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Fetal/Infant Mortality: Understanding Race and Ethnicity, Birthing Location, and Prenatal Care

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Abstract

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MPH, University of Arkansas for Medical Sciences, 2010

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Doctoral Study Submitted in Partial Fulfillment

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Doctor of Public Health

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Abstract

This study addressed whether race and ethnicity, birthing location, the month the mother begins prenatal care, and pregnancy risk level impact fetal/infant mortality. Infant mortality is a gauge by which the efficacy of the healthcare system and the overall health of the country is measured. The United States falls behind most other developed countries in terms of infant mortality rates. The ecological perspective was used as the theoretical framework. The study design was a cross-sectional cohort design using a sample of births and infant deaths from U.S. Vital Statistics data. Binomial logistic regression analyses were carried out to calculate odds ratios. Results of this analysis showed non-Hispanic Black (only) mothers are more likely than non-Hispanic White (only) mothers to have a pregnancy result in fetal/infant death. In terms of prenatal care initiation, beginning care by Month 5 of a pregnancy confers a protective effect. Analyses on birthing location safety resulted in a substantial increased risk for births in freestanding birth centers and births at home that were intended to be at home, when compared to hospital births. Furthermore, women who were high-risk were more likely to have a negative birth outcome compared to low-risk women. Addressing each of these risks can help health care professionals contribute to positive social change by decreasing the incidence of fetal/infant mortality.

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Dedication

This research is dedicated to all mothers who have endured the pain of loss. Losing a child is unimaginable. As public health professionals, we have a duty to do our part to lessen this painful reality. It is my most sincere hope that through my research the burden of fetal and infant mortality will be lifted for countless families.

Acknowledgments

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Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

Introduction

A Closer Look at Fetal/Infant Mortality

Topics of concern for the health of nations often revolve around poverty, access to proper health care, cost of health care, vaccination rates, diabetes, and heart disease, among others. One topic not often discussed, possibly due to its sensitive nature, is that of fetal and infant mortality. The United States, though one of the world’s top ranked for medical technology and medical research, is among the lowest in comparison to other developed nations in terms of infant mortality rates (IMRs) (MacDorman & Mathews, 2014). In 2016, there were 23,161 infant deaths, an IMR of 5.9 deaths per 1,000 live births (United Health Foundation, 2018). For a country that spends more of its gross national product on health care than other developed countries, it would be reasonable to expect that country not to be ranked near the bottom in IMRs (Lorenz et al., 2016). When looking at the health of a population, infant mortality is often used to evaluate the state of a nation’s overall health (Kirby, 2017). If the United States is to be known as a nation of good health, IMRs and the associated disparities need to improve.

Over the past 50 years, public health efforts have resulted in reduced infant mortality in the United States (UHF, 2018). In spite of these improvements, disparities in fetal and infant mortality persist among racial groups, economic groups, regions, age groups, and others (Mathews & Driscoll, 2017; UHF, 2018). Infant mortality is not a new issue; it is not even an issue upon which interventions are currently lacking. It is, however, a health concern that goes beyond a simple outcome and persists despite current interventions.

The problem of fetal/infant mortality is a human rights issue and a social issue at heart. The current efforts have not sufficiently reduced or eliminated the deaths of thousands of infants across the United States (UHF, 2018). There is a need for a new model to target some of the key elements of fetal/infant mortality that are derived or influenced by social constructs. I investigated the following variables to understand better their influence on fetal/infant mortality: race and ethnicity, birthing location, month mother begins prenatal care, and pregnancy risk level. I focused primarily on the control variables birthing location and month mother begins prenatal care, in part, because of their significance found in the literature. I included the remaining control variable, pregnancy risk level, in analysis to better understand the depth of its influence on the outcome of interest, fetal/infant mortality. Through each of these variables I addressed elements beyond biology or access to care.

Lorenz et al. (2016) noted the importance of combining race and ethnicity in analyses. From their insight, I gained a better understanding of how social influences of different racial groups influence birth outcomes. Even in the midst of efforts targeting infant mortality, differences among racial groups persist. Black infants have a disproportionately higher IMR than White infants, for example (Kirby, 2017). To further identify underlying causes to this disparity and explore deeper social elements, I also included ethnicity in my analyses.

In addition to race and ethnicity, through my study I explored the connection between birthing location and birth outcomes. In the United States, a woman is often able to choose where she gives birth. This choice can include a hospital birth with a physician or a midwife (or similarly trained medical professional), a home birth with or without trained medical professionals, and a birth in a freestanding birthing center. For my study I analyzed the following three birthing locations: hospital, home, and birth center. In previous studies on the safety of various birthing locations for mom and baby, mixed results are found (Scarf et al., 2018). Many of these studies are outdated and lack sufficient statistical power to give meaningful results (Scarf et al., 2018). By using a large sample size of reliable, nation-wide data, I provide generalizable, actionable results. I recognize some births occur in locations other than what is planned or hoped. When possible, however, the mother and her medical provider should choose the most appropriate birth setting. Some choices are likely made because of environmental, social, and economic reasons. Women need to be informed of the risks associated with different birth locations before they make their choice. Through this study, I investigated the connection of birthing location and fetal/infant mortality in hopes to provide information to better inform women and health care providers of possible increased risk of adverse birth outcomes such as fetal and infant mortality based on the location of birth.

The third variable of interest in this study was the month the mother begins prenatal care. Prenatal care is widely known to be important to the health of the mother and baby. What may not be as well-known is the number of visits may not be the critical component (Woo et al., 2017). According to Woo et al. (2017), for women who have a healthy pregnancy with no known complications, fewer prenatal visits do not have a negative impact on the health of the pregnancy. In a 1990 article by Coopland, prenatal care was thought to potentially lower infant mortality rates and was most beneficial in providing educational, nutritional, and general behavioral guidance, rather than medical advice (Coopland, 1990). Rather than focusing on the completion of a certain number of prenatal visits, I looked at when prenatal care was initiated. The first prenatal visit is thought to be of particular importance for lower socioeconomic women, since they may not attend many, or any, other prenatal visits (Coopland, 1990). Cost and not seeing the importance of prenatal care are two critical barriers to women receiving prenatal care (Coopland, 1990). As public health practitioners, prevention efforts should be focused at the most critical point; in this case, that point may be getting women to that first prenatal care visit. I looked at the importance of beginning prenatal care, not just in lower socioeconomic women, but all women, to have a more complete picture of the importance of when a woman begins prenatal care.

Potential for Positive Social Change

Basic human rights should not be varied from one group to the next. All people, regardless of race, ethnicity, socioeconomic status, age, etc., should have the ability to make choices, to have access to clean water, food, and affordable health care. There are basic rights that should not be negotiable. For far too many people in the United States, major disparities in these important components of life exist. Fetal and infant mortality are among these issues where major disparities persist. Infant mortality rates differ among racial groups, regions of the country, age groups, and others (Parekh et al., 2018).

A woman’s age or race should not be a reason for her increased risk of an adverse birth outcome. This issue is social in nature. How minority populations and other vulnerable groups are treated is a testament to the health of a society on a moral level. Positive social change regarding fetal and infant deaths in the United States is needed.

Through this study I provided insight into the high fetal and infant mortality rates in the United States, which are far higher than most other developed countries (Lorenz et al., 2016). Considering the country’s affluence, technology, and medical advances, this detriment to United States society is unacceptable. A better understanding of the underlying social nature and resulting impact on fetal and infant mortality of race and ethnicity, birthing location, and when a mother begins prenatal care can all provide guidance for primary interventions, thus potentially reducing the incidences of fetal/infant mortality in the United States and creating positive social change. The results of my study have been used in the development of a model to predict fetal/infant mortality. I made recommendations for potential interventions at various points in a pregnancy based on the information gained. The pregnancy outcome prediction model will reduce fetal and infant mortality among United States infants and lead to positive social change, restoring some of the most basic human rights in the United States.

Background

The United States is a leader in medical and scientific research. Groundbreaking studies are conducted on a regular basis. In general, the country can be described as affluent, democratic, idealistic, and healthy. This is an incomplete picture, however, particularly regarding the health of the country. Infant mortality rates are commonly used as a measuring stick by which the state of the overall health of a country is determined (Kirby, 2017). Regarding this standard, the United States is behind (Lorenz et al., 2016). Much of the current literature expounds upon this issue, highlighting vast disparities from one racial group to another even in spite of programs which are designed to combat racial disparities (Kirby, 2017). While it is known that fetal/infant mortality rates differ across racial groups, there is a lack of knowledge on how the combination of ethnicity with race impacts fetal/infant mortality. Ethnicity provides a social element not often used in studies pertaining to infant mortality. I have provided a more comprehensive understanding of fetal/infant mortality by analyzing variables at multiple levels of influence.

While many women and health care providers do their best to have safe, healthy pregnancies and deliveries, with conflicting evidence on how to do so, this seems an insurmountable challenge (Scarf et al., 2018). Some studies portray home births and births in birthing centers as safe alternatives to hospitals, while other studies state the dangers of such decisions (American College of Obstetricians and Gynecologists 2020; Chervenak & Grunebaum, 2015; Kozhimannil et al., 2018; Malloy, 2010). With conflicting information, it seems unrealistic to assume it would be possible to improve pregnancy outcomes with the current data. Through my study, I have worked to clarify the topic of birthing location safety and highlight the correlation between birthing location and fetal/infant mortality.

Research literature contains a plethora of information regarding the health benefits of prenatal care (2018). The American College of Obstetricians and

Gynecologists has set out guidelines for proper prenatal care, yet many women delay initiation or choose to avoid prenatal care services altogether (Meyer et al., 2016). While there are many studies that provide information on the importance of early care, and even some studies that highlight the possible benefits of early prenatal care and a set number of prenatal care visits, researchers have not looked specifically at the month of pregnancy in which the mother begins prenatal care and the possible correlation to fetal/infant mortality (Coopland, 1990; Parekh, 2018). I addressed this gap and looked beyond the data from one particular state (as is commonly found in the literature) and focused more broadly on U.S. data. Prenatal care is important, but it is not clear if initiation of that care is the most important component. Knowing how prenatal care timing can impact fetal/infant mortality can lead to a reduction in fetal and infant deaths across the United States.

One of the largest gaps in knowledge in the discipline of obstetrical safety is in regard to the age and overall risk level to fetuses and infants. Researchers look most often at infants up to their first year of age to better understand infant mortality. While a noteworthy practice, this age includes a wide range of developmental stages of infants, in which are known to have varying common causes of death such as sudden infant death syndrome (SIDS) in infants up to six months and accidents in older infants (Kochanek et al., 2016; United Health Foundation, 2018). It is also known that certain infections and medical conditions present in the mother can contribute to adverse pregnancy outcomes (Grunebaum et al., 2015). What is less well known is what contributes to fetal and infant mortality among healthy women who do not have known risk factors, in pregnancies that are term (37 – 40 weeks), and in which the infant has no known risk factors in utero. This population of women and infants would be considered otherwise healthy and not expected to result in a fetal or infant death. This is the specific population in which I have conducted my research.

Every year roughly four million women give birth in the United States (Muoto et al., 2016). In 2016, of those births, 23,161 resulted in infant deaths (UHF, 2018). This number is concerning for any country, particularly one with such affluence and technology. Though health care providers, public health experts, community health educators, and others work to reduce this burden, the United States still lags behind other developed countries in fetal and infant mortality rates (MacDorman & Mathews, 2014). I have used the data from my study to create a model by which pregnancy outcomes can be better predicted, thus reducing the burden of fetal/infant mortality in the United States. This model can be a tool to use in the revision of best practices, which has the potential to reduce this unnecessary burden on women, families, the healthcare system, and the United States.

Problem Statement

The problem addressed in this study was: Do race and ethnicity, birthing location, the month the mother begins prenatal care, and pregnancy risk level impact fetal/infant mortality? Medical technology in the United States is constantly evolving and adapting to the needs of its population. Overall, according to Mathews and Driscoll with the National Vital Statistics System (2017), improvements in infant mortality are seen in varying degrees among different racial groups. These improvements, however, vary by racial group and are not consistent over time (Mathews & Driscoll, 2017). Among states within the United States, an incredible disparity has been described (UHF, 2018). IMRs range from 3.9 infant deaths per 1,000 live births in New Hampshire and Vermont to a high of 8.9 infant deaths per 1,000 live births in Mississippi (UHF, 2018). Infant mortality is a gauge by which the efficacy of a healthcare system and the overall health of a country are measured (UHF, 2018). If the country is to have healthy communities and healthy states, there must be an improvement in infant mortality rates in every state in the United States.

While researchers continue to try to understand the trends seen in fetal and infant mortality, there is still much to uncover to help improve trends and bring fetal/infant mortality down to levels comparable with the rest of the world. In a study by MacDorman and Mathews (2014), U.S. infant mortality rates were compared to European and Asian countries in the Organization for Economic Co-operation and Development (OECD). Among the 26 countries in the study, the United States ranked last, with 6.1 infant deaths per 1,000 live births (MacDorman & Mathews, 2014). In further calculations, births that occurred at less than 24 weeks gestation were removed in order to provide an equal comparison on an international level; however, the study still demonstrated U.S. infant mortality rates of 4.2, significantly higher than the other countries in the study (MacDorman & Mathews, 2014).

The problem of fetal and infant mortality in the United States is complex in nature and is likely influenced by multiple factors, making intervention efforts a challenge (UHF, 2018). In 2014, an infant mortality rate of 5.82 deaths per 1,000 live births was the best IMR in U.S. history (Jacob, 2016). This number showed a gradual, continuous improvement in IMR, but still placed the United States behind other developed nations (Jacob, 2016). According to the United Health Foundation (2018), the U.S. IMR was 5.9, a slight increase from the 2014 low point. No substantial changes in IMR occurred over the past few years. A better understanding of contributing factors can help bolster a much-needed period of improved IMRs (Jacob, 2016; UHF, 2018).

With all the research currently available, why fetal and infant mortality rates are high in comparison with other countries of similar economic, medical, and social advancements is still a mystery (MacDorman & Mathews, 2014). The variables of interest for my study have been studied in some capacity, but studied with limited scope, generalizability, power, and clarity. Through statistical analysis, I addressed this gap in the literature by analyzing the following variables: race and ethnicity of mother, birthing location, month mother begins prenatal care, and pregnancy risk level.

Researchers have studied birthing location, but more so as it relates to maternal complications and to overall efficacy of care in comparison to standard obstetrical services (Scarf et al., 2018). According to Grunebaum et al. (2016), in the United States, hospital births are seen as the safest choice for childbirth. At a workshop of medical professionals, governing bodies, and academicians, the participants widely agreed there are increased risks associated with planned home births (Chervenak & Grunebaum, 2015). These experts also agreed further studies are needed to evaluate the associated risks of home births (Chervenak & Grunebaum, 2015). Furthermore, researchers need also to consider the incredibly social nature of childbirth. I looked at the relationship between birthing location and fetal/infant mortality while considering important social influences by assessing the more comprehensive social relationship of childbirth variables (birthing location, prenatal care initiation, and race and ethnicity) to fetal/infant mortality. Through this analysis I more deeply evaluated the birthing location variable than previous researchers, thus providing further clarity into the problem of fetal/infant deaths.

Prenatal care has long been accepted as an important aspect of a healthy pregnancy (Partridge et al., 2012). What is less well known is the potential impact on birth outcomes of the timing of a woman's first prenatal care visit. I looked at trends in birth outcomes among women who started prenatal care at various points in their pregnancy. That a woman should have a certain number of prenatal visits to ensure a healthy delivery is a common theory; however, according to Woo et al. (2017), in the absence of known pregnancy complications, the important component is not the quantity of prenatal visits. So, perhaps the initiation of prenatal care, when a healthcare provider can assess risk and general health, as well as provide education, is the most critical aspect to note (Parekh et al., 2018). According to the American Academy of Pediatrics and American College of Obstetricians and Gynecologists (2017), early prenatal care can result in better birth outcomes. Prenatal care should begin in the first trimester. For women with previous birth or pregnancy complications, prenatal care should begin as early in the pregnancy as possible (American Academy of Pediatrics, American Academy of Pediatrics Committee on Fetus and Newborn, and American Academy of Obstetricians and Gynecologists Committee on Obstetric Practice, 2017). Even in light of this recommendation, the potential correlation between fetal/infant mortality and when a mother begins prenatal care is not well known. Women without previous complications who do not have known risks may receive fewer prenatal care visits, although not specified, is if the initiation of care may be delayed or if a delay in initial care will have risks for adverse birth outcomes (American Academy of Pediatrics, Committee on Fetus and Newborn, & American Academy of Obstetricians and Gynecologists, Committee on Obstetric Practice [AAP, C. F. N., ACOG C.O.P.], 2017). In my study I looked at this population of pregnant women who have no known risk factors for pregnancy and/or birth complications, and I assessed trends in fetal/infant mortality in relation to when the mother begins prenatal care. Unique to my study is the way in which I looked at prenatal care initiation in light of the social influences that may hinder or aid a woman in receiving prenatal care in a timely manner. Understanding how social influences might influence behavior can further lead to positive social change.

When noting the disparity of fetal/infant mortality among racial groups, researchers attempt to better understand why differences persist. Some researchers reveal improved birth outcomes among certain racial groups (Kirby, 2017). Although it is known that race has an impact on infant mortality rates, it is still not fully known why or how to replicate noted improvements. Race and ethnicity are social constructs and should be analyzed as such. I have viewed this variable through the lens of social justice. I analyzed race, birthing location, initiation of prenatal care, and pregnancy risk level to determine their impact on fetal/infant mortality. I used the information gathered from this study to develop a model to predict birth outcomes, which will contribute to positive social change.

Researchers have looked at specific variables that potentially influence the rate of infant mortality; however, many of these efforts have been hindered by a lack of available, usable data (Sappenfield et al., 2010). I used data from the 2017 U.S. Vital Statistics All-County Period Linked Birth/Infant Death Records, which addresses the issue of limited population data and provides a more comprehensive picture of how specific variables influence fetal/infant mortality throughout the United States (USDHHS, 2018). Through my study, I addressed these gaps in the literature, and I worked to bring clarity to the topic of fetal/infant mortality. Unlike previous studies, I have looked at race and ethnicity as the independent variable and the following were my control variables: prenatal care initiation, birthing location, and pregnancy risk level, for possible associations to fetal/infant mortality. Unique social influences surround each of these variables. Looking at the relationships among these variables and how those complex relationships impact fetal/infant mortality provide unique insight into the problem of fetal/infant mortality that researchers have not evaluated.

Purpose of the Study

The purpose of this quantitative study was to explore, through the lens of the ecological perspective, the degree to which race and ethnicity is associated with fetal/infant mortality rates. Variables I controlled for included birthing location, prenatal care initiation, and pregnancy risk level. I selected the sample among fetal and infant births and deaths in 2017 in the U.S. Vital Statistics database.

Research Question and Hypotheses

Research Question (RQ): What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest?

Null Hypothesis (H_0): There is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

Alternative Hypothesis (H_A): There is an association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

The population of interest included women who gave birth in 2017 to a term infant, live in the contiguous United States, Alaska, Hawaii, or the District of Columbia (D.C.), are ages 15 to 44, and have a singleton birth with no known congenital anomalies.

Theoretical Foundation for the Study

Identification of the Theory

The theoretical framework that I used to guide this study was the ecological perspective. The ecological perspective is rooted in concepts from biology and provides for understanding of relationships which occur at multiple levels of environments (Sallis et al., 2008).

Theoretical Propositions and Hypotheses

Sallis et al. (2008) suggested health behaviors need a balance of these varying levels of environments and factors to support positive health behaviors. If policies and environments work in concert with individual factors, beneficial health behaviors will more likely be adopted for long-term benefits (Sallis et al., 2008). In ecological models, multiple levels of influences on health behaviors are interconnected (Sallis et al., 2008). Commonly used are the following levels: intrapersonal, interpersonal, and community factors (United States Department of Health and Human Services, 2005). While some theories and models incorporate one or two levels of influence, according to Sallis et al. (2008), the ecological perspective uses the following four core principles as its foundation: health behaviors are impacted by more than one level of influence and often include intrapersonal, interpersonal, organizational, community, and policy levels; interactions exist across and between all levels of influence and one factor can influence another factor; an intervention based on multiple levels of influence will be more successful in producing behavior changes; targeting a specific behavior increases the success of an intervention. These four principles highlight the important theoretical hypotheses of the ecological perspective.

