the growing body of literature on structural determinants of health care access, offering quantitative evidence relevant to resource allocation and policy development (Horak & Sanborn, 2022). Additionally, the study enhanced health care administration research by examining interactions between healthcare infrastructure and transportation systems, providing an evidence-based foundation for improving maternal health services (Chaturvedi et al., 2024).

The study also had implications for health care administration practice and health policy by identifying systemic barriers to healthcare access and informing strategic planning for healthcare facility distribution, transportation investments, and maternal health service expansion (Dagher & Linares, 2022). The findings supported data-driven decision-making by highlighting geographic disparities in obstetric care access and their relationship to maternal mortality rates. Furthermore, the study provided quantitative support for infrastructure development and funding strategies aimed at underserved areas with elevated maternal health risk, contributing to more equitable healthcare service distribution across U.S. counties (Hung et al., 2023).

Beyond research and policy implications, the study supported positive social change by addressing maternal mortality disparities at a national level. By emphasizing systemic inequities in healthcare access and the role of transportation and healthcare infrastructure, the research contributed empirical evidence to support advocacy for improved maternal healthcare services in underserved communities (Rossen et al., 2022). These findings may inform community-based interventions, transportation policy improvements, and maternal health programs aimed at reducing preventable maternal deaths and improving population health outcomes nationwide (Kim & Rosenberg, 2024).

Summary

This study examined the discipline of health services and health care administration literature by addressing critical analytical gaps in understanding the structural relationships between transportation infrastructure, geographic accessibility, and maternal health outcomes in the United States. Through a systematic analysis of

county-level data, this research advanced healthcare delivery systems research by identifying patterns in transportation accessibility and their influence on maternal mortality rates (Sultan, 2024). The findings added to the growing body of literature on structural determinants of healthcare access, offering quantitative evidence to inform resource allocation and policy interventions at the national level (Horak & Sanborn, 2022). Additionally, this study enhanced healthcare administration research by examining interactions between healthcare infrastructure and transportation systems, providing an evidence-based foundation for improving maternal health services across U.S. counties (Chaturvedi et al., 2024).

The study also had direct implications for healthcare administration practice and health policy. This research identified systemic barriers to healthcare access and informs strategic planning related to healthcare facility distribution, transportation system investments, and maternal health service expansion (Dagher & Linares, 2022). The findings support data-driven decision-making for healthcare administrators by highlighting geographic disparities in obstetric care access and their association with maternal mortality rates. Furthermore, this study provides quantitative support for infrastructure development and funding allocation decisions, assisting policymakers in targeting underserved areas with elevated maternal health risks. The identification of county-level healthcare disparities enables more effective regional and national health policy responses, supporting equitable distribution of healthcare services across the United States (Hung et al., 2023).

In addition to its contributions to research and healthcare policy, this study supported positive social change by addressing maternal mortality disparities at the national level. The research emphasizes systemic inequities in health care access, highlighting the role of transportation and health care infrastructure in shaping maternal health outcomes. By providing empirical evidence on geographic and transportation-related barriers, this study supported advocacy efforts aimed at improving maternal health care services in underserved communities (Rossen et al., 2022). The insights generated by this research can inform community-based interventions, transportation policy improvements, and maternal health programs, contributing to the reduction of preventable maternal deaths. Through these contributions, this study promoted equitable health care access and enhanced maternal health outcomes across U.S. counties, supporting long-term improvements in public health and health care equity (Kim & Rosenberg, 2024).

Chapter 2: Literature Review

Maternal mortality is a pressing public health crisis in the United States, with rates far exceeding those of other high-income countries (Hill et al., 2021). Despite advancements in obstetric care, preventable maternal deaths persist, particularly among underserved, rural, and socioeconomically disadvantaged populations. Studies have documented worsening trends, with persistent racial, geographic, and socioeconomic disparities contributing to maternal health inequities (Singh, 2010). Structural barriers drive these disparities: minimal access to obstetric services and inadequate transportation infrastructure, which delay or prevent timely medical intervention during critical maternal health episodes (Fontenot et al., 2024). Geographic isolation from maternity care facilities increases maternal health complications and reduces service utilization (Wallace et al., 2021).

Transportation availability has emerged as a critical determinant of maternal outcomes. A systematic review by Solomon et al. (2020) found that interventions improving transportation access, such as nonemergency medical transportation and ride-share programs, can significantly enhance care utilization and reduce missed appointments. This was further supported by Dahab and Sakellariou (2020), who noted that limited vehicle access and poor public transit are major contributors to care for delays in low-income and rural settings. Negash et al. (2024) also identified that longer travel times to health care facilities were significantly associated with higher maternal mortality rates in geographically isolated areas. In regions where transportation is

unreliable and underresourced, pregnant individuals face severe delays in reaching life-saving obstetric care.

The current quantitative study examined the relationship between transportation availability and access to obstetric care and maternal mortality rates at the county level in the United States. Various states reported some of the highest maternal mortality rates in the nation (Oyarvide Tuthill, 2024). The current study used county-level data to investigate how transportation availability and obstetric factors influenced maternal mortality. Grounded in the SDOH framework, the study addressed the following research questions: (a) What is the relationship between obstetric care access and maternal mortality rates among U.S. counties? (b) What is the relationship between transportation availability and maternal mortality rates among U.S. counties?

The SDOH framework provided a comprehensive lens for analyzing how environmental and structural conditions, such as facility proximity, emergency transit availability, and infrastructure investment, affect maternal outcomes (see Clark et al., 2022). This approach focused on systemic causes rather than individual risk behaviors and was particularly relevant in understanding disparities shaped by where people live. By applying this framework, the study analyzed standardized transportation access and healthcare availability measures from the 2020 SDOH County 1.0 data set, allowing for detailed exploration of localized variation in maternal mortality outcomes.

Findings across literature consistently demonstrated that limited transportation and obstetric care access were linked to higher maternal mortality. Harrington et al. (2023) reported that rural residents faced greater risks due to longer travel times and a

scarcity of health care providers. According to Goitia et al. (2023), poor vehicle access significantly contributed to delays in obtaining timely Acute Myocardial Infarction (AMI).

Similarly, Musafaah et al. (2023) identified geographic isolation as a major barrier that exacerbated maternal health risks. Wallace et al. (2021) documented elevated maternal mortality rates in maternity care deserts, highlighting the consequences of limited access to essential services. In a quasi-experimental study, Lorch et al. (2012) demonstrated that the closure of obstetric units was associated with an increase in perinatal deaths, further emphasizing the impact of reduced local care access. Collectively, these studies confirmed that structural barriers in transportation and health care access were central to maternal health disparities.

This research contributed to the growing body of work examining place-based disparities in maternal health. Findings provided information to inform equitable allocation of resources, community transportation programs, and targeted investment in maternal health infrastructure. Kozhimannil et al. (2018) showed that the loss of local hospital-based obstetric services in rural counties was associated with poorer birth outcomes and increased out-of-hospital deliveries. This study built on such work by analyzing these access barriers nationally to identify high-risk regions and inform strategic interventions. As maternal mortality continues to disproportionately affect marginalized populations in low-resource areas, this study provided actionable evidence for data-driven maternal health equity initiatives. A comprehensive review of existing literature was undertaken to support this inquiry and identify relevant studies, data

sources, and methodological approaches that inform the analysis of maternal mortality, transportation access, and obstetric care availability.

Literature Search Strategy

A comprehensive literature search was conducted using a multi-database approach to gather relevant sources addressing maternal mortality, obstetric care access, and transportation availability. Databases consulted included PubMed, Google Scholar, JSTOR, ProQuest, Scopus, and the CDC Health Data Portal. These platforms were selected for their breadth and specialization in public health, health policy, healthcare infrastructure, and social science literature. For instance, PubMed provided access to clinical and epidemiological studies on maternal health outcomes, as explored by Kozhimannil et al. (2019), while Google Scholar and JSTOR offered interdisciplinary and historical perspectives on healthcare disparities, including those highlighted by Brailey & Slatton (2024). ProQuest contributed dissertations and high-quality gray literature on transportation and maternal care in underserved regions. The SDOH Health Data Portal provided nation-specific data, including policy briefs and facility-level information essential for examining maternal mortality in the U.S. (Brailey & Slatton, 2024). The search strategy employed Boolean operators (AND, OR) to refine search results and used targeted keyword combinations, as Kozhimannil et al. (2019) demonstrated. These keywords included “maternal mortality nationally,” “transportation access and healthcare utilization,” “geographic disparities in maternal health,” “obstetric care facility availability,” and “emergency transportation outcomes.” Additional terms, such as “maternal healthcare deserts” and “prenatal/postpartum care access,” broadened

the search scope, ensuring a comprehensive examination of relevant literature. Geographic identifiers like “rural areas” and “county-level variation” were applied to focus on disparities specific to maternal health in local and regional contexts (Tegegne et al., 2018).

A structured tracking system was used to document the search process, following the methodologies adapted by Stapleton et al. (2015). This system included recording database results, keyword combinations, and inclusion/exclusion decisions in a spreadsheet. This ensured consistency, transparency, and comprehensiveness while minimizing selection bias during the review process. Studies were included if they addressed one or more core variables, maternal mortality, transportation infrastructure, or obstetric care access, and were published in English. Although preference was given to peer-reviewed journal articles, high-quality gray literature and government publications offering unique, data-driven insights were also considered (Ehiri et al., 2018).

The search focused on publications from 2000 onward to ensure contemporary relevance, incorporating earlier foundational research when necessary. Systematic reviews and meta-analyses, such as those by Tegegne et al. (2018), were prioritized for synthesizing findings across diverse contexts. Data and insights from organizations like the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), and the Department of Health Services supplemented this search, providing valuable evidence on maternal mortality and healthcare infrastructure in rural communities.

An interdisciplinary lens guided the selection process, drawing on research across public health, obstetrics, transportation planning, rural health, and health policy. For instance, Ehiri et al. (2018) investigated emergency transportation interventions for reducing adverse pregnancy outcomes, providing critical insights into addressing transportation barriers. Additionally, Kozhimannil et al. (2019) explored rural-urban differences in severe maternal morbidity and mortality, emphasizing the significance of transportation and healthcare access in maternal health outcomes.

The search revealed key gaps in the literature that this study sought to address. While studies like those by Ehiri et al. (2018) and Kozhimannil et al. (2019) explored maternal health trends and access disparities, few conducted quantitative county-level analyses integrating transportation availability and obstetric care access as core predictors. Existing research often isolated rural or urban populations without considering the rural-urban continuum or relied on broad access indicators instead of specific infrastructure measures, such as road network density or proximity to emergency services. This study addressed these gaps through a data-driven, multi-variable analysis of county-level healthcare and transportation access indicators and their association with maternal mortality. To contextualize these variables within a broader explanatory model, the study employed the Social Determinants of Health (SDOH) framework to guide the analysis of how structural conditions influence maternal mortality.

Theoretical Framework: Social Determinants of Health

This study was grounded in the Social Determinants of Health (SDOH) framework, which emphasizes how social, economic, and environmental conditions

shape health outcomes. Within this framework, transportation availability and access to obstetric care emerge as key structural determinants that help explain disparities in maternal mortality. These factors are not isolated; they interact with broader issues such as economic instability, racial inequity, and geographic isolation to compound barriers to timely and adequate maternal healthcare (Crear-Perry et al., 2020).

The conceptualization of maternal mortality through a social determinants lens has evolved significantly. Early work by McCarthy and Maine (1992) and later the World Health Organization emphasized how maternal health is shaped by the environments in which individuals are born, live, and age. The widely cited "three delays" model by Thaddeus and Maine (1994), delays in seeking care, reaching care, and receiving adequate care, remains a core adaptation of the SDOH framework in maternal health research. More recent applications highlight that transportation limitations and uneven distribution of obstetric services remain major predictors of maternal death even in high-resource countries like the U.S.

Transportation availability and access to obstetric care are not merely logistical issues but critical determinants of maternal outcomes. Counties with limited emergency transportation, inadequate road infrastructure, or extended travel distances to obstetric facilities experience disproportionately higher maternal mortality rates. Holcomb et al. (2021) found that women without prenatal care were more likely to reside in areas with longer public transit times and more bus stops to reach county-sponsored clinics, which contributed to higher risks of preterm birth and more prolonged hospital admissions for

newborns. These barriers, when combined with income level, race, rurality, and insurance coverage, deepen inequities in maternal health (Dagher & Linares, 2022).

This study applied the SDOH framework through national-level analysis in counties with the highest maternal mortality rates and pronounced disparities in health care infrastructure. The goal was to examine how transportation availability and obstetric access, as measurable structural variables, can predict maternal mortality. This approach offers a data-driven path to identifying high-risk counties and prioritizing intervention strategies for more equitable maternal outcomes. Understanding the significance of this framework requires situating it within the broader context of maternal mortality trends in the United States, where structural inequities and health system gaps continue to drive preventable maternal deaths.

Literature Review Related to Key Variables and Concepts

Maternal Mortality Overview

Maternal mortality remains one of the most urgent public health challenges in the United States, reflecting deep-rooted structural inequities that transcend individual health behaviors or clinical risk factors. Despite medical advancements, the nation's maternal death rates have continued to rise, particularly among marginalized racial and ethnic groups. Examining national trends alongside regional patterns is critical for identifying the systemic, policy, and infrastructure failures that perpetuate preventable maternal deaths. Nationally, maternal mortality trends reveal stark disparities linked to health care access, insurance coverage, and rural health care infrastructure. These disparities highlight systemic failures within the U.S. healthcare system, where geographic,

socioeconomic, and racial inequities continue to influence maternal health outcomes. The following section provides a detailed analysis of maternal mortality across all U.S. counties, framing the structural determinants at the center of this study.

Maternal Mortality in the United States

Maternal mortality in the United States represents a persistent and escalating public health crisis, with the nation reporting the highest maternal death rates among high-income, industrialized countries. According to the Centers for Disease Control and Prevention, the U.S. maternal mortality rate reached 32.9 deaths per 100,000 live births in 2021, a level more than three times higher than those observed in peer nations such as the United Kingdom and Canada, which report rates below 10 per 100,000 live births (Hoyert, 2022). These figures underscore systemic failures in the maternal health system, including fragmentation of care, chronic underinvestment in maternal services, and inconsistent implementation of evidence-based clinical protocols.

A defining feature of the U.S. maternal mortality crisis is the persistence of racial and ethnic disparities. Black women are nearly three times more likely than White women to die from pregnancy-related causes, a disparity that persists across income and education levels (Chen et al., 2025). These outcomes are not explained by individual health behaviors or clinical risk factors alone but reflect longstanding structural inequities in access to quality care, implicit bias in clinical encounters, and broader social determinants such as poverty and housing instability. American Indian and Alaska Native women experience the highest rates of maternal mortality in the country, 106.3 deaths per 100,000 live births, reflecting geographic isolation, inadequate access to culturally

responsive obstetric care, and generational disinvestment in health infrastructure (Chen et al., 2025).

Although this study examines maternal mortality across all U.S. counties, Texas stood out within the national landscape. Between 2010 and 2012, the state's maternal mortality rate more than doubled, rising from 18.6 to 38.7 deaths per 100,000 live births (MacDorman et al., 2018). This sharp increase drew national attention and raised concerns about data accuracy and systemic shortcomings in maternal healthcare delivery. While part of the rise may reflect reporting inconsistencies, subsequent analyses confirmed a sustained elevation in mortality particularly among women over age 35 and those residing in rural or medically underserved areas (Texas Department of State Health Services [DSHS], 2024). Texas thus exemplifies the broader structural inequities this study seeks to examine nationwide, where geographic, socioeconomic, and healthcare access disparities collectively shape maternal health outcomes.

