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Effects of Neighborhood Membership and Hypertensive Disorders in Pregnancy on Adverse Birth Outcomes

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Abstract

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Chinyere Onyebuchi

MPH, New York University, 2002

BA, Binghamton University, 1998

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Infant mortality (IM) rates in the United States remains high. The higher rates of IM among specific groups in the United States is believed to be fueled by the high rates of adverse birth outcomes including low birthweight (LBW) and preterm births (PTB) among these groups. Adverse birth outcomes have also been linked to the presence of hypertensive disorders during pregnancy. The purpose of this cross-sectional study was to explore the association between hypertensive disorders during pregnancy and adverse birth outcomes and the impact of the residential neighborhood of expectant mothers on this association. The life course health development theory guided the framework for this study. Study data were obtained from the 2010 New York City birth records and the 2010 US Census. Descriptive statistics and logistic regression analysis were used to address the 3 research hypotheses of the study. The study found that prepregnancy hypertension (HTN) (AOR: 2.84 & 3.25), gestational HTN (AOR: 2.28 & 3.33) and eclampsia (AOR: 4.41 & 6.70) were significantly associated with PTB and LBW respectively. Neighborhood segregation was not significant for PTB (AOR: 1.01) or LBW (AOR: 1.03). Neighborhood poverty was significant for PTB (AOR: 0.86) but not for LBW (AOR: 1.05). Neighborhood segregation and poverty had significant moderating effects on the prepregnancy HTN ($p = 0.00$), gestational HTN ($p = 0.00$), eclampsia ($p = 0.00$) and PTB and LBW association. Results from this study can help to address disparities in birth outcomes among women of differing races and ethnicities and thereby contribute to positive social change.

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Dedication

This dissertation is dedicated to my family, both immediate and extended. They provided unlimited encouragement and support to me throughout my dissertation journey and continue to inspire me to persevere and never give up.

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Chapter 1: Introduction to the Study

Introduction

The higher prevalence of infant mortality among some racial and ethnic minorities in the United States is a public health dilemma. Low birthweight (LBW) is one of the leading causes of infant mortality, and it disproportionately impacts infants of some racial and ethnic groups (Paneth, 1995; Reichman, Hamilton, Hummer, & Padilla, 2008). Preterm birth is a leading cause of infant mortality in the United States, and it is not equally distributed by race (Schempf, Branum, Lukacs, & Schoendorf, 2007). The disproportionality in the rates of preterm birth and LBW is believed to fuel the persistent racial gap in infant mortality rates in the United States. In New York City, the rates of preterm birth, LBW, and overall infant mortality mirror the national rates and vary along racial and ethnicity lines (NYC DOHMH, 2011a). The racial gap in infant mortality among women of varying races and ethnicities in New York City may also be linked to the higher rates of preterm birth (PTB) and LBW among these women.

Hypertensive disorders during pregnancy are well documented and have been acknowledged to complicate approximately 7% of all pregnancies (Buchbinder et al., 2002). In the presence of hypertensive disorders that may include pregnancy-induced hypertension or preeclampsia and chronic hypertension, the incidence of poor or adverse birth outcomes is increased (Bakker, Steegers, Hofman, & Jaddoe, 2011; Buchbinder et al., 2002). Hypertensive disorders are believed to contribute to adverse birth outcomes such, as PTBs and the birth of low weight infants.

The purpose of this study was to explore the association between adverse or poor birth outcomes and hypertensive disorders during pregnancy. The adverse birth outcomes that were

examined in this study included PTB and LBW. The hypertensive disorders under study included chronic hypertension, gestational hypertension, and eclampsia. I also examined the impact of residential neighborhood membership on the possible association between hypertensive disorders during pregnancy and adverse birth outcomes. I examined whether neighborhood membership modified the association between hypertensive disorders during pregnancy and adverse birth outcomes. The population for this study included women of various racial and ethnic backgrounds who resided in New York City at the time of their infant delivery.

Major sections of this chapter include the following areas of focus: background, problem statement, purpose of the study, research questions and hypotheses, conceptual framework of the study, nature of the study, definitions, assumptions, scope and delimitations, limitations, significance, and summary.

Background

Infant mortality is an indicator of a nation's health. Although the United States is considered to be one of the richest nations in the world, its rate of infant mortality remains one of the highest among wealthy countries. In 2010, the infant mortality rate in the United States was 6.14 infant deaths per 1,000 live births (Marian, MacDorman, Hoyert, & Mathews, 2013). This rate added up to over 24,000 infants who died before the age of 1 (Murphy, Xu, & Kochanek, 2012). Within the United States, the rates of infant mortality vary among racial and ethnic groups. In 2009, the infant mortality rate for Puerto Ricans was 1.3 times the rate for non-Hispanic whites and the rate for African Americans was 2.3 times the rate for non-Hispanic whites (Mathews & MacDorman, 2013). African American infants were more likely than their counterparts to die as a result of LBW and PTB (Mathews & MacDorman, 2013).

In New York City (NYC), the national trend of disproportionately higher death rates among African American and some Hispanic infants as compared to infants of some other racial groups is replicated. Among all racial and ethnic groups in NYC, African Americans have consistently had the highest rate of infant mortality over many years. In 2009, infants born to African Americans in NYC were 2.8 times more likely to die than infants born to non-Hispanic whites (NYC DOHMH, 2014). In 2009, the infant mortality rate among Puerto Ricans was 1.9 times the rate for non-Hispanic white women (NYC DOHMH, 2014). LBW, defined as a birthweight less than 2,500 g (5.5 pounds), is among the leading causes of infant deaths in NYC (Goldenberg & Culhane, 2007; NYC DOHMH, 2011c). In 2009, African Americans had the highest percentage of LBW infants (12.9%), Hispanics had the second highest low birthweight percentage at 8%, and whites had the lowest percentage at 7.2% (NYC DOHMH, 2011a). Similarly, in 2009, African Americans were 1.7 times more likely than whites to deliver preterm infants (NYC DOHMH, 2011b). Hispanics were 1.2 times more likely than whites to deliver preterm infants (NYC DOHMH, 2011b).

Hypertensive disorders during pregnancy have been implicated by previous researchers (Duley, 2009; Leeman & Fontaine, 2008; Steer, Little, Kold-Jansen, Chapple, & Elliott, 2004) to play a role in adverse birth outcomes and in the observed rates for infant mortality. Hypertension is the most commonly observed medical problem during pregnancy and has been found to impact approximately 10% of all pregnancies (Duley, 2009). Hypertension is not harmful in all cases but has been found to complicate 2-3% of pregnancies (Mammaro et al., 2009). Hypertensive disorders during pregnancy include gestational (pregnancy-induced)

hypertension, chronic hypertension, preeclampsia, and eclampsia (Browne et al., 2015). These medical complications can result in LBW and early delivery (Mammaro et al., 2009).

NYC is a diverse metropolitan area with a population made up of several racial and ethnic groups. These groups predominantly reside in racially and ethnically segregated neighborhoods. Among these neighborhoods, infant mortality rates including the rates of LBW and PTB have varied along racial and ethnicity lines. Previous scholars (Debbink & Bader, 2011; Grady, 2006; Walton, 2009) have linked residency in neighborhoods with a higher prevalence of delivery of low weight and preterm infants. As the body of available literature supports an association between adverse birth outcomes and hypertensive disorders in pregnancy, it is important to investigate how neighborhood membership or residency in specific communities impacts this relationship.

Problem Statement

Racial disparities in the rates of infant mortality continue to persist despite national priorities to reduce and eliminate them in the United States. This racial disparity in infant mortality rates is attributable to the higher incidence of PTB, LBW, and other causes of infant mortality among infants of some racial and ethnic groups (Hauck, Tanabe, & Moon, 2011). Hauck et al. (2011) estimated that 54% of the persistent black-white infant mortality disparity results from the higher incidence of preterm birth among black women. In fact, black women are twice more likely that their white counterparts to deliver preterm infants (Hauck et al., 2011). Among black women, the rate of LBW has remained about twice the rate for white women for many years (Reichman, 2005). In 2013, black women had a low birth rate of 13.07 while white women had a low birth rate of 6.97 (Hamilton, Martin, Osterman, & Curtin, 2014). Although the

LBW rate for Hispanic women has generally been on par with those of non-Hispanic white women, the rates of LBW among groups of Hispanic women vary widely (Reichman et al., 2008). Women of Puerto Rican origin experience disproportionally higher rates of LBW than women of other Hispanic origin (Reichman, 2005; Reichman et al., 2008).

LBW is a public health issue that requires a permanent solution. LBW has been linked to predispositions to a number of neurodevelopmental disorders and suboptimal health conditions later in life (Paneth, 1995). LBW infants have been found to have increased susceptibility to cerebral palsy, a neurological condition that impacts movement and coordination and results in activity limitation due to nonprogressive disturbances that occur in the developing infant brain (Lie, Groholt, & Eskild, 2010; Paneth, 1995). LBW, and very LBW infants, are 25 times more likely than normal birthweight infants to receive a diagnosis of cerebral palsy (Paneth, 1995). In addition, LBW infants have higher susceptibility to blindness, deafness, hydrocephaly, epilepsy, mental retardation, chronic lung disease, learning disabilities, and attention deficit disorder (Goldenberg & Culhane, 2007; Paneth, 1995).

PTB is also a health issue as it predicts infant mortality (Braveman et al., 2015). PTB is also predictive of short- and long-term disease and disability. Preterm infants are vulnerable to health ailments, such as respiratory distress syndrome, a compromised immune system, cardiovascular disorders, hearing and vision problems, chronic lung disease, and neurological problems (Behrman & Butler, 2007). Long-term health problems for preterm infants can include cerebral palsy, mental retardation, behavioral and emotional problems, and learning difficulties (Behrman & Butler, 2007).

Hypertensive disorders in pregnancy are noted to be contributors to adverse birth outcomes and have been linked to PTB and LBW in various research (McBride, Bernstein, Badger, Horbar, & Soll, 2015; Samadi & Mayberry, 1998; Steer et al., 2004). Hypertensive disorders in pregnancy include chronic hypertension, gestational hypertension, preeclampsia, and preeclampsia superimposed on chronic hypertension. These disorders are a leading cause of maternal mortality and also contributes to PTB, fetal intrauterine growth restriction, LBW, and perinatal death (NYSDOH, 2013). Because PTW and LBW contributes to both infant mortality and childhood disability, it is important to understand their various risk factors including hypertensive disorders in pregnancy and the neighborhood residency of expectant mothers that may interact with hypertensive disorders and contribute further to adverse birth outcomes. Increased knowledge of these risk factors can aid in the formulation of strategies to address and eliminate racial disparities in PTB, LBW, and overall infant mortality rates in the United States.

Purpose of the Study

The purpose of this study was to explore the relationship between hypertensive disorders in pregnancy and adverse birth outcomes, specifically PTB and LBW. In addition, I examined how the residential neighborhood of expectant mothers impacts the association between hypertensive disorders in pregnancy and adverse birth outcomes. Specifically, I investigated whether neighborhood membership in any way modified the association between hypertensive disorders in pregnancy and adverse birth outcomes. The focus and population for this study was in NYC.

Research Questions and Hypotheses

The overarching research investigation that guided this study involved the association between hypertensive disorders in pregnancy and adverse birth outcomes and the neighborhood residency of expectant mothers that may have modified this association. The research questions under study were directly linked to the null hypotheses that was tested in this study. The following research questions and null hypotheses were considered:

RQ1. To what extent does an association exist between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC?

$H_0$1: There is no association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

H_a1: There is an association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

RQ2. To what extent does an association exist between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC?

$H_0$2: There is no association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

H_a2: There is an association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

RQ3. Does the neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes?

$H_0$3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does not moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

H_a3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

Conceptual Framework for the Study

The theoretical framework that was used to explore the association between adverse birth outcomes and hypertensive disorders in pregnancy and examine the possible modifying effects of neighborhood membership on the hypertensive disorders in pregnancy and adverse birth outcomes association was the life course health development (LCHD) framework. According to the LCHD, health is "a consequence of multiple determinants operating in nested genetic, biological, behavioral, social, and economic contexts that change as a person develops" (Halfon & Hochstein, 2002, p. 433). The LCHD theory posits that health develops over a lifetime; health can, therefore, improve or diminish based on an individual's exposure to risk or protective factors. The LCHD theory was employed to ascertain whether the physical, social, behavioral, and economic environments played a role in moderating a residentially segregated woman's risk for experiencing an adverse birth outcome.

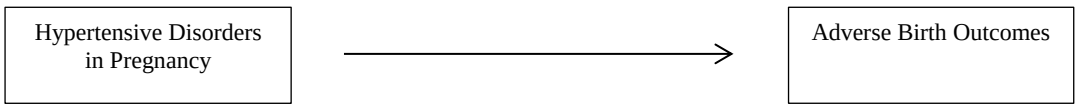
Nature of the Study

I used quantitative methods to examine the association between hypertensive disorders in pregnancy and adverse birth outcomes as well as to explore the potential modifying effects of the neighborhood membership of expectant mothers on this association. The quantitative design

used was a cross-sectional study. Data for the study were collected from the 2010 statistics birth records obtained from the NYC Department of Health and Mental Hygiene. Data were also collected from the 2010 U.S. Census for studying neighborhood characteristics and racial residential segregation in NYC.

The statistical analysis conducted was a logistic regression analysis using a hierarchical method. LBW and PTB were the dependent variables. The independent variables were hypertensive disorders in pregnancy including chronic hypertension, gestational hypertension, and eclampsia. The moderator was neighborhood membership. Two varying effects in the hypertensive disorders in pregnancy and adverse birth outcomes association were examined in this study. The first effect (Path 1) represented a total or direct effect whereby hypertensive disorders in pregnancy directly and fully impacted adverse birth outcomes in the absence of any moderating variable. The second effect (Path 2) considered the impact of a moderator variable (neighborhood membership) on the hypertensive disorders in pregnancy and adverse birth outcome association. The second path considered whether neighborhood membership modified or affected the strength of the relationship between hypertensive disorders in pregnancy and adverse birth outcomes. Figure 1 shows the potential paths for the study.