Variables from multiple levels of influence determine fetal/infant mortality. Variables such as race, culture, and prenatal care can affect fetal/infant mortality (Chima, 2001). The ecological perspective provides a framework for appreciating the interconnectedness of these factors that influence fetal/infant mortality. By including macrolevel factors such as race and microlevel factors such as birthing location and the month the mother begins prenatal care, I can better understand the complex nature of fetal/infant mortality. I used this understanding to develop a model by which fetal/infant mortality is better predicted.

Nature of the Study

Study Design and Variables

I used a quantitative, retrospective, cross-sectional cohort study design to look further into possible associations between mother's race and ethnicity and fetal/infant mortality. I included several control variables in the study in order to minimize biases and target the areas of interest. The following are the study control variables I included: birthing location, month mother begins prenatal care, and pregnancy risk level. Secondary data from the 2017 U.S. Vital Statistics All-County Period Linked Birth/Infant Death Records were used to evaluate these possible associations (USDHHS, 2018). To better understand possible associations among the variables of interest, I focused on better understanding if certain characteristics (inherent or chosen) of a mother contribute to fetal/infant mortality. This understanding helped inform my development of a model that can be used to help inform best practice and reduce the incidence of fetal/infant mortality in the United States.

Methodology

I used secondary data from the U.S. Vital Statistics dataset for this study, specifically, All-County Period Linked Birth/Infant Death Records for the year 2017, as this year includes the most complete and up-to-date data for the variables of interest (USDHHS, 2018). Data are comprised of the 57 vital statistics jurisdictions available (USDHHS, 2018). Inclusion criteria for this study are as follows: women ages 15 to 44, singleton births that are ≥37 weeks gestation and ≤40 weeks gestation, fetal and infant deaths of less than 28 days of life, births with no known congenital anomalies, and women who reside in the contiguous United States, Alaska, and Hawaii, and D.C.

Considering one dependent variable, one independent variable, and multiple control variables, I conducted a binomial logistic regression analysis. Specifically, I carried out logistic regression and calculated odds ratios to look at the association between a single dichotomous, dependent variable, fetal/infant mortality and multiple independent variables (including control variables), race and ethnicity, prenatal care initiation, birthing location, and pregnancy risk level.

When looking at the significance of birthing location, determining those that were planned at home or a birth center versus those that were not planned, but occurred inadvertently at those locations is important (Scarf et al., 2018). Also important is whether or not the pregnancy was considered low-risk or high-risk (Scarf et al., 2018). While these questions are not directly asked on the birth/infant death records, information given such as whether or not a home birth was planned, helped me infer intention (USDHHS, 2018). Also, the data from the birth/infant death records does not provide detailed information on whether a pregnancy was considered low-risk or high-risk (USDHHS, 2018). However, I looked at other information (cigarette use, BMI, pre-pregnancy diabetes, gestational diabetes, hypertension, and presence of sexually transmitted infections) to classify risk status (USDHHS, 2018). I used much of this information to categorize women as a dichotomous variable, high-risk or low-risk.

Literature Search Strategy

For my literature review I accessed the following library databases: CINAHL and MEDLINE Combined Search, CINAHL Plus with Full Text, and ProQuest Nursing and Allied Health Source. I also searched through the internet for the phrases *infant mortality* and *census racial categories*. I used a variety of search terms within the library databases. These terms include the following:

- *Ecological perspective* (17,025 results)
- *Infant mortality AND place of birth* (184 results)
- *Infant mortality AND home birth (*83 results)
- *Birth outcome AND birth center* (12 results)
- *Perinatal mortality AND birth center* (2 results)
- *Infant mortality AND birth center* (12 results)
- *Infant mortality AND prenatal care* (57 results)
- *Prenatal care initiation* (19 results)
- *Prenatal care importance* (8 results)
- *Early initiation AND prenatal care* (8 results)
- *Prenatal care initiation in the US AND infant mortality* (468 results)
- *Infant mortality AND race* (91 results)

In order to focus on recent literature, I included search parameters to include only articles from 2015-2019, with the exception of the inclusion of a few seminal works. Other than the CINAHL & Medline search for “infant mortality AND place of birth,” which produced articles from global studies, I used parameters to specify literature within the United States that were peer reviewed and included the full text of the article. Many of the articles were not relevant to my study and were not included in analysis; however, this search strategy resulted in the inclusion of 40 articles and several websites related directly to information on my study's data set and related information.

Theoretical Framework

Name and Origin of Theory

The lens through which I viewed my study was the ecological perspective. The ecological perspective is rooted in concepts from biology (Sallis et al., 2008). The word ecology, for example, describes the complex relationships between a living being and its various environments (Sallis et al., 2008). The foundation for this framework lies in the complex nature of health. Health is not determined by a single factor, but by a host of factors (Edberg, 2015). The ecological perspective is a multi-level theory that can be used to better understand multiple levels of influence of a health outcome (Sallis et al., 2008).

Multiple ecological models have been developed that help illustrate how people interact with different types of environments (physical, social, cultural, political, etc.) (Sallis et al., 2008). Early on in their development, health behavior theories and models provided a framework by which researchers could better understand the impact on a behavior of an individual's behaviors, personal influences, and close relationships (Sallis et al., 2008). What is missing from this type of model is consideration of the impact of external factors such as community, organizational, and policy considerations; hence, the introduction of ecological models that are more comprehensive in their view of how health is shaped (Sallis et al., 2008).

Major Theoretical Propositions and Hypotheses and Rationale for Theory Selection

The ecological perspective helped me draw attention to different levels of influences – upstream determinants (race and ethnicity) and downstream determinants (prenatal care initiation, birthing location, and pregnancy risk level) – and determine their relationship to fetal/infant mortality. Likewise, Samdal noted the importance of considering upstream and downstream determinants in order to learn more about the interconnected nature of variables (2012)

Each variable in this study is complex in nature and involves relationships with other factors. For example, birthing location may be influenced by financial constraints or religious practices. Moreover, a mother may not be educated concerning her options for birth places or may have limited health literacy, impacting her choice on a place of birth. Most people think a woman makes the choice of where her baby is born (excluding urgent or dangerous situations). This choice goes far beyond personal preferences, however. While a mother's desires do often play a role, a woman's social, religious, political, and physical environments impact that decision as well. I used the ecological perspective as guide for better understanding these influences.

Likewise, a mother's choice for prenatal care may be influenced by a number of elements, socioeconomic status, presence of health insurance, supportive partner, availability of local obstetricians, etc. For example, physical environment limitations may dictate how often a woman is able to travel to see a health care provider. Or, if a woman's religious or cultural beliefs disparage her from being pregnant for any reason she may not feel comfortable going to a doctor. Similarly, if cultural beliefs present a distrust of the healthcare system, a woman is less likely to seek out prenatal care. These factors and others are all connected through complex relationships at the micro and macro levels (Samdal, 2012). I used these principles of the ecological perspective to guide me as I looked at the interconnected relationships of my variables (Samdal, 2012).

The independent variable for my study, race and ethnicity, is also related to the concepts in the ecological model as it provides a foundation for culture, religion, social environment, and more. Race is a biological construct and cannot be changed; ethnicity is more social in nature and is influenced by culture, religion, social networks, etc. Combined, these two facets of this variable have multiple levels of influence. For example, according to Kothari et al. (2017), the Black population has a disproportionate amount of risk for infant mortality, likely because of health differences and behavioral components. Some of these differences are at the individual level (race), while others are at a community level (social influences impacting behavior). The foundation of the ecological perspective provides a platform for teasing out these contributing elements of fetal/infant mortality.

Previous Applications of Theory

The ecological perspective is widely used in health promotion and program planning. This theory has been used as a framework to consider risk factors both at the macro and micro levels for health programming for a variety of health conditions (Wold & Samdal, 2012). Wold and Samdal suggested the use of the ecological perspective to recognize the need for engagement of professionals from multiple disciplines in order to thoroughly address community health concerns (2012).

Henderson et al., sought to better understand the impact of the COVID-19 pandemic on the mental health of children, using an ecological perspective to fully grasp the influence of different spheres of influence in a child's life (2020). The authors in this article recognized the interaction of different environments and the impact of those relationships on the health of individuals (Henderson et al., 2020). Similarly, I have considered how variables at multiple levels of influence have a bearing on fetal/infant mortality.

In an attempt to reduce barriers to healthy self-care among elderly women, authors Moon et al., learned the importance of addressing barriers at several different levels of influence such as intrapersonal, interpersonal, community, and public policy, in order to encourage elderly women to better care for themselves (2020). Through a qualitative analysis of personal behaviors, patterns, thoughts, etc., study authors noted a pattern of women who experienced substantial barriers in multiple levels of influence in their lives (Moon et al., 2020). The researchers hypothesized that designing an intervention to address these multiple influences would be more effective than addressing only one level of influence (Moon et al., 2020).

In a 2020 study by Woodgate et al., an ecological perspective helped explain how anxiety among university students was rooted in multiple determinants from multiple levels of influence. Knowing the impact of these determinants helped the study authors design a model to help prevent anxiety in a comprehensive manner (Woodgate et al., 2020). Woodgate et al., learned the depth of influence that can come from different directions to culminate in a negative health outcome (2020). Addressing all of these influences is more impactful in preventing adverse health outcomes, similar to my study. In the model I created, I included variables at multiple levels in order to create a comprehensive view of the health outcome of interest, fetal/infant mortality.

The ecological perspective is used as a theoretical framework for countless studies, programs, and interventions. Researchers show us the importance of addressing the complexities of health at multiple levels of influence in order to fully represent the impact of the many systems which make up a person's environment (Wold & Samdal, 2012). This way of thinking is the core of the ecological perspective.

Relationship of the Ecological Principle to the Research Questions

I designed the research question in my study so I could utilize the foundational principles of the ecological perspective to better understand the relationship between fetal/infant mortality and the independent and control variables. The research question incorporated upstream and downstream determinants at varying levels of influence, as previously explained. Through the inclusion of the control variables, I was able to better understand these multiple levels of influence that are explained by the ecological perspective. For example, prenatal care (intrapersonal), birthing location (intrapersonal, interpersonal, and sociocultural), and pregnancy risk level (intrapersonal and interpersonal), provided a picture of how infant mortality was impacted by proximal and distal elements, as was also highlighted by Sallis et al. (2008). My selection of confounding variables was influenced by the ecological perspective. The ecological perspective provided a foundation for understanding the complexity of health outcomes, such as infant mortality. Researchers highlight the varied contributing factors to infant mortality through countless studies (Kochanek et al., 2016). This existing evidence aligns with the multi-level principles of the ecological perspective, which guided my selection of pertinent confounding variables. In addition to better understanding factors that influence infant mortality, an important goal I hoped to achieve was to develop a model to better predict pregnancy outcomes. The ecological perspective has guided this model development, which illustrates the overlapping influence and interconnectedness of important variables. My model shows the importance of interventions at the individual level, microsystem, mesosystem, ecosystem, and macrosystem (McLaren & Hawe, 2005).

Theory Constructs and Alignment to Research

The ecological perspective revolves around the following four core principles: “1. Multiple levels of factors influence health behaviors. 2. Influences interact across levels. 3. Multi-level interventions should be most effective in changing behavior. 4. Ecological models are most powerful when they are behavior-specific” (Sallis et al., 2008, p. 470). These four principles make the ecological perspective unique in comparison to other theories or models. This framework shows the interconnectedness of individuals to their various environments and how these connections impact health.

The first core principle, “Multiple levels of factors influence health behaviors” (Sallis et al., 2008, p. 470), highlights the concept that health is complex in nature, affected by upstream and downstream determinants from a variety of sources. For example, fetal/infant mortality is not caused by one factor alone, or else this undesired outcome would finally come to an end. Fetal/infant mortality has layers of influences that range from the health of the mother to the medical expertise available at delivery (Kochanek et al., 2016). Knowing and appreciating these contributing levels of influence is foundational to intervening in health behaviors and health outcomes.

The second core principle, “Influences interact across levels” (Sallis et al., 2008, p. 470), is intended to show how variables from different areas work together (Sallis et al., 2008). For example, individuals on a journey to a healthier body mass index (BMI) would likely have different overall outcomes depending on the presence or absence of policies at work that reinforce physical health, insurance incentives, personal motivation, socioeconomic status (as it relates to residence and ability to afford healthy food options), educational attainment, and more (Sallis et al., 2008). Health is complex and requires the use of theories that allow experts to hone in on this complexity.

Core principle number three, “Multi-level interventions should be most effective in changing behavior” (Sallis et al., 2008, p. 470), provides guidance in creating interventions that thoroughly address health outcomes that are affected at multiple points and by multiple variables. For example, for an intervention focused on weight loss to be effective, it should address the individual’s behaviors, the physical environment, and the social environment, among others. In a program to help individuals who struggle with obesity, addressing individual beliefs about the condition, social support or negative social influences, and the presence or absence of healthy foods nearby is important. Ignoring any one of these levels of influence would be potentially devastating for the program. Likewise, fetal/infant mortality will be best addressed by intervening at multiple levels of influence.

The fourth and final core principle of the ecological perspective, “Ecological models are most powerful when they are behavior-specific” (Sallis et al., 2008, p. 470), helps ground efforts to create behavior change. By tailoring an intervention to target a specific health behavior, the intervention will more likely succeed (Sallis et al., 2008). While this specificity can be a challenge of the ecological perspective, this model does allow for some general models to be used as well, creating some flexibility (Sallis et al., 2008). Whether a general or more specific approach is taken, the ecological perspective provides a foundation for designing interventions or further research that will address the health condition of interest.

Theory’s Relationship to Study

The approach for my study was influenced by the ecological perspective down to the very core of the study design. The culmination of my research informed my development of a model by which pregnancy outcomes can be predicted, delimited by the scope of my research parameters. In this model I followed the four core principles of the ecological perspective described above and considered variables from multiple levels of influence that are interconnected. Consideration for the target points of an intervention spans across these varying spheres of influence. Furthermore, focus of this model was specific, as it looked at the birth outcomes of term infants.

Moreover, when considering the study approach, the ecological perspective helped guide me in my consideration of a host of influences that play a role in pregnancy outcomes. These variables, independent and control, span the following different spheres of influence: intrapersonal, interpersonal, organizational, and policy. Theory is directly related to the research questions in this study as well. The research question was framed with the ecological perspective in mind. In the research question I used the lens of the ecological perspective to view the dependent variable, fetal/infant mortality, as being impacted by variables that are proximal to the individual (mother's race and ethnicity) and distal to the individual (birthing location, month mother begins prenatal care, and pregnancy risk level). I selected the following control variables that were included in the research questions: prenatal care initiation, birthing location, and pregnancy risk level. My selection was based on the importance of variables from varying levels of influence, per the ecological perspective, and upon epidemiological significance found in previous research (Kochanek et al., 2016; Lorenz et al., 2016; Mathews & Driscoll, 2017).

Analysis of the data was also impacted by the ecological perspective. For example, the research question required analysis of the effects of one independent variable on the dependent variable as well as for analysis of the effects of the three control variables. My analysis was grounded in the principles of the ecological perspective in that it took into consideration the complex interactions of different environments, and players within those environments, on the dependent variable, fetal/infant mortality. The ecological perspective guided my study from start to finish, from design and analysis, to conclusions and model development.

Literature Review

Literature Related to Study Constructs and Methodology

Race and Ethnicity

In a study by Kothari et al. (2017), risk of infant mortality was assessed for different racial groups and revealed a disproportionate amount of risk for Black infants. Similar to the goals of my study, this study stratified risk by categories: Perinatal Periods of Risk (PPOR), which identifies certain periods of increased risk for infant mortality (Kothari et al., 2017). The following four risk categories are used with the PPOR system:

1. Maternal Health/Prematurity category (preconception health, health behaviors, perinatal care, etc.)
2. Maternal Care category (prenatal care, referral system, high-risk obstetric care, etc.)
3. Newborn Care category (perinatal management, perinatal system, pediatric surgery, etc.)
4. Infant Health category (sleep-related, injury prevention, breast-feeding, etc.) (Kothari et al., 2017, p. S50).

I did not use these exact categories because the inclusion criteria for age of infants in my study are different; however, I used these PPOR to guide the categorization of risks within my study parameters, upon the final data analysis.

In a study conducted by Rice et al. (2017), ethnicity was included in the analysis along with race—similar to my study—in order to better understand the social and cultural components that affect infant mortality. Many studies include race as a singular variable without the inclusion of ethnicity, likely missing important elements of this dependent variable. Ethnicity provides a window into culture, social norms, and social support structures that impact how a person behaves in her daily living. By including this variable, the researcher gains a more holistic perspective.

As I developed the methodology for my study, I followed some of the guidelines used in a study by Kirby (2017) that similarly used U.S. Vital Statistics data. Kirby utilized data from birth and death certificates after 2003 to include the revisions that were made to birth and death certificate questionnaires in 2003 (2017). I likewise used data after 2003 in order to include the most up-to-date data. Furthermore, in order to maintain statistical power, I excluded states with fewer than 10 annual infant deaths.

Birthing Location

Malloy (2010) studied birth outcomes in hospitals, homes, and birth centers that use certified and noncertified nurse-midwives. I used these three birthing locations, which helped me provide a good picture of the three major locations at which women give birth in the United States. Women are increasingly choosing nonhospital options when it comes to child birth. Similar to Malloy's 2010 study, my analysis included these three important location choices. Because of data limitations in my study, however, I did not distinguish between certified and noncertified midwives and nurse-midwives. I evaluated the safety of birth location rather than the attendant.

In a large European study by Walker (2017), he explained the history of home births versus hospital births, helping clarify the changing perceptions of different birth locations. According to Walker (2017), there is an increased incidence of home births; however, there was a time when this trend differed. In the 1700s to 1800s, women began delivering babies in hospitals (Walker, 2017). Hospitals births, however, were more common to individuals of lesser means who lacked the strong support system common to women of higher socioeconomic status who had home births (Walker, 2017). Perceptions have continued to change over the years. Since those early years of hospital experiences, improvements in medical care have led to more women choosing to have hospital births (Walker, 2017). Even more recently, women are increasingly choosing home births in part, due to perceptions of safety (Walker, 2017). Less commonly known of the studies that demonstrate a level of safety acceptable to women is the study location for many of these pieces of literature. Many of the studies that dispel concerns for safety for home births are conducted in Europe, where many elements are put into place to achieve favorable birth outcomes (Walker, 2017). Unlike these studies, my study was conducted with a U.S. population.

Initiation of Prenatal Care

Knowledge of demographic information is essential in epidemiological studies. In his 1990 study, Coopland provided insight into demographic variations that helped guide me in my selection of some of the control variables for my study. For example, according to Coopland (1990), women in poverty are less likely to receive adequate prenatal care, are more likely to be smokers, use drugs, and are more likely to have sexually transmitted infections and other risk factors. The first prenatal care visit is thought to be of particular importance for lower socioeconomic status women because they may not attend many (or any) other visits throughout their pregnancy because of resource and time limitations, amongst other factors (Coopland, 1990). Cost and lack of perceived importance of prenatal care are two other noteworthy barriers to women receiving prenatal care

(Coopland, 1990). Coopland (1990) conducted his study 3 decades ago, but it provides valuable insight into barriers to care and personal perceptions of prenatal care as well as the possibility of changing the routine of prenatal care without sacrificing positive outcomes. This work provides some justification for further investigation into prenatal care timing and its impact.

Parekh et al. (2018) conducted a study among women who have Medicaid, learning more about disparities seen in prenatal and postpartum care. These authors looked at differences among SES groups, racial and ethnic groups, and urban versus rural women (Parekh et al., 2018). Likewise, in my study I noted trends among some of these variables to inform the development of a model that targets intervention at the most vulnerable points.

Meghea et al. (2015) conducted a study among women in Michigan to determine the importance of prenatal care initiation and frequency. Similar to my study, the research by Meghea et al. (2015) was designed to give Meghea at al. better understanding of the impact on pregnancy outcomes of prenatal care. The population for this 2015 study, however, was restricted to Michigan residents who qualified for Medicaid (Meghea et al., 2015). Conversely, in my study I included women from a variety of income levels and from across the United States to improve study generalizability.

General Infant Mortality Information

The United States rate of preterm births was 11.4% in 2013, one of the highest among other developed countries (Lorenz et al., 2016). In a study conducted by Lorenz et al. (2016), IMRs in the United States were higher for older neonates when looking at neonates of 24 weeks gestation to greater than 37 weeks gestation. Researchers hypothesized that many of the preterm births were ones that would formerly have been stillbirths if not for advances in obstetrical and neonatal health care (Lorenz et al., 2016). Therefore, a changing trend toward younger infants being born contributed to the rise in preterm births (Lorenz et al., 2016). I used this knowledge as I determined the gestational age for inclusion for my study population.