Several interrelated structural issues have exacerbated maternal mortality risk nationally. First, gaps in Medicaid expansion under the Affordable Care Act have left many low-income women without comprehensive postpartum coverage—a period when nearly one-third of pregnancy-related deaths occur (Centers for Disease Control and Prevention [CDC], 2023). Second, more than 80 family planning and maternity care clinics have closed since 2011, disproportionately affecting rural counties with limited obstetric capacity (March of Dimes, 2023). These closures have produced widespread "maternity care deserts," where women must travel long distances for prenatal care, labor and delivery, and postpartum follow-up if they can access services at all.

These factors create an urgent context for examining the relationship between maternal mortality and modifiable system-level factors such as transportation availability and access to obstetric care. At the county level, variation in these structural determinants offers a critical lens for understanding where and why maternal deaths occur and what interventions may be most effective in reducing preventable mortality. This study, therefore, investigated these relationships at the national level to explore how infrastructure and service delivery disparities contribute to adverse maternal outcomes, with the aim of informing policy and public health strategies tailored to high-need communities. Accordingly, a deeper exploration of the Social Determinants of Health framework is warranted to contextualize how structural and environmental factors contribute to maternal mortality disparities across U.S. counties.

Influence of SDOH on Maternal Mortality

The Social Determinants of Health (SDOH) framework offers a critical lens for understanding how structural and contextual conditions, rather than isolated clinical factors, shape maternal health outcomes. The World Health Organization (2022) defines SDOH as the conditions in which individuals are born, grow, live, work, and age. SDOH includes income, education, employment, housing, neighborhood environment, and healthcare access. These non-medical factors influence not only individual health behaviors but also the structural capacity of communities to deliver timely, equitable, and high-quality care throughout the pregnancy continuum.

These determinants operate across multiple levels, from individual and household characteristics to broader community and policy contexts. In maternal health specifically,

disparities in outcomes often mirror entrenched patterns of socioeconomic inequality. Under-resourced communities, particularly in rural regions and communities of color, frequently face intersecting barriers such as transportation insecurity, hospital closures, inadequate prenatal outreach, and fragmented healthcare networks. These conditions do not occur in isolation but interact in ways that compound maternal risk. Moreover, SDOH influences access to care and the quality of care received. Patients from socially vulnerable communities are more likely to encounter discrimination, be subjected to delayed diagnoses, or have their concerns dismissed in clinical settings. This systemic devaluation of patients based on race, income, or insurance status further widens the gap in outcomes (World Health Organization, 2022). In the context of maternal care, such systemic inequities can result in delayed emergency response, missed diagnoses of critical conditions like preeclampsia, and insufficient follow-up during the high-risk postpartum period.

Growing evidence confirms that maternal mortality in the United States is deeply embedded within these systemic inequities. Counties characterized by high levels of social vulnerability, marked by poverty, underinsurance, food insecurity, and residential segregation, tend to report the highest rates of maternal death (Rossen et al., 2022). In the U.S., the burden is most acute in regions where social disadvantages intersect with healthcare workforce shortages and fragile infrastructure, where such counties consistently exhibit higher rates of inadequate prenatal care, unmanaged chronic conditions during pregnancy, and preventable complications during delivery.

Among these structural factors, transportation availability emerges as a particularly significant SDOH linked to maternal mortality. Access to reliable transportation directly affects the ability of pregnant individuals to receive routine prenatal care, attend scheduled diagnostic evaluations, and reach emergency obstetric services during crises. In their prospective cohort study, Ruderman (2021) found that pregnant patients who identified transportation barriers had a 2.7-fold increase in missed postpartum visits and a 64% higher readmission rate due to preventable complications. These figures remained significant even after adjusting to insurance and parity. These findings affirm that transportation constraints are not merely logistical inconveniences but serious health system barriers that elevate maternal risk.

Further supporting this connection, Montalmant and Ettinger (2023) conducted a systematic review of 42 studies across diverse settings and found a consistent association between limited transportation access and increased maternal complications, including delayed care-seeking during emergencies. Their meta-analysis revealed a 28% increase in adverse maternal events among individuals facing transportation-related challenges, underscoring the cumulative effects of mobility limitations on maternal health trajectories.

These studies demonstrate that SDOH functions as a foundational driver of maternal mortality. They reveal how structural inequities, particularly in transportation, insurance access, and community infrastructure, create predictable patterns of risk that disproportionately affect low-income, rural, and racially marginalized populations. Addressing these determinants through targeted public health investment and policy

reform is essential for reducing preventable maternal deaths and advancing equity in maternal care delivery (Crear-Perry et al., 2021).

Geographic Disparities and Regional Variation in Maternal Mortality

Geographic location remains a significant determinant of maternal health. Women residing in rural or geographically isolated counties face disproportionately high rates of maternal morbidity and mortality, even after adjusting for race, income, and insurance status (Harrington et al., 2023; Singh, 2010). Nationally, nearly half of all U.S. counties (47%) are classified as maternity care deserts, with no hospital-based obstetric services or OB-GYN access, underscoring the scope of geographic inequities in maternal healthcare (March of Dimes, 2023).

Geographic Access to Critical Care Obstetrics

Risk-appropriate maternal care aims to ensure that high-risk pregnant women receive specialized obstetrical services in properly equipped facilities or have access to transfer mechanisms to facilities with necessary resources. Geographic access to critical care obstetrics varies considerably across the United States, and this variation may differ by race, ethnicity, and region. Geographic access is defined as living within 50 miles of a facility capable of providing these critical services (Kroelinger et al., 2021). Using spatial analysis, researchers assessed geographic distance to these facilities nationally, by Department of Health and Human Services regions, and across all 50 states and the District of Columbia. Proximity analysis showed the proportion of women living within a 50-mile radius of specialized facilities, with data sourced from the 2015 American Community Survey and the 2015 American Hospital Association Annual Survey.

Findings revealed disparities in geographic access, with Asian and Pacific Islander women having the greatest access (95.8%), followed by Black women (93.5%), Hispanic women (91.4%), and white women (89.1%). American Indian and Alaska Native women had substantially less access, with only 66% living within an appropriate distance to critical care obstetrics facilities. These facilities were predominantly located in urban areas, limiting access for women in rural and frontier regions, including reservations where large populations of white, American Indian, and Alaska Native women reside. Addressing these disparities requires examining additional factors such as insurance coverage, interstate hospital referral networks, and transportation barriers. Further exploration of equity-based measures beyond geographic access is necessary to better address these persistent disparities in maternal health care access and outcomes (Kroelinger et al., 2021).

Maternal Care Deserts and Geographic Barriers to Obstetric Access

Rural maternity care deserts are characterized by long travel distances and extended drive times to reach obstetric hospitals. Women in these areas traveled an average of 33.4 miles, over four times the national average, to access care, with many experiencing drive times exceeding 30 minutes. The burden was most severe among American Indian and Alaska Native communities, where average travel distances surpassed 59 miles. These extended travel times were significantly associated with delays in prenatal care, higher rates of emergency obstetric complications, and out-of-hospital deliveries (Fontenot et al., 2024).

Geospatial analysis identified clusters of high travel burden concentrated in rural and socioeconomically marginalized areas. These patterns highlight how geographic isolation and infrastructure deficiencies compound maternal health risks. Travel distances were calculated using census tract data, road network analysis, and hospital location validation, ensuring high geographic accuracy in measuring care access disparities across diverse regions of the United States (Fontenot et al., 2024).

Inadequate access to obstetric hospitals was identified as a major structural barrier contributing to maternal health disparities. Systemic underinvestment in rural health care infrastructure amplified these risks, especially for minority populations. Targeted, place-based policy interventions were recommended to address the geographic inequities driving adverse maternal outcomes, directly aligning with the focus of this study on how transportation availability and care access predict maternal mortality at the county level (Fontenot et al., 2024).

Transportation Availability

Transportation availability represents a fundamental yet often overlooked determinant of maternal health, particularly in rural and medically underserved regions. Unlike clinical variables that can be addressed within the walls of a healthcare facility, transportation barriers are rooted in the physical and structural environment, impacting whether care can be accessed in the first place. Timely access to prenatal, delivery, and postpartum services is contingent on reaching healthcare facilities. This expectation becomes increasingly complex when public transit is unavailable, ambulance coverage is limited, or care centers are far from residential areas (Fontenot et al., 2024).

The burden of transportation-related barriers is not uniformly distributed but instead reflects broader geographic and infrastructural inequity patterns. In many rural counties, women must travel long distances, often exceeding 30 to 50 miles, to access the nearest facility offering comprehensive obstetric care. This distance can be insurmountable for individuals without a personal vehicle, particularly when compounded by poverty, lack of public transportation routes, or unsafe travel conditions. These delays are especially dangerous in obstetric emergencies, where timely intervention is often the difference between life and death (Fontenot et al., 2024).

Obstetric Care Access

Obstetric care access encompasses the full continuum of maternity services, including prenatal monitoring, labor and delivery, and postpartum care. Both spatial proximity and the availability of skilled healthcare personnel shape it. This system's gaps compromise routine preventive care and jeopardize timely interventions during obstetric emergencies. These service delivery gaps are especially concerning communities with limited facility infrastructure and persistent workforce shortages, where the absence of accessible care leads to measurable increases in maternal and neonatal morbidity and mortality (James et al., 2024).

Together, these findings reveal that obstetric access is not solely a matter of proximity but a multidimensional challenge involving infrastructure, workforce, resource allocation, and system coordination (James et al., 2024). Addressing service delivery gaps requires reinvestment in community-based maternal care, expansion of midwifery and mobile units, and policy measures to support rural hospital sustainability. Without

such targeted interventions, the consequences of inadequate obstetric access continue to manifest in preventable maternal and infant deaths, particularly in high-risk, under-resourced regions across the U.S.

Telehealth

In response to these geographic and infrastructural barriers, recent initiatives have explored whether telehealth can help overcome the geographic barriers to obstetric care identified in rural and underserved areas. Access to telehealth services has emerged as a strategy to address prenatal care barriers among women in underserved rural areas. An analysis of administrative data from 2019 to 2022 was conducted to assess whether telehealth improved prenatal visit adherence for populations residing in maternity care deserts and limited-access areas. Using a multivariable logistic regression approach, the study found that access to telehealth significantly increased the odds of completing scheduled prenatal visits, with the most notable improvements observed among women living in rural maternity care deserts. Although telehealth enhanced continuity of prenatal care, it could not replace the need for in-person obstetric services such as labor monitoring, emergency interventions, or cesarean delivery. These findings highlight that while digital innovations have strengthened preventive care delivery, bolstered regional health systems, and maintained local obstetric services, they remain essential strategies to reduce maternal health disparities (Hawkins, 2023).

National-Level Disparities

Maternal mortality is not randomly distributed across geographic regions; it is concentrated in areas marked by longstanding health system deficiencies and

socioeconomic disadvantages. National-level analysis provides a critical framework for examining how these inequities, particularly in transportation, provider availability, and infrastructure, intersect to produce uneven maternal health outcomes. This localized lens moves beyond state or national averages and captures the nuanced realities faced by community care. At this level of granularity, disparities become most visible and, importantly, most actionable.

These disparities are especially pronounced in the Southern United States. Many counties in the region face simultaneous burdens: underfunded public health systems, high rates of uninsurance, and limited obstetric capacity. The compounding effect of these factors creates environments in which otherwise preventable maternal complications become fatal. Hemorrhage, hypertensive disorders, sepsis, and cardiomyopathy conditions with established, evidence-based management protocols remain among the leading causes of maternal death. However, the consistent presence of these conditions in counties with poor health system infrastructure suggests that timely intervention is not occurring where it is most needed.

At the national level, maternal mortality reflects predictable patterns of structural disadvantage, shaped by fragile health care infrastructures, workforce shortages, and transportation barriers that disproportionately affect rural and socioeconomically disadvantaged communities. Across the Southern United States, counties with persistent structural deficiencies, such as the absence of hospital-based obstetric services, high uninsured rates, and limited provider availability, consistently report some of the highest maternal mortality rates nationwide (March of Dimes, 2023). These localized inequities

allow otherwise preventable conditions, including hemorrhage, sepsis, hypertensive crises, and cardiomyopathy, to escalate into fatal outcomes. Addressing maternal mortality thus requires interventions that target the systemic failures embedded at the county level. Without geographically tailored public health strategies, maternal deaths remain concentrated in the very counties least equipped to prevent them.

National-Level Structural Barriers

In the U.S., these structural inequities are both widespread and geographically concentrated. Counties with high social vulnerability indexes characterized by low income, low educational attainment, and high rates of uninsurance tend to experience higher maternal mortality rates and lower rates of timely prenatal care initiation. Access to maternal care is constrained nationally by service availability and the broader environmental conditions in which women live (March of Dimes, 2023). These communities often lack accessible clinics, experience high provider turnover, and are underserved by public health outreach programs. The result is a landscape in which maternal complications that are preventable or treatable in well-resourced settings escalate to life-threatening outcomes in underserved regions (Crear-Perry et al., 2021).

Quantitative findings from Bordia (2024) reinforce these patterns. In a national study of U.S. counties between 2018 and 2022, the analysis demonstrated that maternal mortality was highly responsive to changes in economic and insurance-related factors. Specifically, for every $1,000 increase in median household income, maternal mortality decreased by 1.04%, while a one-percentage-point increase in the uninsured population corresponded with a 2.00% increase in maternal deaths. The study also highlighted the

disproportionate burden borne by Black women, who had nearly twice the risk of maternal mortality compared to White women (RR = 1.99), even after controlling for income and insurance variables. These findings reveal how structural disadvantages, not individual risk factors, drive population-level disparities.

Assessing maternal mortality through the SDOH framework thus provides a necessary lens for identifying modifiable structural barriers. It shifts the analytical focus from individual-level interventions to system-level reform, emphasizing the need for policies that improve Medicaid access, expand transportation services, invest in health care infrastructure, and ensure equitable provider distribution. Without addressing these foundational disparities, clinical interventions alone are unlikely to reverse the maternal mortality crisis in states where systemic inequities remain deeply embedded in the health care delivery landscape.

Racial Disparities

Armstrong-Mensah et al. (2021) further examined how structural barriers contribute to adverse maternal outcomes, focusing specifically on Georgia's elevated maternal mortality rate (MMR). Their ecological study incorporated a review of 36 peer-reviewed articles and state-level public health data to analyze the roles of geographic access, health care workforce shortages, socioeconomic inequality, and racial discrimination. Between 2013 and 2017, Georgia's MMR reached 66.3 deaths per 100,000 live births, over twice the national average. By 2019, 93 of 109 rural counties had no labor and delivery units, and 75 counties had no obstetricians, leaving 83% of rural women without proximate access to maternal health services.

The study also identified socioeconomic inequities as key contributors to adverse outcomes. Many low-income women lacked health insurance due to Georgia's refusal to expand Medicaid, leaving roughly 240,000 residents without coverage. Even insured individuals experienced fragmented care, long wait times, and limited provider availability. Additionally, poor communication between patients and health care providers led many women to disengage from care, increasing the risk of complications such as emergency cesarean sections and untreated maternal conditions (Armstrong-Mensah et al., 2021).