Path 1:



Path 2:

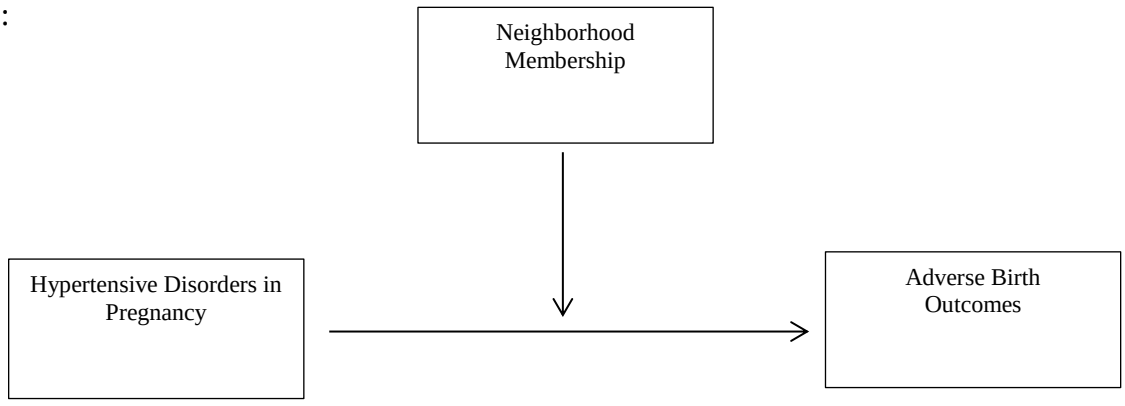


Figure 1. Varying paths for adverse birth outcomes

Statistical testing for modifying effects was performed to answer the question of whether neighborhood membership modified the hypertensive disorders in pregnancy and adverse birth outcomes association.

Definitions

Adverse birth outcomes: An unfavorable outcome of pregnancy that includes PTW, LBW, congenital abnormalities, pregnancy loss, or neurodevelopmental defects. For this paper, the definition of adverse birth outcomes included only the occurrences of LBW and PTB.

Hypertensive disorders during pregnancy: Includes chronic hypertension, preeclampsia-eclampsia, preeclampsia superimposed on chronic hypertension, and gestational hypertension (Leeman & Fontaine, 2008).

Effect modification: Occurs when a moderating variable can be said to affect the direction or strength of the relation between an independent or predictor variable and a dependent or outcome variable.

Low birthweight: A low birthweight infant is an infant with a birthweight less than 2500 grams or 5 pounds, 8 ounces (Paneth, 1995).

Preterm birth: This is an important antecedent to low birthweight and refers to infants born prior to the completion of 37 weeks of gestation (Paneth, 1995).

Racial residential segregation: The physical separation of racial groups through enforced residence in certain areas (Williams & Collins, 2001).

Very low birthweight: A live born infant of 20 weeks gestation or more with a birthweight less than 1,500 grams (Dunlop, Salihu, Freymann, Smith, & Brann, 2011).

Assumptions

This study was guided by the following assumptions:

1. The study sample retrieved from the NYC Department of Health and Mental Hygiene would be representative of the entire NYC population.
2. The NYC Department of Health and Mental Hygiene vital statistics data were complete and accurate.
3. NYC birth certificates contained maternal medical conditions that were all self-reported and these reports represented accurate information.

Scope and Delimitations

The scope of the study included analysis of statistics data for all singleton births in NYC during the year of 2010. This year was selected as this was also the year of the most recent U.S. census. The 2010 census data were employed to assess the neighborhood characteristics of women who delivered infants in NYC in 2010.

The study delimitation included the exclusion of multiple infant births at one time. Only singleton births were included in the study sample as multiple births infants, on average, had lower birth weights. In addition, women who gave birth in NYC but did not have their primary residence in NYC were excluded.

Limitations

There were potential shortcomings or influences that could not be controlled by the researcher and may have impacted or confined the results or conclusions from the study. One

limitation was the reliance on the birth certificate data to be complete and accurate. There may have been underreporting of the comorbid preconception and pregnancy-related medical conditions on birth certificates. Underreporting of these medical conditions would limit my ability to assess the association between hypertensive disorders during pregnancy and adverse birth outcomes. Another limitation of the study was the inherent assumption that women giving birth in NYC have lived in their respective communities for extended periods of time. This assumption was, however, necessary as I had no alternative means of retrieving this information. Using a cross-sectional study design limited the ability to establish causality but helped to describe the relationships between exposures and outcomes.

Significance

This study will add to the existing body of literature on disparities in the rates of infant mortality and adverse birth outcomes among racial and ethnic groups in the United States. It will add clarity to the body of literature as to whether neighborhood membership modified the association between hypertensive disorders in pregnancy and adverse birth outcomes. This research will provide insights in the ongoing effort to decrease and eventually eliminate the disparities that exist in the rates of PTB and LBW among racial and ethnic groups in the country. It could provide confirmatory evidence of the effect modification of neighborhood membership that may exacerbate any relation between hypertensive disorders in pregnancy and adverse birth outcomes. Additionally, the results of this research could have health policy implications. If neighborhood membership was found to modify adverse birth outcomes in women with hypertensive disorders in pregnancy, this knowledge would inform the need to provide targeted and preemptive prepregnancy care to these women. Actions such as this would help to tackle the

disproportionately higher rates of PTB and LBW that impacts women of color and would indeed contribute to social justice and change in NYC.

Summary

PTB and LBW are major public health issues. These are also issues that impact social justice. The racial disparity that exists in PTB, LBW, and overall infant mortality rates in the United States should not be allowed to continue to persist. Although efforts have been previously made to address and eliminate this disparity, it is imperative that these efforts continue. Public health practitioners across the country must work to understand and appreciate the full etiology of this health care dilemma. Through increased research knowledge, the racial disparity in PTB, LBW, and overall infant mortality could be better understood and strategies could be formulated to address these issues.

The goal of this study was to explore the association between adverse birth outcomes and hypertensive disorders in pregnancy in a population of expectant mothers in NYC. Additionally, I explored whether the neighborhood membership of pregnant women in NYC modified the relationship between adverse birth outcomes and hypertensive disorders in pregnancy. The results of this study could help public health practitioners in their efforts to address the increased rates of PTB, LBW, and overall infant mortality among racial groups and ethnicities that have experienced a disproportionately higher burden of this public health dilemma. This study could also help to bring about social change and justice by providing information that could contribute to the work to eliminate health care disparities in the United States.

In the upcoming sections of this dissertation, additional information is provided on PTB and LBW and the risk factors that interact with one another to result in these adverse birth

outcomes. Chapter 2 provides a review of the relevant research literature on the research topic. Research works on hypertensive disorders in pregnancy, adverse birth outcomes, and neighborhood membership that may impact the adverse birth outcomes and hypertensive disorders in pregnancy association are synthesized. In Chapter 3, I focus on the study methodology, the population under study, research design, and information on how the study was conducted and analyzed. Results of the study are provided in Chapter 4. Finally, Chapter 5 provides the summary, conclusion, and recommendations from the research.

Chapter 2: Literature Review

Introduction

Infant mortality is defined as the death of an infant within the infant's first year of life. Although the United States is one of the most developed countries in the world, its rate of infant mortality disappointingly remains higher than the rates of other developed nations (Chen, Oster, & Williams, 2016). Exacerbating this problem is the persistent gap in infant mortality rates that exists among racial and ethnic populations in the United States. Much of the trends in racially disproportionate infant mortality rates at the national level have also been found at the state levels. In this literature review, a summary of relevant work done is presented to better understand the incidences of infant mortality and the existing racial disparity in infant mortality rates. I focus on PTB and LBW as these adverse birth outcomes are among the leading causes of infant mortality in the United States and in NYC, the community of focus in this study. Also presented in this chapter is a synthesis of the studies that reported an association between hypertensive disorders in pregnancy and adverse birth outcomes that include PTB and LBW. Hypertensive disorders in pregnancy are studied as these have been found to contribute to adverse birth outcomes. Finally, available literature on neighborhood membership is synthesized to understand whether this may modify the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

This literature review is divided into subsections. Subsections include the following areas of focus: introduction, literature search strategy, conceptual framework, racial disparities in infant mortality, adverse birth outcomes of PTB and LBW, hypertensive disorders in pregnancy, hypertensive disorders in pregnancy and adverse birth outcomes, neighborhood membership

(racial residential segregation) and adverse birth outcomes, pathways linking racial residential segregation to adverse birth outcomes, effect modification on the hypertensive disorders in pregnancy and adverse birth outcomes association, and summary and conclusion.

Literature Search Strategy

Databases and Search Engines

Various databases and search engines were used to compile relevant research relating to racial residential segregation and LBW or infant mortality. The primary search engines used were PubMed and other Walden University Library databases including CINAHL Plus (with Full Text), Dissertations & Theses at Walden University, and MEDLINE (with Full Text). Additionally, Google Scholar was used to perform various literature searches.

Key Search Terms and Combinations of Search Terms

The search terms used to conduct searches of the literature were numerous. Keywords included the following terms and term combinations: *infant mortality, infant mortality, and health disparities, racial disparities in health, ethnic disparities, health care disparities, adverse birth outcomes, PTB, LBW , low birthweight disparities, hypertensive disorders in pregnancy, hypertensive disorders in pregnancy, and adverse birth outcomes, chronic hypertension, gestational hypertension, pre-eclampsia, racial residential segregation, PTB and LBW and racial residential segregation, isolation and low birthweight/preterm birth, clustering and low birthweight/preterm birth, moderators and hypertensive disorders in pregnancy, moderating effects and hypertensive disorders in pregnancy, hypertension and birth outcome, chronic hypertension and birth outcome, life course theory, life course framework, life course*

perspective, life course perspective and health disparities, life course perspective, and *birth outcomes*.

Search Process

Search of the literature was limited to English-language, peer-reviewed research conducted between 1980 and 2015. In cases where it was not possible to locate any current research on a search topic, notations were made to identify these as areas of potential gap in the literature where further study may be warranted.

Conceptual Framework

According to the LCHD, an individual's health trajectory is developed over a lifetime. As a result, a person's health could improve or diminish over time based on exposures to risk or protective factors (Halfon & Hochstein, 2002). Health development is an additive process composed of numerous interactions between genetic, biological, social, behavioral, economic, and environmental factors that influence a person's life (Halfon & Hochstein, 2002). The LCHD offers a conceptual framework for understanding the development of health and disease causation. It provides a theoretical model by which exposures during a life course can be linked to health outcomes later in life (Kuh, Ben-Shlomo, Lynch, Hallqvist, & Power, 2003).

The LCHD includes a few important concepts. The first concept applies to the causal pathway relating to the accumulation, chain, and trajectory of risks over time (Kuh et al., 2003). The exposure to risks over a life course is cumulative and can yield damaging effects (Kuh et al., 2003). The chain of risk model suggests that linkage of exposures may raise the risk of disease and the trajectory model refers to exposure sequences and outcome over the life course (Braveman & Barclay, 2009; Kuh et al., 2003). The second concept applies to the timing of

causal factors resulting in critical or sensitive periods over a life course (Kuh et al., 2003). The critical period is defined as a limited window of time during which an exposure can yield damaging or protective effects on the development of disease or disease outcome (Kuh et al., 2003). The sensitive period is a time period when an exposure has an effect that might be modified or reversed by later experiences outside the time period (Braveman & Barclay, 2009). The final concept of the life course framework applies to other mechanisms that impact an individual's risks during the life course. These include mediating and modifying factors, susceptibility, and vulnerability to illness and disease (Kuh et al., 2003).

The LCHD has been studied to better understand disease risks and outcome. It has also been applied to research seeking to explain the causes for persistent racial disparities in health. Lu and Halfon (2003) performed a literature review for longitudinal models of health disparities and synthesized two models with the use of the LCHD. Future reproductive potential was impacted by early life exposures while the cumulative pathways model suggested that decline in reproductive health results from cumulative harm to the body's allostatic system (Lu & Halfon, 2003). Lu and Halfon concluded that birth outcome disparities result from differential early life developmental trajectories and the cumulative allostatic load of individuals over the life course. Lu and Chen (2004) used the LCHD as a theoretical model to suggest reasons for the racial and ethnic disparities in preterm birth and the impact of stressful life events on this birth outcome. Because preterm births were found to be highest among African American women, Lu and Chen suggested that the greater risk of African American women for preterm births may be as a result of higher exposures to stressors during pregnancy and to early life stressors that accumulated over their life course.

Strengths and limitations of the LCHD have been reported in the literature. Hutchison (2008) highlighted strengths of the LCHD to be its attention to biological, psychological, and social processes that impact lives and its focus on intergenerational relationships. In addition, the LCHD's attention to cumulative advantage and disadvantage adds to the collective knowledge regarding the impact of societal power and privilege and suggests strategies for social change and justice (Hutchison, 2008). Lu and Halfon (2003) highlighted weakness of the life course perspective. Lu and Halfon acknowledged that life course studies do not integrate biological and sociobehavioral research when assessing health disparities. As a result, it is difficult to understand the biological and sociobehavioral pathways as they relate to disparities in the human context. Lu and Halfon also acknowledged that life course studies lack instruments that accurately measure life course risk factors. In addition, Lu and Halfon noted that life course research focuses on individual-level factors and should focus more on the influences at the neighborhood, community, cultural, and policy levels.