Data from U.S. linked birth/infant death certificates from the National Vital Statistics System (NVSS) were used in a 2017 study by Mathews and Driscoll. I also designed my study with the use of this dataset. I used this dataset so I could investigate trends associated with both race and ethnicity, which would not have been feasible with other datasets. Mathews and Driscoll (2017) noted some trends in IMR within the data. In particular, in 2005 IMR reached a high point before a decline in 2014 (Mathews & Driscoll, 2017). These changes in IMR trends along with birth certificate revisions in 2003 helped me determine a time period to use for my study (Kochanek et al., 2016). As of 2014, 46 states use the revised birth certificates (Kochanek et al., 2016).

Bhatt and Beck-Sague (2018) analyzed possible changes in IMRs because of the adoption of the Patient Protection and Affordable Care Act (ACA), which provided states the opportunity to expand Medicaid, providing additional maternal and prenatal care services. In my study I looked at data after these changes, to account for differences which may be seen due to these Medicaid changes.

Strengths and Weaknesses in the Current Literature

Race and Ethnicity

One strength in a study by Kothari et al. (2017) lies within the concept of PPOR. The study authors did well to classify risk by categories, upon which they created a framework for intervention at targeted points (Kothari et al., 2017). This study was limited by the small sample only of inhabitants of Kalamazoo County, Michigan, as well as by the data set used, which included data from state birth and death certificates, which record maternal race without regard for paternal race, possibly misrepresenting multiracial infants (Kothari et al., 2017). Vital statistics information is commonly recorded with only maternal race information and is an acceptable limitation for studies using this form of data (Kothari et al., 2017).

Roche et al. (2016) utilized statewide data from New Jersey for its sample, which makes it difficult to generalize results to the larger, nationwide population. However, the study authors contributed important information and insight into the issue of infant mortality and possible points of intervention (Roche et al., 2016). For this reason, I used U.S. Vital Statistics data from a sample of U.S. fetal/infant linked birth/infant death certificates.

One noteworthy weakness discussed in an article by Kochanek et al. (2016) was race, as reported on death certificates, for Black and White infants tends to be a good representation of reality. For other racial groups, however, data may not be as accurate. In the 2016 study by Kochanek et al., data were used from infant birth and death certificates that were not linked, which could impact the accuracy of IMR among racial and ethnic groups. Because the linked data set of live births and infant deaths provides a more complete, accurate picture of demographic information, IMRs for different race and ethnicity groups can most accurately be calculated with data from this linked data set (Kochanek et al., 2016). This information, in part, influenced my decision to use the linked birth/infant death certificate files.

Birthing Location

Researchers present inconsistent findings on birthing location safety (Scarf et al., 2018). Scarf et al. (2018) lacked in statistical power necessary to produce statistically significant results for their study. Study results also often vary because of differing study parameters. Weaknesses in studies such as that by Scarf et al. (2018) include mixing cases of home births, which are attended by skilled midwives, with those that are unplanned home births with no midwife. Furthermore, Scarf et al. (2018), in their meta-analysis, used studies from multiple countries, some of which integrate maternal care systems not seen in the United States, which may have skewed the results in a more positive light. These integrated systems are designed to foster a close relationship between midwives and nearby hospitals, ensuring timely and quality care is provided if needed (Scarf et al., 2018). Moreover, in many countries, home births are allowed if hospitals are within close proximity to the home birth location, reducing valuable transfer time that can make a life and death difference to mother and/or baby. This characteristic of home births is not currently required in the United States thus making these studies difficult to compare to the American system (Scarf et al., 2018). These studies are not perfect comparisons to a United States study sample; however, researchers learned more of the further need for investigation into causation of fetal/infant mortality. These study authors also provided insight into some of the positive associations often cited by proponents of home births.

Classifying a birth as being a birth at a birth center, home, or hospital sounds like a straightforward task. Nevertheless, Grunebaum et al. (2016) highlighted some discrepancies with this classification. Following a birth, if an infant is transferred from home to the hospital because of complications that lead to infant mortality, the linked birth/infant death dataset classifies the mortality as a hospital birth, skewing the results (Grunebaum et al., 2016). This concern is echoed by Snyder (2016). Snyder cautioned that negative outcomes resulting from complications from home births are likely transferred to hospitals and recorded as hospital births (2016). Therefore, negative outcomes of home births may actually be understated and worse than is currently believed (Snyder, 2016). A lack of detailed information on birth certificates is partly the reason for this misclassification (Snyder, 2016).

Malloy (2010) conducted a study where participants were limited to term, singleton, vaginal deliveries. These study parameters were used to strengthen the study by only including low-risk pregnancies, thus reducing the chances of study results being confounded by known risk factors (Malloy, 2010). Likewise, I included participants who lacked major contributing factors known to adverse birth outcomes, thus strengthening my study.

The BirthPlace study by Swartz et al. (1998) is considered a seminal work, in part because of the methodology used, which contributed to reliable study results. The study authors used a prospective cohort design, which allowed for women to be followed throughout their pregnancies and included women over the course of four years (Swartz et al., 1998). The study location was unique in that it included women at a freestanding birth center, which was integrated with a large network of healthcare professionals and services (Swartz et al., 1998). This unique, integrated system served as a strength for this study because it mimicked part of the integration seen in European studies, which demonstrate birth safety outside the hospital setting (Swartz et al., 1998). This strength of this particular study is also a weakness, however. By using such a unique setting, it is difficult to generalize these results to the general population. In spite of this weakness, much was learned from the BirthPlace setting regarding, “safety, costs, and patient satisfaction” (Swartz et al., 1998, pg. 207). Additionally, the study included 3,350 subjects, which provided a robustness not all studies are able to achieve (Swartz et al., 1998). One weakness of this study was the limited nature of the location. The study was carried out with San Diego area participants, limiting the generalizability to the rest of the country (Swartz et al., 1998).

A study by Grunebaum et al. (2015) used birth certificate data from across the United States, which provided researchers a sizable sample population from across the United States, and allowed the study results to be representative of the larger United States population and to be statistically significant. These strengths of this study are noteworthy and the authors provided valuable insight into the safety of home births. It is also important to note these authors looked only at births attended by certified nurse-midwives (Grunebaum et al., 2015). This methodology does serve as a strength for this study in that it equalizes some of the elements related to the birth attendant which could affect a home birth. This fact is also a weakness, however, in that it created a more limited sample for the study and did not allow the study authors to note variations among birth attendants of varying skills (Grunebaum et al., 2015). My interests lie more in the safety of the birth location, rather than the attendant and thus, I included all planned home births regardless of attendant's certification.

Initiation of Prenatal Care

Parekh et al. designed their study so they could identify trends among SES groups, racial and ethnic groups, and rural versus urban groups (2018). These divisions served as strengths to this article by giving the authors a picture of what segments of the population are most at risk (Parekh et al., 2018). Knowing who is at greatest risk aids in targeted intervention for program development. Additionally, a weakness of this article was the limited nature of the study sample. The study included women in the Medicaid program in the state of Pennsylvania (Parekh et al., 2018). Limiting the study population to these criteria made it difficult for the authors to generalize the results. While it was helpful for local use, it may not be as useful for models and programs developed at the national level. Using women enrolled in Medicaid provided a good picture of disparities seen within a limited socioeconomic level (Parekh et al., 2018). In my study, I included women with various socioeconomic status levels in order to gain an understanding of the pregnancy outcomes of a variety of women.

Meghea et al. (2015) designed a study which included Medicaid-eligible women who resided in the state of Michigan. The study authors provided valuable information on the impact of Medicaid services, namely prenatal care, on pregnancy outcomes (Meghea et al., 2015). The study results, however, were not generalizable to all pregnant women in the United States. Separating Medicaid-eligible women from those who did not qualify for Medicaid made it impossible to understand how pregnancy services in general affect birth outcomes, because of the demographic differences in that population verses the entire United States population. For the author's study purposes (which were limited to the state of Michigan) this design was effective; however, for my study I used a broader population sample so as to produce more generalizable results, which were used in the creation of a model to predict fetal/infant mortality.

Prenatal care is an important factor when considering the health of a woman and her baby. Certain aspects of prenatal care go beyond meeting the medical needs of a pregnant woman. Ickovics et al. (2019) conducted a study in which pregnant women were placed in group prenatal care that provided social support, guidance on health behaviors, and standard prenatal care. One strength of this study was the social component of the care given. Women who received the group prenatal care had more favorable birth outcomes, possibly indicating a positive association of improved social factors with birth outcomes (Ickovics et al., 2019). Prenatal care, even standard care, has social components (e.g., cultural, economic) associated with a woman choosing to begin or forgo care. I also looked at the importance of social influences on birth outcomes in my study.

General Infant Mortality Information

The ACA was implemented in 2014, thus initiating Medicaid expansion (Bhatt & Beck-Sague, 2018). Therefore, in Bhatt and Beck-Sague's 2018 analysis, they used 2010 as a baseline by which to compare infant mortality rates prior to Medicaid expansion. This approach provided an excellent comparison for investigation into the effects on IMR of increased Medicaid coverage. For my study, I likewise analyzed data after this 2014 change in Medicaid coverage.

Justification for Selection of Variables

Race and Ethnicity

From 1999 to 2013, researchers recorded 13 states as having statistically significant improvements in the infant mortality gap between Black infants and White infants (Brown Speights et al., 2017). In general, IMRs in the United States declined 13% in the 2000 to 2013 timeframe, but the disparities among racial groups remained a significant issue (Brown Speights et al., 2017). If the disparity seen between Black and White infants were completely erased, according to Brown Speights et al. (2017), 64,876 infants could be saved from 1999 to 2013, a significant number worth further research. One of the leading health indicators of Healthy People 2020 is to reduce infant mortality, a task I am undertaking with my study (Office of Disease Prevention and Health Promotion, 2020). Furthermore, by adding ethnicity with the race variable, I helped bring further clarification into this concern. A study by Rice et al. (2017) demonstrated the potential significance of ethnicity on infant mortality. A protective effect of Hispanic ethnicity exists, for example, on fetal/infant mortality that warrants additional investigation, further supporting the selection of this variable (Rice et al., 2017).

Birthing Location

In recent years, planned home births have increased in frequency in comparison to other birth location choices (Grunebaum, 2016). While planned home births are less likely to require medical intervention compared to planned hospital births, the risk of home births remains present (American College of Obstetricians and Gynecologists, 2020). According to the American College of Obstetricians and Gynecologists (ACOG) (2020), a noteworthy risk (two to three times the risk) involved in a planned home birth compared to a planned hospital birth remains. In spite of this risk, women are still choosing home births. In my study, I looked further into the risks associated with the three main birthing locations - home births, hospital births, and birth centers - to better understand who is at greatest risk of adverse birth outcomes and at what point interventions should focus. In a study by Malloy (2010), women who chose home births were more likely to be non-Hispanic, White, multiparous, older, and have a higher level of education. While his was an older study, Malloy provided guidance in my selection of inclusion criteria and control variables for my study.

A professional gathering of experts in medicine and academia concluded with the consensus that planned home births are associated with increased risks in comparison to hospital births and warrant further investigation into these risks (Chervenak & Grunebaum, 2015). This group of experts also agreed it unethical for obstetricians and midwives not to caution women against home births (Chervenak & Grunebaum, 2015). Some researchers have found outcomes in hospital births to be similar for both physician and midwife births and some have even shown midwife births to have better birth outcomes (Chervenak & Grunebaum, 2015). The mixed study findings and vast concerns from the medical community over the safety of births outside the hospital further justify the need for my study, which provides insight into the potential risks and optimal points of intervention to reduce risk.

In Snyder's letter to the editor (2016), she expressed concern over misclassification of negative outcomes because of a lack of detail on birth certificates. Snyder noted that negative outcomes from planned home births are higher than planned hospital births even in spite of this misclassification (2016). These study results differed from other studies – there is still much to learn on this issue.

Initiation of prenatal care

Advice to receive prenatal care is commonly given to pregnant women. Doctors set up a list of routine visits over the course of a woman's pregnancy and for a short time after. Many professionals see this routine as an important component in a healthy pregnancy. But can there be variations to this routine without adverse outcomes? According to Woo et al. (2017), for women who have a healthy pregnancy without known complications, fewer prenatal visits are possible, while still maintaining a healthy pregnancy with positive outcomes. I looked deeper into the importance of prenatal care and its relationship to birth outcomes to better inform women who are at risk of adverse birth outcomes.

In a special section published by the *American Journal of Obstetrics and Gynecology*, Pilliod et al. (2015), compared California mothers who began prenatal care in their first two trimesters of pregnancy with women who delayed care until the third trimester or at birth. Infants born to women who received prenatal care in the final trimester or at time of delivery were at an increased risk of infant and neonatal death (regardless of gestational age of baby) compared to infants born to women who received prenatal care during the first or second trimester of pregnancy (Pilliod et al., 2015). Though a relatively small sample among California women, the authors in this study bolster the concept I have further investigated – a correlation between the initiation of prenatal care and fetal/infant mortality. I investigated this concept with a more robust sample of United States women and looked more specifically at the month prenatal care began, rather than the trimester of pregnancy.

In a study among Latina women in Los Angeles County, California, women who began supplement use later in their pregnancies were more likely to have preterm births (Alfonso et al., 2016). This association was particularly strong for women who were born in the United States. Preterm babies born at less than 37 completed weeks gestation with associated complications were the main culprits for infant mortality in the United States. Among study participants, Hispanic women were less likely than White women to begin prenatal supplements prior to pregnancy. This area may be a target for intervention and education. Among Hispanic women were improved birth outcomes when women began prenatal care early, as opposed to later in pregnancy (Alfonso et al., 2016). This association was not found in White women who were more likely to have a balanced nutritional and overall health status (Alfonso et al., 2016). Early care and intervention have the potential to reduce negative birth and pregnancy outcomes for more at-risk groups of women.

General infant mortality information

Rates of infant mortality in the United States drastically improved from 100 infant deaths per 1,000 population in 1915, to six infant deaths per 1,000 population in 2014 (Jacob, 2016; Kothari et al., 2017). This number showed a gradual, continuous improvement in IMR, but still placed the United States behind other developed nations (Jacob, 2016). Developments in sanitation practices, medical technology, public health initiatives, and infant safe sleep practices were largely responsible for this improvement (Kothari et al., 2017). Disparities still exist among geographical regions, but improvements were substantial when considering numbers from previous decades (Kothari et al., 2017). These persistent disparities help justify the need for further investigation. Looking at the health of a nation through that nation's infant mortality rate is a common practice (Kirby, 2017). As racial disparities in infant mortality rates persist in the United States, research and programs to reduce infant mortality at the local, state, and national level, as well as recent changes to improve insurance coverage, have not been entirely successful in bringing disparities to a halt (Kirby, 2017). Increased efforts in research are needed to reduce these unhealthy disparities and better understand the biological, social, environmental, and psychological aspects of fetal/infant mortality.

ACOG lists criteria recommended in order for a home birth to be a viable option (Grunebaum et al., 2015). Among those criteria are an absence of preexisting maternal diseases, no new diseases since pregnancy, and a singleton pregnancy (Grunebaum et al., 2015). ACOG's recommendations influenced my selection of control variables (pregnancy risk level and singleton birth) for my study (Grunebaum et al., 2015). My controlling for these risks helped highlight the level of inherent risk of having a birth outside a hospital.

Roche et al. (2016), conducted a study among New Jersey births that highlighted the importance of poverty, lack of prenatal care, non-Hispanic Black race, low SES, unmarried status, gestational age, and low birth weight in infant mortality. The study population (New Jersey births) created limitation and a lack of generalizability; however, the authors did provide further guidance and insight into key areas for further research (Roche et al., 2016).

Having a better understanding of factors related to preterm births can help answer questions regarding high rates of infant mortality (Lorenz et al., 2016). According to Lorenz et al. (2016), the following variables were considered to be associated with preterm birth: “maternal smoking, induced-PTB (both non-medically and medically indicated), induced ovulation and artificial reproductive technologies (ART), multiple gestations unrelated to induced ovulation/ART, teen pregnancy and advanced maternal age, maternal obesity and disadvantaged socioeconomic status (SES)” (Lorenz et al., 2016, p. 798).

Improving women’s health before they become pregnant and providing care during pregnancy are important facets of improving fetal/infant mortality rates; however, these points of preventative care may not be sufficient, particularly for women who are younger, have low socioeconomic status or who experience shame or embarrassment as a result of the knowledge of their pregnancy by their familial and/or social environments. For many of these vulnerable groups, standard preconception and prenatal care are not easy choices. Women need a model to address the gaps in appropriate care for them before and during their pregnancies. To better understand how to most effectively develop this model, I looked at the social, biological, and inherent characteristics of three variables that impact fetal/infant mortality in the United States. According to the United Health Foundation (2018), the groups most disproportionately affected by infant mortality include non-Hispanic Black women, families with low SES, unmarried women, women under age 20 and older than age 40, obese mothers, and women who smoke or drink alcohol while pregnant. Many of these factors that increase risk of infant mortality are also associated with my three variables of interest, race and ethnicity, birthing location, and prenatal care. In particular, the social element of these variables was addressed to better understand fetal/infant mortality risk.

Understanding what the data means is an important element of research. Infant mortality statistics show a host of nuances and definitions that make the data what it is. For example, according to Kowaleski (1997), an infant of any gestational age and weight who has been removed from the mother and displays a sign of life such as a heartbeat, pulsing of the umbilical cord, voluntary muscle movement, and breaths, is considered a live birth in all states for birth certificate data purposes. On the other hand, states have more variation in their reporting of fetal deaths (Kowaleski, 1997). For the linked birth/infant death data from NVSS, the generally accepted age of gestation to be included in an infant death certificate is greater than or equal to 20 weeks gestation (Gregory et al., 2014).

Moreover, according to Curtin et al. (2019), state laws differ as to who is responsible for completing and filing infant death certificates. This responsibility lies with physicians, hospitals, other institutions where the fetal death occurred, funeral director, medical examiner, or coroner (Curtin et al., 2019). No standard exists where a fetal death is recognized as one requiring a formal death report (Curtin et al., 2019). In some states all fetal deaths are required to be reported, while in others, fetal deaths are only reported if the fetus weighs greater than or equal to 350 grams or is a minimum of 20 completed weeks gestation (Curtin et al., 2019). The differences in state reporting provide further support for using data files for infant deaths that are over 20 weeks gestation.

Findings in the Current Literature

Race and ethnicity

After PPOR were established among study participants, Kothar et al. noted increased risk of infant mortality among Black individuals that exceeded explanation of differing socioeconomic circumstances alone (2017). The study authors used this information to guide future research to move beyond the single construct of socioeconomic status (SES) and include other variables of interest when seeking to better understand the effects of race on fetal/infant mortality. According to Rice et al. (2017), non-Hispanic Black individuals have an increased risk of mortality for infants one-week-old to infants up to one-year-old, when compared to non-Hispanic White and Hispanic White infants. Roche et al. (2016) added to this research with their study findings - non-Hispanic Black race is a risk factor for infant mortality. Infant mortality can be categorized based on gestational age and infant age, an important aspect of looking at infant mortality because rates of death vary from one category to the next. In particular, neonatal mortality (death occurring in the first 28 days of life) does not have substantial improvements from 2000-2009, as it does in the 30 years prior to that timeframe, even in spite of recent improvements in healthcare resources and some demographic variables (Govande et al., 2015; Patel, 2017). According to Govande et al. (2015), race is a likely underlying risk factor to neonatal morality, as neonatal mortality rates are higher among Black women. Infant mortality is in general, lower for Hispanic infants across racial groups, which demonstrates a protective effect of ethnicity and a possible social aspect of race (Rice et al., 2017). Rice et al. (2017, pg. 1585) use the “Hispanic paradox” concept to explain the protective nature of the Hispanic culture that involves behavioral norms, social norms, diet, lifestyle, etc., at levels varying from the individual to the community. This protection also wanes over time as individuals begin to acculturate into their surrounding culture (Rice et al., 2017). Certain social aspects such as environmental exposures to pollution, toxicants, and violence mediate the effects of race on infant mortality (Rice et al., 2017). Furthermore, discrimination, stress, and other psychological stressors of racial discrimination increase norepinephrine and cortisol production that can lead to corticotrophin-releasing hormone genes being expressed in pregnant women, resulting in increased risk for preterm births (Rice et al., 2017). Kirby (2017) also demonstrated higher infant mortality rates among Black infants compared to White infants in most U.S. states.