Armstrong-Mensah et al. also underscored the impact of racism and discrimination, particularly among African American women. Approximately 21% reported experiencing racism in maternal care settings, often manifesting as dismissed concerns or delayed clinical responses. In 2018, the MMR for African American women in Georgia was 66.6 per 100,000 live births, nearly four times that of Hispanic women. The authors called for comprehensive reforms, including expanding Medicaid, cultural competency training, and developing a racially and geographically representative maternal health workforce to advance equity and reduce maternal mortality. Structural inequities that contribute to racial disparities in maternal mortality are further exacerbated by barriers in transportation availability, which remain a critical determinant of access to timely obstetric care in rural and underserved communities.

Provider Shortages

Additionally, provider shortages contribute significantly to perinatal service delivery gaps. Many rural hospitals have closed labor and delivery units due to financial

constraints or lack of staffing, leaving existing providers with high patient volumes and reduced capacity for individualized care. These shortages disproportionately affect low-income and minority communities, where obstetric workforce recruitment and retention remain chronic challenges. In such contexts, the few remaining maternity care providers may be stretched across vast service areas, reducing appointment availability, increasing wait times, and constraining the delivery of evidence-based, patient-centered care (Fontenot et al., 2024).

Health System Inequities

Maternal mortality risk is significantly elevated in counties where multiple structural barriers, such as low median income, high uninsurance rates, and low provider density, intersect. National-level analysis has shown that these characteristics frequently co-occur in areas with the highest maternal mortality rates, underscoring that maternal death is rarely driven by a single factor. Instead, it reflects systemic failures across interconnected domains of access, affordability, and service delivery (Bordia, 2024).

Policy Implications and Systems-Level Strategies

The persistent elevation of maternal mortality in the U.S. is characterized by limited obstetric access, inadequate transportation infrastructure, and high social vulnerability, underscoring the urgent need for targeted policy reform. While clinical interventions remain essential, the structural determinants of maternal death, particularly those related to geography, workforce distribution, and insurance coverage, require sustained policy action at both the state and federal levels.

Postpartum Medicaid Coverage Gaps

One of the most critical gaps in the maternal health policy landscape is the limited scope of postpartum Medicaid coverage. Unlike states that have adopted the federally supported 12-month postpartum Medicaid extension under the American Rescue Plan Act, states like Texas have historically restricted postpartum coverage to just 60 days (Wang et al., 2022). This policy decision leaves thousands of low-income women uninsured during the period when nearly one-third of maternal deaths occur (Gordon et al.,2020). Extending postpartum Medicaid coverage is not only evidence-based but essential for addressing late maternal mortality due to cardiovascular disease, mental health complications, and delayed care for chronic conditions.

Rural Hospital Sustainability

In addition, the closure of hospital-based obstetric units in rural areas has created vast maternity care deserts, leaving entire counties without labor and delivery services (March of Dimes, 2023). Current funding mechanisms have not adequately protected these facilities from financial decline. Policy efforts to stabilize rural hospitals through state-level subsidies, bundled maternity care payments, and incentives for recruiting OB-GYNs and certified nurse midwives are essential to restoring regional maternal care capacity.

Transportation Policy and Maternal Health Access

Transportation policy plays a central role in improving maternal health equity. Non-emergency medical transportation (NEMT) is covered under Medicaid for eligible beneficiaries (42 CFR § 440.170), but access remains inconsistent, particularly in rural

areas where services are limited or require lengthy scheduling processes. Strengthening and streamlining the NEMT benefit, especially for high-risk pregnancies, can directly reduce barriers to prenatal care and emergency services. Investments in mobile maternal health clinics and expanding community-based transportation solutions, such as public-private transit partnerships, could further close critical gaps in care access for geographically isolated populations.

Federal Program Utilization

At the federal level, continued funding for Title V Maternal and Child Health Services Block Grants and HRSA's Rural Maternity and Obstetrics Management Strategies (RMOMS) program represents an opportunity to direct resources to all counties with elevated maternal mortality. However, state-level adoption and implementation remain inconsistent. Counties with the highest maternal mortality rates often lack the administrative capacity to apply for and manage these grants, reinforcing the need for technical assistance and state-facilitated grant coordination.

Recommendations for Policy

Maternal Mortality Review Committees (MMRCs) play a vital role in identifying the causes and contributing factors of maternal deaths. However, translating their findings into policy action has been uneven. Strengthening the policy link between MMRC recommendations and legislative initiatives through mandatory legislative reporting or budget-linked implementation benchmarks could improve system responsiveness and accountability. Beyond improving system responsiveness through

better translation of review findings, addressing maternal mortality in the U.S. requires a broader shift toward preventive health policy targeting upstream structural determinants.

Preventive Health Policy

Improving maternal outcomes across counties requires shifting from reactive to preventive health policy. This includes expanding Medicaid coverage, stabilizing obstetric infrastructure, enhancing transportation networks, and investing in local workforce pipelines. Preventive health policy measures aim to enhance timely access to prenatal and postpartum care, strengthen management of chronic health conditions, reduce racial and geographic disparities in maternal outcomes, and ultimately lower the rate of preventable maternal deaths. Preventive policies proactively strengthen the maternal health system by addressing structural determinants such as insurance coverage, provider availability, and transportation access rather than responding only after adverse outcomes occur. The findings of this study aimed to inform such policy directions by identifying specific geographic regions where maternal deaths are most concentrated and by highlighting the modifiable structural determinants contributing to those outcomes. While structural and policy-level solutions are critical, the following studies provide robust empirical evidence that underscores the urgent need for these interventions.

The Relationship Between Transportation Availability and Maternal Mortality

Harrington et al. (2023) examined the relationship between geographic access to obstetric care, focusing on the physical distance and travel time from maternal residence to healthcare facilities, and adverse maternal outcomes, including maternal ICU admissions and maternal mortality. The authors used maternal rural versus urban

residence to measure geographic access, as those in rural areas typically face longer travel times and fewer transportation options to reach necessary obstetric care. This disparity in access can significantly influence maternal health outcomes, as timely care is critical for preventing complications during pregnancy and childbirth.

The study used nationally representative data from the National Vital Statistics System and the National Inpatient Sample to analyze 15,691,884 live births from 2016 to 2019. Maternal residence (rural or urban) was the primary independent variable, and outcomes were stratified by geographic setting. The researchers employed age-standardized rates and multivariable Poisson regression models to estimate rate ratios (RR) with 95% confidence intervals, adjusting for maternal age, comorbidities, and delivery type. The analysis found that the maternal ICU admissions in rural areas were significantly higher than in urban areas. In 2019, the rural-to-urban RR for ICU admission was 1.14 (95% CI: 1.04–1.20, $p < .01$), indicating a meaningful disparity in access to emergency obstetric care. These disparities persisted after adjustment for individual risk factors, underscoring systemic limitations in rural maternal health infrastructure that contribute to elevated maternal mortality risks.

In addition to disparities in ICU admissions, Harrington et al. (2023) also documented significant differences in maternal mortality trends between rural and urban populations over time. Between 2016 and 2019, maternal mortality increased in both rural and urban areas; however, the rise was more pronounced in rural settings. In rural counties, maternal mortality rates rose from 66.9 to 81.7 deaths per 100,000 live births**,** while in urban areas, rates increased more modestly from 38.1 to 42.3 deaths per 100,000

live births. In 2019, the adjusted risk ratio (aRR) for maternal mortality comparing rural to urban areas was 1.93 (95% CI: 1.71–2.17), indicating that rural women faced nearly double the risk of maternal death compared to their urban counterparts. This difference was highly statistically significant ($p < .001$), meaning there is less than a 0.1% probability that the observed disparity occurred by chance. These findings highlight persistent and widening geographic inequities in maternal health outcomes. The significant p-values underscore the statistical robustness of the results and affirm that rural residence independently predicts higher maternal mortality, even after accounting for individual-level factors such as age, race, insurance status, and comorbidities. These patterns are particularly relevant to research examining how transportation limitations, provider shortages, and spatial healthcare access barriers contribute to adverse maternal outcomes.

Harrington et al. (2023) concluded that rural residence remains a powerful predictor of maternal risk and called for targeted interventions to mitigate this disparity. They recommended expanding access to maternal care through investments in rural health infrastructure, enhancing the obstetric workforce, and implementing Medicaid expansion and telehealth solutions to support maternal health in underserved communities. For research focused on maternal mortality in the Southern United States, especially in rural counties with limited obstetric access, this study provides a compelling quantitative foundation. It demonstrates how geographic location intersects with system-level health service constraints to create substantial maternal health inequities. These

findings directly inform research questions on how transportation availability and access to obstetric providers influence maternal mortality rates.

Goitia et al. (2023) explored the relationship between disparities in household vehicle ownership and all-cause mortality following myocardial infarction (MI) in neighborhoods with varying levels of transportation access. This retrospective observational study utilized data from the Kaiser Permanente Southern California (KPSC) Health System, an extensive, integrated health system serving over 4.5 million members, representing the diverse racial and ethnic demographics of the region. Data from KPSC's centralized electronic data warehouse, which includes comprehensive information on patient demographics, pharmacy records, laboratory results, and healthcare utilization, were used to analyze the association between vehicle ownership and mortality outcomes after MI. The study also incorporated neighborhood data from the 2014–2018 American Community Survey, explicitly focusing on the percentage of households in a census tract that did not own a vehicle.

Neighborhoods were categorized into two groups based on the percentage of households without a vehicle: those with higher vehicle ownership (<4.34%) and those with lower vehicle ownership (≥4.34%). Mortality data were obtained from KPSC's mortality file, which integrates records from insurance enrollment, hospital death reports, and state and federal death master files. Statistical analyses, including Kaplan-Meier survival curves and Cox proportional hazards regression models, assessed the relationship between neighborhood vehicle ownership and all-cause mortality, adjusting for potential confounders such as age, sex, race/ethnicity, income, and comorbid

conditions. The study found that individuals living in neighborhoods with lower vehicle ownership had significantly higher mortality rates compared to those in neighborhoods with higher vehicle ownership, with disparities in mortality particularly pronounced among Black patients.

The association between vehicle ownership and all-cause mortality was significant even after adjusting for age, gender, race/ethnicity, and medical comorbidities. Specifically, living in a neighborhood with lower vehicle ownership was associated with significantly higher all-cause mortality when compared to living in a neighborhood with higher vehicle ownership (hazard ratio [HR] 1.10; 95% confidence interval [CI] 1.06–1.14; $p < 0.001$). This difference remained significant after adjusting for neighborhood median household income (HR 1.06; 95% CI 1.02–1.10; $p = 0.007$). These findings underscore the critical role that neighborhood-level transportation access plays in determining health outcomes, particularly in post-MI recovery, and highlight the need for targeted interventions to address transportation disparities in underserved communities.

The study also emphasizes the importance of finding the relationship between transportation access and mortality, suggesting that improved transportation options may lead to better health outcomes for individuals living in areas with limited vehicle ownership. The lack of reliable transportation can delay medical care, limit access to essential resources, and exacerbate existing health conditions, contributing to higher mortality rates. Understanding these relationships is critical for developing policies and interventions that address transportation as a key social determinant of health, which could ultimately reduce disparities in health outcomes, particularly in marginalized and

underserved neighborhoods. The findings stress the need for healthcare systems and public health initiatives to consider transportation as an integral factor in improving long-term health outcomes and reducing mortality, especially for vulnerable populations.

Musafaah et al. (2023) examined the relationship between geographic access to healthcare and maternal mortality in Banjar Regency, Indonesia, focusing on how transportation barriers, such as travel distance, time, and transportation availability, impact maternal health outcomes. The study used a retrospective case-control design from 2015 to 2018, comparing maternal deaths (cases) with non-death controls (controls). Data were collected from health records, midwife records, and health facility documents. GPS technology was used to track the precise geographic locations of maternal deaths and healthcare facilities. Geographic access was assessed using Geographic Information Systems (GIS)**,** specifically ArcView GIS**,** to measure travel distances and times.

The study used multivariate logistic regression to estimate the relationship between geographic access and maternal mortality, adjusting for potential confounders such as age, socioeconomic status, and comorbid conditions. The sample included local health records from 2015 to 2018, with statistical methods focused on travel distance, time, and transportation availability. The study found that maternal mortality was significantly associated with longer travel distances to healthcare facilities. Specifically, maternal deaths occurred more frequently in neighborhoods located farther than 3 km from health facilities, with 60% of deaths occurring after follow-up referrals to distant hospitals.

The analysis revealed that longer travel times also contributed to maternal mortality, though the relationship was less significant than travel distance. The odds ratio (OR) for long travel times was 3.63 (95% CI: 0.92–14.34; p = 0.075), suggesting a weaker impact than distance. Despite this, the findings underscore the importance of timely access to care and indicate that delays in reaching healthcare facilities can exacerbate maternal health risks.

Spatial analysis using GIS mapped maternal deaths, highlighting areas with higher mortality rates linked to poor transportation access. The study found that maternal deaths were more common among women residing within 3 km of health facilities. The maximum recommended service range for health facilities was 5 km, with the ideal service range being 3 km. Of the maternal deaths, 80% occurred in hospitals within Banjar Regency, while 20% occurred in hospitals in Banjarmasin City. The study also noted that 40% of maternal deaths occurred in village health centers and midwife facilities, underscoring the need for improved local healthcare infrastructure.

The Relationship Between Obstetric Access and Maternal Mortality

Wallace et al. (2021) examined the relationship between geographic access to maternity care and pregnancy-associated mortality in Louisiana. The study used 2016–2017 data from the Louisiana Vital Records birth and death files, which included 101,142 live births and 112 pregnancy-associated deaths. Geographic access was measured by the presence or absence of maternity care services in each parish, defined as hospitals providing obstetric care, OB/GYNs, or certified nurse midwives. Pregnancy-associated

mortality and pregnancy-related mortality served as the outcome variables to measure maternal mortality risks associated with a lack of access to maternity services.

Women residing in parishes designated as maternity care deserts were compared to those living in parishes with available maternity care services. Maternity care deserts were identified as parishes with no hospitals offering obstetric services, no OB/GYNs, and no certified nurse midwives. Maternal demographic characteristics, including race/ethnicity, age, education level, and insurance status, were collected to adjust for individual-level differences. The total sample reflected a statewide population-based cohort of all births and pregnancy-associated deaths recorded over the two years.

Modified Poisson regression with robust error variance was used to estimate adjusted risk ratios (aRR) for the associations between maternity care access and maternal mortality outcomes. Statistical significance was determined by 95% confidence intervals and p-values. In addition to regression analysis, spatial statistical techniques were employed. Global Moran's I was used to test for spatial autocorrelation. Local Indicators of Spatial Autocorrelation (LISA) identified specific geographic clusters of elevated maternal mortality risk associated with maternity care access.