In the present study, the LCHD was used to study whether the physical, social, behavioral, and economic environments played a role in modifying a hypertensive woman's risk for delivering a PTB or LBW infant. In addition, the LCHD was employed to examine the possible moderating effects of neighborhood membership on the hypertensive disorder in pregnancy and adverse birth outcome association.

Literature Review Related to Key Variables and/or Concepts

Racial Disparities in Infant Mortality

The disparity in infant mortality rates among racial and ethnic groups in the United States has been documented. In 2009, the infant mortality rate for non-Hispanic black women was 2.3

and 2.8 times the rate for non-Hispanic white and Asian or Pacific Islander women respectively (Mathews & MacDorman, 2013). Mathews and MacDorman also reported higher infant mortality rates for Puerto Rican mothers and American Indian or Alaskan Native mothers. The disparity in infant mortality rates among racial and ethnic groups have persisted despite an observed decline in the U.S. rates of infant mortality over the last few decades (Wise, 2003). Researchers have sought to shed light on reasons for this perplexing phenomenon.

Several scholars (Cleary-Goldman et al., 2005; Elder, Goddeeris, Haider, & Paneth, 1995; Luo, Wilkins, & Kramer, 2006; Mazzucco et al., 2011; Michielutte, Moore, Meis, Ernest, & Wells, 1994) have sought to identify the root cause of the infant mortality racial disparity. These scholars examined various maternal risk factors that have been thought to contribute to poor birth outcomes. Risk factors such as advanced maternal age, socioeconomic status, maternal education, marital status, maternal residential neighborhood, and race/ethnicity have been investigated for their contributions to adverse birth outcomes.

Michielutte et al. (1994) used vital statistics data to study the associations between birthweight and mortality among singleton births in North Carolina during a defined time period. Similarly, Elder et al. (2014) used national vital statistics data to study the contribution of maternal risk factors to infant mortality. Some of these risk factors included maternal age, education, and previous pregnancy loss. Although Michielutte et al. found that the excess deaths among black infants were attributable to the larger incidence of LBW among this group, Elder et al. found that that the observed maternal risk factors they studied became less predictive of infant mortality over time. Instead, Elder et al. found an unexplained gap or disparity in infant mortality among infants with very LBW. The disparity in infant mortality rates has been linked

by researchers to the higher rates of preterm birth and the resulting prevalence of LBW among infants of particular racial and ethnic groups (Paneth, 1995; Schempf et al., 2007; Wise, 2003). PTB and LBW, therefore, are factors that may explain the racial gap in U.S. infant mortality rates.

Adverse Birth Outcomes: Low Birthweight and Preterm Birth

LBW and PTB are adverse birth outcomes that contribute to infant mortality. Both are among the leading causes of infant mortality in NYC (NYC DOHMH, 2011c). Defined as a birthweight less than 2,500 g (5.5 pounds), LBW can lead to serious health complications for an infant including death (NYC DOHMH, 2011a). PTB, an antecedent to LBW, refers to infants born prior to the completion of 37 weeks of gestation and can also lead to health complications including the death of an infant (Paneth, 1995). In NYC, higher rates of preterm birth and LBW have consistently been observed among African American and some Hispanic infants than in white infants (NYC DOHMH, 2011a). This racial disparity in the rates of PTB and LBW is, however, not strictly isolated to NYC. This disparity has been observed at the national level and has contributed to the disproportionate rates in infant mortality among infants of varying racial and ethnic groups. Nationally, black infants are 2.5 times more likely to die in infancy than infants, and American Indian or Alaskan Native and Puerto Rican infants are respectively 1.5 and 1.4 times more likely to die in infancy than non-Hispanic white infants (Hauck et al., 2011). Attributed to the persistent racial disparity in infant mortality rates is the higher rate of PTB and resulting low birthweight in African American and other populations. LBW infants are 25 times more likely to die than normal birthweight infants (Hauck et al., 2011). Infants of very LBW are 100 times more likely to date than normal birthweight infants (Hauck et al., 2011).

LBW is the immediate outcome of two governing factors including a short duration of gestation or prematurity and a reduced fetal rate of growth or intrauterine growth restriction (Almond, Chay, & Lee, 2005). Zoldi et al. (2012) also cited that LBW results from intrauterine growth restriction (IUGR) and/or preterm birth (see Figure 2). IUGR accounts for impaired fetal growth and, when combined with preterm delivery, can yield infant death. IUGR is defined as a fetal birthweight or birth length that is below the 10th percentile for gestational age (Zoldi et al., 2012). IUGR can also be referred to as pathological small for gestational age (SGA) or fetal growth restriction (FGR).

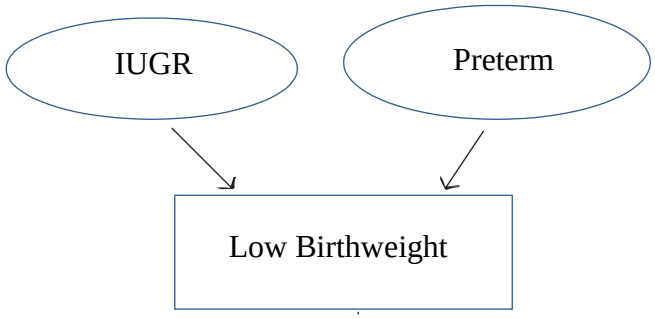


Figure 2. Causes of LBW

IUGR occurs in about 10% of all pregnancies and is associated with increased fetal and neonatal mortality (Albu, Anca, Horhoianu, & Horhoianu, 2014). Its causes are multifactorial in origin and results from maternal, placental and fetal factors (see Figure 3). These risk factors work individually or in combination with one another to result in impaired fetal growth.

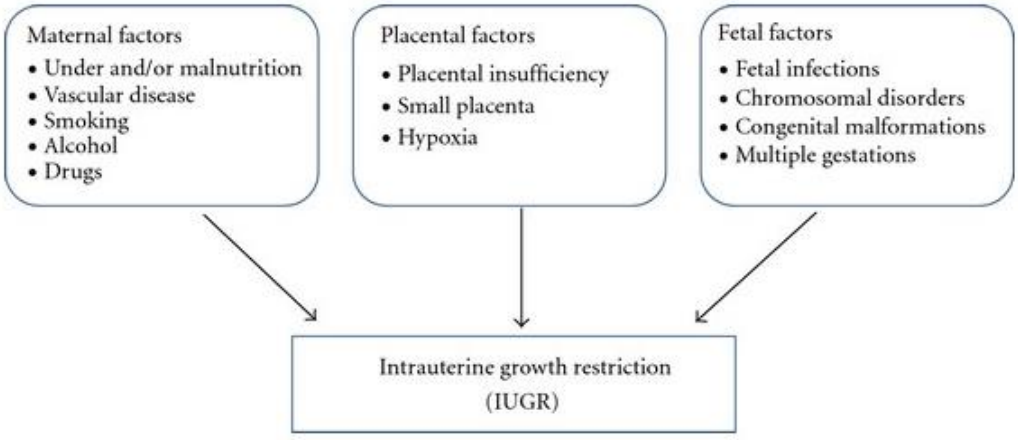


Figure 3. IUGR risk factors

In most IUGR pregnancies, blood flow to the fetus is restricted. As a result, the fetus is deprived of oxygen and nutrients that are critical to its development and growth (Zoldi et al., 2012). This occurrence plays a role in the inability of the fetus to achieve its full growth potential.

Researchers have studied the LBW problem to understand the etiology of this problem and begin to eradicate it. Paneth (1995) acknowledged that LBW was not a simple public health problem but rather an intricate conundrum that has continued to persist despite medical advances in pregnancy care and delivery. Neonatal mortality (death within the first 28 days of life) represents two thirds of the infant deaths (Heron, 2010). As such, an infant's birthweight is a critical indicator of how well a pregnancy has progressed and may be used as a reliable birth outcome predicator.

LBW has been implicated as a causal factor in most neonatal deaths (Heron, 2010). One approach that researchers sought to use to address this issue was to focus their studies on predicting preterm births because these births result in the birth of infants with LBW. Preterm

birth is defined as the birth of an infant prior to the completion of 37 weeks of gestation (Zoldi et al., 2012). A majority of preterm births occur as a result of spontaneous preterm labor, and others occur because of premature prelabor rupture of membranes or clinical indication (Zoldi et al., 2012). The causes of preterm births have been found to be multifactorial in nature. The implicated risk factors include maternal ethnicity; previous preterm birth; and short time interval between pregnancies and maternal medical conditions, such as depression and hypertension (Zoldi et al., 2012).

Goldenberg et al. (1998) found that the odds ratio for spontaneous preterm birth was highest for the presence of fetal fibronectin, a protein produced by fetal cells, in the vagina or cervix. Other strong predictors of spontaneous birth included being African American, having a short cervix, having a low body mass index, and having history of a prior preterm birth (Goldenberg & Culhane, 2007; Goldenberg et al., 1998; Iams et al., 1996). Although these predictors of spontaneous birth are now well documented, knowledge of them has not resulted in noticeable reductions in the incidence of spontaneous births.

Another approach taken by researchers to understand the LBW disparity was to examine the hospitals at which infants were born to ascertain whether the hospitals themselves were prone to higher rates of neonatal mortality. Howell, Herbert, Chatterjee, and Kleinman (2008) examined differences in the distribution of non-Hispanic black and non-Hispanic white births that yielded very LBW infants among several hospitals in NYC. Howell et al. found that very LBW white infants were more likely to be born at hospitals with the lowest neonatal mortality rates while very LBW black infants were likely to be born at hospitals with higher neonatal mortality rates. Howell et al. demonstrated that the wide variations in risk-adjusted neonatal

mortality rates among NYC hospitals may reveal the existence of differences in the quality of care of these hospitals. Chien et al. (2002) and Leviton et al. (1999) had similar findings in their studies that demonstrated variations in hospital use of treatments for prematurity. Improving outcomes at the lowest performing hospitals may yield significant benefits, such as the reduction of excess infant deaths.

Since the problem of LBW continues to persist despite much research into this topic, additional theories have been offered to account for the reasons for this persistent racial disparity. Researchers observed that in racially segregated communities such as NYC, the gap in the incidence of LBW among racial and ethnic groups has been much more pronounced. Possible reasons for this trend have been further investigated.

Hypertensive disorders in pregnancy

Hypertensive disorders are the most common medical complication experienced during pregnancy. Roberts, Pearson, Cutler, and Lindheimer (2003) cite these disorders to be leading contributors to maternal mortality as well as to preterm delivery, fetal intrauterine growth restriction, LBW, and perinatal death. Approximately 5% to 10% of all pregnancies in the United States are affected by complications relating to hypertensive disorders (Kuklina, Ayala, & Callaghan, 2009). Hypertensive disorders in pregnancy are classified into four distinct categories. These are 1) chronic hypertension, 2) gestational hypertension 3) preeclampsia, and 4) preeclampsia superimposed on chronic hypertension (Mammaro et al., 2009).

Chronic hypertension is defined as high blood pressure that either precedes pregnancy, is diagnosed within the first 20 weeks of pregnancy or persists beyond 12 weeks postpartum (Leeman & Fontaine, 2008: Mammaro et al., 2009). Categories of chronic hypertension include

mild (up to 179mm Hg systolic and 109mm Hg diastolic) and severe (≥180 mm Hg systolic and 110 mm Hg diastolic) (Mammaro et al., 2009). The rates of chronic hypertension among women of childbearing potential are on the rise due to increasing delays in childbearing. Chronic hypertension is believed to complicate approximately 5% of all pregnancies (Mammaro et al., 2009). It contributes to maternal and perinatal morbidity and mortality mostly due to the increased risk of superimposed preeclampsia (Mammaro et al., 2009). The risk to infants include the risk of premature birth, small for gestational age infants, placental abruption and intrauterine death (Mammaro et al., 2009).

Gestational hypertension (previously known as pregnancy-induced hypertension) is defined as having systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mmHg or both (Mammaro et al., 2009). It is new hypertension without proteinuria that develops after 20 weeks of gestation (Leeman & Fontaine, 2008). Gestational hypertension complicates approximately 6% of pregnancies and can lead to the more serious condition of preeclampsia (Lain & Roberts, 2002).

Preeclampsia is "a multiorgan disease process of unknown etiology characterized by the development of hypertension and proteinuria after 20 weeks of gestation" (Mammaro et al., 2009, p. 2). It is defined as new hypertension and substantial proteinuria at or after 20 weeks of gestation (Steegers, von Dadelszen, Duvekot, & Pijnenborg, 2010). Preeclampsia complicates an estimated 2-8% of pregnancies and is a major contributor to maternal mortality (Steegers et al., 2010). Severe preeclampsia is defined as the presence one or more of the following conditions: severe hypertension, severe proteinuria, severe oliguria, cerebral or visual disturbances, epigastric or right upper-quadrant pain, pulmonary edema or cyanosis, impaired liver function,

thrombocytopenia and fetal growth restriction (Kuklina et al., 2009). Severe preeclampsia can result in obstetric complications that include intrauterine growth restriction, placental abruption and fetal demise (Leeman & Fontaine, 2008).

Preeclampsia superimposed on chronic hypertension accounts for the development of preeclampsia in women with chronic or preexisting hypertension (Perni et al., 2012). It is diagnosed by the presence of increased blood pressure above the patient's baseline, a change in the baseline proteinuria or evidence of end-organ dysfunction (Lain & Roberts, 2002). Superimposed preeclampsia develops at or after the 20th week of pregnancy and is known to be associated with greater maternal and fetal morbidity and mortality than preeclampsia in women without chronic hypertension (Perni et al., 2012). It is often accompanied by fetal growth restriction and occurs in approximately 20% to 25% of women with chronic hypertension (Magee, Pels, Helewa, Rey, & von Dadelszen, 2014). Preeclampsia and other hypertensive disorders during pregnancy therefore appear to increase the risk of experiencing an adverse birth outcome.