A portion of the Black-White infant mortality disparity can be explained by known risk factors such as maternal behaviors and socioeconomic status, and has improved over recent years (Brown Speights, 2017). According to Parekh et al. (2018), part of the disparity noted among Black women resulted from the higher rate of teenage pregnancy among this population, which also has a trend of inadequate or absent prenatal care. Remaining, however, is a portion of the IMR from unknown factors that has not improved (Brown Speights, 2017). In some states with high IMR, local levels have had improvements, indicating the importance of factors other than race or geography alone (Brown Speights, 2017). For my study, I looked also at the effects of both race and ethnicity. As an infant ages from the neonatal phase to the post neonatal phase, different factors affect mortality risk (Brown Speights, 2017). For younger infants, preterm birth, low-birth-weight, congenital defects, and difficulties with the pregnancy are the major contributors to mortality (Brown Speights, 2017). On the other hand, for post neonatal mortality, important risk factors include congenital defects, SIDS, and accidents (Brown Speights, 2017). From preconception throughout the pregnancy and into the formative years of an infant's life, a host of emotional, environmental, social, racial, and structural factors that cannot all be controlled, influence the risk of infant mortality and other adverse birth and pregnancy outcomes (Brown Speights, 2017). Researchers who better understand the influence of race and ethnicity on IMR can then develop models to lessen the burden of infant mortality in the U.S. because some of the variables of influence can be improved (Brown Speights, 2017).

According to Lorenz et al. (2016), it is estimated that social and environmental components between and among racial groups have a far higher impact than biological factors on preterm births. Race is not a function of biology alone, it is an issue of social and environmental factors which create disparity (Lorenz et al., 2016).

Birthing location

A baby’s birthing location continues to have an association with varying results in terms of birth outcomes (Scarf et al., 2018). According to Scarf et al. (2018), the odds of a vaginal birth (versus cesarean delivery) were significantly lower in planned hospital births than other locations. Certain maternal complications were lower among planned home births than birth centers or hospitals, and infant mortality was no different based on place of birth (Scarf et al., 2018). Scarf et al. (2018) showed, through their meta-analysis, no significant difference in odds of stillbirth for place of birth even in multiparous births and births with no known congenital anomalies. Furthermore, these authors demonstrated through analysis, significantly lower odds of neonatal intensive care unit (NICU) admissions for planned home births versus hospital births for singleton and multiparous births, no difference among nulliparous women, and no differences compared to birth centers (Scarf et al., 2018). The authors in the studies in the Scarf et al. (2018) meta-analysis did, however, show demographic differences among study participants. While results of this analysis were optimistic for home births and birth centers, other studies and recommendations differ.

When researchers evaluate birthing location, also important to note, is the type of attendant at these locations. Births can be attended by certified midwives, uncertified midwives, physicians, lay people, and others. Birth outcomes in some studies, such as that by Grunebaum et al. (2016), reflect some of these differences. Grunebaum et al. (2016) learned neonatal mortality rates have no statistically significant difference between certified and uncertified midwives for home births. Also, compared to hospital births with midwives, home births with midwives had higher neonatal mortality rates (Grunebaum et al., 2016). Over the previous several years, the incidence of planned home births has increased. This increase is thought to be associated with increased infant mortality, giving credence to the school of thought that hospital births are a safer choice than home births in the United States (Grunebaum et al., 2016). This school of thought differs from European opinions that births outside the hospital are equally safe (Grunebaum et al., 2016). These differing views are likely, at least in part, because of key organizational differences and requirements among the integrated health systems of Europe - compared to a non-integrated system in the United States where midwives are not under the same requirements and are not equipped with the same support system as those in certain European countries such as England (Grunebaum et al., 2016).

An invaluable source for health and safety recommendations for obstetrics and gynecology, ACOG (2020), suggests the safest places to give birth are hospitals and birth centers with appropriate accreditation. Many women choose home births because of cost savings (Malloy, 2010). Among previous studies, results are varied. Some authors showed higher odds of infant mortality among hospital births, while others showed similar risk among home births (Malloy, 2010).

Kozhimannil et al. (2018) highlighted increasing declines from 55 to 46% among rural counties in the availability of obstetrical services offered by hospitals. The loss of hospital obstetric services was likely associated with an increased risk of preterm birth, a leading cause of infant mortality (Kozhimannil et al., 2018).

According to Walker (2017), maternal and perinatal mortality rates have improved in recent years. These improvements have led to a sense of maternal safety that has contributed to a shift towards women choosing home births (Walker, 2017). Nevertheless, medical professionals warn this practice as unsafe for most women (Walker, 2017). Much of the evidence demonstrating safety for home births stems from European studies (Walker, 2017). In a large study in England, home births were less likely to require medical intervention; however, for nulliparous women who had planned home births, negative perinatal outcomes were more likely (Walker, 2017). In part, these differences from United States studies were likely because of differing types of medical systems (Walker, 2017). Better outcomes in Europe may have resulted from the integrated system of trained midwives and hospitals (Walker, 2017). According to Walker (2017), women who choose a home birth are required to plan their home birth no more than five kilometers away from a hospital in case of emergency. Conversely, the United States lacks this type of integration and easy transfer system, which may result in increased risks for home births (Walker, 2017). In and of itself, home births are not riskier than hospital births (Walker, 2017). Much of the risk lies in the response process that occurs if a problem does arise during labor and/or delivery (Walker, 2017). As deduced by Walker (2017), three main factors most impact birth outcomes, “(1) a delayed decision to seek care, (2) delayed arrival at a healthcare facility and (3) delayed provision of hospital-based obstetric care" (Walker, 2017, pg. 83). Roughly 25 to 35% of pregnant women have had a previous vaginal birth without the need for induction and are considered the lowest risk for adverse events during labor that would necessitate a transfer to a hospital (Walker, 2017). These women are considered good candidates for home births (Walker, 2017).

Swarts et al. (1998) conducted a seminal work to compare the safety of births in a freestanding birth center to births in a hospital. Through the early results of the study, the authors showed similar results for fetal mortality rates between births in the BirthPlace setting and traditional hospital settings (Swartz et al., 1998). These data likely resulted because of the carefully integrated system set in place for the study (Swartz et al., 1998). Results were more favorable when there was an integration between certified nurse-midwives and hospital staff (Swartz et al., 1998). This integration, designed for the study, mimicked that of certain areas of Europe with low rates of infant mortality (Swartz et al., 1998). This type of integration could be a valuable tool in the United States to improve birth outcomes.

Many European countries require certain certifications for midwives before they may attend a home birth (Walker, 2017). Unfortunately, the United States does not hold the same requirements. Many home births are attended by certified nurse-midwives, but still many home births are overseen by individuals lacking qualifications. "The American Congress of Obstetricians and Gynecologists acknowledges that 75% of home births are attended by unqualified individuals" (Snyder, 2016, pg. 295), in part, contributing to worse birth outcomes in planned home births.

Grunebaum et al. (2015) recognized the following four perinatal risk factors associated with planned home births: prior cesarean delivery, birth of twins, pregnancy at or longer than 41 weeks gestation, and breech presentation of the baby. These risks are significantly increased among home births with midwives when compared to hospital births with certified nurse-midwives (Grunebaum et al., 2015). The American College of Obstetricians and Gynecologists (ACOG) and the American Academy of Pediatrics (AAP) have recommendations of standards for midwives who attend births (Grunebaum et al., 2015). In an estimated 65.7% of planned home births, the midwives are not certified by the American Midwifery Certification Board (AMCB), which is recommended by ACOG and AAP (Grunebaum et al., 2015). Furthermore, neonatal mortality rates are higher among planned home births than among hospital births (Grunebaum et al., 2015). Between 98-99% of home births in this study were planned – regardless of whether or not they were attended by a certified nurse-midwife, a certified midwife, or a noncertified midwife, indicating the decision to have a home birth is not likely based on the recommendations of ACOG and AAP alone (Grunebaum et al., 2015). Similar to the list of recommendations of this study, ACOG has a list of criteria that should be met before a planned home birth is recommended as safe (Grunebaum et al., 2015). This vital list includes the following criteria: singleton pregnancy, gestational age between 37 to 40 weeks, head presentation of baby, no prior cesarean delivery, no preexisting maternal diseases, no new disease since pregnancy, spontaneous labor or induced labor as an outpatient procedure, the woman has not been transferred from a hospital, and the midwife is certified by the AMCB (Grunebaum et al., 2015). They also recommend a medical facility nearby that has a plan in place for a patient transfer if necessary (Grunebaum et al., 2015).

Grunebaum et al. (2017) highlighted the increased risk of perinatal and neonatal mortality in planned home births. These authors suggested two additional risk factors be added to ACOG's list of absolute contraindications for women considering a home birth a first-time birth and gestational age of greater than or equal to 41 weeks (Grunebaum et al., 2017). Increased risks for mortality are particularly evident among breech births, births of women who previously had a cesarean delivery, and women with a first-time birth (Grunebaum et al., 2017). Physician-attended hospital births also have an increased risk of neonatal mortality compared to midwife-attended hospital births, likely because births attended by physicians are often with babies who develop complications during birth and need additional expertise (Grunebaum et al., 2017). Some of the factors associated with increased neonatal death for babies delivered at planned home births include neonatal brain damage and infections, which may be a result of a lack of proper system integration between home births and hospitals, particularly in emergent situations (this is likely more to blame than the lack of appropriate certification of midwives) (Grunebaum et al., 2017). In some circumstances (first-time birth or gestation greater than or equal to 41 weeks) births of women over age 35 are at greater risk for neonatal death (Grunebaum et al., 2017). Even in light of these risks, the incidence of home births has increased in the 10 years prior to the 2015 Grunebaum et al.'s study. These somewhat mixed results are difficult to sift through. Ample space remains to learn more about the safety of a home birth or a birth in a freestanding birth center in comparison to a hospital birth.

Initiation of prenatal care

Coopland (1990) added to the foundational thinking on the importance of prenatal care. According to Coopland (1990), prenatal care serves primarily to provide education, nutritional, and general behavioral guidance, rather than medical advice. Prenatal care is a contributing factor to the periodically improved rates of infant mortality, in part, as a result of the educational advice given during prenatal visits (Coopland, 1990). Coopland (1990) used his foundational thinking to help lay the groundwork for why prenatal care is pushed for so much in the United States.

In a Pennsylvania study among pregnant women enrolled in Medicaid, infant mortality rates were higher among racial and ethnic minority women, even when compared to White women with equal poverty levels (Parekh et al., 2018). Other disparities in negative birth outcomes existed among rural versus urban women and among those with differing insurance statuses (Parekh et al., 2018). Through early prenatal care, physicians can help in the identification and treatment of maternal diseases such as gestational diabetes and pre-eclampsia, identification of harmful drug or alcohol use, and recognition of other poor behaviors (Parekh et al., 2018). Identifying and intervening early in these situations can help improve infant mortality rates (Parekh et al., 2018). Neonatal death rates are higher among pregnancies in which the mother begins prenatal care late or not at all (Parekh et al., 2018). Although, and of particular importance here, these death rates are among those who are at increased risk for negative birth outcomes based on their lower income status, possibly skewing the results (Parekh et al., 2018). In Parekah et al.'s study (2018), White women were more likely to begin prenatal care sooner than Black women. Over the past 20 years, disparities within the United States population improved, which paralleled improvements in disparities in prenatal care (Parekh et al., 2018). Furthermore, disparities persisted for quality care among minority populations even when controlling for health insurance and income factors (Parekh et al., 2018).

Knowing why women behave the way they do in terms of prenatal care is critical to the development of models to improve prenatal care use. According to Meyer et al. (2016), women delayed prenatal care for many reasons, including the following: lack of awareness of the pregnancy, denial of the pregnancy, stigma or shame of being pregnant, lack of a belief of the importance of prenatal care, unplanned nature of the pregnancy leading to unawareness, lack of knowledge of the importance of prenatal care early in pregnancy, and shame due to pregnancy in teenage mothers. Other barriers to women seeking care in a timely manner included the inability to find a doctor who met specific personal preferences, difficulty finding a physician close enough to the woman's home, and finding a provider who worked with specific insurance requirements (Meyer et al., 2016).

Authors of a study among 18-21-year-old Latina women in Texas assessed the effects on maternal health and birth outcomes (Torres et al., 2018). In general, women had a positive view of prenatal care, but that outlook did not positively affect prenatal care utilization. AAP and the ACOG, beginning prenatal care in the first trimester of pregnancy and having 14 or more prenatal visits is the standard women should maintain in order to achieve healthy pregnancy and birth outcomes (Torres et al., 2018). Medical professionals generally agree, prenatal care is important for mother and baby. But room for further understanding remains beyond these assertions. The number of visits may not be the most critical component of care. For example, some study results highlight the importance of the length of a prenatal visit (Ickovics et al., 2019). In my study I explored the possibility that the timing of the initiation of prenatal care is an important component to the health of the baby.

According to Wherry (2018), prenatal care and preconception care may be crucial points of intervention for improving infant and neonatal mortality rates. Women who have insurance before they become pregnant are more likely to seek prenatal care earlier in their pregnancy than women who do not have health insurance prior to pregnancy (Wherry, 2018). In Wherry's (2018) research, she also learned low-income women were more likely than higher-income women to have chronic diseases and other health concerns, which further contributed to poor birth outcomes. Cost continues to be an issue when it comes to accessing care. But with some steps such as the ACA, which have begun to alleviate the disparity present for so many women, more women are able to access prenatal care earlier in their pregnancies (Wherry, 2018). For the states that chose to expand Medicaid, women were more likely to access pregnancy health services, which could help women improve their health or plan future pregnancies, thus potentially improving birth outcomes (Wherry, 2018).

In a study by Meghea et al. (2015), in order to better understand the effects of prenatal care on birth outcomes, study authors enrolled women in a pregnancy program. Study authors revealed lower risks of neonatal and post neonatal death for infants of women who began a program to initiate prenatal care by their second trimester and included a minimum of three prenatal visits. The authors did not evaluate women who began prenatal care late, thus limiting the study results. The program used in the study is the Michigan-based Maternal Infant Health Program (MIHP). This program is for Medicaid-eligible women and included home visits and additional prenatal services beyond the standard of care. The study investigators found better birth outcomes as a result of these additional services (Meghea et al., 2015). Important implications of prenatal care have already been learned, yet further understanding is still needed. With my study I looked further into the impact of prenatal care initiation, regardless of frequency, on birth outcomes for women of a spectrum of demographic information.

In a clinical trial, Ickovics et al. (2019) evaluated the effect on birth outcomes of group prenatal care, focusing on health behaviors, social support, and other prenatal care. The study investigators learned preterm birth rates decreased, as did rates of babies who were small for gestational age among women who were in the group prenatal care (Ickovics et al., 2019). The authors of the study also learned the length of a prenatal visit may be more important than the quantity of visits. The social ecology theory was foundational for this study. Multiple levels of influence on health interact with one another – intrapersonal, interpersonal, institutional, community, and societal (Ickovics et al., 2019).

In a study among Healthy Start program participants in Indianapolis, researchers learned some infant deaths could be prevented if education and increased quality of prenatal care were provided to the mother before conception and throughout her pregnancy (Brown et al., 2017). Some of the infant and fetal deaths were related to a variety of factors that were discovered during prenatal care. Many contributing factors to congenital abnormalities often lead to infant and fetal death. Some noteworthy conditions were obesity and diabetes. These concerns could be identified and monitored in prenatal care or preconception care to possibly prevent fetal and infant death. According to the National Center for Health Statistics, congenital abnormalities such as those caused by diabetes and obesity are associated with roughly 20% of infant deaths (Brown et al., 2017). By focusing on better prenatal care and pushing women to supplement with folic acid prior to and during pregnancy, treating with prophylactic doses of progesterone for women who have previously had preterm births, improving maternal weight and pregnancy weight gain, and overall family planning, birth outcomes could improve (Brown et al., 2017).

Both the AAP and ACOG emphasize the importance of receiving prenatal care early specifically, in the first trimester (AAP et al., 2017). These professional entities mostly give recommendations for a standard of care if a woman has had previous pregnancy and/or birth complications. Fewer strict guidelines for women without these previous risk factors exist, leaving a knowledge gap of the importance of the timing of initiating prenatal care for low-risk women (AAP et al., 2017). Also, group prenatal care is gaining popularity and, though it requires further research, is associated with a reduced risk of preterm deliveries (AAP et al., 2017). Through the ACA, more women of reproductive age are insured and have been given the option for prenatal care (Daw & Sommers, 2019). Daw and Sommers (2019), however, did not see differences in maternal and birth outcomes because of this change in availability of care. It is hypothesized that in the coming years improvements in maternal and birth outcomes will be evident as more women seek prenatal care earlier in their pregnancies and continue that care throughout (Daw & Sommers, 2019). The ACA was signed into law in 2010 (Daw & Sommers, 2019). My study sample included women after 2010 to take into consideration this change in the accessibility and affordability of prenatal care (Daw & Sommers, 2019).

Wheeler et al. (2018) noted that women who began prenatal care late were more likely to be Black, young (average age of 29), uninsured, and use tobacco and/or other substances. Moreover, in the state of Oregon, coordinated care organizations (CCOs) were established as a revised component of Medicaid (Muoto et al., 2016). Women who were engaged in these CCOs were more likely to initiate prenatal care earlier (Muoto et al., 2016). Knowing these risk factors helps in targeting further investigation and tailoring future interventions to reduce the disparity of fetal/infant mortality.

General infant mortality information

Infant mortality is impacted by baby’s birth weight and gestational age (Roche et al., 2016). According to Roche et al. (2016), infant mortality in 2007 was 25 times more likely for babies with low-birth-weight (less than 2,500 grams) when compared to babies born with a birth weight greater than or equal to 2,500 grams. Study authors also learned of other risk factors for infant mortality, including the following: mother not having prenatal care, non-Hispanic Black race, low SES, and mother being unmarried (Roche et al., 2016). Overall, poverty and non-Hispanic Black race were important variables in their relationship to infant mortality (Roche et al., 2016), which strengthened my decision to investigate race and ethnicity variables.

In 2013, the United States IMR was 6.0 per 1,000 live births (Lorenz et al., 2016). Specifically, IMR was more than twice as high among Black infants (11.11 deaths per 1,000 live births) as among White infants (5.06 deaths per 1,000 live births) (Lorenz et al., 2016). IMRs for American Indians or Alaska Native infants were also higher (7.61 deaths per 1,000 live births) than those of White infants. IMRs for Hispanic (5.0 deaths per 1,000 live births), Asian or Pacific Islander (4.07 deaths per 1,000 live births) infants were better than that of White infants, bringing to light the likelihood of factors beyond race that influences IMRs (Lorenz et al., 2016). According to Lorenz et al. (2016), improving social conditions and access to quality health care, particularly to individuals of low SES, would alleviate the burden experienced by racial disparity more than other possible points of intervention for the issue of IMR.

In spite of improvements in most racial groups, the mortality rates among Puerto Rican and Mexican infants were especially high from 2005-2014 (Mathews & Driscoll, 2017). A disparity within ethnic and racial groups remains in the United States (Mathews & Driscoll, 2017). In the years 2005 to 2007 and 2012 to 2014, 33 states had improved IMRs and 17 states had no significant changes in IMRs (Mathews & Driscoll, 2017). Around 2013 to 2014, improvements in IMRs either made no changes or only minimal changes throughout the United States (Mathews & Driscoll, 2017). From 2005 to 2014, IMR trends varied among racial and ethnic groups (Mathews & Driscoll, 2017). These inconsistent changes warrant further investigation into other underlying factors that contributed to these trends.

In 2014, the infant mortality rate of 5.82 infant deaths per 1,000 live births was largely comprised of the following 10 causes of infant death:

1. Congenital malformations
2. Complications due to preterm birth and low-birth-weight
3. Maternal pregnancy complications
4. SIDS
5. Accidents (unintentional injuries)
6. Cord and placental problems
7. Bacterial sepsis of infant
8. Newborn respiratory distress
9. Diseases involving the circulatory system
10. Neonatal hemorrhage (Kochanek et al., 2016).