The study found that women residing in maternity care deserts experienced significantly elevated risks of both pregnancy-associated and pregnancy-related mortality compared to women with local access to maternity services. Specifically, the risk of pregnancy-associated mortality was 1.91 times higher (adjusted risk ratio [aRR] = 1.91, 95% CI: 1.15–3.18) and was statistically significant at the $p < .05$ level. The risk of pregnancy-related mortality was even greater, with a 3.37 times higher likelihood of

death directly caused by pregnancy complications (aRR = 3.37, 95% CI: 1.71–6.65) and was statistically significant at the $p < .01$ level. After adjusting for demographic factors, non-Hispanic Black women faced substantially higher mortality risks than non-Hispanic White women. The risk of pregnancy-associated mortality among Black women was 2.22 times higher (aRR = 2.22, 95% CI: 1.39–3.56), reaching statistical significance at the $p < .01$ level. Similarly, the risk of pregnancy-related mortality was 2.66 times higher for Black women (aRR = 2.66, 95% CI: 1.16–6.12), with statistical significance at the $p < .05$ level.

Spatial analysis further supported these findings. Global Moran's I value was 0.16, indicating a positive spatial autocorrelation, where counties with high maternal mortality risks tended to cluster geographically rather than being randomly distributed. This pattern was statistically significant ($p = .02$), meaning there is only a 2% probability that the observed clustering occurred by chance. These results suggest that maternity care deserts were geographically patterned rather than randomly distributed. Further, LISA (Local Indicators of Spatial Association) analysis revealed specific high-risk clusters where limited or no access to maternity care services corresponded with elevated maternal mortality rates, particularly in rural and structurally underserved regions.

Overall, Wallace et al. (2021) found a strong relationship between lack of geographic access to maternity care and increased pregnancy-associated mortality, particularly among non-Hispanic Black women. The study emphasized that geographic barriers to maternity care infrastructure, combined with systemic racial disparities, significantly contribute to maternal mortality risks. These findings highlight the

importance of addressing healthcare service availability and structural inequities to reduce maternal mortality. This directly relates to the present study's focus on improving geographic and racial equity in maternal health outcomes.

While Wallace et al. (2021) demonstrated the relationship between maternity care deserts and increased maternal mortality, additional research has focused on the specific travel burdens contributing to care delays. Fontenot et al. (2024) examined how extended travel distances in rural maternity care deserts exacerbate barriers to timely obstetric services.

Lorch et al. (2012) conducted a quasi-experimental study in Pennsylvania to examine the impact of obstetric unit closures on perinatal outcomes. Analyzing over 3 million birth records between 1995 and 2005, the researchers focused on Philadelphia, where nine of the city's nineteen obstetric units closed during the study period. Using a difference-in-differences approach, the study compared perinatal outcomes in Philadelphia with those in surrounding counties that retained stable obstetric services. The findings revealed a significant rise in neonatal mortality (49% increase, OR = 1.49, 95% CI: 1.12–2.00) and perinatal mortality (53% increase, OR = 1.53, 95% CI: 1.14–2.04) in the years immediately following the closures. These results persisted after adjusting for maternal age, gestational age, and insurance status, underscoring the critical role of proximity to functional labor and delivery units in preventing adverse perinatal outcomes.

The study also highlights broader systemic implications of obstetric unit closures. Hospitals that discontinue labor and delivery services often reduce associated specialties

such as maternal-fetal medicine, anesthesia, and neonatal intensive care, which can weaken local healthcare infrastructure. Women residing in affected counties may be forced to seek care at distant or overburdened urban hospitals, where delays in emergency obstetric interventions and gaps in culturally competent care may exacerbate risks. The findings by Lorch et al. (2012) emphasize the necessity of accessible, risk-appropriate obstetric services as a safeguard against preventable maternal and neonatal morbidity and mortality.

Importantly, the temporary nature of the increased mortality rates observed in Philadelphia provides insight into how health system adaptors fail to adapt during periods of service loss. While mortality rates returned to baseline after 2000, the short-term consequences of closures were both measurable and severe. This suggests that transitional periods following obstetric service reductions represent windows of heightened vulnerability. Without proactive planning, alternative care pathways, or policy interventions to support displaced populations, these transitions can have detrimental effects on maternal and infant health.

The study's use of a natural experiment adds to its methodological rigor. The authors effectively isolated the impact of reduced obstetric access by leveraging the staggered closure of units over time and comparing Philadelphia with demographically similar counties that did not experience closures. This strengthens the causal inference and reinforces the study's relevance for healthcare policymakers, especially in rural or underserved areas where closures threaten maternal care delivery.

Furthermore, Lorch et al. (2012) contribute to a growing body of literature documenting how structural changes in healthcare access, particularly reductions in service availability, translate into measurable disparities in health outcomes. Their findings support a broader public health imperative: to ensure that obstetric care is available and equitably distributed across regions. As healthcare systems in the United States continue to consolidate, studies like this underscore the need to assess the economic rationale for closures and the human costs that follow.

Summary

The cumulative evidence presented in this chapter emphasizes the profound impact of transportation availability and obstetric care access on maternal mortality, particularly in rural and socioeconomically disadvantaged communities. These factors consistently emerge in the literature as critical structural determinants of maternal mortality. Delays caused by long travel distances, inadequate transit infrastructure, and the closure of obstetric units elevate the risk of preventable complications, particularly in rural and underserved regions (Kozhimannil et al., 2018). These barriers are intensified by broader social inequities such as poverty, lack of insurance, and limited healthcare infrastructure.

Several studies included in the in-depth review further support these findings. Harrington et al. (2023) demonstrated that rural residence nearly doubled the risk of maternal mortality, highlighting how geographic isolation limits timely access to obstetric care. Goitia et al. (2023) linked low neighborhood vehicle ownership to increased all-cause mortality, emphasizing transportation as a key determinant of health

outcomes. Musafaah et al. (2023) found that maternal deaths were significantly more likely when women had to travel longer distances to health facilities. Wallace et al. (2021) reported that women in maternity care deserts experienced significantly higher pregnancy-related mortality, with racial disparities compounding geographic barriers. Lorch et al. (2012) showed that closures of obstetric units led to a measurable rise in neonatal and perinatal mortality, underscoring the critical importance of maintaining local labor and delivery services.

Although existing studies have documented these risks, few have conducted integrated, county-level analyses that assess how transportation and obstetric access jointly influence maternal mortality. Most research isolates single factors, limiting the development of effective, data-driven solutions (Fontenot et al., 2024).

The current study applied a multivariable approach within the Social Determinants of Health framework to address this gap. Chapter 3 outlines the methodological design, including the data sources, variable construction, and statistical procedures used to examine these structural predictors of maternal mortality.

Chapter 3: Research Method

This chapter outlines the methodology employed to assess how transportation access and availability of obstetric care services are related to maternal mortality rates across counties in the United States. The research followed a quantitative cross-sectional design, using secondary data to examine associations among key variables. Grounded in the SDOH framework, the study examined how community-level structural factors, specifically transportation systems and obstetric care accessibility, influence maternal health outcomes (see WHO, 2022).

The analysis utilized national-level data from the 2020 SDOH County 1.0 data set, which integrated transportation infrastructure indicators, health care provider access, and maternal mortality statistics. This public-use data set supported rigorous quantitative analysis of structural disparities across counties and aligned with prior research that emphasized the geographic and infrastructural determinants of maternal health (Barrera et al., 2022). By employing a correlational design, the study assessed the strength and direction of relationships between the independent variable (transportation availability) and obstetric care access, and the dependent variable (maternal mortality rate). Data analysis was conducted using IBM Statistical Package for Social Sciences(SPSS) Version 29, which facilitated descriptive and multivariate statistical testing, including multiple linear regression models.

This methodology sought to reveal patterns that may help explain persistent disparities in maternal health outcomes, particularly in underserved or rural areas. Previous studies showed that distance to care, provider shortages, and lack of public

transportation can significantly delay access to obstetric services and increase maternal risk (Kroelinger et al., 2021). The findings from the current study may inform policy interventions that address geographic barriers and promote equitable maternal care access across U.S. counties.

Research Design and Rationale

This study included a quantitative nonexperimental cross-sectional correlational design to examine associations among variables of interest at a single point in time. The quantitative approach was used to conduct statistical analysis of large-scale, county-level data and was used to identify predictive relationships among variables (see Hendryx et al., 2017). A nonexperimental design was appropriate because no variables were manipulated and no random assignment was employed. Instead, the study analyzed naturally occurring differences in transportation infrastructure, obstetric care availability, and maternal outcomes across geographic regions. A cross-sectional design was suitable for providing a snapshot of these variables during the same temporal window, thereby supporting meaningful inferences about structural influences on maternal mortality (see Sajedinejad et al., 2015).

The correlational design was well suited to investigate the strength and direction of associations between independent variables (transportation availability and obstetric care access) and the dependent variable (maternal mortality rate). Unlike experimental designs that test causality through manipulation and control, correlational studies identify patterns of association that may inform targeted interventions or future causal research.

This design is particularly relevant for health services research that relies on observational data and aims to uncover structural determinants of health inequities.

The unit of analysis in this study was the county, and the analytical sample included all U.S. counties for which complete data are available (N = 187). The county level was chosen because it reflects the jurisdictional structure of healthcare planning and delivery, making it an ideal scale for policy intervention and resource allocation. Furthermore, maternal mortality reporting and public health data are often aggregated at the county level, enabling standardized comparisons across jurisdictions (Barrera et al., 2022).

The theoretical grounding in the SDOH framework strengthened methodological rationale by situating maternal mortality within broader environmental and systemic conditions. According to the WHO (2022), SDOH include economic stability, education, neighborhood and built environment, social and community context, and healthcare access and quality. These determinants interacted to shape individuals' capacity to engage with the healthcare system and influence clinical outcomes. In the context of maternal health, structural barriers such as transportation deficits and facility closures limit access to prenatal, intrapartum, and postpartum care, increasing the likelihood of adverse outcomes (Crear-Perry et al., 2021).

Power Analysis and Sample Adequacy

A priori power analysis was conducted using G*Power version 3.1 to confirm that the study had sufficient statistical power for the planned analyses (Faul et al., 2009). The analysis was based on a multiple linear regression model with five predictors, an alpha

level of .05, and a desired power of .80. Results indicated that a minimum of 92 cases was required to detect a medium effect size ($f^2 = 0.15$). Although the Social Determinants of Health (SDOH) 2020 County 1.0 dataset includes data for more than 3,000+ U.S. counties, only 187 counties reported complete data on maternal mortality and all predictor variables. This sample size exceeded the required threshold, confirming that the study achieved adequate statistical power for the regression analysis.

Methodology

The methodology for this study employed a structured quantitative approach to examine how transportation availability and obstetric care access predict maternal mortality rates at the county level in the United States. It utilized secondary data analysis, an efficient and effective method in public health research that enables the exploration of research questions using pre-existing large datasets without additional data collection.

Counties served as the unit of analysis because county-level data aligned with national public health planning and represented the standard reporting level for maternal mortality and healthcare infrastructure variables. This methodology was grounded in the Social Determinants of Health (SDOH) framework, which emphasizes that health outcomes, such as maternal mortality, are shaped by systemic and structural factors, including transportation infrastructure and service availability.

The study relied on the 2020 SDOH County 1.0 Dataset for variables such as maternal mortality rates, transportation measures, and indicators of obstetric care access services. These publicly available secondary data sources are widely recognized in public health research for their methodological rigor and consistency (Areco et al., 2021).

IBM SPSS Statistics was used for all statistical analyses because it is widely adopted in health services research for its capacity to handle large datasets, perform regression diagnostics, and conduct data transformations (Dembe et al., 2011).

Population

The population for this study comprised all counties in the U.S. included in the SDOH dataset. The analytic sample (N = 187) consisted of counties with complete data on all study variables: maternal mortality, transportation availability, obstetric care access, and covariates. This county-level approach is suitable for examining national public health patterns, as counties represented fundamental units of healthcare governance and service delivery across the U.S. (Barrera et al., 2022).

Each county acted as a distinct observational unit representing a combination of social, economic, and infrastructural characteristics that may influence maternal mortality. The heterogeneity across counties regarding urbanization, access to obstetric facilities, and socioeconomic status allows for a practical assessment of systemic patterns. Because maternal mortality events are relatively rare, using all available counties with complete data maximizes statistical power and enhances the generalizability of results to national contexts (MacDorman et al., 2018).

The study focused only on counties with complete data for all key variable maternal mortality, transportation availability, and obstetric care access. Counties missing one or more of these data points were excluded from the analysis to preserve the integrity and comparability of the dataset. This complete-case approach reduces potential biases

associated with imputation techniques and ensures uniformity in variable inclusion criteria (Sajedinejad et al., 2015).

Sampling and Sampling Procedures

This study employed a census sampling strategy, which analyzes data from all available U.S. counties that meet the inclusion criteria within the 2020 Social Determinants of Health (SDOH) County 1.0 Dataset. Census sampling is appropriate for this research because it aims to maximize generalizability and statistical power by utilizing the entire accessible population of counties with valid data. Rather than selecting a representative sample, this approach enables the analysis of regional disparities without the risks of selection bias or sampling error that might occur in probabilistic or convenience sampling (Li et al., 2021).

Inclusion criteria for counties in the final analysis were as follows: (1) availability of complete data for maternal mortality rates, (2) availability of transportation-related indicators, and (3) availability of obstetric care access variables. Counties with missing values for any variables under study were excluded to maintain consistency across statistical models. This complete-case analysis approach strengthens internal validity by ensuring that each observation contributes equally to multivariable analyses without the distortion introduced by imputation or substitution methods (Sajedinejad et al., 2015).

The rationale for using counties as the unit of analysis was grounded in the structure of the U.S. public health and emergency response system. Counties function as administrative units that coordinate health departments, transportation services, and emergency medical response systems. Consequently, examining county-level differences

provides critical insight into systemic and geographic disparities in maternal health outcomes and offers an evidence base for national and regional policy interventions (Barrera et al., 2022).

By applying a census sampling method, this study was well-positioned to capture nationwide variation in the structural determinants of maternal health and to generate findings that can inform both broad and targeted policy responses across diverse geographic settings.

Population and Sampling Procedures

The population of interest comprised all counties in the United States represented in the 2020 SDOH County 1.0 Dataset. A census sampling approach was employed whereby all counties with available and complete data on maternal mortality, transportation infrastructure, and obstetric care services were included in the analytic sample. This approach is appropriate because it maximizes the use of available data and supports population-level inference across U.S. counties (Centers for Disease Control and Prevention [CDC], 2023). Counties with missing data for any key study variable were excluded from the final analysis, with data completeness verified during the data preparation stage. The resulting analytic sample consisted of 187 U.S. counties with valid data on all study measures.

County-level analysis was further justified based on the role of counties in healthcare system planning, public health funding allocation, and emergency service delivery. Prior research has demonstrated that health outcomes vary substantially across geographic regions due to differences in social vulnerability, healthcare infrastructure,

and transportation barriers. Using the county as the unit of analysis allowed this study to capture spatial and structural disparities that may be obscured in broader regional or state-level analyses, thereby strengthening the relevance of findings for public health decision-making (Weeks et al., 2023).

Secondary Data Collection

The study utilized secondary data from the primary source: the 2020 Social Determinants of Health (SDOH) County 1.0 Dataset. This national-level dataset provided validated, public-use data relevant to maternal mortality rates within the United States, including transportation viability, obstetric care access, and related structural and contextual factors. The SDOH County 1.0 Dataset includes measures of transportation access, such as the percentage of households without vehicle access, and healthcare provider density, which are essential for assessing obstetric care access (Agency for Healthcare Research and Quality [AHRQ], 2022). The transportation access variable, ACS_PCT_HU_NO_VEH, was sourced from the U.S. Census Bureau's American Community Survey (ACS) 5-Year Estimates (U.S. Census Bureau, 2021). Healthcare provider access, including the median distance to the nearest obstetrics department, was measured by the variable POS_MEDIAN_DIST_OBSTETRICS, which is derived from the Centers for Medicare & Medicaid Services (CMS) Provider of Services (POS) File and calculated using population-weighted tract centroids within each county (Centers for Medicare & Medicaid Services, 2021).