Hypertensive disorders in pregnancy and adverse birth outcomes

Hypertensive disorders are recognized as leading causes of maternal, fetal and neonatal morbidity, and mortality. Numerous studies have demonstrated that in the presence of hypertensive disorders in pregnancy, adverse birth outcomes are more prevalent. Buchbinder et al. (2002) compared the frequency of adverse birth outcomes in women with hypertensive disorders with or without proteinuria. They found increased rates of preterm delivery and small for gestational age infants among women with severe hypertension. The finding that blood pressure abnormality during pregnancy was associated with adverse birth outcomes was

substantiated by several studies. Bakker et al. (2011) found elevated blood pressure in pregnancy to be associated with a higher risk for adverse birth outcomes. Specifically, they found that higher blood pressure in pregnancy was associated with smaller fetal head circumference and femur length and lower fetal weight. Similarly, Macdonald-Wallis, Tilling, Fraser, Nelson, and Lawlor (2014) found that women who experience greater increases in blood pressure during pregnancy have a highly likelihood than women without blood pressure increases of experiencing reduced fetal growth and shorter gestation. An additional study by Lim et al. (2014) also found higher blood pressures during pregnancy to be associated with reduced offspring size at birth.

Additional studies have investigated the contribution of various categories of hypertensive disorders during pregnancy on birth outcomes. Allen, Joseph, Murphy, Magee, and Ohlsson (2004) conducted an investigation to quantify the effect of hypertensive disorders during pregnancy on adverse perinatal outcomes. They found that women with any hypertensive disorder in pregnancy were 1.6 times more likely to deliver infants who are small for their gestational age. These women were also 1.4 times more likely than women with no hypertensive disorder to experience a stillbirth. Allen et al. (2004) also focused on the effect of chronic hypertension on pregnancy outcome and found that women with chronic hypertension were more likely to deliver small for gestational age infants as well as stillborn infants. Similarly, Ananth, and Basson (2010) also found a larger burden of stillbirth and neonatal mortality to be associated with chronic hypertension.

The effect of preeclampsia on pregnancy outcome has been well documented in the literature. Odegard, Vatten, Nilsen, Salvesen, and Austgulen (2000) noted preeclampsia to be

associated with a 5% reduction in birthweight. In severe preeclampsia, they found a 12% reduction in birthweight. Both early-onset and severe preeclampsia were found to be associated with significant fetal growth restriction. Sibai (2003) noted the rates of perinatal mortality and morbidity as well as the rates of placental abruption to be substantially higher in women with severe preeclampsia. Singhal, Deepika, Anshu, and Nanda (2009) cited complications of preeclampsia to include preterm labor, intrauterine growth restriction, accidental hemorrhage and intrauterine death. These maternal and perinatal complications reinforce the dangers of preeclampsia and other hypertensive disorders in pregnancy to birth outcomes.

Membership in racially segregated areas and adverse birth outcomes

Racial residential segregation is defined as the physical separation of racial groups through enforced residence in certain areas (Williams & Collins, 2001). Racial residential segregation is also implicated as a contributor to the disparities in health that continue to persist among racial groups in the country (Collins & Williams, 1999; Landrine & Corral, 2009; Williams & Collins, 2001). Some of these racial health disparities include: 1) higher prevalence of asthma among African American children and adults than in their white counterparts (Gold & Wright, 2005), 2) higher diabetes prevalence and death rates among blacks (Peek, Cargill, & Huang, 2007), and 3) higher death rates from cardiovascular diseases in blacks than in whites (Davis, Vinci, Okwuosa, Chase, & Huang, 2007).

Several studies have explored the possible association between racial residential segregation and adverse birth outcomes. Grady (2006) investigated whether residency in racially segregated areas played any role in the higher observed rates of LBW among African American women living in New York City. Similarly, Debbink, and Bader (2011) undertook a study to

examine the influence of residency in racially segregated neighborhoods on the overall risks of LBW. Findings from both studies revealed an association between racial residential segregation and low birthweight. Grady (2006) specifically found that at the neighborhood level, residential segregation was significantly associated with LBW even after neighborhood poverty and individual-level risk factors were controlled for. Debbink and Bader (2011) found that characteristics such as racial segregation predicted growth-restricted LBW on the neighborhood scale, and that black mothers living in segregated neighborhoods had significantly increased odds of having a LBW infant by growth restriction. Since the association between racial residential segregation and LBW persisted in both studies, even after the researchers controlled for economic factors, the relationship between these two variables was thought to be a meaningful one.

Five separate dimensions or measures of racial residential segregation have been identified. These dimensions are unevenness, isolation, centralization, concentration, and clustering (Massey & Denton, 1988). Unevenness measures the extent to which minority populations are distributed in a manner that makes them overrepresented in some areas and underrepresented in other areas. Isolation measures the extent to which a group's exposure to other groups may be limited due to their confinement in a particular area or neighborhood. Centralization measures the extent to which a group is congregated around the center of an urban area and concentration measures the extent to which a group is concentrated within a small area and occupying less physical space than another group. Finally, clustering measures the extent to which minority settlements are either tightly clustered into large enclaves or dispersed around urban settings (Massey & Denton, 1988).

Segregation at the residential level has been implicated as a contributing factor in observed racial disparities in health and wellbeing. Acevedo-Garcia (2000) found that residency in racially segregated neighborhoods resulted in diminished health outcomes due to neighborhood disadvantages such as concentrated poverty and limited access to adequate health care. Using this and similar observations, Williams and Collins (2001) concluded that racial residential segregation is the fundamental cause of racial inequalities in health. Racial residential segregation has been hypothesized to contribute to poor birth outcomes among particular racial and ethnic groups. The disproportionate rate of LBW and preterm birth among some racial and ethnic groups may also be attributable to some degree to residency in racially segregated neighborhoods. Findings for various racial and ethnic groups are as follows:

African Americans (Blacks). Residence in a segregated black neighborhood has been found by researchers to be associated with an increased risk of having an adverse birth outcome. African American mothers have been noted to have higher risks of giving birth to PTB and LBW if they live in highly segregated African American neighborhoods. Debbink and Bader (2011) found that racial segregation predicted growth-restricted low birthweight and that black mothers living in segregated neighborhoods had significantly increased odds of having a LBW infant by growth restriction. Similarly, Anthopolos, James, Gelfand and Miranda (2011) found that non-Hispanic black mothers living in racially isolated African American neighborhoods also had increased odds of having LBW infants.

The conclusion from these and other researchers is that concentration of blacks in a residential area can particularly be troublesome with regards to the health and wellbeing of the neighborhood residents. This is because black neighborhoods have been found more likely to

have fewer resources such as technologically advanced hospitals, medical specialists, and reduced opportunities for early medical interventions (Landrine & Corral, 2009). As such, residents in predominantly African American neighborhoods face disparities in health care quality and access.

Isolation and clustering have been implicated as dimensions of neighborhood segregation that particularly impact African American birth outcomes. Bell, Zimmerman, Almgren, Mayer, and Huebner (2006) found that moderate and high levels of isolation resulted in poorer black birth outcomes. In the presence of neighborhood isolation, Bell et al. identified higher rates of LBW and PTB. With regards to clustering, Bell et al. did not find that this resulted in deleterious birth outcomes for African American mothers. Various categories of clustering were found to be associated with higher birthweight and reduced odds of PTB.

The finding by Bell et al. is consistent with that of other studies (Collins & Williams, 1999; Kramer, Cooper, Drews-Botsch, Waller, & Hogue, 2010; Subramanian, Acevedo-Garcia, & Osypuk, 2005) that linked racial isolation with adverse health effects and poor birth outcomes in some cases. Kramer et al. (2010) found that isolation of African American mothers was associated with higher rates of premature birth. Through racial residential segregation, isolation has been shown to be an important factor that contributes to the disproportionate observance of adverse birth outcomes in African American women.

Asian Americans. Although Asian Americans have been noted to be less residentially segregated than Hispanics and Blacks, they have become more isolated from whites as their population has grown (Logan, 2011). Some Asian American groups, regardless of their income, prefer to live in ethnic communities contributing to residential isolation from whites (Logan,

2011). Residence in ethnic communities however does not necessarily mean that Asian ethnic communities have fewer resources. In fact, Asian Americans were generally found to have higher incomes than whites and reside in more prosperous neighborhoods (Logan, 2011). This finding is however not the case in for all Asian Americans. Generally, Asian Americans who are not at the high income range are found to be more disadvantaged as compared to whites (Logan, 2011).

Unfortunately, most studies that examined the contribution of racial residential segregation to adverse birth outcomes have focused primarily on the black-white disparity. As such, Asian Americans have not been studied extensively with regards to any association of racial residential segregation to adverse health outcomes in this population. One of the few studies to examine this issue among Asian Americans specifically looked at the potential association between residential segregation and birth outcome for Asian American women. Walton (2009) found that Asian American women who resided in racially isolated neighborhoods had significantly lower odds of having a LBW infant. Higher degrees of Asian American clustering in neighborhoods were also found to result in lower odds of women having LBW infants (Walton, 2009).

A study by Janevic et al. (2010) revealed that women of East Asian descent had an increased risk of PTB in the presence of neighborhood deprivation. This study found no effect on LBW for any Asian subgroup population as a result of neighborhood disadvantage. One additional study by Pearl, Braveman, and Abrams (2001) did identify an association between less favorable neighborhood characteristics and lower birthweight among Asian American women.

The conflicting findings of the limited studies referenced above make it challenging to draw any definitive conclusions about the association between neighborhood isolation and birth outcome among Asian American women. The only valid conclusion that can be drawn is that the Asian American population requires further study to clearly identify any existing association between racial residential segregation and birth outcome.

Latino Americans (Hispanics). There are a limited number of studies that have specifically examined racial residential segregation and birth outcomes among Latino Americans. One of the few studies to perform this inquiry considered the association of residential isolation and clustering with birthweight among Latino Americans. Walton (2009) found that while residential segregation had an effect on birthweight for some other racial groups, no such association was found among Latino American. Another study by Osypuk, Bates, and Acevedo-Garcia (2010) specifically examined how residential segregation impacted birthweight for US- and foreign (Mexico)-born Mexican-origin residents. They found that residence in areas with high levels of segregation was associated with lower birthweight for infants born to US-born Mexican-origin women. No such association was identified for infants born to Mexico-born women (Osypuk et al., 2010).

Pearl et al. (2001) examined the relationship between birthweight and neighborhood socioeconomic characteristics and found that while less favorable neighborhood characteristics yielded lower birthweights among Blacks and Asians, no definitive relationship was found to exist among Latino Americans. Instead, the study surprisingly found birthweight to increase with less favorable neighborhood characteristics among foreign-born Hispanics.

A Hispanic paradox has been described in the literature. This paradox relates to the favorable birth outcomes that have been observed for Hispanic women relative to non-Hispanic white women despite their higher levels of socioeconomic disadvantage (Buekens, Norton, Kotelchuk, & Wilcox, 2000; Markides & Coreil, 1986; Stein, Savitz, Janevic et al., 2009). The Hispanic paradox also suggests that the risk of adverse birth outcomes increases for Hispanic immigrants as they become acculturated in the United States (Collins & David, 2004). Although this paradox is typically applied to the general Hispanic population, some Hispanic subgroups do not experience favorable birth outcomes to the same extent as others. In fact, some Hispanic subgroups consistently experience higher rates of adverse birth outcomes.

Of all infants born to women of various Hispanic origins, infants born to Puerto Rican mothers experience the highest infant mortality rates (Mathews & MacDorman, 2009). In 2009, the infant mortality rate for Puerto Rican infants was 7.18 as compared to the rates for Cuban (5.77) and Mexican (5.12) infants (Mathews & MacDorman, 2009). Infants born to Central South American mothers also had a lower rate of infant mortality (4.47) than that of Puerto Rican infants (Mathews & MacDorman, 2009). The favorable birth outcomes described by the Hispanic paradox therefore does not appear to be applicable across all women of Hispanic origin.

Hispanic women of Mexican origin experience lower rates of LBW. The low birthweight rate among Mexican American women was even lower than the LBW rate for non-Hispanic white women (Buekens et al., 2000). Reasons for this surprising trend are not entirely clear to researchers. However, the fewer numbers of LBW infants born to Mexican Americans implies that 1) infants born to these women are born heavier than expected and/or 2) Mexican American women deliver fewer preterm infants (Buekens et al., 2000). Unfortunately, data to substantiate

these possible contributors to the Hispanic paradox have been inconsistent. Although some studies have reported fewer preterm births for women of Mexican origin (Cervantes, Keith, & Wyshak, 1999; Guendelman & English, 1995), data from vital statistics show that Mexican American women deliver more preterm infants than white women (Mathews & MacDorman, 2013; Singh & Yu, 1996). This inconsistency in research findings does not allow for any reasonable conclusion to be drawn on the causes of the Hispanic paradox. As such, additional studies are warranted to further investigate the Hispanic paradox and understand why women of some Hispanic origins appear to escape the harmful effects of their adverse socioeconomic conditions with favorable birth outcomes unlike others.

Pathways linking racial residential segregation to adverse birth outcomes

Although several of the studies referenced above have linked residency in racially segregated communities to adverse birth outcomes including LBW (or preterm) deliveries of infants born to women of varying racial and ethnic groups, many of them have not addressed the pathways that link residential segregation to LBW (or PTB). As a result, the pathway through which racial residential segregation is positively associated with the birth outcome of LBW (or PTB) is not thoroughly understood.