Bhatt and Beck-Sague (2018) compared infant mortality rates in states that adopted the ACA's optional Medicaid expansion with states that did not choose to expand the Medicaid plan and found that from 2014 to 2016, states that chose to expand Medicaid had an improvement in mean IMRs from 5.9 to 5.6 deaths per 1,000 live births. Conversely, states that did not expand Medicaid had an increase in mean IMRs from 6.4 to 6.5 deaths per 1,000 live births (Bhatt & Beck-Sague, 2018). Medicaid services include contraception, pregnancy, maternal, and pediatric care – making Medicaid, or the presence of health insurance in general, an invaluable asset to lessening the burden of infant mortality (Bhatt & Beck-Sague, 2018). Through their analysis, Bhatt and Beck-Sague (2018) demonstrated greater overall improvements in infant mortality from 2010 to 2016 in states that expanded Medicaid compared to states that did not expand Medicaid. Moreover, this effect may be confounded by the regional differences already present among the states (Bhatt & Beck-Sague, 2018). In particular, many of the states that did not expand Medicaid are southern states that already had a disproportionate rate of infant mortality (Bhatt & Beck-Sague, 2018). The states that did expand Medicaid had better infant mortality rates than their counterparts prior to Medicaid expansion, indicating possible variables that were already present and working to improve infant mortality before the ACA began (Bhatt & Beck-Sague, 2018). Regardless, the increased presence of Medicaid throughout the United States likely helped reduce IMRs even when considering other variables that were also improving this burden (Bhatt & Beck-Sague, 2018).

In the 2018 Annual Report from United Health Foundation (UHF), analyses were conducted on infant mortality data from the Centers for Disease Control and Prevention. Researchers identified the following three main causes of infant mortality in 2016: birth defects, low-birth-weight, preterm birth, and SIDS, which together are responsible for almost 45% of deaths in infants under age one in the United States (UHF, 2018). Govande et al. (2015) echoed the conclusion of the importance of premature birth and its associated complications as contributing factors to neonatal mortality. While the UHF

(2018) provided an invaluable report to highlight the major causes of death for infants, it did not look further at the upstream determinants of health, an endeavor I have pursued with my study.

Definitions

Independent Variables

To provide clarification into the subject matter of my study, I have defined the independent variable, dependent variable, and the associated control variables. The independent variable, race and ethnicity, was two descriptive variables recoded from the linked birth/infant death data set into one variable (DHHS, 2016). This combined race and ethnicity variable was used in my study to incorporate important social constructs with racial intricacies. Race alone was defined as, "any one of the groups that humans are often divided into based on physical traits regarded as common among people of shared ancestry" (Merriam-Webster, n.d.-b). Ethnic was defined as, "relating to large groups of people classed according to common racial, national, tribal, religious, linguistic, or cultural origin or background," (Merriam-Webster, n.d.-a). Thus, in my study, ethnicity referred to the Hispanic origins of an individual. The following categories were included in the analysis: non-Hispanic White (only), non-Hispanic Black (only), non-Hispanic AIAN (American Indian or Alaska Native) (only), non-Hispanic Asian (only), non-Hispanic NHOPI (Native Hawaiian or Other Pacific Islander) (only), non-Hispanic more than one race, Hispanic, origin unknown or not stated (DHHS, 2016).

Dependent Variable

The dependent variable, fetal/infant mortality, for my study included fetal and/or infant deaths which occurred before the first 28 days of life. This definition differed from the standard definition of infant mortality, which included any death that occured until the first birthday of a child (Centers for Disease Control and Prevention, Division of Reproductive Health, 2020). This distinction was key to my study, as it was not the typical timeframe used when identifying infant mortality.

Control Variables

To increase the accuracy of my study results, I also included several control variables. The following variables were controlled for in the analysis: birthing location, prenatal care initiation, and pregnancy risk level.

The control variable, birthing location, was defined as the location of the infant's birth that was reported in the linked birth/infant death dataset. Participants in the following categories were included in the analysis for this variable: hospital, freestanding birth center, home (intended), home (not intended), unknown (DHHS, 2016).

The second control variable, prenatal care initiation, was defined as the month of the pregnancy in which the mother begins receiving care related to her pregnancy. The following divisions were analyzed: no prenatal care; months 1-10, unknown or not stated. In some cases, the month prenatal care began was unknown or not stated by the participant and was coded as such. In the dataset, prenatal care was not defined or specified; therefore, the interpretation of what prenatal care included was left to each respondent. As a result, prenatal care may vary from one person to another, but was likely to follow standard prenatal care guidelines. According to the Office on Women's Health, prenatal care is defined as care a woman receives when she is pregnant (2019). I used this definition to define prenatal care.

Pregnancy risk level was defined by the presence (high-risk) or absence (low-risk) of maternal morbidity. Pregnancy risk included two aspects of maternal health - the presence or absence of maternal risk factors and presence or absence of maternal infections. The following risk factors were included in the determination of the presence or absence of risk factors: pre-pregnancy diabetes, gestational diabetes, pre-pregnancy hypertension, gestational hypertension, hypertension eclampsia, previous preterm birth, infertility treatment, fertility enhancing drugs, assisted reproductive technology, and previous cesarean (DHHS, 2017). If the respondent selected at least one risk factor, she was coded as having a risk factor. If the respondent did not select any risk factors, she was coded as not having risk factors. Some respondents were also coded as, Not Reported (DHHS, 2017). The second component of assessing pregnancy risk level was the presence or absence of infections. The following infections were included in the 2017 all-county period linked birth/infant death dataset: gonorrhea, syphilis, chlamydia, hepatitis B, and hepatitis C (DHHS, 2017). If no infections were selected by the respondent, she was coded as having no infections. If the respondent selected one or more infections, she was coded as having an infection present. For my study I combined these two variables, maternal risk factors and infections present, to ascertain whether the respondent was a high-risk level pregnancy (maternal risk factors and/or infections present) or low-risk level pregnancy (no maternal risk factors or infections present).

Other Key Terms

Infant mortality is commonly thought to include infant deaths up to the first birthday of the child (CDC, DHR, 2020). In my study I used the term fetal/infant mortality to provide clarity and specificity on the time period of interest. The fetal/infant mortality period of analysis began at 37 weeks of gestation (the fetal period of interest) and ended after the 27th day of life (the neonatal or infant period of interest). This time period eliminated fetal deaths for preterm infants, which are known to be associated with higher rates of infant mortality, as well as intentionally included the time period when 2/3 of infant deaths less than one-year-of-age occur (OECD, 2019; UHF, 2018). By using this unique period of interest, I was able to learn more about important contributing factors to fetal/infant mortality that have not previously been studied.

I also used length of gestation in my study to rule out births that were preterm, thus contributing substantial, known risk to adverse birth outcomes, as well as those that were post-term (greater than 40 weeks gestation), which conveyed added risk (Grunebaum et al., 2017). For my study, a term pregnancy was defined as being $\geq$ 37 and $\leq$ 40 weeks gestation.

Age of mother categories were based on the 2017 all-county period linked birth/infant death data file. Respondents under age 15 and over age 44 were excluded so as to rule out age categories which had known increased risks to fetal/infant mortality. Likewise, infant births below 2,500 grams (5.5 pounds) were excluded from analysis. A birth weight below 2,500 grams was considered low-birth-weight and was associated with increased risk of morbidity, mortality, and hospitalization (OECD, 2019). Length of gestation was also an important variable to consider. Infants who were considered term were included. Specifically, this time period included 37 to 40 weeks of gestation. This time period was considered low-risk and was best suited for my study (Grunebaum et al., 2015). Excluding these higher-risk infants provided clarity to the results of my study. The following age categories for the mother were used in my study: 15 to 19 years, 20 to 24 years, 25 to 29 years, 30 to 34 years, 35 to 39 years, and 40 to 44 years (DHHS, 2017).

Assumptions

Assumptions were made based on personal beliefs, experiences, and previous research. An important paradigm assumption in my study was an epistemological assumption. This assumption was based on the idea that the researcher is independent or separate from the research. This assumption was evident in my study, as the research itself is not intrinsically connected to me.

One important assumption worth clarifying in this study was the likely positive impact on fetal/infant mortality through the creation of a model to better predict increased risk to fetal/infant mortality. I used insights gained from my study as the foundation for the development of such a model that focused on key social elements that can be addressed in order to reduce the risk of fetal and infant mortality. These key social elements were the independent and control variables previously mentioned. I assumed this model will lead to positive social change. This assumption is key to my study, as it is the driving force for the overarching purpose of it.

One additional assumption in my study was the presence of a social quality in each of the independent and control variables. The independent and control variables were independent from one another while also being connected through similar social elements, which can be explained by the ecological principle. Through an understanding of the ecological principle, these variables were, in part, selected for the manner in which they affect fetal/infant mortality.

Scope and Delimitations

The following research problem was addressed by this study: Do race and ethnicity, birthing location, prenatal care initiation, pregnancy risk level, and insurance status impact fetal/infant mortality?

Internal Validity

The control variables selected for this study were chosen to ensure internal validity of the study results. A researcher includes control variables into a study design to ensure the dependent variable is directly influenced by the independent variable(s), rather than outside influences (the control variables) (Frankfort-Nachmias, 2015). A host of factors impact fetal and infant mortality. By controlling for some of the most prominent influences on the health of mom and baby, prenatal care initiation, birthing location, and pregnancy risk level, I was better able to ascertain the level of influence of the independent and control variables on the dependent variable, and thus provided for greater internal validity.

In developing the research problem, I selected the independent and control variables based on their shared social qualities and levels of influence as highlighted by the ecological perspective (Sallis et al., 2008), as well as their demonstrated influence on fetal and/or infant mortality. Other researchers have explored the connection of these variables, in some form, with birth outcomes. These relationships have provided a foundation for my research and guided my selection of the independent and control variables. Specifically, known disparities exist in infant mortality among racial and ethnic groups (Kothari et al., 2017). In order to better account for the social implications of these disparities, I included ethnicity along with race as an independent variable and improved internal validity by accounting for important individual and community influences that interacted with fetal and infant mortality. Race is an important variable to consider, but myriad other influences related to race can be accounted for by including ethnicity as well.

Another important component of the research problem, birthing location, was selected in part because of the growing social influences which help a woman determine where she will give birth (Walker, 2017). Currently, a shift in the trend on where women choose to give birth is prevalent (Walker, 2017). As we work to lessen the burden of fetal/infant mortality in the United States, will this shift on birthing location preference impact those efforts negatively, positively, or not at all? This issue was addressed in my study. Infant mortality rates are impacted by birthing location, and that influence should not be ignored as we seek to better understand fetal and infant mortality rates (Snyder, 2016). Including this variable helped me increase internal validity for my study.

Another critical element in my research problem was prenatal care initiation. Researchers widely accept that prenatal care has an impact on pregnancies and birth outcomes (AAP, C.F.N., ACOG C.O.P., 2017). My accounting for this influence was also important to the internal validity of my study. In particular, access to prenatal care services has changed in much of the United States in recent years and would likely affect the internal validity of my study if it were not taken into consideration (Wherry, 2018). Knowing this fact, I used a data set from the years after the introduction of the ACA health care changes.

External Validity

With the design of my study, I took into consideration a host of factors and variables which may have affected the external validity of the study results. In order to generate results that were generalizable to the larger population, I employed several key measures. For example, the data set I used in my study included vital statistics data from across the United States. This data included any infant birth or death, thus reducing discriminatory selection procedures. Also noteworthy, infant deaths which occurred after the first 28 days of life were excluded from study, as the first 28 days of life are the most vulnerable in terms of IMR and is the period in which 2/3 of infant deaths occur (OECD, 2019). Furthermore, I put into place several exclusion criteria on the sample population in order to analyze a sample population without major, known risk factors to fetal/infant mortality, which could skew and/or confound the results and reduce generalizability. Two points of exclusion was for high-risk infants who are less than 2,500 grams birthweight and/or were less than 37 weeks gestation or greater than 40 weeks gestation. These criteria helped focus on births from lower-risk infants. Likewise, only singleton pregnancies were considered for analysis, since multiple gestations create an increased risk for adverse birth outcomes (Grunebaum et al., 2015).

To further enhance the generalizability of the sample population and reduce the likelihood that the study results were due to intrinsic characteristics of the study population, the moms who were included fell between the ages of 15 to 44 to further provide a sample without known increased risk factors to adverse birth outcomes.

I analyzed data from the U.S. Vital Statistics All-County Period Linked Birth/Infant Death Public Use File, which provided a large sample population from across the United States and helped improve external validity by creating a robust, generalizable sample (DHHS, 2016). The specific data set was from 2017, which is after questionnaire changes were made in 2003 and after important changes to health care from the ACA in 2014 (Bhatt & Beck-Sague, 2018; Kirby, 2017). This data set provided the most up-to-date information for analysis. Each of these criteria for inclusion in my study contributed to the generalizability of the study results, which was invaluable in my creation of a model to predict fetal and infant mortality.

Some important theoretical concepts related to this subject matter, but were not fully explored in this study. One such concept was that of social networks and social support. This concept of individuals surrounding themselves with a variety of resources, physical, mental, social, appraisal, informational, instrumental, and emotional support, provides insight into how a person’s environment influences her and the choices she makes (Glanz et al., 2008). These resources can impact choices to seek prenatal care and birthing location. These concepts are similar to the ecological model I used as a framework for my study, but they are more focused on proximal relationships and networks, rather than looking further out into distal influences.

One other important theory not addressed in my study is the health belief model (HBM). The HBM is a valuable tool in understanding and predicting why a person behaves the way she does (Glanz et al., 2008). Perceived susceptibility (believing you are in danger of a certain outcome), perceived severity (believing a certain outcome will produce negative consequences for you), perceived benefits (believing a specific behavior will produce beneficial results), perceived barriers (there are certain obstacles which prevent a person from performing specific behaviors), cues to action (there are a variety of mechanisms which can impact your decision to perform a behavior), and self-efficacy (belief in your ability to perform a behavior with success) are constructs of this model (Glanz et al., 2008). The authors of these constructs provide explanation and insight into individual behaviors or lack of behaviors (Glanz et al., 2008). While these concepts can help predict some elements of the variables I used in my study, namely, why a woman chooses a birth location or whether to receive prenatal care or not, these concepts are too limited in scope for my particular study. I looked at both individual and population characteristics and evaluated influences that went beyond personal choices to impact multiple levels of influence.

Albert Bandura recognized the importance of a reciprocal relationship between human interactions and their environment through his development of the social cognitive theory (SCT) (Glanz et al., 2008). The SCT poses that people have certain behaviors that can help them shape their environment, thus affecting how that shaping could lead to social change (Glanz et al., 2008). While Bandura provides a good foundation for understanding the relationship between individuals and their environments, the SCT is limited in scope by not looking more broadly at other levels of influence (Glanz et al., 2008). These individual-environment interactions were important in understanding some aspects of my study, but I investigated other levels of influence as well in order to create a more complete picture of the dependent variable.

Limitations

Studies are often limited by available data, time constraints, and even by the nature of what is being studied. A researcher must decide if these limitations are acceptable and if they will significantly impact the study results. Limitations in my study were primarily related to the available data set. One limitation in my study was in the independent variable, race and ethnicity. Previous data showed race, as reported on death certificates for Black and White infants, as a good representation of reality. However, for other racial groups, data may not be as accurate (Kochanek et al., 2016). The race category options on the data set were relatively comprehensive though and provided the respondent with a variety of options (USDHHS, 2018). There may have been some discrepancy in the respondent's knowledge of racial and ethnic data, but this discrepancy was an acceptable limitation. Race categories used in the data set followed standard categorical divisions as required by the 1997 Office of Management and Budget standards, which regulates the U.S. Census Bureau questionnaires (U.S. Census Bureau, 2020). These standards and rigorous testing added to the strength of this variable and further provided acceptability of any limitations to its use.

A second limitation in my study regarded the control variable, birthing location. It was possible for births to be miscoded, particularly for births of infants who were previously planned to be at home or in a freestanding birthing center. Births outside of hospitals that develop complications and require emergency medical care are typically transported to a nearby hospital. After being transferred, the birth is often coded as a hospital birth. This is a recognized limitation of studies that evaluate place of birth (Grunebaum et al., 2016). Though this may still be a concern for use of my dataset, a clarifying question in the questionnaire helped alleviate some of this threat to validity. The data set contained a question of birth location intent in order to determine if the birth location was the respondent’s planned place of birth (USDHHS, 2018). This question did provide clarity on the issue, but was not a perfect solution. It was possible for a respondent to specify their intent based on faulty recall or what they deemed a socially acceptable answer, particularly for instances in which the birth resulted in complications. This limitation was noteworthy, but an acceptable weakness in my study.

Study Biases

One possible bias worth mentioning is response bias. A response bias can occur when a study participant answers a sensitive question based on how they perceive the nature of that question. For example, sensitive questions on the questionnaire included information regarding the mother having a sexually transmitted infection or another illness. Some other personal health information in the data set could also fall within this type of bias. Additionally, personal information about race and ethnicity, or even baby’s place of birth could be sensitive and susceptible to response bias. One way this was overcome in my study was through the use of a questionnaire with a long-standing history of testing and use. The Vital Statistics data sets are available online beginning with 1995 (USDHHS, 2018). Small changes to questionnaires were made in 2003, but were not substantial enough to negate the quality of this instrument (Kochanek et al., 2016). Birth and death certificates in the United States remain largely unchanged, thus reducing the likelihood of introducing threatening or sensitive language.

Recall bias was also a possibility in my study. Mothers who have recently undergone childbirth, resulting in a live or stillbirth, might be influenced by their exhaustion, hormones, environment, social cues, or otherwise, when providing information for birth certificates. This is a particular concern for women who have complications during labor and delivery or who have a negative birth outcome. This bias was overcome as much as possible by the simple, direct nature of the questionnaires. Birth and death certificates are standard and expected in the event of an infant birth or death. There are often medical personnel present who can assist in this process as well, providing comfort and, potentially, improved recall for those mothers who might be experiencing trauma.

Significance

Potential Study Contributions to Advance Knowledge

The research problem in this study, Do race and ethnicity, prenatal care initiation, birthing location, and pregnancy risk level impact fetal/infant mortality rates?, was answered through carefully executed statistical analyses. As laid out in the literature review section of this paper, a host of information exists from credible resources on the issue of fetal and infant mortality. Nevertheless, while researchers have learned much on this topic, unknowns still remain. For example, why do disparities among racial groups persist in spite of efforts to reduce them? To what degree is it safe for women to have home births? If a mom begins prenatal care at the end of her pregnancy, will the result be a greater risk for fetal or infant mortality? These questions and others were answered within the bounds of this study. One important benefit of using the Vital Statistics data was the results were based on a large sample of infant births from across the United States, which heled me create generalizable results. The vast majority of studies on fetal and infant mortality conducted in the United States are confined to a particular state or subset of the population. These study authors provide a foundation and direction for future research, but results are not always generalizable to the greater population. Through my research, I broadened the scope of fetal and infant mortality to provide increased understanding of why fetal and infant mortality rates remain as high as they do in the United States. Furthermore, I specifically looked at infant births from term infants, which adds to the knowledge of why mortality rates are so high for babies with no known risk factors.

Potential Study Contributions to Advance Practice and Create Social Change

Through increased knowledge on fetal and infant mortality risk factors, I have developed a model by which we can better predict fetal and infant mortality. With the results from my study, I have provided a better understanding of possible associations among the variables of interest. I have provided an enhanced understanding of how inherent and chosen characteristics of a mother impact fetal and infant mortality, thus informing the development of a model by which we can adjust best practice and reduce incidence of fetal and infant mortality in the United States. With added knowledge on key contributing factors to fetal and infant mortality, altering current recommendations for preconception and prenatal care in order to improve birth outcomes will be possible.

Fetal and infant mortality rates have improved in recent years, but they consistently fall above other developed nations (OECD, 2019). Women are increasingly choosing home births over hospital births and go one step further to increase their risk of adverse birth outcomes by using unqualified attendants (Grunebaum et al., 2015; Snyder, 2016). Black women begin prenatal care later than White women, possibly increasing the disproportionate burden of fetal and infant mortality on Black infants (Parekh et al., 2018). Women should be made aware of factors which increase their risk for adverse birth outcomes. This knowledge should move from data analysis to model development, best practice development, and to information dissemination in the public. What would it look like if we could decrease the incidence of fetal and infant mortality? Social change through fewer fetal and infant lives lost is a goal for which we should strive. The model I have developed has the potential to achieve this positive social change.