The maternal death rate, (*CDCW_MATERNAL_DTH_RATE)*, was assessed as the outcome variable, with county-level mortality statistics compiled as the number of

maternal deaths per 100,000 live births, based on vital records and clinical reviews, ensuring consistency with national definitions. The dataset includes key infrastructure and socioeconomic indicators for understanding the relationship between transportation, healthcare access, and maternal mortality (U.S. Census Bureau, 2021). This dataset was integrated at the county level using Federal Information Processing Standards (FIPS) codes to ensure consistent alignment across sources.

Archival Data Use

This study utilized archival data compiled from government agencies and publicly available repositories, which were not originally collected for this specific research purpose. Archival data refers to pre-existing datasets gathered for administrative, surveillance, or reporting objectives, which can be repurposed for secondary analysis in health services research. The primary archival source for this study is the 2020 Social Determinants of Health (SDOH) County 1.0 Dataset, which aggregates data from validated sources such as the U.S. Census Bureau (2023) for transportation and demographics and the Centers for Disease Control and Prevention (CDC, 2023) for maternal mortality and the Centers for Medicare & Medicaid Services (CMS, 2021) healthcare facility data. These agencies follow strict data collection and coding protocols, ensuring consistency and reliability in the variables of interest.

Using archival data was methodologically appropriate here, as it allows the study to assess county-level health outcomes, specifically maternal death rates, without the logistical constraints of primary data collection. Archival datasets provide geographic breadth and stay free from researcher-introduced bias since the data collection occurred

independently of the study. Moreover, they facilitated meaningful comparisons over time and across jurisdictions (Pederson et al., 2020).

Variables such as the percentage of households without access to a vehicle, access to obstetric care, and maternal mortality rates were sourced from these archival datasets and linked through Federal Information Processing Standards (FIPS) codes. This geo-coding ensured precise alignment between county-level indicators. The archival nature of the data and its administrative origin confirmed that these variables represent unbiased, systematic measures, forming a strong empirical basis for investigating structural influences on maternal mortality nationally.

Instrumentation and Operationalization of Constructs

This study's measurable constructs are derived from the 2020 SDOH County 1.0 Dataset, which integrates county-level indicators from federal sources, including the U.S. Census Bureau's American Community Survey (ACS), the Centers for Medicare & Medicaid Services (CMS), and CDC WONDER. Three primary variables and control variables were operationalized as follows:

Independent Variables

Transportation Availability (Independent Variable 1). Percentage of households without access to a vehicle.

Instrumentation. Data from the American Community Survey (ACS) sub-sample in the SDOH dataset provides the percentage of households lacking private transportation.

Operationalization. This continuous variable ranges from 0% to 55% across U.S. counties. Higher percentages indicate greater structural barriers to accessing healthcare, particularly prenatal and emergency obstetric services (U.S. Census Bureau, 2023).

Obstetric Care Access (Independent Variable 2).

Instrumentation. Obstetric care access was operationalized using a single variable from the SDOH County 1.0 Dataset: median travel time in minutes to the nearest obstetric facility (POS_MEDIAN_DIST_OBSTETRICS). This variable reflects geographic proximity to maternal health services; a key component of access identified in the multidimensional framework by Hung et al. (2017).

Operationalization. POS_MEDIAN_DIST_OBSTETRICS is a continuous variable measured in minutes. Higher values indicate longer travel times and, therefore, reduced geographic accessibility to obstetric care. This variable was used independently to examine its relationship with maternal mortality.

Dependent Variable

Maternal Death Rate.

Instrumentation. The outcome variable, labeled `CDCW_MATERNAL_DTH_RATE`, captures the number of maternal deaths per 100,000 live births at the county level. It is derived from CDC WONDER mortality data using ICD-10 codes O00–O99 and reflects a five-year average (2016–2020) to account for the rarity of maternal deaths in some counties (Centers for Disease Control and Prevention, 2024).

Operationalization. The variable is continuous and standardized per 100,000 live births to allow for comparability across counties of varying population sizes. Counties

with suppressed data due to fewer than 10 maternal deaths were excluded using case wise deletion, consistent with public health reporting standards (Petersen et al., 2019).

Control Variables

Median Household Income (Control Variable 1).

Instrumentation. The variable ACS_MED_HH_INC represents the median household income for each county, drawn from ACS estimates within the SDOH dataset. Income serves as a proxy for economic advantage and is linked to access to care and health-seeking behavior.

Operationalization. This continuous variable ranges from approximately $28,000 to $148,000 across U.S. counties. Higher income levels are generally associated with a reduced risk of maternal mortality due to improved access to and quality of healthcare.

Rurality (Control Variable 2).

Instrumentation. Rurality was measured using the AHRF_USDA_RUCC_2013 variable, which represents the county's degree of urbanization and proximity to metropolitan areas, as defined by the U.S. Department of Agriculture Rural–Urban Continuum Codes (RUCC, 2013). This classification differentiates metropolitan, micropolitan, and rural counties based on population density and adjacency to urban centers. The variable was originally a string and subsequently recoded into a numeric format (RUCC_NUM) to enable quantitative analysis in SPSS.

Operationalization. The RUCC scale ranges from 1 (urban, ≥1 million residents) to 9 (completely rural, not adjacent to a metropolitan area). Across U.S. counties, scores ranged from 1 to 9, reflecting wide variation in geographic isolation and urban proximity.

Higher scores indicate more rural areas, which may experience reduced access to obstetric services and greater transportation barriers affecting maternal outcomes.

Racial/Ethnic Minority Proportion (Control Variable 3).

Instrumentation. This variable is calculated by subtracting the percentage of non-Hispanic White residents from 100%, using ACS race/ethnicity indicators in the SDOH dataset. It captures racial and ethnic diversity at the county level. Racial disparities in maternal health are widely documented, with systemic factors contributing to higher risks for minority populations (Petersen et al., 2019).

Operationalization. This continuous variable spans a wide range across U.S. counties. Higher percentages indicate greater racial/ethnic minority representation, which is used to assess potential structural inequities influencing maternal health outcomes.

This framework is grounded in the Social Determinants of Health (SDOH) model, which emphasizes the role of structural, contextual, and systemic factors in shaping population-level health outcomes (Marmot et al., 2008). The selection and operationalization of variables in this study reflect this framework by incorporating both access-related indicators (transportation and obstetric care) and sociodemographic controls (income, insurance status, and racial/ethnic composition). This approach enables the assessment of structural predictors of maternal mortality while accounting for known confounding influences across U.S. counties.

Data Analysis Plan

The data analysis plan for this quantitative study is structured to systematically evaluate the associations between transportation availability, access to obstetric care, and

maternal mortality rates across U.S. counties. All statistical analyses were performed using IBM SPSS Statistics Version 29, consistent with procedures for handling large national datasets and assessing structural health determinants.

Software for Analysis

All statistical analyses for this study were conducted using IBM SPSS (Statistical Package for the Social Sciences) Statistics, Version. SPSS is a widely used statistical software package in the social and health sciences, well-suited for performing descriptive, correlational, and multiple regression analyses. Its interface supports syntax-based and point-and-click approaches, providing flexibility in data management, computation, and diagnostic evaluation. SPSS was selected for its ability to efficiently manage large datasets, generate comprehensive statistical outputs, and perform diagnostic checks essential for evaluating the assumptions of regression models (Vandever, 2020). The software also allows for creating visualizations, such as histograms and scatterplots, which are essential in assessing distributional characteristics, identifying outliers, and confirming model assumptions.

Data Cleaning and Screening Procedures

Data cleaning and screening were conducted to ensure the accuracy, consistency, and validity of the dataset prior to statistical analysis. All raw data files were imported into SPSS and subjected to rigorous quality checks before analysis. Variable names were standardized, and categorical variables were appropriately labeled. Casewise deletion was used to address missing data, whereby counties lacking information on any of the primary variables were excluded from the final analytic sample (Van den Broeck et al., 2005).

This approach prevents the distortion of regression estimates due to incomplete cases (Sharifnia et al., 2025). Outliers and data entry errors were identified through boxplots and frequency tables, and normality of continuous variables was evaluated using skewness and kurtosis statistics (Sharifnia et al., 2025). All variables included in composite indices were normalized using z-score transformations to ensure comparability and consistency across counties. These procedures ensured that all analytic variables met the statistical assumptions required for valid correlation and multiple linear regression analyses.

Research Questions and Hypotheses

This study was guided by two primary research questions that examine how structural determinants, specifically transportation availability and obstetric care access, predict maternal mortality rates across counties in the U.S. These questions are rooted in the Social Determinants of Health (SDOH) framework, which emphasizes how non-medical factors influence health outcomes, including access to care and the built environment (World Health Organization [WHO], 2022).

RQ1: What is the relationship between obstetric care access and maternal mortality rates at the county level in the United States?

H_o1: There is no statistically significant relationship between obstetric care access and maternal mortality rates at the county level in the United States.

H_a1: Obstetric care access is significantly associated with maternal mortality rates at the county level in the United States.

RQ2: What is the relationship between transportation availability and maternal mortality rates at the county level in the United States?

H_o2: There is no statistically significant relationship between transportation availability and maternal mortality rates at the county level in the United States.

H_a1: Transportation availability is significantly associated with maternal mortality rates at the county level in the United States.

These research questions are designed to examine bivariate associations introducing covariates, focusing on the direct impact of each structural variable on maternal health outcomes. This approach allows a clearer understanding of how specific community-level barriers influence maternal mortality. Previous studies have indicated that limited access to obstetric services and transportation infrastructure may increase maternal mortality risks, particularly in underserved or rural communities (Barrera et al., 2022). The hypotheses were tested using multiple linear regression models based on aggregated county-level data.

Analysis Plan

The analysis proceed logically, beginning with descriptive statistics to summarize the data, followed by inferential techniques to evaluate relationships between variables. A priori power analysis, conducted using G*Power version 3.1, confirmed that the study sample size was adequate for the planned analyses. Based on a multiple linear regression model with five predictors, an alpha level of .05, desired power of .80, and a medium effect size ($f^2 = 0.15$), a minimum of 92 cases was required. The final analytic sample of 187 U.S. counties exceeded this threshold, ensuring sufficient statistical power to detect

moderate associations between the independent variables (transportation availability and obstetric care access) and the dependent variable (maternal mortality rate).

Bivariate correlation analysis determined whether significant associations were present between variables. Two separate multiple linear regression models examined the predictive associations between maternal mortality rates and access to obstetric care and transportation availability for each independent variable. Assumptions of regression linearity, normality, homoscedasticity, and absence of multicollinearity were tested using diagnostic tools such as scatterplots, residual plots, and variance inflation factors (Tabachnick & Fidell, 2019).

Descriptive Statistics

Descriptive statistics provided an overview of the central tendencies and distributions of all study variables. This includes the mean, median, standard deviation, minimum, and maximum values for maternal mortality rates, transportation availability, and access to obstetric care. These summaries helped identify outliers or skewness in the data and confirm the suitability of the data for parametric tests.

Inferential Statistics

Inferential analyses included Pearson correlation coefficients to examine bivariate associations and multiple linear regression to test the predictive power of the independent variables. Statistical significance was evaluated using p-values ($\alpha = 0.05$), and model fit were assessed via adjusted R^2. The strength and direction of each predictor's effect on maternal mortality was interpreted using standardized beta coefficients.

Univariate Analyses

Univariate analysis was performed to examine the distribution and properties of each variable independently. This includes evaluating the frequency distributions, central tendency (mean, median), and dispersion (standard deviation, range) for maternal mortality rate, transportation availability, and obstetric care access. Histograms and boxplots were used to inspect data for outliers and skewness visually. These preliminary steps are essential for understanding the dataset's general characteristics and confirming assumptions required for parametric statistical analysis (Canova et al., 2017).

Multivariate Regression Analyses

Multivariate analysis consisted of two separate multiple linear regression models. The first model evaluated the relationship between obstetric care access and maternal mortality, while the second assessed the association between transportation availability and maternal mortality. Both models were designed to estimate the unique contribution of each predictor to the outcome variable. Model diagnostics, including R^2, adjusted R^2, and standardized regression coefficients reported, along with significance levels. Multicollinearity were evaluated using variance inflation factors (VIF), and residual plots were reviewed to assess homoscedasticity and independence of errors (Sun et al., 2023).

Covariates and Confounding

This study included key county-level control variables to address potential confounding factors and strengthen the validity of the findings. Specifically, income level (e.g., median household income), racial/ethnic composition (e.g., percentage of non-Hispanic Black residents), and rurality (e.g., rural–urban classification codes) were

included as covariates. These variables are known to predict both healthcare access and maternal mortality and help account for underlying social and structural disparities across counties. Controlling for these variables enables the study to more accurately isolate the independent effects of transportation availability and access to obstetric care on maternal outcomes (Andrade, 2024).

Interpretation of Results

Results were interpreted by evaluating the regression coefficients' size, direction, and statistical significance. A positive or negative beta value indicated the direction of the relationship, while significance levels ($p < .05$) determined whether findings are likely due to chance. Effect sizes and confidence intervals were also considered when contextualizing practical significance.

Statistical Tests and Rationale

Pearson correlation analysis was conducted to assess bivariate associations between maternal mortality rates and each independent variable: transportation availability and obstetric care access (Ranganathan, 2021). Although correlation is not a formal test of the hypotheses, it provides preliminary insight into the direction and strength of linear associations among continuous variables. This study employs multiple linear regression as the primary inferential technique for hypothesis testing. This method is suitable for examining the predictive relationship between continuous independent variables, obstetric care access, and transportation availability, and the continuous dependent variable, maternal mortality rate. Regression analysis quantifies the extent to which variance in maternal mortality can be explained by the predictors, evaluates model

fit, and determines the statistical significance of each coefficient. The significance of individual predictors was tested using *t*-tests on the unstandardized regression coefficients, with a two-tailed p-value of $< .05$ serving as the threshold for significance (Kim, 2015).

To account for potential confounding, county-level covariates including median household income, percentage of non-Hispanic Black residents, and rural–urban classification was included in the model. These control variables are well-documented structural determinants that may influence both access to care and maternal mortality outcomes. Diagnostic procedures, including assessments of linearity, normality, homoscedasticity, and multicollinearity, were conducted to ensure that the assumptions of multiple linear regression are met. This combination of inferential techniques provides a foundational and comparative understanding of the strength and direction of structural predictors of maternal mortality.

Threats to Validity

Internal Validity

The internal validity of this study is limited by its cross-sectional, correlational design, which does not allow for causal inference (Andrade, 2018). Because the data are observational and no variables are manipulated, it is impossible to determine whether transportation availability or access to obstetric care directly causes differences in maternal mortality rates. Additional threats to internal validity common to secondary data sources include potential measurement error and missing or incomplete data. Measurement error may arise from variations in how variables were defined or reported

across counties, while incomplete records can reduce statistical power and introduce bias (Matthay & Glymour, 2020). Nevertheless, efforts were made to enhance internal validity through careful data cleaning and standardization procedures, including using composite indicators and excluding incomplete records. All data were sourced from reputable, standardized datasets to ensure consistency and reliability in measurement.