Osypuk and Acevedo-Garcia (2008) and Osypuk et al. (2010) provided some proposed pathways that link racial residential segregation to birthweight. They hypothesized that racial residential segregation works through various mechanisms to ultimately impact birthweight. The proposed mechanisms involved neighborhood-level factors such as existing ethnic and immigrant residential enclaves, social networks, neighborhood poverty, and violence; and individual-level factors such as socioeconomic status, social support, health behaviors (i.e.

smoking, alcohol or drugs) and psychosocial factors (i.e. depression, maternal stress). Osypuk and Acevedo-Garcia and Osypuk et al. believe that these neighborhood- and individual-level factors interact with one another to yield either negative or positive associations between racial residential segregation and birthweight.

Another proposed pathway linking racial residential segregation to birth outcome involves the isolation and clustering indices and their respective interactions with community and individual attributes. Bell et al. theorized that isolation interacts with community attributes such as concentrated poverty and neighborhood quality, discrimination exposure, social support and community cohesion and individual attributes such as stress, health status, and health behavior to produce adverse birth outcomes. Conversely, clustering was theorized to interact with the same community and individual attributes to yield favorable birth outcomes. Bell et al. therefore found that, unlike clustering, isolation captures all of the negative elements of segregation (i.e. poverty concentration, violent crime, reduced access to healthy food options, disenfranchisement, etc.) that results in deleterious health effects. In addition, these factors are believed to contribute to chronic exposure to psychosocial stressors for expectant mothers that directly and negatively impact their birth outcome.

Effect modification on the hypertensive disorders in pregnancy and adverse birth outcomes association

There is sufficient evidence in the literature to confirm that a positive association exists between hypertensive disorders in pregnancy and adverse birth outcomes. Fang, Madhavan, and Alderman (1999) studied the influence of maternal hypertension on the risk of LBW and found maternal hypertension to be an important risk factor for this adverse birth outcome. In their

investigation, Fang et al. noted that the risk of LBW differed by race/ethnicity and since black mothers presented with higher prevalence of hypertension, their risk was highest for LBW.

Jain, Ferre, and Vidyasagar (1998) similarly found hypertension to be associated with a reduction in the birthweight of newborns in both whites and blacks. However, in this study, white hypertensive women were found to demonstrate a higher risk for LBW than black hypertensive women. Another study of hypertension and adverse birth outcomes was performed by Ananth, Peedicayil, and Savitz (1995) and they examined the impact of hypertensive disorders during pregnancy. The hypertensive disorders studied included chronic hypertension, pregnancy-induced hypertension and eclampsia. Ananth et al. found that the risk of LBW was substantially increased when hypertensive disorders were present during pregnancy. Lim et al. (2014) also found that among a cohort of multi-ethnic Asian women, maternal hypertension in pregnancy was an important determinant of infant size at birth. More specifically, Lim et al. found that higher blood pressures in the second trimester of pregnancy were associated with a lower infant size at birth.

Very limited studies have investigated whether the risk of hypertensive disorders is higher in areas of neighborhood racial segregation. Kershaw et al. (2011) used national survey data to examine whether black-white disparities in hypertension varied by the level of racial residential segregation. They found that racial disparities in hypertension were modified by the levels of racial segregation. That is, the association between race and hypertension was found to be smallest among individuals living in integrated neighborhoods and largest among those living in areas of higher segregation. Diez Roux et al. (2001) found that with regards to cardiovascular disease risk factors such as hypertension, an individual's neighborhood of residence plays a

mitigating role in the chance of developing heart disease over time. Individuals residing in disadvantaged neighborhoods were found to have a higher likelihood of developing heart disease than those living in more advantaged neighborhoods. Another study by Mujahid, Diez Roux, Cooper, Shea, and Williams (2001) found that chronic neighborhood stressors including psychosocial stressors (e.g. stressful life events, perceived discrimination and job strain) and neighborhood problems (e.g. vandalism, violence, overcrowding, noise) may contribute to racial and ethnic differences in the prevalence of hypertension.

Although there is sufficient evidence in the literature to substantiate that a strong association exists between hypertensive disorders in pregnancy and adverse birth outcomes, there is limited knowledge of whether neighborhood membership plays a role, if any, in this relationship. Very few studies have tackled this subject even though there was clear evidence that neighborhood residency could contribute to various health disparities. As such, the present study explored the association of hypertensive disorders in pregnancy, adverse birth outcomes and residential segregation. More specifically, the study examined whether neighborhood membership provided an effect modification between hypertensive disorders in pregnancy and adverse birth outcomes. That is, this study considered whether neighborhood membership modified the association between these two variables.

Summary and Conclusions

The purpose of this study was to investigate the relationship between hypertensive disorders in pregnancy and adverse birth outcomes and to consider whether neighborhood membership modifies this relationship. One of the primary research questions was to assess the extent to which an association existed between hypertensive disorders in pregnancy and adverse

birth outcomes among women of varying ethnic/racial groups in New York City. The study also assessed whether a correlation existed between neighborhood membership and adverse birth outcomes. In addition, the study examined whether neighborhood membership modified the association between hypertensive disorders in pregnancy and adverse birth outcomes.

This study utilized the life course framework to examine the contribution of various factors including neighborhood, psychosocial and cultural dynamics on a woman's risk experiencing an adverse birth outcome. Biological factors were also considered with regards to a woman's predisposition to particular medical conditions and how these exposures modified the woman's risk of experiencing an adverse birth outcome.

Since membership in racially segregated areas is believed to be associated with higher risks for experiencing health disparities, this study sought to answer important research questions that could fill a present gap in the literature and provide useful insights in the ongoing effort to decrease and eventually eliminate the disparities that exist in the rates of LBW and PTB among racial and ethnic groups in the country. Findings from this study could potentially provide confirmatory evidence of the additional factors that may exacerbate any relationship between hypertensive disorders in pregnancy and adverse birth outcomes. Additionally, results of this research could have health policy implications as well as implications for social change and justice.

Chapter 3: Research Method

Introduction

Higher prevalence of infant mortality among some racial and ethnic groups may be caused by differences in birthweight between racial groups (Paneth, 1995; Reichman et al., 2008) or by varying rates of preterm birth within each racial group (Schempf et al., 2007). In NYC, the rates of preterm birth, LBW, and overall infant mortality closely match national rates of variation between racial groups. Hypertensive disorders during pregnancy, which can complicate approximately 7% of all pregnancies (Buchbinder et al., 2002), may play a role in adverse birth outcomes such as PTB and LBW.

The purpose of this study was to explore the relationship between hypertensive disorders in pregnancy and adverse birth outcomes, specifically PTB and LBW, in NYC. In addition, I examined how the residential neighborhood of expectant mothers impacted the association between hypertensive disorders in pregnancy and adverse birth outcomes. I investigated whether neighborhood membership in any way modified the association between hypertensive disorders in pregnancy and adverse birth outcomes. In line with this, the research questions and hypotheses were as follows:

RQ1. To what extent does an association exist between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC?

$H_0$1: There is no association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

H_a1: There is an association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

RQ2. To what extent does an association exist between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC?

$H_0$2: There is no association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

H_a2: There is an association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

RQ3. Does the neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes?

$H_0$3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does not moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

H_a3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

This chapter includes a discussion of the research design and rationale of the research design, population, sampling and sampling procedures, procedures for recruitment, participation, data collection, instrumentation, and operationalization of constructs used in the study. Information is also provided on the procedures of data analysis, threats to validity, and ethical procedures. This chapter ends with the summary of the research methodology used for this study.

Research Design and Rationale

I used the quantitative methodology and a cross-sectional research design. Quantitative methodologies are usually used when the goal of the study is to investigate relationships between variables measured numerically (Babbie, 2012). Quantitative methodologies require the use of quantitative measurement and statistical analysis to explain the topic being investigated (Mustafa, 2011). Numerical data of the study variables were obtained using existing data from secondary sources. The independent variables were hypertensive disorders in pregnancy including chronic hypertension, gestational hypertension, and eclampsia. The moderator variable was neighborhood membership. Neighborhood membership acted as a proxy variable for ethnic grouping in this study. Although each neighborhood was not generally composed of entirely one ethnic group, it could capture the numerous environmental aspects that may also be associated with membership in a particular ethnic group. Such aspects include income, culture, lifestyle, and access to medical care; these components may be modifiers of the relationship between hypertensive disorders and birth outcomes. The dependent variables were the adverse birth outcomes of LBW and PTB.

The main objective of this quantitative study was to determine the effects of one variable on another variable. In line with this objective, the quantitative design that was used was a cross-sectional study. This design was appropriate as it allowed me to observe variables in their natural setting. A cross-sectional study is conducted to measure relationships between exposures and outcome at a point or period in time. Within that design, correlational analysis and regression analysis can be used to determine relationships between variables or to determine the influence of various independent variables on a particular dependent variable (Leedy & Omrod,

2010). Causality cannot be determined in a cross-sectional study, as it may be difficult to discern temporality as in a cohort study or experimental study (Babbie, 2012). The effect of the independent variable to the dependent variables will determine the existence of the relationships between variables. In this study, the objective was to determine the effect of the independent variable of hypertensive disorders in pregnancy on the dependent variables of adverse birth outcomes including LBW and PTB, while also considering the moderating effects of neighborhood membership on the relationship between independent and dependent variables.

Methodology

Population

The population for this study included women of various racial and ethnic backgrounds who resided in NYC at the time of their infant delivery. The population for this study were the five boroughs of NYC including the Bronx, Brooklyn, Manhattan, Queens, and Staten Island. This study only included singleton births in NYC during the year of 2010. Only singleton births were included in the study sample as multiple births infants on average have lower birth weights. The year 2010 was selected as this was also the year of the most recent U.S. census. The 2010 census data were employed to assess the neighborhood characteristics of women who delivered infants in NYC in 2010. The overall exclusion criteria of the study included those women who had multiple infant births at one time and women who gave birth in NYC but did not have their primary residency in NYC.

Sampling and Sampling Procedures

The required sample size for the study was determined using a power analysis through the calculation in the G*Power software. The sample size was calculated based on the different

factors of Cohen's effect size, the level of significance (alpha level), and the power of the study, which is the likelihood of rejecting a false null hypothesis (Cohen, 188). A power of 0.80 is normally used in quantitative research to provide valid statistical results (Faul, Erdfelder, Lang, & Buchner, 2009). A medium effect size was used in order not to be lenient and strict at the same time. An a priori power analysis was conducted considering the statistical test of logistic regression analysis, two tailed test, a statistical power of 0.8, an odds ratio of 1.3, and a level of significance of 0.05; the total sample size computed was 721 (See Appendix A). I had to collect data from at least 721 women who passed the study's inclusion criteria from the secondary data sources.

A purposive sampling plan was used to recruit the samples of women. Purposive sampling was conducted because it offered accessibility advantage, higher speed, and lesser costs to recruit sample study participants (Coy, 2008). A purposive sampling was also chosen because the study participants should match to a set of inclusion criteria in order for them to be eligible for participation in the study. The population for this study included women of various racial and ethnic backgrounds who resided in NYC at the time of their infant delivery. Purposive sampling of individuals enables the researcher to gather an in-depth understanding of a topic (Marshall & Rossman, 2011).

Procedures for Recruitment, Participation, and Data Collection

Data for this study were obtained from two different data sources. Data sources included the NYC Department of Health and Mental Hygiene from which the 2010 vital statistics birth records were obtained. The second source of data was the U.S. Census from which the 2010 census data were collected for use in studying neighborhood characteristics and residential

segregation in NYC. The U.S. census data were readily available online for retrieval and use. Permission to receive and use the 2010 NYC birth records data was obtained from the NYC Department of Health and Mental Hygiene data administrator. Permission was secured by completion and submission of a formal data request application form to the data administrator. Information included in the application included explanation of the purpose of the study and intent for the use of data. The 2010 birth records data were released to me after a required data use agreement form was signed by me and returned to the data administrator. No informed consent was collected or needed as there was no actual survey or testing conducted in the study. All data were secured from secondary data sources.

The data sets collected were inputted in an Excel spreadsheet format that was uploaded to the statistical assessment software of SPSS where the statistical analysis was conducted. In the Excel spreadsheet, the columns displayed the names of the study variables as an enumerated list, while the rows listed the data of the different study variables of the different samples.

Instrumentation and Operationalization of Constructs

This study obtained data from secondary sources. Specifically, two data sources were used to retrieve the 2010 vital statistics birth records obtained from the NYC Department of Health and Mental Hygiene and the 2010 U.S. Census data for use in studying neighborhood characteristics and racial residential segregation in NYC. These data sources were used to obtain secondary data on the variables of maternal characteristics such as age, race, marital status, education level, and comorbid medical conditions during pregnancy and at the time of infant delivery; the neighborhood characteristics of racial segregation; the independent variables of hypertensive disorders measure of chronic hypertension, gestational hypertension, and

eclampsia; moderator of neighborhood membership; and dependent variable of LBW and PTB. Secondary data are existing data available in historical records, database, and documents (Andrews, Higgins, Andrews, & Lalor, 2012). The data of the study variables collected were singleton births in NYC during the year of 2010.

Operationalization

LBW was one of the measures of adverse birth outcome. It was a dependent variable in the study. It was a dichotomous measure with two categories of LBW including a child not having LBW (0) and a child having LBW (1). A child with LBW had a birth weight less than 1,500 grams.

PTB was another measure of adverse birth outcome. It was a dependent variable in the study and a dichotomous measure with two categories of PTB including a woman not experiencing PTB (0) and a woman experiencing PTB (1). Those women with PTB were those that had their infants born prior to the completion of 37 weeks of gestation (< 37 weeks).

Chronic hypertension was one of the measures of hypertensive disorders in pregnancy. It was an independent variable in the study and a categorical measure with three categories of chronic hypertension including no chronic hypertension (< 179mm Hg systolic and < 109mm Hg diastolic), mild (up to 179mm Hg systolic and 109mm Hg diastolic), and severe ($\geq$180 mm Hg systolic and 110 mm Hg diastolic).