Summary and Conclusions

Major Themes Found in the Literature

The United States is a well-developed nation with exceptional medical technology. In spite of our medical advances, however, fetal and infant mortality rates remain at unacceptably high levels (OECD, 2019). One important theme throughout the literature is the persistent disparity in fetal and infant mortality among racial groups (Parekh et al., 2018). If a disparity persists in groups of people who have similarities within those groups, group characteristics likely exist which can explain that disparity.

Study authors continue to point to the need to reduce the disproportionate burden felt by minority racial groups.

A theme found in the literature worth mentioning is the importance of prenatal care to the health of the baby and mother. Standard prenatal care is recommended for pregnant women and is known to have substantial benefits. Conversely, a lack of prenatal care is thought to contribute to adverse birth outcomes (Brown et al., 2017). Even in spite of efforts to improve access to care and encourage women to seek care soon after the initiation of a pregnancy, incident cases of fetal and infant mortality remain.

Another noteworthy theme found in the literature is the increasing notion in the United States population that home births are an acceptably safe alternative to giving birth in a hospital or birthing center. Among medical professionals, though, hospital births are still seen as the safer option (Malloy, 2010). A disconnect exists between the concerns in the medical community and practices of many women. Increasingly, women are choosing home births over hospital births, but at what cost (Walker, 2017)? Decisions of birth location should be made with full knowledge of the most up-to-date research findings.

Summary of Literature: Addressing the Gap

Regarding fetal/infant mortality risk factors, researchers have provided valuable insights as well as areas that need further research. Regarding race, authors Parekh et al. (2018) highlighted the higher incidence of pregnancies among teenage girls within Black communities compared to White communities. This younger population of pregnant girls experienced less access to proper preconception and prenatal care, possibly contributing to an increased risk for adverse birth outcomes among Black infants (Parekh et al., 2018). Also, we know prenatal care is related to better fetal and infant birth outcomes. What is less well known is the impact of the timing of that care. In a study conducted in California, authors highlighted worse neonatal and infant outcomes when prenatal care was initiated in the second or third trimester of pregnancy (Pilliod et al., 2015). Another author brought attention to the importance of early prenatal care initiation in combination with a minimum number of care visits (Meghea et al., 2015). These studies and others provided a foundation for the importance of prenatal care. What is lacking from these studies was a more comprehensive picture of the impact of prenatal care timing. I addressed this gap and broadened the focus by analyzing data from women across the United States and looked more specifically at the month of pregnancy in which the mother began prenatal care. My data analysis was not limited to the state level, but I also utilized national data to produce results that are generalizable. Additionally, by looking at the month the mother begins prenatal care rather than the trimester, I had a deeper understanding of how prenatal care impacts fetal and infant health at specific stages of development, thus filling in the gap in the literature on more intricate ways in which prenatal care plays a role in a pregnancy.

While the debate on the safety of various types of birthing locations continues, some commonly accepted information on risk factors is found throughout the literature. For example, according to the ACOG, the following criteria should be met before a home birth is considered: singleton pregnancy, gestational age between 37 to 40 weeks, head presentation of baby, no prior cesarean delivery, no preexisting maternal diseases, no disease new since pregnancy, the labor is spontaneous or induced in an outpatient procedure, no hospital transfer, and the midwife is certified by the AMCB (Grunebaum et al., 2015). What still remains to be known is why a home birth, for a low-risk woman, can result in fetal or infant mortality. While the conditions recommended by ACOG may be met, the outcome might still be negative. Medical professionals also conclude a need for a better understanding of the increased risks associated with home births (Chervenak & Grunebaum, 2015). I addressed this unknown by looking more closely at other potential risk factors at multiple levels of influence.

In much of the literature, authors focus on the safety of using a certified midwife compared to a noncertified midwife, or on the safety of a hospital birth versus a home birth (Grunebaum et al., 2015). Far less information exists on the safety of freestanding birth centers. For this reason, I included this birth location in the analysis to better understand risks and/or benefits associated with this unique setting.

Widespread information throughout the literature exists on risk factors which contribute to infant mortality. For example, the following risk factors are generally known: maternal obesity, low SES, Black race, mother’s age below 20 or above 40, tobacco use, alcohol consumption, low-birth-weight, and more (UHF, 2018). A disconnect with knowing this information and putting it together remains an improved best practice policy that effectively eliminates fetal and infant mortality in preventable cases. Using the results of my study, I have developed a model to help predict pregnancy outcomes and reduce the unnecessary burden of fetal/infant mortality. By including the variables selected in my study, I further aimed to fill this gap in knowledge and practice by addressing missing elements of the overall risk for fetal and infant mortality for low-risk births. This complex issue with multiple upstream determinants remains. Programs in place address some risks, but not all. Perhaps by focusing on different risks, the burden of fetal and infant mortality can be lessened.

Researchers have laid a great foundation and have provided direction into gaps which remain in this issue of fetal and infant mortality. Through a quantitative, cross-sectional cohort study, I have sought to address some of these gaps in order to improve birth outcomes for women across the United States. The analytical strategies I used allowed me to look further into possible associations among mother's race and ethnicity, birthing location, prenatal care initiation, pregnancy risk level, and fetal/infant mortality. I included several control variables in the study in order to ensure internal and external validity of the study results. I used following study control variables: prenatal care initiation, birthing location, and pregnancy risk level. I used secondary data from the U.S. Vital Statistics all-county period linked birth/infant death records from 2017 to evaluate these possible associations (USDHHS, 2018).

Section 2: Research Design and Data Collection

Introduction

The purpose of this quantitative study was to explore, through the lens of the ecological perspective, the degree to which race and ethnicity are associated with fetal/infant mortality rates. Variables I controlled for included birthing location, prenatal care initiation, and pregnancy risk level. I selected the sample among fetal and infant births and deaths in 2017 in the U.S. Vital Statistics database.

I developed the following research question and hypotheses to better explore possible associations:

RQ: What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest?

H_0: There is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

H_A: There is an association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

The population of interest included women who gave birth in 2017 to a term infant, live in the contiguous United States, Alaska, Hawaii, or D.C., are ages 15 to 44, and have a singleton birth with no known congenital anomalies.

I used secondary data from the U.S. Vital Statistics dataset for this study, specifically, All-County Period Linked Birth/Infant Death Records for the year 2017, as this year included the most complete and up-to-date data for the variables of interest (USDHHS, 2018). Data were composed of the 57 vital statistics jurisdictions available (USDHHS, 2018). Inclusion criteria for this study were as follows: women ages 15 to 44, singleton births that were ≥ 37 weeks gestation and ≤ 40 weeks gestation, fetal and infant deaths of less than 28 days of life, births with no known congenital anomalies, and women who resided in the 50 United States and D.C.

Considering one dependent variable, one independent variable, and multiple control variables, I conducted a binomial logistic regression analysis. Specifically, I carried out logistic regression and calculated odds ratios to look at the association between a single categorical, dependent variable: fetal/infant mortality, and multiple independent variables (including control variables): race and ethnicity, prenatal care initiation, birthing location, and pregnancy risk level.

The culmination of this research is a model by which fetal/infant mortality can be better predicted, thus improving intervention and outreach efforts. Social justice is an important element of public health. I will use what I have learned to improve social justice in the United States.

Research Design and Rationale

Study Variables

The dependent variable in this study was fetal/infant mortality. The independent variable was race and ethnicity. The control variables were prenatal care initiation, birthing location, and pregnancy risk level.

Research Design and Connection to Research Questions

The study design was a cross-sectional cohort design using a sample of infant births and deaths from U.S. Vital Statistics data. Through the research question, I explored the association between race and ethnicity and fetal/infant mortality. I used a cross-sectional approach to look at a group of people from a section in time, in this case, the year 2017. The population included a variety of characteristics, which was ideal in achieving study generalizability. Furthermore, the study population was also a cohort due to the selection criteria. Certain infant/fetal births and deaths were excluded based on known risk factors for mortality.

There were no known time or resource constraints associated with this design choice. The design choice was well suited for a secondary analysis. This particular design choice was appropriate in advancing knowledge in the discipline of maternal and infant health. The participants were varied in their demographic characteristics, which makes this study applicable to the broader population. I used a cross-sectional study design to develop explanatory results, which assisted in filling gaps in the knowledge of high fetal/infant mortality rates in the United States.

Methodology

Population

The target population included women ages 15 to 44, singleton births in 2017 that were ≥ 37 weeks gestation and ≤ 40 weeks gestation, fetal and infant deaths in 2017 of less than 28 days of life, births with no known congenital anomalies, and women who resided in the contiguous United States, Alaska, Hawaii, and D.C. The approximate target population size from the original data set was four million infant births and 22 thousand fetal/infant deaths. Additionally, some of the infant deaths included birth years in 2016.

Sampling Procedures for Original Data Set

The original data set did not contain a sampling technique but included the entire population of live infant births and infant deaths (less than 1 year of age) of infants in the United States in 2017 and some infant deaths to infants with a birth year of 2016 (USDHHS, 2018). Data were composed of birth and death certificate data.

To be considered an infant death, the infant had to be less than 356 days of age (USDHHS, 2018). The death certificates were linked to the corresponding birth certificates in the linked birth/infant death files. States that had fewer than 10 infant deaths were excluded from inclusion in the data set (USDHHS, 2018).

Public use files are available on an aggregate level. To gain access to individual level data (all-county period linked records) I submitted an application to the National Center for Health Statistics. I completed a data use agreement with study information including the title and nature of the study, faculty advisor information, and my information. Once the application was reviewed and approved, data were available to me through a temporary location. Permissions were granted for me to download the requested data after I provided sufficient description of safeguards to maintain data security. University IRB approval was also given me before the data were downloaded.

Source Reputability

The National Center for Vital Statistics is the standard for reporting of birth and death certificate data. Though minor adjustments to birth and death certificates have been made over the years, these forms have largely remained consistent. This consistency provides the most complete, available data for births and deaths of infants of mothers who reside in the United States, making this sample fitting for my study. This is the largest, most complete sample of this nature within the United States.

Power Analysis

I used G*Power Software to calculate power and sample size (Faul et al., 2007). I used logistic regression for a categorical predictor (categorical predictor is race and ethnicity, white used as baseline as this was the majority of the population sample). With this information, I tested whether the dependent variable was a significant predictor of a binomial outcome (fetal/infant mortality), with or without other covariates.

I used a power of 80% and alpha level of .05 to follow with convention for these values. I used an effect size converter with a medium level effect size of Cohen's d =.5 to calculate an odds ratio of 2.477 (Faul et al., 2007). Using G*Power Software (Faul et al., 2007), I used these values to calculate an estimated minimum sample population of 335 participants.

Instrumentation and Operationalization of Constructs

Birth and death certificates have been used in the United States for decades. These instruments have been updated and revised over the years. New recommendations were made for the most recent revisions in 1999 by a panel of experts and the changes were then tested (Centers for Disease Control and Prevention. National Center for Health Statistics. Division of Vital Statistics, Reproductive Statistics Branch, n.d.). These birth and death certificates are used for all infant births and deaths in the United States and are particularly appropriate for my study. The data needed for my study included data from these instruments and provided the most robust population sample available, making them the best options for use in my study in order to generate statistical significance.

Operationalization for Variables

Dependent Variable

The variable fetal/infant mortality included fetal and/or infant deaths which occurred before the first 28 days of life for a term infant who was ≥ 37 weeks gestation and ≤ 40 weeks gestation. Mortality divisions for inclusion in analysis included the following: Under 1 hour, 1 to 23 hours, 1 to 6 days, and 7 to 27 days (late neonatal). I excluded any deaths over 27 days in order to eliminate deaths which may have occurred due to accidents for older infants. Moreover, the first 28 days of life are the most vulnerable in terms of IMR and is the period in which 2/3 of infant deaths occur (OECD, 2019). I considered this vulnerable timeframe as I developed the mortality timeframe of my study. I used the category of live births as the baseline for my study and compared it against non-live births in analysis. The resulting variable I used in analysis was a dichotomous variable.

Independent Variable

The independent variable, race and ethnicity, was a single, categorical, descriptive variable that included characteristics of both race and ethnicity in order to include social characteristics important to this study. Race alone is defined as, "any one of the groups that humans are often divided into based on physical traits regarded as common among people of shared ancestry" (Merriam-Webster, n.d.-b). Ethnic is defined as, "relating to large groups of people classed according to common racial, national, tribal, religious, linguistic, or cultural origin or background," (Merriam-Webster, n.d.-a). Thus, in my study, I used ethnicity to refer to the Hispanic origins of an individual. The following categories were included in the analysis: non-Hispanic White (only), non-Hispanic Black (only), non-Hispanic AIAN (American Indian or Alaska Native; only), non-Hispanic Asian (only), non-Hispanic NHOPI (Native Hawaiian or Other Pacific Islander; only), non-Hispanic more than one race, Hispanic, origin unknown or not stated (DHHS, 2016). Because White was the majority of the population sample, I used it as the baseline comparison group.

Control Variables

Birthing location was a categorical variable and was defined as the location at which the mother gave birth to the baby. This location was ascertained through the variable, Birth Place (Revised), in the original data set. The following response options were analyzed from the original data set: Hospital, Freestanding Birth Center, Home (intended), Home (not intended), Home (unknown if intended), Clinic/Doctor’s Office, Other, Unknown.

The second control variable was prenatal care initiation. According to the Office on Women’s Health (2019), prenatal care is defined as care a woman receives when she is pregnant. I used this definition to define prenatal care. This variable was a nominal variable and included the following responses: no prenatal care, month prenatal care began (01 – 10), unknown or not stated.

The third control variable, pregnancy risk level, was a dichotomous variable and was defined as low-risk (0) and high-risk (1). Pregnancy risk level was defined by the presence (high-risk) or absence (low-risk) of maternal morbidity. Pregnancy risk included two aspects of maternal health: the presence or absence of maternal risk factors and presence or absence of maternal infections. I included the following risk factors in the determination of the presence or absence of risk factors: pre-pregnancy diabetes, gestational diabetes, pre-pregnancy hypertension, gestational hypertension, hypertension eclampsia, previous preterm birth, infertility treatment, fertility enhancing drugs, assisted reproductive technology, and previous cesarean. On the original data set I used the variable, No Risk Factors Checked, (True, False, Not Reported) to assess presence or absence of maternal risk factors. For the presence of maternal infections, the following infections were included: gonorrhea, syphilis, chlamydia, hepatitis B, and hepatitis C. I used the variable, No Infections Checked, (True, False, Not Reported) to assess presence or absence of maternal infections.

I also used responses of 1-True for, No Risk Factors Checked, in combination with responses of 1-True for, No Infections Checked, to label those women who were low-risk (0). Responses of 0-False for, No Risk Factors Checked, were used in combination with responses of 0-False for, No Infections Checked, for me to label those women who were high-risk (1). I used these two responses to create the dichotomous variable, Pregnancy Risk Level.

Data Analysis Plan

Data Cleaning and Missing Data

I used SPSS software for all data analyses. The data were received in two large text files. The smaller file, the mortality file, included all fetal/infant deaths in 2017 of infants up to one year in age. I copied this file into an Excel document and any variables which were not needed for analysis were removed. I then renamed usable variables and exported them into SPSS, where I gave value labels to each variable.

For the larger natality file, the file was too large to import in its entirety. I cut the file into seven smaller files and imported them into Excel files. I removed unnecessary variables and appended them into the SPSS mortality file. I gave value labels to each variable.

For both the mortality and nativity files, I did not include missing values in analysis. I only included cases with complete records. In order to further narrow down the population of interest, I specified inclusion criteria in SPSS. I used the following criteria: mothers between ages 15 to 44, full-term infants between 37 and 40 weeks gestation, singleton births, births with no known congenital anomalies, infant deaths up to 28 days of life, and infant birth weights between 2500 to 8165 grams.

Research Question and Hypotheses

RQ: What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest?

H_0: There is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

H_A: There is an association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

The population of interest included women who gave birth in 2017 to a term infant, live in the contiguous United States, Alaska, Hawaii, or D.C., are ages 15 to 44, and have a singleton birth with no known congenital anomalies.

Statistical Tests and Associated Assumptions

The statistical test I used to test the hypotheses was binomial logistic regression. When using logistic regression for cohort data, I made five important assumptions. According to Szklo and Nieto (2017), the initial following two assumptions were needed: no further follow-up for study participants was necessary and the timing of the outcome was inconsequential. A third assumption for this analysis was the resulting odds ratios would result in a linear increase in the logarithmic odds according to the incremental increase in the independent variable (Szklo & Nieto, 2007). Assumption number four, the dependent variable was dichotomous. The fifth assumption was there was more than one independent variable, which could be continuous or categorical.

Testing the Assumptions

The first assumption, no necessary follow-up, was satisfied due to the nature of the instruments I used. If no infant death certificate was linked to the birth certificate, that data point was finalized and no further information was needed. Likewise, fetal/infant death was the outcome of interest and once a fetal/infant death certificate was linked to a birth certificate, no other follow-up was necessary for my study parameters.

In many studies, participants are recruited over an extended period of time, which provides opportunity for a loss of follow-up. My study participants were over the span of one year and the deaths were only included for those infants who died less than 28 days after their birth, which limited the follow-up timespan and reduced the likelihood of the violation of the timing of follow-up assumption. This was also not likely to be violated due to the standard reporting procedures for a fetal/infant death.

To test the third assumption, I calculated the odds ratios. The results demonstrated a log odds scale across the range of values for the dependent variable. For example, as infant mortality increased, so should each of the independent variables, on a log scale. Since the independent variable, race and ethnicity, was considered dichotomous, this assumption was less stringent.

To test the forth assumption, I ensured the dependent variable was dichotomous. The dependent variable, fetal/infant mortality, contained two groups – non-live birth and live-birth, thus satisfying this assumption. I tested the fifth assumption by evaluating the number of independent variables. There were four independent variables, race and ethnicity (nominal), prenatal care initiation (nominal), birthing location (nominal), and pregnancy risk level (nominal).

Actions for Violated Assumptions

If the aforementioned assumptions were violated, different statistical procedures should be conducted. Further, if the frequency of the dependent variable (fetal/infant mortality) was > 10% or 20%, this would be considered high and would result in the odds ratios being biased, thus inflating the association between the dependent and predictor variables (Szklo & Nieto, 2007). As a result, different statistical techniques would need to be used. For example, the log-binomial regression model might be implemented to give a more precise estimate of incidence or prevalence rate ratios (Szklo & Nieto, 2007).

Rationale for Inclusion of Confounding Variables

I selected the confounding variables in this study largely after a search through the literature on fetal/infant mortality risks. I used the ecological perspective to frame the study parameters as well. The ecological perspective highlighted the importance of including variables from multiple levels of influence, which accounted for the multiple levels of influence of the selected confounding variables. Fetal/infant mortality was influenced by social, biological, environmental, policy, and other variables. Prenatal care initiation, birthing location, and pregnancy risk level are all variables that took into consideration these multiple influences, were measurable through the instruments I used for this study, and were demonstrated to impact fetal/infant mortality to varying degrees, as seen in the literature, thus making them fitting as confounding variables.

How Results will be Interpreted

I interpreted the results through the use of odds ratios. I used a baseline category of each of the four independent variables and compared them against values which were statistically significant to calculate associated odds ratios.

Threats to Validity

Types of Validity Addressed

External Validity

To address possible threats to external validity in my study, I used a binomial logistic regression approach to the analysis. Through this approach, I took into consideration that multiple variables (the control variables) may alter the relationship seen between the independent and dependent variable. I used logistic regression to look at a dichotomous outcome, fetal/infant mortality, and its relationship to a categorical, independent variable, race and ethnicity, and the possible impact of control variables. I selected the control variables, in part, for their likely impact on the dependent variable. This inclusion and consideration in the data analysis helped alleviate issues with external validity.

Another possible threat to validity is reactive arrangements. This threat occurs when the setting in which the surveys or experiments are conducted differs from a natural setting in which the researcher aims to generalize results (Frankfort-Nachmias et al., 2015). Birth and death certificates are given for each case of a birth and infant death, typically in the birth location and at the location of the death or the medical facility in which the death was attended. These locations were not altered for the study sample and thus are able to be generalized to the natural setting.

Internal Validity

Much of the threat to the internal validity of this study was resolved in the manner in which the study sample was obtained. The sample population consisted of a population sample of birth and death records, which alleviated issues with intrinsic factors related to the collection of study participants. Because this was a cohort study, there were no selection-maturation concerns between experimental and control groups or possible issues with randomization errors. All study participants were evaluated under the same inclusion criteria from one large population sample. This also removed the possibility of regression artifact, because cases and controls were not assigned. Furthermore, there was no concern with instrumentation in my study due to the nature of the instruments used. The instruments, birth and death certificates, differed from a pretest-posttest design in that the birth and death certificates measured different outcomes, rather than testing for the changes in the same variables over time as in a pretest-posttest design.