External Validity

External validity refers to the degree to which the findings of this study can be generalized beyond the sample (Andrade, 2018). By including complete data from all counties across the United States, the study enhances its generalizability at the national level. The variation across urban, suburban, and rural counties provides various contexts for interpreting the relationship between transportation, obstetric care, and maternal mortality. However, the findings may not be generalizable to regions with different healthcare policies, geographic configurations, or social determinants of health. Structural and contextual differences among states may influence how these factors interact, potentially affecting the strength and direction of associations between the studied variables.

Construct Validity

Construct validity is relevant to whether the variables used in this study accurately represent the theoretical constructs of interest: transportation availability and obstetric care access. Transportation availability is measured by the percentage of households without access to a vehicle, a widely recognized indicator of mobility barriers and structural transportation inequity. Obstetric care access is measured using the median

travel distance to the nearest obstetric facility and the distribution of hospital-based obstetric services, both of which serve as validated proxies for spatial healthcare accessibility (Fontenot et al., 2024). However, some aspects of the constructs, such as service quality or patient perception of access, are not captured due to the limitations of secondary data. Despite these constraints, the operational definitions reflect accepted measures in the public health literature and are appropriate for county-level analysis.

Ethical Procedures

This study relies solely on publicly available, de-identified secondary data, including the 2020 Social Determinants of Health (SDOH) County 1.0 Dataset, the U.S. Census Bureau, and the Department of Health and Human Services. Since no primary data collection or direct interaction with human participants was conducted, the study does not involve human subjects. Therefore, it qualifies for exemption from Institutional Review Board (IRB) review under 45 CFR 46.104(d)(4). No IRB approval number is required, as the research involves existing datasets that are publicly accessible and contain no personally identifiable information (PII).

No recruitment materials, consent forms, or participant engagement procedures were necessary for this study. As the research does not involve any interventions, interviews, or surveys, concerns related to participant withdrawal, coercion, or adverse events do not apply. Ethical concerns typically associated with human subject research are inherently minimized due to the exclusive use of pre-existing, de-identified, national-level data.

Although the datasets are already anonymized, the researcher followed rigorous data management protocols to ensure additional confidentiality and security. All datasets were stored on encrypted and password-protected devices accessible only to the researcher. No re-identification efforts were made, and data were used strictly for the purposes outlined in this dissertation. Following the completion of the research, all data files were destroyed in accordance with institutional guidelines.

This study aligns with the ethical principles outlined in the federal public health research standards, emphasizing the importance of safeguarding data confidentiality, particularly when working with maternal health statistics. No incentives were offered, and there are no conflicts of interest. The researcher conducted the study independently and externally to any professional work environment, ensuring impartiality and adherence to academic standards.

Summary

This chapter presented the methodological framework used to examine how transportation availability and access to obstetric care influence maternal mortality rates across the United States. Guided by the Social Determinants of Health (SDOH) framework, the study employed a quantitative, cross-sectional, correlational design using secondary data derived from validated, publicly available sources, including the SDOH County 1.0 Dataset and the U.S. Census Bureau.

A census sampling strategy included all U.S. counties with complete data, and the unit of analysis was at the county level. The variables were operationalized based on established public health indicators. Maternal mortality was the dependent variable, while

transportation availability and obstetric care access were the primary independent variables.

Data were cleaned, screened, and analyzed using IBM SPSS Statistics Version 29. The analysis included descriptive statistics, correlation analysis, and multiple linear regression, with diagnostic tests performed to verify assumptions. An a priori power analysis conducted in G*Power confirmed that the final sample size provided sufficient statistical power for the planned analyses. Ethical procedures were strictly followed, and confidentiality was maintained despite using non-identifiable secondary data.

Chapter 4 presents the results of the data analysis, highlighting patterns and statistical associations that may inform interventions aimed at reducing maternal mortality and improving healthcare accessibility in underserved regions of the United States.

Chapter 4: Results

This quantitative cross-sectional study examined the relationship between transportation availability and access to obstetric care in predicting maternal mortality rates across counties in the United States. The study aimed to determine whether limited vehicle access and greater travel distance to obstetric facilities were associated with higher maternal death rates. Two research questions and their corresponding hypotheses guided this analysis:

RQ1: What is the relationship between transportation availability in predicting maternal mortality rates at the county level in the United States?

H_o1: There is no statistically significant relationship between transportation availability (percentage of households without vehicle access) and maternal mortality rates at the county level in the United States.

H_a1: There is a statistically significant relationship between transportation availability (percentage of households without vehicle access) and maternal mortality rates at the county level in the United States.

RQ2: What is the relationship between obstetric care access in predicting maternal mortality rates at the county level in the United States?

H_o2: There is no statistically significant relationship between obstetric care access (average travel time to the nearest obstetric facility) and maternal mortality at the county level in the United States.

H_a2: There is a statistically significant relationship between obstetric care access (average travel time to the nearest obstetric facility) and maternal mortality rates at the county level in the United States.

The analysis was conducted using IBM SPSS Version 29. Statistical procedures included descriptive analysis, Pearson correlation, and multiple linear regression to assess the relationship between transportation availability and obstetric access in predicting maternal death rates at the county level. Transportation availability and obstetric access were the primary independent predictor variables, and the maternal death rate served as the dependent variable. Median household income and the percentage of non-Hispanic Black female residents were included as covariates to account for socioeconomic and demographic variation across counties. Rurality, as measured by the Rural–Urban Continuum Codes, was also included to account for geographic context and differences in county classification.

The remainder of this chapter presents the results of the data analysis. The first section describes the data screening and preparation process, including the handling of missing data and verification of variable ranges. The second section provides descriptive statistics for all study variables, summarizing their distributions, central tendencies, and variability. The third section presents the results of assumption testing for multiple linear regression, confirming that the statistical requirements were met. The fourth section reports the results of the correlation and regression analyses, addressing each research question and hypothesis. The fifth section concludes with a summary of the key findings.

Data Screening and Preparation

Data Cleaning

The dataset was imported into IBM SPSS Statistics Version 29 for analysis. Initial data cleaning procedures included verifying variable accuracy, confirming that values fell within valid and nationally expected numeric ranges, and ensuring consistent labeling across all variables. Variables unrelated to the study's purpose were removed to streamline the dataset. Column headers were standardized to align with SPSS naming conventions, and variable labels were refined to reflect their operational definitions and improve clarity.

Outliers and potential data entry anomalies were examined using boxplots, frequency tables, and z-score inspection. No extreme outliers were identified that required removal or transformation. Visual inspection of histograms and Q–Q plots indicated that the continuous variables demonstrated distributions suitable for regression analysis. As the variables were measured on appropriate and comparable scales, no transformations or standardization procedures were required.

Missing Data

Each variable was assessed for completeness using SPSS frequency and descriptive procedures. The dependent variable (maternal death rate) was only available for counties with fully reported maternal mortality data, resulting in a final analytic sample of 187 counties. Listwise deletion in SPSS was applied to ensure that all analyses were conducted using complete cases. No imputation procedures were used to preserve the integrity and accuracy of the original dataset.

Variable Selection and Coding

Variables were selected based on the research questions and the Social Determinants of Health framework. Each variable was operationalized as follows:

Dependent Variable

Maternal Mortality Rate. Number of maternal deaths per 100,000 live births at the county level in the U.S.

Independent Variables

Transportation Availability. Percentage of households without access to a vehicle at the county level in the U.S.

Obstetric Care Access. Median travel distance, in miles, to the nearest obstetric care facility at the county level in the U.S.

Covariates

Median Household Income. Median household income in U.S. dollars, representing socioeconomic status at the county level in the U.S.

Percentage of Non-Hispanic Black Residents. County-level proportion of non-Hispanic Black, reflecting demographic variation at the county level in the U.S.

Rurality. Originally coded as AHRF_USDA_RUCC_2013, which included non-numeric classification codes at the county level in the U.S. This variable was recoded into a numeric format (RUCC_NUM) to support statistical analysis and to represent county-level rural–urban classification more precisely.

Descriptive Statistics

Descriptive statistics were calculated for the dependent variable, independent variables, and covariates for the analytic sample of 187 counties (see Table 1). The maternal death rate ranged from 0.13 to 2.30 deaths per 100,000 live births, with a mean of 0.68 (SD = 0.39). Transportation availability, measured as the percentage of households without access to a vehicle, had a mean of 9.06% (SD = 8.99), indicating substantial variation across counties. Obstetric care access, operationalized as the average travel time to the nearest obstetric facility, ranged from 0.63 to 13.58 minutes, with a mean of 3.24 minutes (SD = 1.50). The covariates also demonstrated meaningful variability. The percentage of non-Hispanic Black female residents ranged from 0.31% to 68.82%, with a mean of 17.47% (SD = 14.43). Median household income ranged from $41,846 to $130,890, with a mean of $68,797.04 (SD = $17,781.17). Rurality, coded using the RUCC numeric scale, ranged from 1 (urban) to 4 (rural), with a mean value of 1.39 (SD = 0.58), indicating that many counties in the sample were more urban than rural.

Table 1

*Descriptive Statistics for Study Variables (*N = *187)*

Variable	*M*	*SD*	Min	Max
Maternal death rate (per 100,000)	0.68	0.39	0.13	2.30
Transportation availability (% no vehicle)	9.06	8.99	1.91	77.63
Obstetric access (avg. travel time, minutes)	3.24	1.50	0.63	13.58
% Non-Hispanic Black female residents	17.47	14.43	0.31	68.82
Median household income (USD)	$68,797.04	$17,781.17	$41,846	$130,890
Rurality (RUCC_NUM)	1.39	0.58	1.00	4.00

Note. Higher RUCC_NUM values indicate increasingly rural classification.

Assumption Testing

Before conducting the multiple linear regression analysis, key assumptions were assessed to ensure the appropriateness of the statistical tests. The assumptions examined included linearity, homoscedasticity, normality of residuals, independence of errors, multicollinearity, and the presence of influential observations.

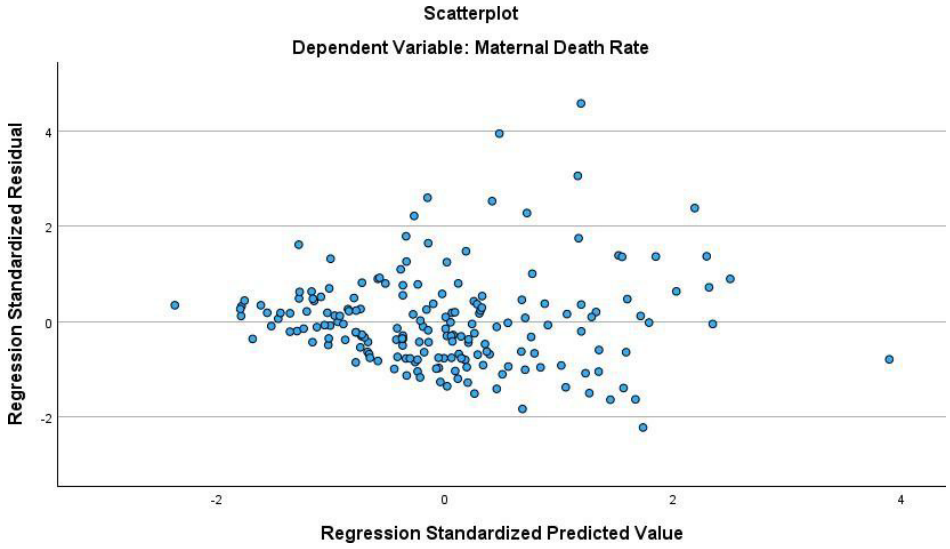
Linearity and Homoscedasticity

The assumption of linearity was evaluated through the scatterplot of standardized residuals versus standardized predicted values (Figure 1). The points formed a diffuse, circular pattern without visible curvature, indicating that the relationships between the predictors and the dependent variable were approximately linear. The same scatterplot demonstrated relatively constant variance across levels of the predicted values,

suggesting no evidence of severe heteroscedasticity. Therefore, the assumptions of linearity and homoscedasticity were met.

Figure 1

Scatterplot of Standardized Residuals Versus Standardized Predicted Values for the Regression Model Predicting Maternal Death Rate



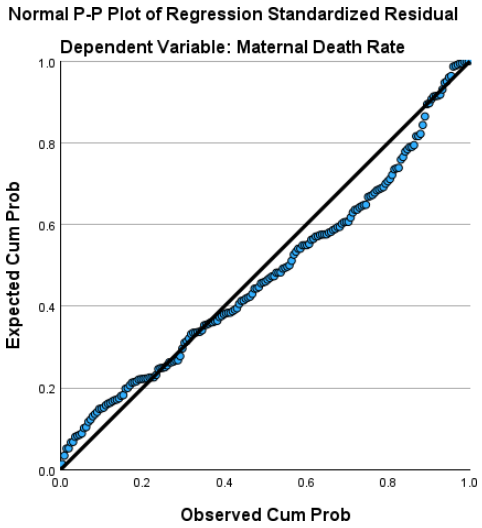
Normality of Residuals

The normality of residuals was assessed using the Normal P–P Plot of standardized residuals (Figure 2). The plotted points closely followed the diagonal reference line, with only minor deviations at the upper and lower tails, indicating that the residuals were approximately normally distributed. This pattern suggests that the errors in the model were randomly distributed rather than systematically over- or underestimating maternal death rates. Additionally, because multiple linear regression is robust to slight departures from normality in samples larger than 100, the observed minor deviations

were not considered problematic. Therefore, the assumption of normality was deemed met.

Figure 2

Normal P–P Plot of Standardized Residuals for the Regression Model Predicting Maternal Death Rate



Independence of Error

The assumption of independence of errors was reviewed based on the study design and residual patterns. The data were collected at the county level, and no hierarchical or repeated-measures structure was present, reducing the likelihood of correlated residuals across observations. Although the Durbin–Watson statistic was not computed, visual inspection of the residual plots did not reveal systematic clustering or sequential patterning. Given the cross-sectional design and non-nested data structure, the assumption of independence of errors was considered satisfied.

Multicollinearity

Multicollinearity was assessed using Tolerance and Variance Inflation Factor (VIF) values reported in the coefficient's matrix. The VIF values ranged from 1.23 to 1.48, and Tolerance values ranged from 0.675 to 0.815, all within acceptable thresholds (VIF < 10 and Tolerance > 0.10). These results indicate that the predictor variables were not excessively correlated with one another and that each predictor contributed unique explanatory value to the model. Therefore, multicollinearity was not considered a concern in this analysis.