Gestational hypertension was one of the measures of hypertensive disorders in pregnancy. It was an independent variable in the study and a dichotomous measure with two categories of gestational hypertension including not experiencing gestational hypertension (0) and

experiencing gestational hypertension (1). Gestational hypertension was defined as the onset of new hypertension in a pregnant woman after 20 weeks of gestation.

Eclampsia was one of the measures of hypertensive disorders in pregnancy. It was an independent variable in the study and a dichotomous measure with two categories of eclampsia including not experiencing eclampsia (0) and experiencing eclampsia (1). Eclampsia is a serious medical condition where high blood pressure leads to seizures during pregnancy.

Neighborhood membership was the moderator and was separated into two variables: poverty percentage of neighborhood and segregation grouping. Poverty percentage was measured as the percentage of families/ individuals that fell below a given income threshold that was dependent on the number of individuals in the family unit. Segregation was measured on two levels: living in a neighborhood that did not have high segregation (0) and living in a neighborhood that did have high segregation (0).

The categories were manually determined using the data obtained from the secondary sources and then by identifying the range of possible values to categorize whether the data were above or below the means to consider the neighborhood as having high poverty rates or high segregation. To determine whether the neighborhood NYC had or did not have high poverty rates, the percentage of families with incomes below poverty was used to characterize census tracts according to poverty level. This measure was based on the ratio of family income to an appropriate poverty threshold. The poverty threshold was based on family size and residential location (urban/rural). A similar method was used for segregation, where the average percentage and standard deviation of inhabitants who identified as White was calculated. It was assumed that neighborhoods that had a low percentage of white inhabitants exhibited racial segregation;

therefore, neighborhoods that had less than two standard deviations from the mean percentage of white inhabitants were considered racially segregated.

Data Analysis Plan

Descriptive Statistics

Data for the demographic information of maternal characteristics such as age, race, marital status, educational level, and comorbid medical conditions during pregnancy and at the time of infant delivery; the neighborhood characteristics of racial segregation and poverty level; the independent variables of hypertensive disorders in pregnancy including chronic hypertension, gestational hypertension, and eclampsia; moderator of neighborhood membership; and dependent variable of adverse birth outcomes of LBW and PTB were summarized. Most of the data were categorically measured. This was summarized using frequency and percentage summaries. Descriptive statistics of the central tendency measures of mean and standard deviation were obtained to summarize the data of the continuous measured study variables.

Inferential Statistics

A logistic regression analysis was performed to determine if the independent variables of hypertensive disorders in pregnancy were significantly related with the dependent variables of adverse birth outcomes, specifically PTB and LBW. The logistic regression analysis was also used to determine the moderation effect of the neighborhood membership of expectant mothers on the association between hypertensive disorders in pregnancy and adverse birth outcomes. A logistic regression was used because the two measures of the dependent variables of adverse birth outcomes of PTB and LBW were dichotomous variables measured with the binary codes of 0 (no) and 1 (yes). A logistic regression is used when the dependent variable is a binary variable.

A level of significance of 0.05 is used in the logistic regression analysis. There is a significant relationship if the *p*-value is less than or equal to the level of significance value. There were two logistic regression models generated; one for each of the two measures of the dependent variables of adverse birth outcomes of PTB and LBW.

A hierarchical method was used in which the independent variables are first entered in the analysis and then the moderation effect in the logistic regression model. Two varying effects in the hypertensive disorders in pregnancy and adverse birth outcomes association were examined in this study. The first effect (Path 1) represented a total or direct effect whereby hypertensive disorders in pregnancy directly and fully impacted adverse birth outcomes in the absence of any moderating variable. This meant that the independent variables (the hypertensive disorders measure of chronic hypertension, gestational hypertension, and eclampsia) were first included in the model to determine the relationships of hypertensive disorders in pregnancy and adverse birth outcomes. In addition, the individual effect of the moderator variable of neighborhood membership on the dependent variable of adverse birth outcomes was also tested and included in the first block of the logistic regression model. The second effect (Path 2) considered the impact of a moderator variable (neighborhood membership) on the hypertensive disorders in pregnancy and adverse birth outcome association. The second path considered whether neighborhood membership modified or affected the strength of the relationship between hypertensive disorders in pregnancy and adverse birth outcomes.

As neighborhood membership was split into two variables (poverty level and segregation), the neighborhood did not fit into this category. By splitting the variable into two, the separate effect of poverty and racial segregation on birth outcome could be assessed, as well

as their separate significance. The interaction between the two variables was assessed in the model. The interaction between the neighborhood variables and independent variables were also assessed. The three-way interaction between poverty, segregation, and each of the independent variables were assessed. This provided the fullest picture of the relationships between each variable and birth outcomes, as well as the moderating effects that neighborhood membership had on each. In order to adjust for covariates in this study, maternal-level control variables such as race, ethnicity, age, residence, education, and marital status were used.

The values generated in the logistic regression analysis included the Beta coefficients, standard errors, the Wald test statistic with associated degrees of freedom, *p*-values, and the exponentiated coefficient or the odds ratio. A level of significance of 0.05 was used in the statistical testing wherein there was a significant relation or moderation effect if the p-values were less than or equal to the level of significance value of 0.05. Then, the coefficient of the odd ratio statistic of Exp(B) of the significant independent variables and also the moderator effects would be investigated to determine the change in the log odds of the dependent variable for a one-unit increase in the values of the independent variable and also the effect of the moderator. The relationship between the independent and the dependent variables would be stronger when the deviation of the odds is farther from one.

Threats to Validity

Validity is the extent to which a measurement is truthful, accurate, authentic, or free of system error with evidence supporting the conclusion. Studies are valid if the instrument used to test consistently measures what it is intended to measure. Validation of findings is evident

through activities such as entering responses accurately to an Excel spreadsheet and accuracy of analysis (Leedy & Ormrod, 2010). Threats to validity can be both external and internal.

The internal validity of a quantitative study is "the degree to which observed changes in a dependent variable can be attributed to changes in an independent variable" (Pedhazur & Schmelkin, 2013, p. 154). In research studies, the degree to which threats to internal validity influence the study are determined by the type of research design and the degree of control that the researcher has with regard to sampling, data collection, and data analyses (Mertens, 2014). For this study, there were no threats to internal validity involving history, statistical regression, instrumentation, and mortality. These internal threats to validity are relevant only to experimental studies and other studies that use pretest and posttest data, or longitudinal studies (Mertens, 2014).

External validity concerns the degree to which conclusions from a study can be generalized to other categories of people, settings, or times (Salkind, 2010). In this study, the results of the study were only true for women of various racial and ethnic backgrounds who resided in NYC at the time of their infant delivery. Results from this study therefore may not be generalized to other study population group. The results may have also not be generalizable to other age groups, or cultures. Also, the nature of a correlative examination of isolated variables could reveal correlation but not causation. The inability to adjust the independent variable to determine impact on the dependent variable(s) meant that a cause and effect relationship could not be established. However, the generalizability of the findings to a specific subset of the population may be high. Precautionary measures were taken to ensure that validity and reliability of the data and results drawn from this research were conclusively justified. However,

there was less issue in terms of the validity for this study since there was no actual data collection conducted and the data was obtained from secondary and reputable sources.

Ethical Procedures

The use of archival data precluded the need to protect the sample of women's identity. Data did not include any identifying information on the women. No identifying information such as name or addresses were collected from the archival data so that the privacy of the samples could be protected. There was no informed consent conducted in the data collection since the data of the study variables were obtained from secondary data sources. There was no actual data collection conducted in the study.

The researcher followed the required retention period of the documents set by Institutional Review Board (IRB). The data obtained from secondary sources will be stored for three years after data collection, as required by IRB. As a precautionary measure, the researcher agreed t, destroy and replace with a numerical code any identifiable information, such as names and contact information, to ensure confidentiality. No unauthorized persons could access the data, since the data was kept in strong password-protected files in the researcher's computer. The hard copies of the data were destroyed and the electronic files of the data would be permanently deleted upon completion of the research. Specifically, data stored on the researcher's hard drive would be electronically wiped clean and the hard copies of the data would be shredded upon completion of the research.

Summary

Chapter 3 discussed the research methodology used in the study including population and sampling procedures, instrumentation, data collection procedures, data analysis method, threats

to validity, and ethical procedures. This study used a quantitative, cross-sectional study with the objective of determining the relationship between hypertensive disorders in pregnancy and adverse birth outcomes specifically PTB and LBW; as well as how the residential neighborhood of expectant mothers moderated the association between hypertensive disorders in pregnancy and adverse birth outcomes. Secondary data obtained from pre-existing database was used to measure the study variables. Data analysis included using descriptive statistics and logistic regression analysis to address the three research hypotheses of the study. Chapter 4 provides information on the findings from the data analysis. Thereafter, Chapter 5 discusses the findings of the research, their theoretical basis and implications for future research and practice.

Chapter 4: Results

Introduction

The purpose of this study was to explore the relationship between hypertensive disorders in pregnancy and adverse birth outcomes, specifically preterm birth and LBW, among women who delivered infants in NYC in 2000. In addition, I examined how the neighborhood membership (neighborhood poverty and segregation) of expectant mothers impacted the association between hypertensive disorders in pregnancy and adverse birth outcomes. Specifically, I investigated whether neighborhood membership in any way modified the association between hypertensive disorders in pregnancy and adverse birth outcomes. In line with this, the research question and hypotheses are as follows:

RQ1. To what extent does an association exist between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC?

$H_0$1: There is no association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

H_a1: There is an association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

RQ2. To what extent does an association exist between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC?

$H_0$2: There is no association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

H_a2: There is an association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

RQ3. Does the neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes?

H_03: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does not moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

H_a3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

This chapter will include a discussion of the data collection procedures, as well as report baseline demographics. Descriptive statistics of the sample will be presented, as well as results of the analysis performed. Finally, a summary of the findings will be discussed.

Data Collection

Data for this study were collected from two different data sources. Data sources included the NYC Department of Health and Mental Hygiene from which the 2010 vital statistics birth records were obtained. The second source of data was the U.S. Census from which the 2010 census data were collected for use in studying neighborhood characteristics and racial residential segregation in NYC. All data were collected and exported in Excel spreadsheet format and imported into SPSS for statistical analysis. The actual method of data collection did not deviate from the proposed method as described in Chapter 3.

The data collected for this study consisted of total of N = 124,791 women from different regions of New York. After cleaning the data and applying the exclusion criteria that consisted of eliminating data for women who (a) did not have a primary residency in NYC and (b) did not have singleton births, 110,662 women remained in the study population. Among these women, 9512 had preterm births (8.60%) and 7,487 (6.80%) had babies with LBW. Table 1 below provides a general description of the study population preterm birth and LBW outcomes by sociodemographic characteristics of the mother.

Table 1. Distribution of Adverse Birth Outcomes by Sociodemographic Characteristics for Women who Resided in New York City and had Singleton Births in 2010 (n=110,662).

	Total		**Preterm births**		**Low birth weight**	
	n	%	*N*	%	*n*	%
Total	110662		9512	8.60	7487	6.80
Mother's Race:						
White	60655	54.80	4530	7.50	3129	5.20
Black	28287	25.60	3300	11.80	2893	10.20
Asian	15997	14.50	1172	7.30	1075	6.70
Multi-racial	5060	4.60	436	8.70	331	6.50
Other*	236	0.20	25	10.80	20	8.50
Mother's Ethnicity:						
Puerto Rican	8819	8.00	862	9.90	715	8.10
Other Hispanic	28009	25.30	2454	8.80	1602	5.70
Asian and Pacific Islander	16024	14.50	1175	7.40	1078	6.70
Multiracial Non-Hispanic	2026	1.80	167	8.30	144	7.10
Black Non-Hispanic	24456	22.10	2943	12.20	2617	10.70
Other Non-Hispanic	287	0.30	31	11.00	34	11.80
White Non-Hispanic	30812	27.80	1849	6.00	1275	4.10
Mother's age (years):						
<20	7002	6.30	740	10.70	581	8.30
20-34	81237	73.40	6504	8.10	5218	6.40
>34	22423	20.30	2268	10.20	1688	7.50
Marital Status:						
Married	59238	53.50	4255	7.20	3268	5.50
Unmarried	51424	46.50	5257	10.30	4219	8.20
Mother's Education:						
< High School	28282	25.60	2808	10.00	2068	7.30
High School Graduate	25996	23.50	2306	8.90	1837	7.10
Some College	17317	15.60	1550	9.00	1303	7.50
College Graduate	38606	28.80	2757	7.20	2212	5.70
Mother's Residence:						
Manhattan	18585	16.80	1531	8.30	1128	6.10
Bronx	20584	18.60	1860	9.10	1683	8.20
Staten Island	5314	4.80	417	7.90	317	6.00
Queens	26139	23.60	2250	8.60	1721	6.60
Brooklyn	40040	36.20	3454	8.70	2638	6.60

Note. Unknowns (race = 427; ethnicity = 229; education = 461) *includes American Indian/ Alaska Native/ Native Hawaiian/ Pacific Islander

Table 1 depicts adverse birth outcomes by sociodemographic characteristics for women who resided in NYC and had singleton births in 2000. With regards to race, 54.80% were White;

25.60% were Black;14.50% were Asian 4.60% were multiracial; and 0.20% identified as other races including American Indian, Alaska Native, Native Hawaiian, and Pacific Islander. Among the women, reported ethnicities included White Non-Hispanic (27.80%), Black Non-Hispanic (22.10%), Other Hispanic (25.30%), Asian and Pacific Islander (14.50%), Puerto Rican (8.0%), multiracial non-Hispanic (1.80%), and other non-Hispanic (0.30%). Most women were between 20 and 34 years of age (73.40%), followed by women over 34 years of age (20.30%) and 6.30% were under 20-years-old. A majority of the women were married (53.50%) as compared to 46.50% who were unmarried. A greater percentage of the women were college graduates (28.80%) while 15.60% had some college education but did not graduate; 23.50% completed only high school, and 25.60% did not complete high school. All women resided within the five boroughs of NYC including 36.20% who resided in Brooklyn, 23.60% in Queens, 18.60% in the Bronx, 16.80% in Manhattan, and 4.80% in Staten Island.