Construct Validity

Construct validity was ensured by using an instrument which measured what is actually intended to measured. In my study, the instruments used were birth and death certificates. These instruments have been widely used for decades and do well to provide actual measurements of birth and fetal/infant deaths. As was previously discussed, not all states recognize fetal deaths if they are under 20 weeks gestation (Gregory et al., 2014). Because the inclusion criteria for my study only considered fetal/infant deaths for full-term infants (37-40 weeks gestation), this instrument did well to measure fetal/infant deaths. As such, the concern of construct validity was addressed in my study.

Ethical Procedures

The data received did not contain any personal identifiers, thus protecting the privacy of the sample population. The data were stored on an encrypted, password protected computer that remained in a locked office. I am the only person who had access to the data and did not attempt to link any of the data with individually identifiable records from any other NCHS or non-NCHS data set, per the data use agreement. Furthermore, any state that contained fewer than 10 births or deaths was not included in analysis. All data will be securely stored for two years and then deleted. Upon completion of data deletion, I will notify the Division of Vital Statistics. No other ethical considerations exist for this data set.

Summary

The purpose of this quantitative study was to explore, through the lens of the ecological perspective, the degree to which race and ethnicity are associated with fetal/infant mortality rates. The dependent variable in this study was fetal/infant mortality. The independent variable was race and ethnicity. Control variables that were included were prenatal care initiation, birthing location, and pregnancy risk level.

The study design was a cross-sectional cohort design and utilized a sample of births and fetal/infant deaths from U.S. Vital Statistics data. The target population included women ages 15 to 44, singleton births in 2017 that were $\geq$ 37 weeks gestation and ≤ 40 weeks gestation, fetal and infant deaths in 2017 of less than 28 days of life, births with no known congenital anomalies, and women who resided in the 50 United States and D.C.

I used SPSS statistical software to perform binomial logistic regression on a dichotomous outcome (fetal/infant mortality). I calculated odds ratios for the four predictor variables (race and ethnicity, prenatal care initiation, birthing location, and pregnancy risk level). Furthermore, I used robust statistical procedures to evaluate possible associations among the variables of interest.

Section 3: Presentation of the Results and Findings

Introduction

Study Purpose

The purpose of this quantitative study was to explore, through the lens of the ecological perspective, the degree to which race and ethnicity are associated with fetal/infant mortality rates.

Research Question and Hypotheses

RQ: What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest?

H_0: There is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

H_A: There is an association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

The population of interest included women who gave birth in 2017 to a term infant, live in the contiguous United States, Alaska, Hawaii, or D.C., are ages 15 to 44, and have a singleton birth with no known congenital anomalies.

Accessing the Data Set for Secondary Analysis

The total population sample size after inclusion criteria were met was 3,003,533 births and 1,681 fetal/infant deaths. The dataset was composed primarily of births and infant deaths from 2017. Of the sample population, 99.9% of births were in 2017, 0.1% of births were in 2016 (these were included because the files were linked to fetal/infant deaths in 2017). Of the birthing locations of interest, 98.4% were hospital births, 0.5% were freestanding birth center births, 0.7% were home (intended) births, 01% were home (not intended) births, 0.1% were home (unknown if intended) births, and 0.1% were classified as other for location (Table 1). Almost the entire sample population fell within the ages of 15 to 44, at 99.7% of mothers (Table 5; National Center for Health Statistics, 2017).

The division of race and ethnicity among the sample population was as follows: 51.5% non-Hispanic White (only), 14.6% non-Hispanic Black (only), 0.8% non-Hispanic AIAN (only), 6.4% non-Hispanic Asian (only), 0.2% non-Hispanic NHOPI (only), 2.1% non-Hispanic more than one race, 23.4% Hispanic, 0.9% origin unknown or not stated (Table 2). Descriptive statistics for the control variable, prenatal care initiation, included the following percentiles: 1.8% no prenatal care, 6.1% care initiation in month 1, 39.1% care initiation in month 2, 30.0% care initiation in month 3, 8.8% care initiation in month 4, 4.5% care initiation in month 5, 2.7% care initiation in month 6, 2.2% care initiation in month 7, 1.6% care initiation in month 8, 0.6% care initiation in month 9, 2.6% unknown or not stated (Table 3; NCHS, 2017).

The control variable, pregnancy risk level, combined the variables maternal risk factors and maternal infections to create a dichotomous variable in which the mother was classified as being low-risk or high-risk. In this recoded variable, 67.7% of mothers were low-risk, 32.0% were high-risk, and 0.3% were missing values (Table 4; NCHS, 2017).

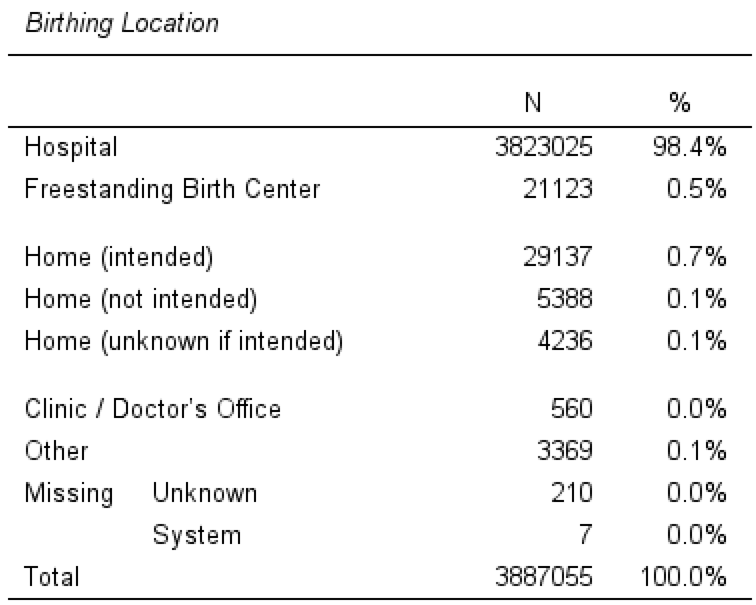
The sample was a good representation of the larger population. After inclusion criteria were met, the remaining sample population maintained the same proportions of demographic characteristics seen in the population.

In the univariate results, the dependent variable, fetal/infant mortality, was analyzed with the independent variable, race and ethnicity. Mother's race and ethnicity was the predictor and I used non-Hispanic White (only) as the baseline comparison group. From this analysis, the following race and ethnic groups were statistically significant: non-Hispanic Black (only) (.000 sig), non-Hispanic Asian (only) (.002 sig), Hispanic (.001 sig), and origin unknown or not stated (.006 sig). Each of these used a $p < .05$.

For non-Hispanic Black (only) mothers, an Exp(B) value of 1.268 was calculated. This value was used to calculate an estimated odds ratio (OR) of a 26.8% increase, demonstrating non-Hispanic Black (only) mothers are 26.8% more likely than non-Hispanic White (only) mothers to have a pregnancy result in fetal/infant death. For non-Hispanic Asian (only) mothers, an Exp(B) value of 0.701 was calculated. This value was used to calculate an estimated OR of a 29.9% decrease, demonstrating non-Hispanic Asian (only) mothers are 29.9% less likely than non-Hispanic White (only) mothers to have a pregnancy result in fetal/infant death. Mothers who were Hispanic had an Exp(B) value of 0.802. This value was used to calculate an estimated OR of a 19.8% decrease, demonstrating Hispanic mothers are 19.8% less likely than non-Hispanic White (only) mothers to have a pregnancy result in fetal/infant death. Lastly, for mothers with origin unknown or not stated, an Exp(B) value of 1.785 was calculated. This value was used to calculate an estimated OR of a 78.5% increase, demonstrating unknown or not stated mothers are 78.5% more likely than non-Hispanic White (only) mothers to have a pregnancy result in fetal/infant death. These results demonstrate a need for inclusion of appropriate control variables to more clearly understand how the predictor variables provide clarity to fetal/infant mortality.

Table 1

Frequencies of Birthing Locations

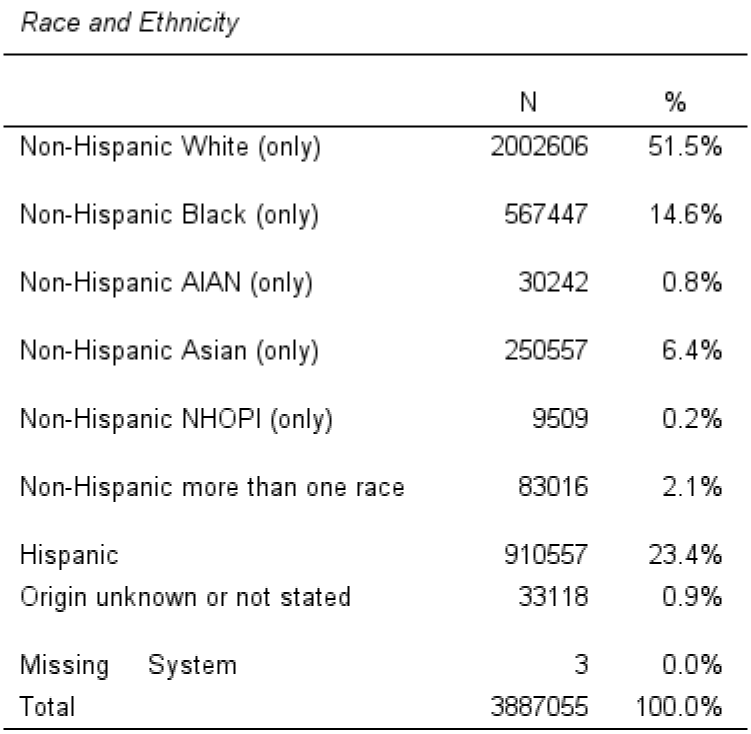


Birthing Location

		N	%
Hospital		3823025	98.4%
Freestanding Birth Center		21123	0.5%
Home (intended)		29137	0.7%
Home (not intended)		5388	0.1%
Home (unknown if intended)		4236	0.1%
Clinic / Doctor's Office		560	0.0%
Other		3369	0.1%
Missing	Unknown	210	0.0%
	System	7	0.0%
Total		3887055	100.0%

Table 2

Divisions of Race and Ethnicity and Associated Frequencies

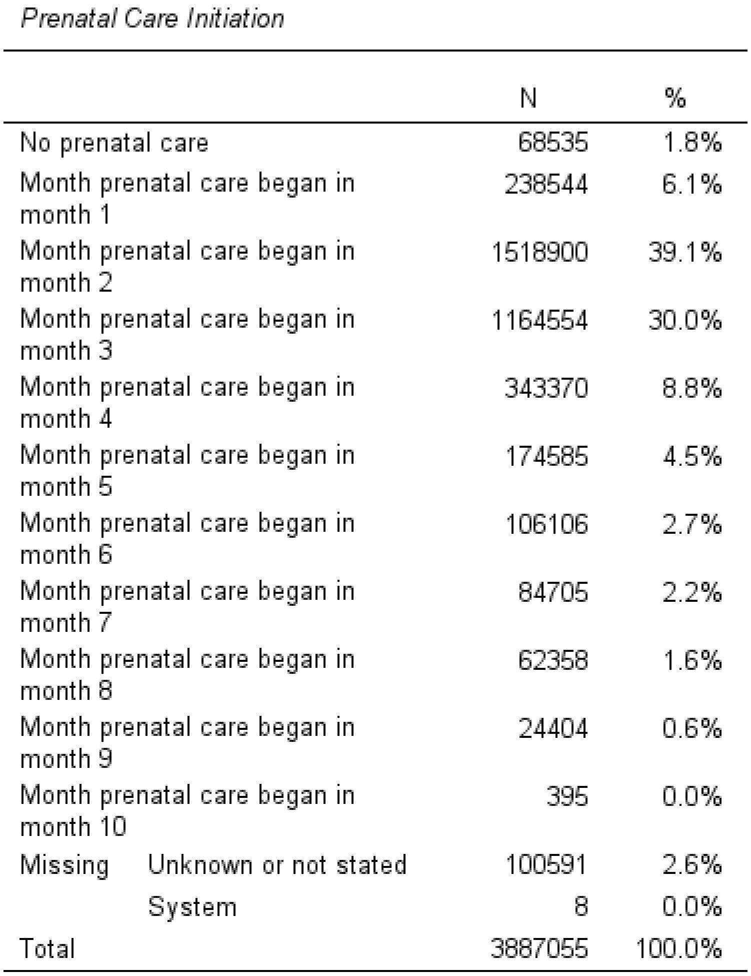


Race and Ethnicity

	N	%
Non-Hispanic White (only)	2002606	51.5%
Non-Hispanic Black (only)	567447	14.6%
Non-Hispanic AIAN (only)	30242	0.8%
Non-Hispanic Asian (only)	250557	6.4%
Non-Hispanic NHOPI (only)	9509	0.2%
Non-Hispanic more than one race	83016	2.1%
Hispanic	910557	23.4%
Origin unknown or not stated	33118	0.9%
Missing System	3	0.0%
Total	3887055	100.0%

Table 3

Prenatal Care Initiation Frequencies

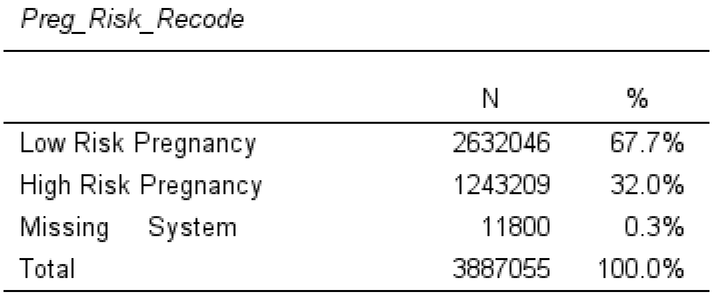


Prenatal Care Initiation

		N	%
No prenatal care		68535	1.8%
Month prenatal care began in month 1		238544	6.1%
Month prenatal care began in month 2		1518900	39.1%
Month prenatal care began in month 3		1164554	30.0%
Month prenatal care began in month 4		343370	8.8%
Month prenatal care began in month 5		174585	4.5%
Month prenatal care began in month 6		106106	2.7%
Month prenatal care began in month 7		84705	2.2%
Month prenatal care began in month 8		62358	1.6%
Month prenatal care began in month 9		24404	0.6%
Month prenatal care began in month 10		395	0.0%
Missing	Unknown or not stated	100591	2.6%
	System	8	0.0%
Total		3887055	100.0%

Table 4

Pregnancy Risk Level Frequencies



Preg_Risk_Recode

		N	%
Low Risk Pregnancy		2632046	67.7%
High Risk Pregnancy		1243209	32.0%
Missing	System	11800	0.3%
Total		3887055	100.0%

Results

Descriptive Statistics

Additional descriptive statistics which characterized the sample included mother's nativity. A majority 76.6% of the mothers were born in the 50 United States. For mothers who had prenatal care, 84% initiated prenatal care before their fifth month of pregnancy and only 1.8% of mothers received no prenatal care. Plurality was an important consideration in my study as well. Among the sample, 96.5% of pregnancies were singleton. I also used full-term gestational age as inclusion criteria for my sample. A majority of the sample, 83.1% were considered full-term births at 37 to 40 weeks gestation. Additionally, a majority of the sample, 99.5% had no congenital anomalies present during pregnancy (NCHS, 2017).

Univariate Analysis Race and Ethnicity as Predictor

I conducted a binomial logistic regression analysis to investigate whether or not there was an association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest. The outcome of interest was fetal/infant mortality. The possible predictor variables were: race and ethnicity; prenatal care initiation, birthing location, and pregnancy risk level. The Hosmer-Lemeshow goodness-of-fit was not significant ($p > .05$) indicating the model was correctly specified. Additionally, the -2 log Likelihood =28292.156 and the Nagelkerke R squared = .009. The Nagelkerke R squared value of .009 was an improvement over the value of .002 for the model without the control variables, indicating the importance of their inclusion. The model resulted in the independent variable, race and ethnicity, as having some race and ethnicity groups which were statistically significant predictors of fetal/infant mortality ($p < .05$). Controlling for prenatal care initiation, birthing location, and pregnancy risk level, I found the predictor variable, race and ethnicity in the logistic regression analysis to contribute to the model.

Regression Analyses with Four Predictor Variables (RQ)

Race and Ethnicity

In the model with all four predictor variables, the analyses resulted in the following for the race and ethnicity variable, with non-Hispanic White (only) used as baseline: for non-Hispanic Black (only) mothers, the unstandardized B = .135, SE = .069, Wald = 3.870, $p < .05$; non-Hispanic Asian (only) mothers, the unstandardized B = -.353, SE = .117, Wald = 9.094, $p < .05$; for Hispanic mothers, the unstandardized B = -.281, SE = .065, Wald = 18.586, $p < .05$; for origin unknown or not stated mothers, the unstandardized B = .534, SE = .211, Wald = 6.373, $p < .05$. The estimated OR favored a positive relationship of nearly 14.5% increase [Exp (B) =1.145, 95% CI 1.001, 1.310] for every one-unit increase of non-Hispanic Black (only) mothers. The estimated OR favored a negative relationship of nearly 29.7% decrease [Exp (B) = .703, 95% CI .559, .884] for every one-unit increase of non-Hispanic Asian (only) mothers. The estimated OR favored a negative relationship of nearly 24.5% decrease [Exp (B) = .755, 95% CI .664, .858] for every one-unit increase of Hispanic mothers. The estimated OR favored a positive relationship of nearly 70.5% increase [Exp (B) = 1.705, 95% CI 1.127, 2.581] for every one-unit increase of origin unknown or not stated mothers. These ORs showed an increased likelihood of non-Hispanic Black and origin unknown or not stated mothers having a pregnancy result in fetal/infant mortality when compared to non-Hispanic White mothers. The ORs for non-Hispanic Asian and Hispanic mothers also demonstrated these pregnancies were less likely to result in fetal/infant mortality compared to non-Hispanic White pregnancies (Table 5).

Table 5

Regression Analysis with Race and Ethnicity as Predictor Variable, Non-Hispanic White as Baseline Comparison Group

Predictor Sub-Group	Estimated Odds Ratio	Relationship	Sig.
Non-Hispanic Black	14.5% increase	positive	.049
Non-Hispanic Asian	29.7% decrease	negative	.003
Hispanic	24.5% decrease	negative	.000
Origin unknown or not stated	70.5% increase	positive	.012

Prenatal Care Initiation

The measure of prenatal care used as baseline in the analyses with prenatal care initiation was, no prenatal care. The analyses resulted in the following for the prenatal care initiation variable: for care in Month 1, the unstandardized B = -.787, SE = .166, Wald = 22.522, $p < .05$; for care in Month 2, the unstandardized B = -1.048, SE = .141, Wald = 54.892, $p < .05$; for care in Month 3, the unstandardized B = -1.035, SE = .143, Wald = 52.400, $p < .05$; for care in Month 4, the unstandardized B = -.800, SE = .155, Wald = 26.510, $p < .05$; and for care in Month 5, the unstandardized B = -.528, SE = .165, Wald = 10.229, $p < .05$. The estimated OR favored a negative relationship of nearly 54.5% decrease [Exp (B) =.455, 95% CI .329, .630] for every one-unit increase of prenatal care initiation for Month 1. The estimated OR favored a negative relationship of nearly 64.9% decrease [Exp (B) =.351, 95% CI .266, .463] for every one-unit increase of prenatal care initiation for Month 2. The estimated OR favored a negative relationship of nearly 64.5% decrease [Exp (B) =.355, 95% CI .268, .470] for every one-unit increase of prenatal care initiation for Month 3. The estimated OR favored a negative relationship of nearly 55.1% decrease [Exp (B) =.449, 95% CI .331, .609] for every one-unit increase of prenatal care initiation for Month 4. The estimated OR favored a negative relationship of nearly 41.0% decrease [Exp (B) =.590, 95% CI .427, .815] for every one-unit increase of prenatal care initiation for Month 5. These ORs demonstrated prenatal care initiation through Month 5 of pregnancy as reducing the likelihood of fetal/infant mortality when compared to no prenatal care (Table 6).