Influential Observations

Influential observations were evaluated using Cook's Distance, studentized deleted residuals, and leverage statistics. Cook's Distance values ranged from 0.000 to 0.607, below the commonly accepted threshold of 1.0, indicating the absence of excessively influential cases. Studentized deleted residuals were generally within the recommended ±3 range, and although a small number of counties exhibited moderately elevated leverage values (up to 0.368), none exceeded standard criteria for exclusion. Because no cases demonstrated undue influence on the regression model, all 187 counties were retained in the final analysis**.**

Correlation Analysis

Pearson correlation analysis was conducted to examine the bivariate relationships among the study variables (Table 2). Maternal death rate was positively correlated with obstetric care access **(**$r = .224$, $p < .01$**),** indicating that counties with longer travel times to obstetric care tended to have higher maternal death rates. Maternal death rate was also

positively correlated with the percentage of non-Hispanic Black female residents ($r = .479$, $p < .01$) and with rurality ($r = .384$, $p < .01$), suggesting higher maternal mortality in counties with larger non-Hispanic Black female populations and more rural classification. Several covariates also demonstrated meaningful associations with maternal mortality. Median household income was negatively correlated with maternal death rate ($r = -.514$, $p < .001$), indicating that counties with higher income levels tended to have lower maternal mortality. The percentage of non-Hispanic Black female residents was strongly correlated with maternal mortality ($r = .479$, $p < .001$), highlighting persistent racial disparities in maternal health outcomes. Additionally, rurality was positively associated with maternal death rate ($r = .384$, $p < .001$), suggesting that more rural counties experienced higher maternal mortality than more urban counties. Together, these patterns illustrated a broader structural relationship: maternal mortality was higher in counties that were more rural, had lower income, had higher proportions of non-Hispanic Black women, and were farther from obstetric services. While transportation availability alone did not demonstrate a significant direct correlation, the broader geographic and demographic context showed meaningful and systematic associations with maternal health outcomes.

Table 2

*Pearson Correlations Among Study Variables (*N = *187)*

Variable	1	2	3	4	5	6
Maternal death rate	—					
% no vehicle	−.018	—				
Obstetric access (travel time)	.224**	.083**	—			
% non-Hispanic Black female	.479**	.236**	−.023	—		
Median household income (USD)	−.514**	−.282**	−.086**	−.200**	—	
Rurality (RUCC_NUM)	.384**	−.048**	.294**	−.121**	−.374**	—

Note. Pearson *r* values are reported. ** $p < .01$ (two-tailed). Higher rurality scores indicate increasing levels of rural classification.

Multiple Linear Regression Results

A multiple linear regression analysis was conducted to examine whether transportation availability and obstetric care access predicted maternal death rates at the county level, while controlling for median household income, percentage of non-Hispanic Black female residents, and rurality. The overall model was statistically significant, $F(5, 181) = 32.38$, $p < .001$, and explained 47.2% of the variance in maternal death rates ($R^2 = .472$, Adjusted $R^2 = .458$). This suggests that nearly half of the variation in maternal mortality across U.S. counties can be attributed to differences in geographic access to care, demographic composition, and community socioeconomic conditions.

Table 3

*Multiple Linear Regression Predicting Maternal Death Rate (*N = *187)*

Predictor	*B*	*SE B*	β	*t*	*p*	95% CI lower	95% CI upper	VIF
Intercept	.496	.161	—	3.08	.002	.178	.813	—
% no vehicle	−.001	.003	−.015	−0.25	.805	−.006	.005	1.301
Distance to OB facility (miles)	.049	.016	.191	3.07	.002	.018	.080	1.317
% non-Hispanic Black female	.011	.002	.427	7.15	< .001	.008	.015	1.227
Median household income (USD)	−5.651e	−6.000	−.260	−3.95	< .001	.000	.000	1.482
Rurality (RUCC Code)	.157	.043	.236	3.68	< .001	.073	.242	1.407

Note. B = unstandardized coefficients; β = standardized coefficients; CI = confidence interval; VIF = Variance Inflation Factor.

Predictor Relationships

Inspection of the regression coefficients indicated that several predictors were statistically significant in the model. Distance to obstetric care access was a significant positive predictor of maternal death rate (B = .049, p = .002), indicating that counties located farther from obstetric facilities tended to experience higher maternal mortality. The percentage of non-Hispanic Black female residents also significantly predicted maternal mortality (B = .011, p < .001), consistent with documented racial disparities in maternal health outcomes. Median household income was a significant negative predictor

($B = -5.651 \times 10^{-6}$, $p < .001$), indicating that counties with higher incomes generally had lower maternal death rates. Rurality was also a significant positive predictor ($B = 0.157$, $p < 0.001$), indicating that counties in more rural areas exhibited higher mortality rates than those in more urban areas. In contrast, transportation availability (measured as the percentage of households without a vehicle) was not a statistically significant predictor ($B = -0.001$, $p = 0.805$), indicating that vehicle access alone did not significantly contribute to maternal mortality when other demographic and geographic factors were considered.

Research Questions and Hypotheses

RQ1: What is the relationship between transportation availability and maternal mortality rates at the county level in the United States?

H_o1: There is no statistically significant relationship between transportation availability (percentage of households without vehicle access) and maternal mortality rates.

H_a1: There is a statistically significant relationship between transportation availability and maternal mortality rates.

The regression results indicated that transportation availability was not a statistically significant predictor of maternal mortality ($B = -0.001$, $\beta = -0.015$, $p = 0.805$). The percentage of households without vehicle access did not meaningfully change maternal death rates after accounting for income, race, and rurality. This finding suggests that the mere presence or absence of household vehicle access does not determine whether maternal risk increases. This finding is consistent with the earlier

correlation result ($r = -0.018$), which showed no linear association. Transportation barriers may operate in more complex ways, for example, involving travel infrastructure, distance to care, or emergency transport availability, rather than simply whether a household owns a vehicle. Because transportation availability was not a significant predictor, H_{01} is retained**.** There is no evidence that transportation availability directly predicts maternal mortality.

RQ2: What is the relationship between obstetric care access and maternal mortality rates at the county level in the United States?

H_o2: There is no statistically significant relationship between obstetric care access (average travel time to the nearest obstetric facility) and maternal mortality rates.

H_a2: There is a statistically significant relationship between obstetric care access and maternal mortality rates.

Obstetric care access was a statistically significant positive predictor of maternal mortality ($B = 0.049$, $\beta = 0.191$, $p = 0.002$). Counties with longer travel distances to obstetric services experienced higher maternal death rates. This indicates that geographic access to maternity care is a meaningful structural factor in maternal mortality. When individuals must travel farther to reach obstetric care, the likelihood of delayed treatment, complications, and preventable maternal harm increases. This finding is consistent with the bivariate correlation result ($r = .224$, $p < .01$), reinforcing that access matters. Because obstetric access was a significant predictor of maternal mortality, H_{02} is rejected. Obstetric care access does significantly predict maternal death rates at the county level.

Summary of Findings

This chapter presented the results of statistical analyses examining the relationship between transportation availability, access to obstetric care, and maternal mortality rates at the county level in the United States. Descriptive statistics summarized the characteristics of the study variables across 187 counties with complete maternal mortality data. Assumption testing confirmed that the data met the requirements for multiple linear regression, including linearity, normality of residuals, absence of multicollinearity, and acceptable influence diagnostics.

Correlation analysis indicated that maternal death rates were significantly associated with obstetric care access, median household income, the percentage of non-Hispanic Black female residents, and rurality. At the same time, transportation availability did not demonstrate a significant bivariate relationship with maternal mortality. The multiple linear regression model was statistically significant and explained approximately 47% of the variance in maternal death rates ($R^2 = .472$).

Regarding the research questions, the percentage of households without access to a vehicle was not a significant predictor of maternal mortality; therefore, the null hypothesis for RQ1 was retained. In contrast, greater travel distance to obstetric care was a significant positive predictor of maternal mortality, leading to rejection of the null hypothesis for RQ2. Counties that were more rural, lower in median household income, and had higher percentages of non-Hispanic Black female residents also exhibited significantly higher maternal death rates, underscoring the influence of structural and demographic determinants.

Overall, the findings accentuated the substantial impact of structural and geographic factors on maternal health outcomes. These results were consistent with the Social Determinants of Health (SDOH) framework, which emphasizes that social and community-level conditions, rather than individual factors alone, play a critical role in shaping maternal mortality. Chapter 5 discusses these findings in greater detail, interpreting their implications for healthcare policy, clinical practice, and future research.

Chapter 5: Discussion, Conclusions, and Recommendations

This quantitative study examined the relationship between transportation availability, obstetric care access, and maternal mortality rates at the county level in the United States. Using the SDOH framework, this study examined how structural and geographic conditions influence maternal health outcomes. Two research questions guided the analysis: (a) whether transportation availability predicts maternal mortality, and (b) whether obstetric care access predicts maternal mortality. The study also accounted for income, racial composition, and rurality as key contextual factors known to affect maternal health risk.

Chapter 4 presented the results of the descriptive analyses, assumption testing, bivariate correlations, and multiple linear regression. Findings indicated that transportation availability, measured as the percentage of households without access to a vehicle, was not a statistically significant predictor of maternal mortality after accounting for contextual factors. In contrast, greater travel distance to obstetric care facilities significantly predicted higher maternal death rates. Additionally, counties with lower median household income, higher percentages of non-Hispanic Black female residents, and more rural classifications experienced disproportionately higher levels of maternal mortality.

This chapter provides an interpretation of these findings, situates them within the broader maternal health literature, and discusses their alignment with the SDOH framework. The chapter also outlines implications for health care policy and clinical practice, addresses study limitations, and presents recommendations for future research.

Interpretation of Findings

The study examined whether transportation availability and obstetric care access predicted maternal mortality rates at the county level in the United States while accounting for socioeconomic, demographic, and geographic conditions. The findings provide insight into how structural inequities and access-related barriers influence maternal health outcomes and highlight the importance of the SDOH framework in understanding maternal mortality.

Interpretation of RQ1: Transportation Availability

RQ1 addressed whether transportation availability, measured as the percentage of households without access to a vehicle, predicted maternal mortality. The results indicated that this variable was not a statistically significant predictor of maternal death rates after controlling for income, racial composition, and rurality. This suggests that vehicle ownership alone does not sufficiently capture the transportation conditions that shape maternal health risk.

One possible explanation is that transportation barriers are more complex than simply having or not having a personal vehicle. For example, public transportation availability, road infrastructure, emergency medical transport response times, and the geographic distance to services may play a stronger role in determining whether individuals can reach obstetric care when needed. Although transportation is widely recognized as a barrier in maternal health research, the current study suggests that transportation constraints operate through broader geographic and system-level access issues rather than through household vehicle status alone (see Usigbe et al., 2025).

The nonsignificant finding for transportation availability diverges from several key studies reviewed in Chapter 2. For example, Harrington et al. (2023) found that rural residence, a proxy for transportation burden and limited access, was associated with nearly double the risk of maternal mortality (aRR = 1.93, $p < .001$). Although the present study did not find household vehicle access to be predictive, the significant effect of rurality in the broader model aligns with Harrington's conclusion that system-level transportation barriers and geographic constraints meaningfully shape maternal risk. Thus, these findings disconfirm the role of household vehicle ownership but confirm the broader significance of structural geographic barriers highlighted in Harrington's work.

The results also differ from Goitia et al. (2023), who found that lower neighborhood vehicle ownership predicted higher all-cause mortality following myocardial infarction. Their findings demonstrated that vehicle access had a significant impact on emergency cardiovascular outcomes. In contrast, the present study disconfirms this association in the context of maternal mortality, extending the literature by showing that the effect of vehicle ownership does not generalize across all health conditions. Maternal outcomes are influenced more by continuous access to prenatal and obstetric services than by household access to a vehicle alone.

Finally, the findings partially align with Musafaah et al. (2023), who documented that longer travel distances and limited transportation availability were significant predictors of maternal mortality in Indonesia. The present study confirmed Musafaah's broader point that geographic accessibility is a major determinant of maternal outcomes but disconfirms their conclusion that transportation availability directly predicted

mortality. This distinction extends current knowledge by suggesting that, in the U.S. context, structural service proximity, not vehicle access, were the primary mechanism through which transportation barriers affect maternal mortality.

Overall, the findings for RQ1 clarified that transportation availability does not operate as an independent predictor of maternal risk. Instead, transportation barriers are embedded within broader patterns of geographic access to care, confirming and extending the literature on structural determinants of maternal health.

Interpretation of RQ2: Obstetric Care Access

RQ2 examined whether the average travel distance to the nearest obstetric facility predicted maternal mortality. Findings showed that counties with longer travel distances had significantly higher maternal mortality rates, even after accounting for income, race, and rurality. This result highlighted geographic access to care as a direct and critical structural factor affecting maternal health**.**

A greater distance to obstetric care may increase delays in accessing prenatal, labor, and emergency services. For individuals experiencing obstetric emergencies, particularly hemorrhage, hypertensive crisis, or birth complications, delays of even minutes can be life-threatening. Limited local maternity care also reduces opportunities for routine prenatal monitoring and early detection of complications. These findings are consistent with research on maternity care deserts, which has repeatedly shown that counties lacking nearby obstetric services face higher maternal morbidity and mortality (Bartick et al., 2025).

The present findings strongly align with and confirm the results of Wallace et al. (2021), who showed that women residing in maternity care deserts experienced significantly higher pregnancy-associated and pregnancy-related mortality. Wallace also demonstrated that these geographic disparities clustered spatially across Louisiana. The findings of the current study extend Wallace's work by showing that this pattern holds nationally and remains significant even when socioeconomic and demographic variables are controlled.

The findings also support and extend the research of Lorch et al. (2012), who documented increased neonatal and perinatal mortality following obstetric unit closures that forced women to travel farther for delivery. Although the present study does not focus on closure events, it confirms the same underlying mechanism: increased distance to obstetric care elevates the risk of adverse maternal outcomes. This extension suggests that the distance mortality relationship persists across broader and more stable geographic contexts, further strengthening the evidence that proximity to maternity care is essential for maternal survival.

Collectively, the findings for RQ2 demonstrate that greater travel distance is a consistent, structural predictor of maternal mortality, reaffirming and extending the most relevant literature in the field

Interpretation of Covariates

Several covariates also demonstrated significant associations with maternal mortality. Counties with lower median household income experienced higher maternal death rates, reinforcing that economic disadvantage increases vulnerability to poor

maternal outcomes. This finding confirms prior research showing that lower-income communities face reduced access to prenatal care, insurance coverage barriers, and fewer specialized maternity providers, all of which elevate maternal health risks (Singh & Lee, 2020). Maternal mortality was also significantly higher in counties with greater percentages of non-Hispanic Black female residents. This result aligns with longstanding evidence that Black women experience disproportionately high maternal mortality due to structural racism, inequitable treatment within healthcare settings, and cumulative exposure to social stressors (Harrington et al., 2023). The present study **c**onfirms these disparities and demonstrates that they persist even at the county level when socioeconomic and geographic factors are controlled.

Finally, rural counties experienced higher maternal mortality, reflecting persistent challenges such as limited healthcare infrastructure, obstetric unit closures, and shortages of maternal health providers. This finding confirms prior research that has documented the rural–urban divide in maternal health outcomes and the elevated risks associated with geographic isolation (Kozhimannil et al., 2018).

Taken together, the covariate findings illustrate that maternal mortality was shaped by the structural conditions under which individuals live, economic disadvantages, racialized community composition, and rural isolation rather than individual-level characteristics. These results align with the SDOH framework and emphasize that maternal health disparities reflect systemic and place-based inequities across U.S. counties.

Connection to Theoretical Framework

This study was guided by the Social Determinants of Health (SDOH) framework, which posits that health outcomes are shaped by environmental and structural conditions rather than solely by individual behavior or biological factors (Solar & Irwin, 2010). The SDOH framework emphasizes that access to healthcare, socioeconomic status, neighborhood environment, and social and demographic structures collectively influence the likelihood of achieving positive health outcomes. The findings of this study align closely with this framework and reinforce the importance of addressing systemic conditions to reduce maternal mortality.