To address the research questions of the study, binary logistic regression analysis was performed. Prior to the analysis, there were assumptions of logistic regression that had to be examined and tested prior to running the logistic regression. One such assumption is that there needs to be a linear relationship between the continuous independent variables and the logit transformation of the dependent variable. The Box-Tidwell (Fox, 2008) approach, which adds an interaction term between the continuous independent variables and their natural logs to the regression equation, was used to test this. Because the independent variables were categorical, the linearity assumption did not apply.

The other assumption is that there must not be any multicollinearity (Hilbe, 2009), meaning that there should not be any strong relationships between the independent variables. To

test for this, the variance inflation factors (VIF) were assessed. Any VIF (Fox, 2016) larger than 9 would be deemed problematic. All VIFs were approximately 1.00, which were acceptable; thus, there were no issues with multicollinearity.

Logistic regression was first performed to investigate adverse outcomes by sociodemographic characteristics for women who delivered in NYC. Blacks were 1.11 (0.99, 1.25) times as likely as Whites to have PTBs. Asians were less likely than Whites to have PTBs; multiracial women were 0.95 (0.83, 1.09) times as likely, and other races were 1.14 (0.69, 1.87) times as likely than Whites to have PTBs. Compared to women in the 20-34 age range, those less than 20-years-old were 1.06 (0.97, 1.15) times as likely to have PTBs, and those over 34 years of age were 1.44 (1.36, 1.51) times as likely to have PTBs. Mothers who were unmarried were 1.18 (1.12, 1.25) times as likely than married women to have PTBs. Compared to college graduates, mothers who did not complete high school were 1.27 (1.20, 1.36) times as likely to have PTBs. Those with only a high school education were 1.14 (1.07, 1.22) times as likely than college grads to have PTBs, and those with some college were 1.11 (1.03, 1.19) times as likely.

Compared to Whites, Black mothers were 1.21 (1.06, 1.39) times as likely to have LBW births; Asians were 0.89 (0.37, 2.14) times as likely; multiracial women were 0.98 (0.83, 1.15) times as likely; and women of other races were 0.96 (0.55, 1.70) times as likely to have LBW births compared to Whites. Compared to the 20-34-year-old category, mothers less than 20 years of age were 1.06 (0.97, 1.17) times as likely to have LBW births, and those more than 34 years of age were 1.31 (1.24, 1.39) times as likely. Those who were unmarried were 1.23 (1.16, 1.30) times as likely to have LBW births than married mothers. Compared to college graduates, those who did not graduate high school were 1.10 (1.03, 1.19) times as likely to have LBW births;

highs school graduates were 1.08 (1.01, 1.16) times as likely; and women with some college education were 1.11 (1.03, 1.19) times as likely to have LBW births. Crude odds ratio and odds ratio that was adjusted for the mother's race, ethnicity, age, residence, education, and marital status are depicted in Table 2 below.

Table 2. Crude and Adjusted Odds Ratios for Preterm Birth and low Birth Weight by Sociodemographic Characteristics for Women who delivered in New York City (n=110,662) in 2010

	Preterm births (*n*=9512)		**Low birth weight (*n*=7487)**	
	Crude Odds ratio (95% *CI*)	*Adjusted Odds ratio (95% *CI*)	Crude Odds ratio (95% *CI*)	*Adjusted Odds ratio (95% *CI*)
Mother's Race:				
White	Ref	Ref	Ref	Ref
Black	1.65 (1.57, 1.73)	1.11 (0.99, 1.25)	2.09 (1.99, 2.21)	1.21 (1.06, 1.39)
Asian	0.98 (0.91, 1.05)	0.91 (0.42, 1.96)	1.32 (1.23, 1.42)	0.89 (0.37, 2.14)
Multi-racial	1.18 (1.06, 1.30)	0.95 (0.83, 1.09)	1.29 (1.15, 1.45)	0.98 (0.83, 1.15)
Other*	1.49 (0.98, 2.26)	1.14 (0.69, 1.87)	1.70 (1.08, 2.70)	0.96 (0.55, 1.70)
Mother's Ethnicity:				
Puerto Rican	1.70 (1.57, 1.85)	1.58 (1.44, 1.74)	2.04 (1.90, 2.25)	1.72 (1.54, 1.91)
Other Hispanic	1.51 (1.42, 1.61)	1.35 (1.25, 1.46)	1.41 (1.30, 1.52)	1.19 (1.08, 1.30)
Asian and Pacific	1.24 (1.15, 1.34)	1.32 (0.61, 2.86)	1.67 (1.54, 1.82)	1.86 (0.77, 4.50)
Multiracial Non-	1.42 (1.20, 1.67)	1.46 (1.17, 1.81)	1.77 (1.48, 2.12)	1.75 (1.37, 2.23)
Black Non-Hispanic	2.16 (2.03, 2.29)	1.78 (1.55, 2.04)	2.78 (2.59, 2.98)	1.98 (1.70, 2.31)
Other Non-Hispanic	1.93 (1.32, 2.80)	1.84 (1.21, 2.82)	3.11 (2.17, 4.47)	2.99 (1.96, 4.57)
White Non-Hispanic	Ref	Ref	Ref	Ref
Mother's age (years):				
<20	1.36 (1.26, 1.48)	1.06 (0.97, 1.15)	1.32 (1.21, 1.44)	1.06 (0.97, 1.17)
20-34	Ref	Ref	Ref	Ref
>34	1.29 (1.23, 1.36)	1.44 (1.36, 1.51)	1.19 (1.12, 1.26)	1.31 (1.24, 1.39)
Marital Status:				
Married	Ref	Ref	Ref	Ref
Unmarried	1.48 (1.42, 1.54)	1.18 (1.12, 1.25)	1.53 (1.46, 1.61)	1.23 (1.16, 1.30)
Mother's Education:				
< High School	1.44 (1.36, 1.52)	1.27 (1.20, 1.36)	1.30 (1.22, 1.38)	1.10 (1.03, 1.19)
High School Graduate	1.27 (1.20, 1.34)	1.14 (1.07, 1.22)	1.25 (1.17, 1.33)	1.08 (1.01, 1.16)
Some College	1.28 (1.20, 1.37)	1.11 (1.03, 1.19)	1.34 (1.25, 1.44)	1.11 (1.03, 1.19)
College Graduate	Ref	Ref	Ref	Ref
Mother's Residence:				
Manhattan	0.95 (0.89, 1.01)	1.04 (0.97, 1.11)	0.92 (0.85, 0.99)	1.04 (0.96, 1.12)
Bronx	1.05 (0.99, 1.11)	0.87 (0.81, 0.92)	1.26 (1.19, 1.35)	1.10 (1.03, 1.18)
Staten Island	0.90 (0.81, 1.00)	1.01 (0.90, 1.12)	0.90 (0.80, 1.01)	1.05 (0.93, 1.19)
Queens	1.00 (0.94, 1.05)	1.00 (0.94, 1.06)	1.00 (0.94, 1.06)	1.02 (0.95, 1.08)
Brooklyn	Ref	Ref	Ref	Ref

Note. *Adjusted for mother's race, ethnicity, age, residence, education and marital status

Among the study population, 1,501 women had prepregnancy hypertension, 2,572 had gestational hypertension, and 659 had eclampsia. Of the prepregnancy hypertensive group, 24.2% had PTBs, and 22.7% had LBWs. Of the gestational hypertensive group, 18.8% had PTBs, and 20.3% had LBW. Of the eclampsia group, 31.8% had PTBs, and 34.7% had LBWs. Table 3 below depicts this information.

Table 3. Distribution of Adverse Birth Outcomes by Hypertensive Disorders for Deliveries in New York City (n= 110,662) in 2010

Hypertensive Disorders in Pregnancy	**Total Births**	**Preterm birth (*n* = 9512)**		**Low birth weight (*n* = 7487)**	
Totals	110662	N	%	N	%
Pre-Pregnancy Hypertension	1501	360	24.2	340	22.7
Gestational Hypertension	2572	481	18.8	522	20.3
Eclampsia	659	208	31.8	229	34.7

The results of the study were only true for women of various racial and ethnic backgrounds who resided in NYC at the time of their infant delivery. Results from this study, therefore, may not be generalized to other study population group. The results might not be generalizable to other age groups, or cultures.

Logistic regression was performed with SPSS to address the following first research question. The independent variables were prepregnancy hypertension, gestational hypertension, and eclampsia. The two models are defined below:

$$\textbf{Logit(Low Birth Weight)} = \beta_0 + \beta_1 \textit{PrePregnancyHypertension} + \beta_2 \textit{GestationalHypertension} + \beta_3 \textit{Eclampsia} + \varepsilon.$$

$$\textbf{Logit(Pre-term Birth)} = \beta_0 + \beta_1 \textit{PrePregnancyHypertension} + \beta_2 \textit{GestationalHypertension} + \beta_3 \textit{Eclampsia} + \varepsilon$$

Table 4 below shows the crude and adjusted odds ratio for PTB and LBW by adverse birth outcomes (prepregnancy hypertension, gestational hypertension, and eclampsia) for women who delivered infants in NYC in 2000. Women who had prepregnancy hypertension were 2.84 (2.51, 3.22) times as likely to have PTB as those who did not. Women with gestational hypertension were 2.28 (2.06, 2.53) times as likely to have preterm babies, and women with eclampsia were 4.41 (3.72, 5.22) times as likely to have preterm babies as those who did not. Women with prepregnancy hypertension were also found to be 3.25 (2.87, 3.69) times as likely to have babies with LBW as those who did not. Women with gestational hypertension were 3.33 (3.01, 3.68) times as likely to have babies with LBW, and women with eclampsia were 6.70 (5.68, 7.91) times as likely to have babies with LBW as those who did not.

Table 4. Crude and Adjusted Odds Ratios for Preterm Birth and low Birth Weight by Adverse Birth Outcomes for Women who Delivered in New York City (n=110,662) in 2010.

	Preterm births			**Low birth weight**		
	n	Crude Odds ratio (95%	*Adjusted Odds ratio (95% *CI*)	*n*	Crude Odds ratio (95% *CI*)	*Adjusted Odds ratio (95% *CI*)
Prepregnancy Hypertension						
Yes	360	3.47 (3.08, 3.91)	2.84 (2.51, 3.22)	340	4.18 (3.70, 4.73)	3.25 (2.87, 3.69)
No	99298	Ref	Ref	102014	Ref	Ref
Gestational Hypertension						
Yes	481	2.52 (2.28, 2.79)	2.28 (2.06, 2.53)	522	3.70 (3.35, 4.08)	3.33 (3.01, 3.68)
No	98349	Ref	Ref	101125	Ref	Ref
Eclampsia						
Yes	208	5.00 (4.24, 5.90)	4.41 (3.72, 5.22)	229	7.54 (6.41, 8.87)	6.70 (5.68, 7.91)
No	99977	Ref	Ref	102745	Ref	Ref

*Note.**Adjusted for mother's race, ethnicity, age, residence, education and marital status

Logistic regression was performed to address the second research question. The following models were tested:

$$\textbf{logit(Low Birth Weight)} = \beta_0 + \beta_1 \textit{Segregation} + \beta_2 \textit{PovertyPct} + \varepsilon.$$

$$\textbf{logit(Pre-Term Birth)} = \beta_0 + \beta_1 \textit{Segregation} + \beta_2 \textit{PovertyPct} + \varepsilon.$$

Table 5 below summarizes the distribution of adverse birth outcomes by poverty and segregation. Among the women, 18.6% lived below the poverty line as compared to 81.4% who did not; 21.6% lived in segregated neighborhoods. Women who lived in poverty were 0.86 (0.77, 0.97) times as likely as those who did not to give birth to preterm babies. Women who resided in an area with racial segregation were 1.01 (0.90, 1.13) times as likely to have PTBs than those who were not.

Women who lived in poverty were 1.05 (0.92, 1.19) times as likely to have low birth weight deliveries than those who did not. Those who lived in segregated neighborhoods were 1.03 (0.91, 1.17) times as likely to have LBW deliveries than those who did not. Tables 5 and 6

summarizes these findings. Additionally, table 6 provides both the crude and adjusted odds ratio; adjustments for maternal race, ethnicity, age, residence, education and marital status were added.

Table 5. Distribution of Adverse Birth Outcomes by Poverty and Segregation for Deliveries in New York City (n= 110,662) in 2010

	Total Births		**Preterm birth**		**Low birth weight**	
Total	N	%	n	%	n	%
	110662		9512	8.6	7487	6.8
Poverty						
Yes	20584	18.6	1860	19.6	1683	22.5
No	90078	81.4	81834	81.5	84274	81.7
Segregation						
Yes	23899	21.6	1948	20.5	1445	19.3
No	86763	78.4	78651	78.3	80721	78.2

Table 6. Crude and Adjusted Odds Ratios for Adverse Birth Outcomes by Poverty and Segregation for Women who Delivered in New York City (n=110,662) in 2010.