Table 6

Regression Analysis with Prenatal Care Initiation as Predictor Variable, No Prenatal Care as Baseline Comparison Group

Predictor Sub-Group	Estimated Odds Ratio	Relationship	Sig.
Month 1	54.5% decrease	negative	.000
Month 2	64.9% decrease	negative	.000
Month 3	64.5% decrease	negative	.000
Month 4	55.1% decrease	negative	.000
Month 5	41.0% decrease	negative	.001

Birthing Location

The location used as baseline in the analyses for birthing location was hospital. The analyses resulted in the following for the birthing location variable: freestanding birth center, the unstandardized B = .895, SE = .211, Wald = 17.962, $p < .05$; home (intended), the unstandardized B = .848, SE = .184, Wald = 21.296, $p < .05$. The estimated OR favored a positive relationship of nearly 144.8% increase [Exp (B) = 2.448, 95% CI 1.618, 3.704] for every one-unit increase of freestanding birth center location. The estimated OR favored a positive relationship of nearly 133.4% increase [Exp (B) = 2.334, 95% CI 1.629, 3.346] for every one-unit increase of home (intended) location. These ORs demonstrated an increased likelihood of fetal/infant mortality when the birthing location was home (intended) or freestanding birth center, when compared to births in a hospital (Table 7).

Table 7

Regression Analysis with Birthing Location as Predictor Variable, Hospital as Baseline Comparison Group

Predictor Sub-Group	Estimated Odds Ratio	Relationship	Sig.
Freestanding Birth Center	144.8% increase	positive	.000
Home (intended)	133.4% increase	positive	.000

Pregnancy Risk Level

The pregnancy risk which was used as baseline in the analyses of pregnancy risk level was low-risk pregnancy. The association seen for pregnancy risk level was not significant, but was borderline at .051 sig., and will thus be included for discussion. The analyses resulted in the following for the pregnancy risk level variable: high-risk pregnancy, the unstandardized B = .102, SE = .052, Wald = 3.822, $p > .05$. The estimated OR favored a positive relationship of nearly 10.8% increase [Exp (B) = 1.108, 95% CI 1.000, 1.227] for every one-unit increase of high-risk pregnancy. This OR showed an increased likelihood of fetal/infant mortality for pregnancies classified as high-risk, though this association was not statistically significant (Table 8).

Table 8

Regression Analysis with Pregnancy Risk Level as Predictor Variable, Low-Risk as Baseline Comparison Group

Predictor Sub-Group	Estimated Odds Ratio	Relationship	Sig.
High-Risk Pregnancy	10.8% increase	positive	.051*

* Non-significant *p* value

Addressing the Hypotheses

RQ: What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest?

H_0: There is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

H_A: There is an association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

The population of interest included women who gave birth in 2017 to a term infant, live in the contiguous United States, Alaska, Hawaii, or D.C., are ages 15 to 44, and have a singleton birth with no known congenital anomalies.

The estimated ORs lead me to reject the null hypothesis that there is no association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest. There is a positive association between fetal/infant mortality and race and ethnicity, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest.

Summary

The research question for my study was as follows: What is the association between race and ethnicity and fetal/infant mortality, controlling for prenatal care initiation, birthing location, and pregnancy risk level among the population of interest? The following associations were seen: the estimated ORs showed for non-Hispanic Asian and Hispanic mothers pregnancies were less likely to result in fetal/infant mortality compared to non-Hispanic White pregnancies; prenatal care initiation through Month 5 of pregnancy reduced the likelihood of fetal/infant mortality when compared to no prenatal care; an increased likelihood of fetal/infant mortality when the birthing location was home (intended) or freestanding birth center, when compared to births in a hospital; an increased likelihood of fetal/infant mortality for pregnancies classified as high-risk, though this association was not statistically significant.

The findings in this study add to the knowledge of fetal/infant mortality. The associations helped in my creation of a model to better predict fetal/infant mortality, thus contributing to positive social change and improving the lives of countless families.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Study Purpose

The purpose of this quantitative study was to explore, through the lens of the ecological perspective, the degree to which race and ethnicity are associated with fetal/infant mortality rates. I conducted this study to better understand how fetal/infant mortality may be prevented in the United States population. I used a quantitative, cross-sectional retrospective cohort study design to look further into possible associations between mother's race and ethnicity and fetal/infant mortality. I included several control variables in the study in order to minimize biases and target the areas of interest. The following were the study control variables: birthing location, month mother begins prenatal care, and pregnancy risk level. My understanding gained from this study helped me develop a model that can be used to help inform best practice and reduce the incidence of fetal/infant mortality in the United States, thus imparting positive social change.

Key Findings

My analyses conducted showed there is an association between race and ethnicity and fetal/infant mortality. This association was strengthened with the inclusion of the following control variables: prenatal care initiation, birthing location, and pregnancy risk level. I saw the following associations: the estimated ORs showed for non-Hispanic Asian and Hispanic mothers, pregnancies were less likely to result in fetal/infant mortality compared to non-Hispanic White pregnancies; prenatal care initiation through

Month 5 of pregnancy reduced the likelihood of fetal/infant mortality when compared to no prenatal care; an increased likelihood of fetal/infant mortality when the birthing location was home (intended) or freestanding birth center, when compared to births in a hospital; and an increased likelihood of fetal/infant mortality for pregnancies classified as high-risk, though this association was not statistically significant.

Interpretation of the Findings

Through my findings in this study, I confirmed and extended knowledge in the discipline on the influences of fetal/infant mortality. Many researchers have noted the disproportionate risk of infant mortality to various racial groups (Kirby, 2017; Kothari et al., 2017; Rice et al., 2017). Kothari et al. (2017) suggested Black race as having an increased risk of infant mortality. This was also demonstrated in my study results: non-Hispanic Black women had a 14.5% increase in odds of having a fetal/infant death compared to non-Hispanic White women. Adding to the knowledge of how race and ethnicity affect fetal/infant mortality rates, non-Hispanic Asian (only) and Hispanic race and ethnicities provided protective effects. Both of these groups were less likely than non-Hispanic White women to have a pregnancy result in fetal/infant death. This protective effect of Hispanic ethnicity was also highlighted by Rice et al. (2017). Rice et al. termed this finding the “Hispanic paradox” (p. 1585, 2017). Hispanic culture is thought to include norms, attitudes, and beliefs that are protective in nature against fetal/infant mortality (Rice et al., 2017). Likewise, in my study, in addition to Hispanic race and ethnicity being protective, non-Hispanic Asian race and ethnicity also had better odds of a positive pregnancy result. Through these results, I have both confirmed findings in the literature as well as expanded that knowledge by highlighting protective effects and including ethnicity in the analyses.

Many of the researchers in the current literature have focused on emphasizing the number of prenatal visits for healthy pregnancies (AAP, C. F. N., ACOG C.O.P., 2017). While these recommendations are sound, I have provided further clarity on this topic. Specifically, the odds of a pregnancy resulting in fetal/infant mortality are improved if prenatal care is begun within the first five months of pregnancy. Getting a woman to that first prenatal care appointment by month five can help improve the rates of fetal/infant mortality.

In terms of birthing location safety, researchers have found varying results (Scarf et al., 2018). In general, the majority of researchers and governing bodies have agreed hospitals and birth centers are the safest birthing locations (ACOG, 2020). In my findings I confirmed this of hospitals and disconfirmed this of birth centers through increased odds (144.8% and 133.4% increases, respectively) of fetal/infant mortality among births which occured in freestanding birth centers and among intended home births.

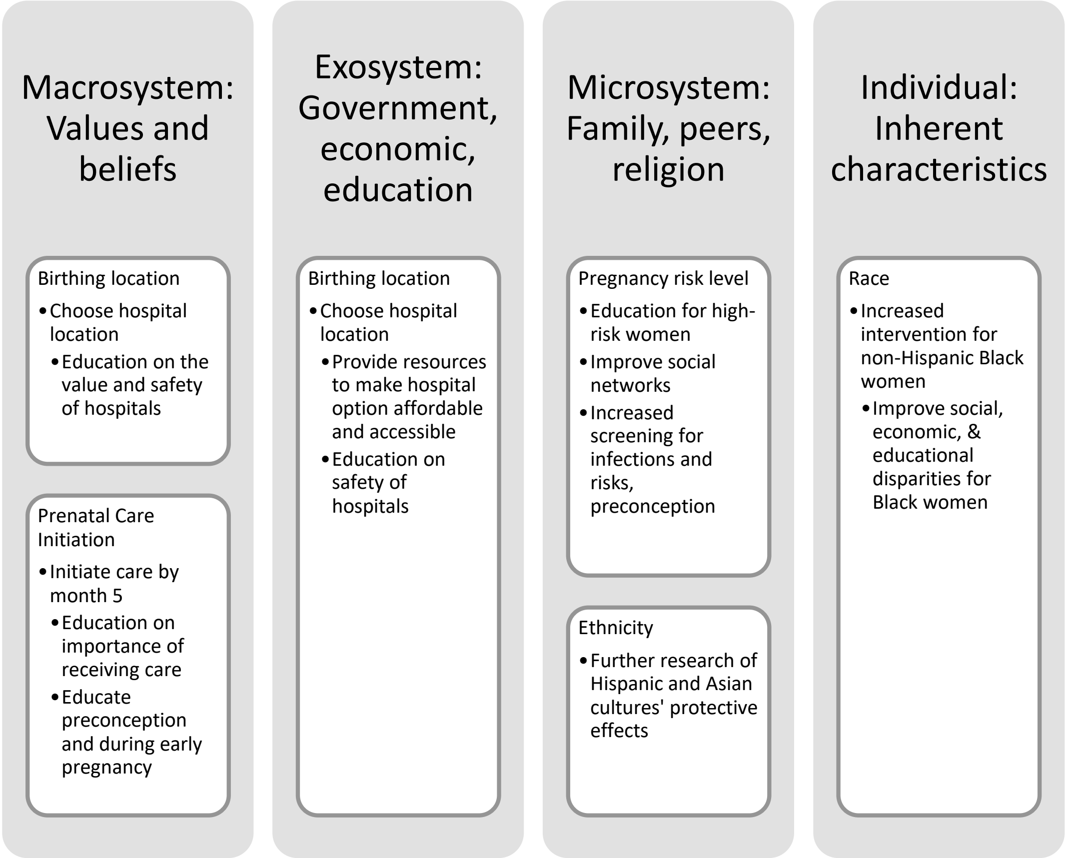
Researchers widely caution against certain maternal risk factors such as infections and against certain maternal risk behaviors such as drug use, etc. (Brown Speights, et al., 2017). These and other risks have been of concern in their contribution to fetal/infant mortality. For this reason, I compared women who were high-risk and those who were low-risk. The results from my analysis were not statistically significant but did show a 10.8% increase odds of a pregnancy resulting in a fetal/infant death for women who were high-risk compared to women who were low-risk. Through my study findings, I further highlighted the risk of fetal/infant mortality associated with known maternal risks and infections.

Relationship to Theoretical Framework

I designed my research question to utilize the foundational principles of the ecological perspective in order to better understand the relationship between fetal/infant mortality and the independent and control variables. The research question incorporated upstream and downstream determinants at varying levels of influence. By including the control variables, I allowed for more depth of understanding into the importance of these multiple levels of influence which I explained with the ecological perspective. For example, prenatal care (intrapersonal), birthing location (intrapersonal, interpersonal, and sociocultural), and pregnancy risk level (intrapersonal and interpersonal), provide a picture of how infant mortality is impacted by proximal and distal elements (Sallis et al., 2008). My selection of confounding variables was influenced by the ecological perspective. I used the ecological perspective as a foundation for understanding the complexity of health outcomes such as infant mortality. Through my study findings I have reiterated the importance of including factors at multiple levels. When I ran my analysis with the dependent and independent variables alone, statistically significant increased odds for fetal/infant mortality were calculated. However, when I included the control variables, which incorporated additional levels of influence, I was able to further improve the mathematical model used (seen through an improved Nagelkerke R Square value .009 compared to the univariate value of .002). I used these calculations to confirm the importance of the ecological principles in my study. There was a stronger association between race and ethnicity and fetal/infant mortality when my additional control variables were added. My consideration of various levels of influence was key to better understanding fetal/infant mortality. I developed a model based on the principles of the ecological perspective and my study findings to help predict pregnancy outcomes (see Figure 1). In each level of influence, different factors are at work to influence a series of decisions a woman makes that affect her health and the health of her unborn infant. In my model I highlighted these influences that were analyzed in my study. Intervention at these points can help lead to a reduction in fetal/infant mortality for United States women.

Figure 1

Model to Predict Pregnancy Outcomes: Intervention Points



Limitations of Study

After I conducted the secondary analysis, the study limitations were not altered. The previously mentioned limitations with the data remain and I found them acceptable to my study. With the robust sample size used (3,003,533 infant births and 1,681 fetal/infant deaths), which were comprised of births and deaths from all 50 United States and D.C., generalizability was maintained. Frankfort-Nachmias (2015) suggested internal validity can be maintained by the inclusion of control variables, as I used in my study.

Recommendations

Through my study results, I showed a robust protective effect of Hispanic ethnicity and non-Hispanic Asian race and ethnicity. My inclusion of ethnicity in this study helped me include important cultural norms, behaviors, and belief systems unique to the cultures they represent. These factors offered protection against fetal/infant mortality and warrant further research to better understand the specific elements that offered protection. Additionally, though the sample size was robust, there was a small proportion (1.5%) of births which occurred outside a hospital. In light of this, I recommend studying birthing location further with a larger sample of births outside the hospital to better understand birthing location risks. Furthermore, many researchers highlight the importance of maternal risk factors as they relate to fetal/infant mortality. The results in my study were not statistically significant in regard to pregnancy risk level. I recommend further studies analyze specific risk factors, rather than risks as a whole. By looking at this level of detail, researchers can better understand the magnitude of these specific risks and how to target interventions.

Implications for Professional Practice and Social Change

Professional Practice

My overarching goal for this study was to decrease the incidence of fetal/infant mortality in the United States. As this goal relates to professional practice, my recommendation to primary care physicians is to provide education to young women on their risk factors for fetal/infant mortality. For example, knowing the importance of initiating prenatal care by the 5th month of pregnancy, physicians can inform their patients who are considering becoming pregnant of the importance of seeking obstetrical care for any pregnancy no later than their 5th month of that pregnancy. Further, clinical staff and case workers should work with patients who are considering becoming pregnant to ensure they are able to find affordable obstetrical care services. Removing barriers to care is a critical component that should be addressed before care is needed, when possible. Primary care physicians should also discuss any risk factors a woman may have before she becomes pregnant, or early on in the pregnancy when prevention is not possible. Many of the infections that increase risk to fetal/infant mortality are treatable and should be treated prior to a pregnancy. Because of the substantial increased risk of fetal/infant mortality among non-Hispanic Black women, particular attention should be paid to this population when they seek wellness or obstetrical care from primary care physicians or obstetricians to ensure other risk factors such as infections are minimized.

Furthermore, I recommend a revision in best practice for obstetrical care. Rather than emphasizing a specific number of prenatal visits, prenatal care should emphasize initiating care prior to Month 5 of pregnancy. Specifically, Month 1, Month 4, and Month 5 conferred the most improved odds of a positive pregnancy outcome compared to not receiving prenatal care or receiving care in a different month of pregnancy. Additionally, women who are considering becoming pregnant should receive testing for sexually transmitted infections and screening for chronic and acute diseases which I included in maternal infections and maternal risk factors in my study. Addressing these risk factors prior to conception can help lessen the risk of fetal/infant mortality.

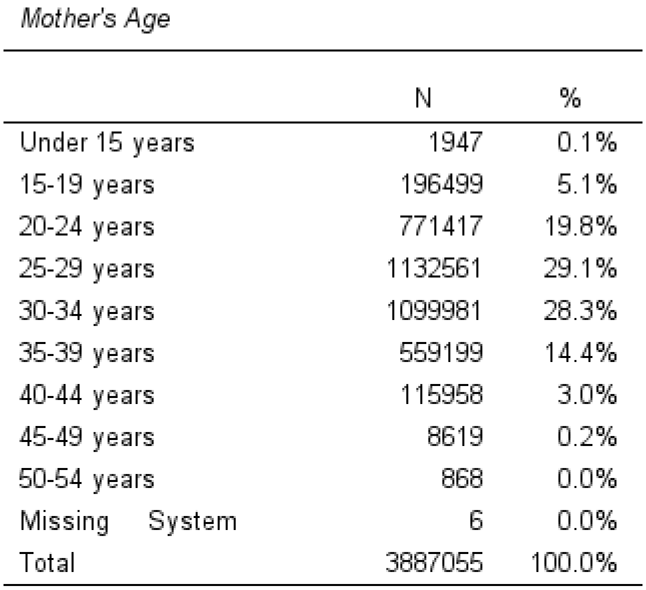
One noteworthy empirical implication of my study is in the analysis of birth location. Though a relatively small number of births outside hospitals was analyzed, results were statistically significant. Freestanding birth center births carried a 144.8% increase in odds of the birth resulting in fetal/infant mortality when compared to hospital births. Home births that were intended to be at home showed a 133.4% increase in odds of the birth resulting in fetal/infant mortality when compared to hospital births. These are substantial risks that should be conveyed to women who are considering these options. These study results also warrant further research into the safety of birth locations outside a hospital setting.

A second empirical implication of my study is the added knowledge of the importance of race and ethnicity as a combined variable. Non-Hispanic Black women had 14.5% increased odds of having a pregnancy result in fetal/infant mortality when compared to non-Hispanic White women. Racial and ethnic disparities remain a threat to the United States population. Further efforts are needed to reduce these disparities.

Of additional importance, the inclusion criteria for this study only included women between ages 15 to 44. The vast majority of the sample population fell within this age range (Table 9). Future intervention efforts should target this particular age group, as it was the majority of pregnant women.

Table 9

Frequency of Mother's Age within Sample Population



Mother's Age

	N	%
Under 15 years	1947	0.1%
15-19 years	196499	5.1%
20-24 years	771417	19.8%
25-29 years	1132561	29.1%
30-34 years	1099981	28.3%
35-39 years	559199	14.4%
40-44 years	115958	3.0%
45-49 years	8619	0.2%
50-54 years	868	0.0%
Missing System	6	0.0%
Total	3887055	100.0%

Positive Social Change

Implications of social change of these study results span multiple levels. Social change is possible on societal and policy levels as we work to better understand how certain race and ethnicity groups have characteristics that provide protection against fetal/infant mortality. Conversely, as some race and ethnic groups have a disproportionate burden of fetal/infant mortality, societal norms and policies should be altered to address social and economic burdens these groups face. Overall, we need to work to achieve equality among race and ethnic groups.

On a familial level, social change can be achieved through a better understanding of the importance of a supportive network of family and friends, particularly when a woman is considering becoming pregnant or is already pregnant. Ethnicity carries with it a social element. These social qualities, which largely come from friends and family, can be protective or harmful in terms of fetal/infant mortality. Educating women on these factors can help encourage them to seek supportive relationships and thus, improve fetal/infant mortality rates.

Ultimately, many of the choices surrounding a pregnancy are made by the woman herself. Women should receive education on important and relevant risk factors and then provided with the resources to make the best choices possible. It is not enough to stop at education. Often, a lack of resources and follow-through are noteworthy barriers to a woman making healthy choices. If we can adapt our medical system to better provide a continuity of care and follow-up, women can be better prepared to make choices that will positively influence them and their babies. Through the results of my study, I have provided insight into some key areas of education and intervention, which lend well to this follow-up process. Ultimately, this will lead to positive social change through fewer fetal/infant lives lost.

Conclusion

Roughly 4 million women give birth every year in the United States (Muoto et al., 2016). Of these 4 million, approximately 23,000 end in a fetal/infant death in a given year (UHF, 2018). This is an unacceptable loss, particularly for a well-developed, affluent nation such as the United States. I have conducted my study with the intent to better understand how to improve the incidence of fetal/infant mortality. Through a secondary analysis of U.S. Vital Statistics data, I have found race and ethnicity, prenatal care initiation, birthing location, and pregnancy risk level to be associated with fetal/infant mortality. The risks that can be changed, prenatal care initiation, birthing location, and pregnancy risk level, should be better addressed in order to prevent fetal/infant death. Education on these risk factors is one method of addressing important predictors. But the effort cannot stop at education. Follow-through is necessary. Women need to be supported in their journey from preconception through pregnancy and delivery. Intervening on these multiple levels can improve IMRs in the United States and lessen this unnecessary burden on countless families.

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