The significant association between access to obstetric care and maternal mortality supports the SDOH principle that the availability and accessibility of health services are fundamental determinants of health. Counties where individuals must travel longer distances to reach obstetric services experienced higher maternal death rates. This finding demonstrates that the geographic availability of maternal healthcare is not merely a convenience variable but a critical determinant of survival. When maternity care services are distant or unavailable, the capacity to manage complications, receive timely emergency response, and engage in consistent prenatal care is reduced, directly influencing maternal mortality outcomes (Kozhimannil et al., 2018).

The strong predictive relationship between racial composition and maternal mortality also aligns with the SDOH framework. Higher percentages of non-Hispanic Black female residents were associated with increased maternal mortality rates, reflecting documented patterns of racial inequity in healthcare access, treatment quality, and

cumulative exposure to social and economic disadvantage. This finding underscores that maternal mortality is not distributed randomly; it reflects historical and ongoing structural inequities, including systemic racism, discrimination in clinical settings, and inequitable resource allocation across communities (Harrington et al., 2023).

The influence of median household income and rurality further reinforces the SDOH perspective. Lower-income counties and more rural counties experienced higher maternal mortality, highlighting how economic deprivation and geographic isolation shape health outcomes. Rural counties often face reduced healthcare infrastructure, provider shortages, and fewer specialized maternity care services. Likewise, lower-income regions may experience inadequate insurance coverage, transportation challenges, and limited access to prenatal and preventive care. These structural factors converge to elevate maternal risk in already vulnerable communities (Geddes-Barton et al., 2024).

Finally, the finding that transportation availability was not an independent predictor of maternal mortality does not contradict the SDOH framework; rather, it clarifies that transportation barriers manifest primarily through broader geographic access limitations. In other words, the issue is less about whether households own a vehicle and more about whether the necessary healthcare services are physically reachable. Transportation challenges become most consequential when obstetric services are far away, further emphasizing the central role of service availability and community infrastructure (Usigbe et al., 2025).

Comparison to Existing Literature

The findings of this study both confirm and extend prior research on maternal mortality and access to care in the United States. Consistent with previous literature, this study found that geographic access to obstetric services is a significant predictor of maternal mortality. Prior research has shown that counties classified as maternity care deserts or located far from obstetric facilities experience higher rates of maternal death due to extended travel times, limited emergency response capacity, and reduced access to prenatal monitoring (Fontenot et al., 2024; Wallace et al., 2021). The present study reinforces these findings by demonstrating that longer travel distance to obstetric care was associated with increased maternal mortality, even after controlling for socioeconomic and demographic factors. Thus, this study contributes additional evidence that geographic service availability remains a critical structural determinant of maternal health outcomes.

The finding that counties with higher percentages of non-Hispanic Black females experienced greater maternal mortality is also consistent with longstanding research documenting racial disparities in maternal outcomes (Harrington et al., 2023). Studies have attributed these disparities to the cumulative effects of systemic racism, unequal access to high-quality care, and chronic stress exposure. This study adds to this body of literature by showing that these disparities are evident not only at the individual level but also at the county-level population structure, reinforcing that maternal mortality disparities are rooted in place-based inequity and structural disadvantage.

Additionally, the negative association between median household income and maternal mortality aligns with literature linking socioeconomic deprivation to worse maternal outcomes (Singh & Lee, 2020). Communities with lower economic resources often have fewer healthcare facilities, reduced access to specialized providers, and lower availability of insurance coverage and prenatal care. The current findings extend this work by demonstrating that economic disadvantage remains a powerful predictor of maternal mortality, even when geographic access and demographic composition are considered (Geddes-Barton et al., 2024).

The significant influence of rurality found in this study also supports prior research documenting the persistent maternal health disadvantages in rural communities (Harrington et al., 2023). Rural counties often face hospital closures, shortages of obstetric providers, and inadequate emergency care capacity. The present findings reaffirm that maternal health inequities are geographically concentrated, and rural healthcare infrastructure requires targeted support to reduce preventable maternal deaths (Kozhimannil et al., 2024).

In contrast, the finding that transportation availability (measured as the percentage of households without vehicle access) was not a significant predictor of maternal mortality offers a nuanced contribution to existing literature. While transportation is commonly cited as a barrier to maternity care, this study suggests that transportation barriers may operate indirectly through geographic service availability rather than vehicle ownership itself. This distinction adds clarity to the field and suggests that policy efforts

may be more effective if directed toward expanding obstetric service availability rather than focusing solely on household-level transportation interventions.

Overall, the findings of this study align closely with existing research demonstrating that geographic access, socioeconomic disadvantage, racial inequities, and rurality shape maternal mortality. At the same time, the study contributes new evidence that clarifies the role of transportation, showing that access to obstetric care, rather than household vehicle ownership, is the more direct barrier affecting maternal outcomes.

Implications

Implications for Health Care Practice

The findings of this study highlight the importance of ensuring that pregnant individuals have consistent and timely access to obstetric care throughout pregnancy and delivery. Because greater travel distance to obstetric services was associated with higher maternal mortality, clinical practice models that extend maternity care into underserved and rural regions may reduce preventable maternal deaths. This may include deploying mobile maternity care units, midwife-led birthing centers, telehealth-supported prenatal monitoring, and integrated community health nursing services in areas with limited facility-based care (Fontenot et al., 2024).

Additionally, the strong relationship between racial composition and maternal mortality underscores the need to strengthen culturally responsive, equity-centered care practices, including provider training in implicit bias mitigation, patient-centered communication strategies, and enhanced support services for communities disproportionately affected by maternal mortality. Evidence indicates that racial

disparities in maternal outcomes are linked to systemic inequities, differential treatment, and inconsistent quality of care for Black women (Harrington et al., 2023). Improving care coordination across prenatal, emergency, and postpartum services is also crucial, particularly for rural and low-income communities where maintaining continuity of care is more challenging. Research shows that socioeconomic disadvantage reduces access to consistent prenatal care and increases the likelihood of adverse maternal outcomes (Geddes-Barton et al., 2024).

Overall, the results suggest that improving maternal health outcomes requires proactive, community-embedded care delivery models that reduce distance barriers, support continuity of care, and ensure that obstetric services are responsive to the social and cultural context of the populations they serve (Geddes-Barton et al., 2024). Strengthening healthcare infrastructure in underserved regions remains a critical strategy for reducing preventable maternal deaths (Wallace et al., 2021).

Implications for Policy

The finding that geographic access to obstetric care significantly predicts maternal mortality has direct policy implications. Policymakers may need to prioritize expanding and sustaining obstetric services in rural and underserved counties, including preventing further closure of labor and delivery units (Kozhimannil et al., 2018). This could involve revising reimbursement structures, increasing federal and state funding for rural hospitals, incentivizing maternal health providers to practice in areas of shortage, and developing regionalized maternal care networks to ensure timely emergency referral pathways (Wallace et al., 2021).

Additionally, the significant effects of racial and economic composition on maternal mortality reinforce the need for structural policy interventions that address healthcare affordability, insurance coverage stability (including postpartum Medicaid extension), and investments in community-based maternal support programs. Policy actions that reduce socioeconomic barriers and improve geographic access may have a direct impact on reducing maternal mortality and narrowing racial and regional disparities (Harrington et al., 2023).

Implications for Future Research

Future research should examine transportation barriers in more nuanced ways than focusing solely on household vehicle ownership. Measures such as public transit availability, travel time reliability, ambulance response time, and maternity care referral pathways may capture the impact of transportation on maternal outcomes (Usigbe et al., 2025). Qualitative or mixed-methods research could also explore how pregnant individuals experience access barriers in real-world care-seeking scenarios, particularly during obstetric emergencies (Harrington et al., 2023).

Additionally, research should assess the effectiveness of alternative maternity care delivery models, such as telehealth-supported prenatal care, community birth centers, and midwifery-led care, in reducing maternal mortality in areas without nearby obstetric hospitals. Further studies examining how structural racism intersects with geographic access would also deepen understanding of the mechanisms driving racial disparities in maternal mortality. These implications emphasize that improving maternal outcomes

required coordinated efforts across clinical practice, health policy, and ongoing research to ensure equitable access to safe and timely obstetric care.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the analysis relied on secondary, county-level aggregated data, which limits the ability to draw conclusions about individuals within those counties. County-level measures are useful for identifying structural and geographic patterns; however, they cannot account for variation in individual health behaviors, clinical decisions, or personal experiences. As a result, the findings reflect population-level associations, rather than direct causal relationships at the individual level.

Second, the study was limited to the 187 counties that had complete maternal mortality data available. Many U.S. counties suppress maternal mortality data due to small case counts or privacy restrictions. While listwise deletion was necessary to maintain statistical integrity, it also reduced the representativeness of the sample. Therefore, the findings may not generalize fully to counties with very low population density or limited reporting infrastructure, where maternal mortality risk may differ.

Third, transportation availability was operationalized using the percentage of households without vehicle access, which may not fully capture the complexity of transportation barriers. Factors such as public transit access, road conditions, travel time reliability, emergency medical transport systems, and community-level infrastructure were not included. This may explain why transportation availability did not emerge as a

significant predictor in this study. A more comprehensive transportation measure may yield different results.

Fourth, although the study controlled for income, race, and rurality, additional factors that may influence maternal mortality were not included due to data limitations. These may include provider availability, insurance coverage continuity, quality of hospital care, prevalence of chronic health conditions, and state-level maternal health policies. Future research could incorporate these variables to build more robust and nuanced predictive models.

Finally, a cross-sectional research design prevents the drawing of conclusions about causality. The study identifies statistically significant relationships among structural conditions and maternal mortality, but it cannot determine temporal sequencing or causal pathways. Longitudinal research tracking changes in access to care and maternal outcomes over time would provide stronger evidence of causal relationships.

Despite these limitations, the study provides meaningful insights into the structural determinants of maternal mortality and offers guidance for improving access to obstetric care in underserved regions.

Recommendations

Based on the findings of this study, several recommendations can be made to improve maternal health outcomes and reduce preventable maternal deaths. These recommendations address clinical practice, policy development, and further research, reflecting the structural nature of maternal mortality identified in this analysis.

Recommendations for Practice

The findings of this study highlight an urgent need to expand maternity care access in communities where geographic distance creates barriers to safe and timely care. Since longer travel distances are associated with higher maternal mortality, healthcare systems should explore care models that bring services closer to patients, rather than expecting patients to travel to distant facilities. Mobile maternity care units, satellite prenatal clinics, and integrated telehealth services are practical strategies that can reduce delays for individuals living in rural or underserved regions. Research shows that gaps in obstetric service availability contribute directly to preventable maternal complications, particularly in counties where local maternity units have closed or staffing has declined (Fontenot et al., 2024).

Recommendations for Policy

Geographic access to obstetric services emerged as a strong structural predictor of maternal mortality in this study, indicating a critical need for policy interventions that stabilize and expand maternity care capacity across the United States. Policymakers should prioritize investments that prevent the continued closure of labor and delivery units, an issue that has disproportionately affected rural counties and increased travel distances for essential care (Kozhimannil et al., 2018). Strengthening maternal health infrastructure through targeted funding initiatives, updated reimbursement models, and workforce incentives for obstetric providers could help sustain local services and support birthing individuals in regions located far from obstetric hospitals.

Policy reforms that improve continuity of care are likewise essential. Extending Medicaid postpartum coverage to 12 months statewide would promote ongoing monitoring and timely treatment of complications that commonly arise after delivery, particularly among populations with limited economic resources (Singh & Lee, 2020). Additionally, developing stronger regional maternal health networks where smaller counties are formally integrated with higher-level referral hospitals may reduce delays in emergency transport and enhance outcomes for high-risk patients. Collectively, these policy directions reflect the structural nature of maternal mortality and offer viable pathways for reducing geographic and racial inequities in maternal health outcomes.

Recommendations for Future Research

Future research should refine the measurement of transportation barriers by incorporating indicators beyond household vehicle ownership. Measures such as emergency medical transport response times, public transit reliability, road and weather conditions, and travel-time burden may better capture the structural challenges that shape access to timely obstetric care. Transportation barriers often intersect with broader inequities that disproportionately affect rural and underserved regions; therefore, incorporating these more precise measures would strengthen predictive models of maternal risk and guide the development of targeted interventions (McCoy et al., 2023). Additional work is needed to evaluate the role of doulas and community-based perinatal support workers within coordinated maternity care models. Evidence suggests that doula support can improve birth outcomes and patient engagement (Falconi et al., 2024). However, larger studies are needed to assess how integrating doulas into care teams,

particularly in maternity care deserts, may influence maternal mortality rates. Research should also examine how Medicaid reimbursement and expansion policies affect the sustainability of community-based doula programs (Farewell et al., 2025).

Future studies should also assess how digital health technologies can enhance maternal safety for individuals residing far from obstetric facilities. Remote blood pressure monitoring, cellular-enabled tracking for high-risk pregnancies, and telehealth-supported prenatal care have shown potential to reduce delays in risk detection and care escalation (Jones et al., 2024). Broader digital platforms used in antenatal care similarly show promise in enhancing continuity, personalized monitoring, and timely access to support services (Mohamed et al., 2025). Evaluating how these technological tools can be combined with community-based support models would provide insight into strategies for reducing preventable maternal morbidity and mortality. Ultimately, longitudinal and mixed-methods research should examine how trends in obstetric unit closures, shifts in the healthcare workforce, and evolving policy environments impact maternal outcomes over time. Studies that incorporate patient perspectives are especially important for understanding how structural racism, economic disadvantage, and geographic isolation collectively shape the care experiences of pregnant individuals.

Conclusion

This study examined how transportation availability and obstetric care access relate to maternal mortality at the county level in the United States. Grounded in the Social Determinants of Health (SDOH) framework, the results demonstrated that maternal mortality is more shaped by the structural and geographic conditions in which

people live, rather than by individual-level characteristics. While household vehicle access did not independently predict maternal mortality, greater travel distance to obstetric care was a significant predictor of maternal mortality. Counties with more limited access to obstetric services experienced higher maternal death rates, reinforcing the critical role of healthcare infrastructure in maternal health outcomes.

The study also found that counties with lower median household incomes, higher percentages of non-Hispanic Black female residents, and more rural classification had significantly higher maternal mortality rates. These findings align with longstanding evidence documenting the combined impact of economic disadvantage, racial inequities, and geographic isolation on health outcomes. Taken together, the results indicate that maternal mortality is not random but reflects structural and place-based inequities that shape access to timely, high-quality care.

Reducing maternal mortality requires strategies that address these structural determinants. Strengthening maternity care networks, expanding clinical services in underserved areas, supporting culturally responsive and equitable care practices, and investing in maternal health infrastructure are essential steps toward achieving more equitable outcomes. Continued research that examines how access barriers are experienced in real time and how care delivery models can adapt to meet community needs to further advance efforts to prevent maternal deaths.

In conclusion, improving maternal health in the United States depended on recognizing maternal mortality as a result of systemic conditions, not solely individual circumstances. By focusing on accessibility, equity, and community-level resource

distribution, healthcare systems and policymakers can work towards ensuring that all individuals, regardless of their geography, race, or socioeconomic status, have the opportunity for safe and healthy pregnancy outcomes.

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