	Preterm births			**Low birth weight**		
	n	Crude Odds ratio (95% *CI*)	*Adjusted Odds ratio (95% *CI*)	*n*	Crude Odds ratio (95% *CI*)	*Adjusted Odds ratio (95% *CI*)
Poverty						
Yes	1860	1.07 (1.02, 1.13)	0.86 (0.77, 0.97)	1683	1.29 (1.22, 1.37)	1.05 (0.92, 1.19)
No	81834	Ref	Ref	84274	Ref	Ref
Segregation						
Yes	1948	0.93 (0.88, 0.98)	1.01 (0.90, 1.13)	1445	0.86 (0.81, 0.91)	1.03 (0.91, 1.17)
No	78651	Ref	Ref	80721	Ref	Ref

*Note.**Adjusted for mother's race, ethnicity, age, residence, education and marital status

Logistic regression was also performed to address the third research question. The models tested are given below:

$$\textbf{logit(Low Birth Weight)} = \beta_0 + \beta_1 \textbf{\textit{PrePregnancyHypertension}} + \beta_2 \textbf{\textit{GestationalHypertension}} +$$

$$\beta_3 \textbf{\textit{PrePregnancyHypertension}} * \textbf{Segregation} + \beta_4 \textbf{\textit{GestationalHypertension*Segregation}} +$$

$$\beta_5 Eclamspia*Segregation + \beta_6 PrePregnancyHypertension * \beta_7 PovertyPct + \beta_8 GestationalHypertension* PovertyPct + \beta_8 Eclampsia* PovertyPct + \varepsilon$$

$$\text{logit(Pre-Term Birth)} = \beta_0 + \beta_1 PrePregnancyHypertension + \beta_2 GestationalHypertension + \beta_3 PrePregnancyHypertension * \text{Segregation} + \beta_4 GestationalHypertension*Segregation + \beta_5 Eclamspia*Segregation + \beta_6 PrePregnancyHypertension * \beta_7 PovertyPct + \beta_8 GestationalHypertension* PovertyPct + \beta_8 Eclampsia* PovertyPct + \varepsilon$$

Interaction terms of each type of hypertension with segregation and poverty were tested for statistical significance. For PTB, after adjusting for confounders, there were significant interactions between pregnancy hypertension and segregation (AOR = 3.91 (2.90, 5.28)); gestational hypertension and segregation (AOR = 2.24 (1.77, 2.84)); eclampsia and segregation (AOR = 4.63 (3.24, 6.61)); prepregnancy hypertension by poverty (AOR = 2.55 (2.04, 3.20)); gestational hypertension by poverty (AOR = 1.68 (1.33, 2.11)); and eclampsia by poverty (AOR = 4.16 (2.55, 6.76)).

For LBW, after adjusting for confounders, there were significant interactions between prepregnancy hypertension and segregation (AOR = 4.26 (3.10, 5.85)); gestational hypertension and segregation (AOR = 3.62 (2.88, 4.56)); eclampsia by segregation (AOR = 6.30 (4.40, 9.02)); prepregnancy hypertension by poverty (AOR = 2.67 (2.13, 3.35)); gestational hypertension by poverty (AOR = 2.51 (2.03, 3.10)); and eclampsia by poverty (AOR = 6.83 (4.30, 10.85)). Table 7 below provides this information, including the observed p-values for each of the interactions.

Table 7. Moderating Effects of Neighborhood Poverty and Segregation on Association of Hypertensive Disorders in Pregnancy (Prepregnancy Hypertension, Gestational Hypertension and Eclampsia) and Adverse Birth Outcomes (PTB and LBW).

	Preterm birth			**Low birth weight**		
Main Effects	n	*Adjusted Odds ratio (95% *CI*)	P value	n	*Adjusted Odds ratio (95% *CI*)	P value
Independent Variables						
Prepregnancy Hypertension	360	2.84 (2.51, 3.22)	0.00	340	3.25 (2.87, 3.69)	0.00
Gestational Hypertension	481	2.28 (2.06, 2.53)	0.00	522	3.33 (3.01, 3.68)	0.00
Eclampsia	208	4.41 (3.72, 5.22)	0.00	229	6.70 (5.68, 7.91)	0.00
Moderator Variables						
Segregation	1948	1.01 (0.90, 1.13)	0.90	1445	1.03 (0.91, 1.17)	0.61
Poverty	1860	0.86 (0.77, 0.97)	0.01	1683	1.05 (0.92, 1.19)	0.49
Interactions						
Prepregnancy Hypertension by Segregation	n/a	3.91 (2.90, 5.28)	0.00	n/a	4.26 (3.10, 5.85)	0.00
Gestational Hypertension by Segregation	n/a	2.24 (1.77, 2.84)	0.00	n/a	3.62 (2.88, 4.56)	0.00
Eclampsia by Segregation	n/a	4.63 (3.24, 6.61)	0.00	n/a	6.30 (4.40, 9.02)	0.00
Prepregnancy Hypertension by Poverty	n/a	2.55 (2.04, 3.20)	0.00	n/a	2.67 (2.13, 3.35)	0.00
Gestational Hypertension by Poverty	n/a	1.68 (1.33, 2.11)	0.00	n/a	2.51 (2.03, 3.10)	0.00
Eclampsia by Poverty	n/a	4.16 (2.55, 6.76)	0.00	n/a	6.83 (4.30, 10.85)	0.00

*Note.**Adjusted for mother's race, ethnicity, age, residence, education and marital status

Summary

The purpose of this study was to explore the relationship between hypertensive disorders in pregnancy and adverse birth outcomes, specifically PTB and LBW, in NYC. In addition, the study examined how the neighborhood membership (neighborhood poverty and segregation) of expectant mothers impacts the association between hypertensive disorders in pregnancy and adverse birth outcomes. Specifically, the study investigated whether neighborhood membership in any way modified the association between hypertensive disorders in pregnancy and adverse birth outcomes.

The first research question examined the relationship between prepregnancy hypertension, gestational hypertension, eclampsia and the adverse birth outcomes of PTB and LBW among women who delivered infants in NYC in 2010. For PTBs, after adjusting for confounders, the analysis found that women with prepregnancy hypertension were 2.84 (2.51, 3.22) times as likely to have PTB compared to women with normal prepregnancy blood pressure. Women with gestational hypertension were 2.28 (2.06, 2.53) times as likely to have PTBs compared to women without gestational hypertension. Women with eclampsia were 4.41 (3.72, 5.22) times as likely to have PTBs as women without eclampsia.

For LBW, after adjusting for confounders, women with prepregnancy hypertension were 3.25 (2.87, 3.69) times as likely to have low birth weight babies as compared to women with normal prepregnancy blood pressure. Women with gestational hypertension were 3.33 (3.01, 3.68) times as likely to have low birth weight babies compared to women without gestational hypertension. Women with eclampsia were 6.70 (5.68, 7.91) times as likely than those without

eclampsia to have LBW babies. These adjusted odd ratios and observed p-values were reported in Table 7.

The second research question explored the extent to which an association existed between the neighborhood membership (neighborhood poverty and segregation) of expectant mothers and the adverse birth outcomes of LBW and PTB among women in NYC. After adjusting for confounders, neighborhood segregation (AOR: 1.03 (0.91, 1.17)) and poverty (AOR: 1.05 (0.92, 1.19)) were not found to be statistically significant for LBW. Similarly, after adjusting for confounders, neighborhood segregation (AOR: 1.01 (0.90, 1.13)) was not found to be statistically significant for PTB. However, neighborhood poverty (AOR: 0.86 (0.77, 0.97)) was found to be statistically significant for PTB, after adjusting for confounders.

The third research question examined whether the neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC moderated the possible association between hypertensive disorders in pregnancy (prepregnancy hypertension, gestational hypertension and eclampsia) and the adverse birth outcomes of LBW and PTB. Significant moderating effects were found for neighborhood segregation on the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW. Similarly, neighborhood segregation had significant moderating effects on an association between prepregnancy hypertension, gestational hypertension, eclampsia and PTB.

Relative to neighborhood poverty, significant moderating effects were confirmed for the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW. Similarly, neighborhood poverty had significant moderating effects on the association between

prepregnancy hypertension, gestational hypertension, eclampsia and PTB. These adjusted odd ratios and observed p-values for the various interactions were reported in Table 7.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The higher prevalence of infant mortality among some racial and ethnic minorities in the United States is a public health issue. Higher incidences of PTB, LBW, and other causes of infant mortality are rampant among some racial and ethnic minority groups (Hauck et al., 2011). The purpose of this study was to explore the association between adverse birth outcomes, specifically PTB and LBW, and hypertensive disorders in pregnancy. In addition, I aimed to determine how the residential neighborhood of expectant mothers impacted the possible association between hypertensive disorders in pregnancy and adverse birth outcomes. The LCHD framework was employed as the conceptual framework of the study. Data were collected from two sources for this study. The 2010 vital statistics birth records were obtained from the NYC Department of Health and Mental Hygiene, and the 2010 U.S. Census data were used in studying the neighborhood characteristics and racial residential segregation in NYC.

The following research questions and hypotheses were used to guide the study:

RQ1. To what extent does an association exist between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC?

$H_0$1: There is no association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

H_a1: There is an association between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC.

RQ2. To what extent does an association exist between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC?

$H_0$2: There is no association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

H_a2: There is an association between neighborhood membership (neighborhood poverty and segregation) of expectant mothers and adverse birth outcomes among women in NYC.

RQ3. Does the neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes?

$H_0$3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does not moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

H_a3: The neighborhood membership (neighborhood poverty and segregation) of expectant mothers in NYC does moderate the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

Based on the results of the logistic regression analysis using a hierarchal method, prepregnancy hypertension and gestational hypertension were found to be significantly associated with LBW and PTB. The findings were (a) women with prepregnancy hypertension were 2.84 (2.51, 3.22) and 3.25 (2.87, 3.69) times as likely to have preterm and LBW babies respectively when compared to women with normal prepregnancy blood pressure, (b) women with gestational hypertension were 2.28 (2.06, 2.53) and 3.33 (3.01, 3.68) times as likely to have

preterm and LBW babies respectively when compared to women without gestational hypertension, and (c) women with eclampsia were 4.41 (3.72, 5.22) and 6.70 (5.68, 7.91) times as likely to have preterm and LBW babies when compared to women who did not have eclampsia.

The second research question explored the extent to which an association existed between the neighborhood membership (neighborhood poverty and segregation) and the adverse birth outcomes of LBW and PTB. After adjusting for confounders, neighborhood segregation (AOR: 1.03 (0.91, 1.17)) and poverty (AOR: 1.05 (0.92, 1.19)) were not found to be statistically significant for LBW. Similarly, after adjusting for confounders, neighborhood segregation (AOR: 1.01 (0.90, 1.13)) was not found to be statistically significant for PTB. However, neighborhood poverty (AOR: 0.86 (0.77, 0.97)) was found to be statistically significant for PTB, after adjusting for confounders.

The third research question examined the possible moderating effect of neighborhood membership (neighborhood poverty and segregation) on the association between adverse birth outcomes, specifically LBW and PTB, and hypertensive disorders in pregnancy including prepregnancy hypertension, gestational hypertension, and eclampsia. Results revealed that neighborhood segregation had significant moderating effects on the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW. Similarly, neighborhood segregation had significant moderating effects on an association between prepregnancy hypertension, gestational hypertension, eclampsia and PTB. Relative to neighborhood poverty, significant moderating effects were confirmed for the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW. Similarly,

neighborhood poverty had significant moderating effects on the association between prepregnancy hypertension, gestational hypertension, eclampsia and PTB.

These findings contribute to the literature on the racial disparities relating to infant mortality rates and prepregnancy health conditions among women from racial and ethnic groups. Understanding how environmental factors such as neighborhood membership and its relationship to adverse birth outcomes among racial and ethnic groups may help in addressing the racial disparities of infant mortality rates. These results offer insights into the different factors that could affect and impact the birth outcomes of women living in the NYC.

In the next subsections for this chapter, the findings are interpreted considering the current literature on the relationship of hypertensive disorders and adverse birth outcomes and how neighborhood membership affects this relationship. Moreover, the results are discussed according to the research questions. The limitations of the study are then discussed and as well as the main basis of the recommendations for future research. The implications of the results of the study are also enumerated. Finally, the chapter is concluded with a summary of the discussion.

Interpretation of the Findings

The research questions that guided this study aimed to explore the different relationships among prepregnancy hypertension, gestational hypertension, eclampsia, LBW and PTB, and neighborhood membership. The first research question explored the link between hypertensive disorders during pregnancy (prepregnancy hypertension, gestational hypertension, eclampsia) and adverse birth outcomes (LBW and PTB). The second research question determined the relationship between neighborhood membership (poverty and segregation) and LBW and PTB.

The third research question tackled the moderating effect, if any, of neighborhood membership (poverty and segregation) between the adverse birth outcomes of LBW and PTB and hypertensive disorders in pregnancy (prepregnancy hypertension, gestational hypertension, and eclampsia).

Hypertensive Disorders in Pregnancy and Adverse Birth Outcomes

The first research question focused on the association between hypertensive disorders during pregnancy and the adverse birth outcomes. Drawing from previous literature on racial disparities relating to birth outcomes (Paneth, 1995; Reichman et al., 2008), it was hypothesized that there would be a statistically significant relationship that exists between hypertensive disorders in pregnancy and adverse birth outcomes among women in NYC. In particular, it was hypothesized that prepregnancy hypertension, gestational hypertension and eclampsia are significantly related to PTB and LBW.

The results of the logistic regression analysis showed that relationships between the dependent variables (PTB and LBW) and independent variables (prepregnancy hypertension, gestational hypertension and eclampsia) were statistically significant. These findings further substantiate previous studies that focused on the link between hypertension and birth outcomes (Kuklina et al., 2009; Leeman & Fontaine, 2008; Mammaro et al., 2009). The results for Research Question 1 reflect how LBW is one of the leading causes of infant mortality and disproportionately impacts infants of some racial and ethnic groups. Hypertensive disorders are the most common medical complication experienced during pregnancy and are the leading contributors to maternal mortality (Roberts et al., 2003). In addition, it contributes to maternal and perinatal morbidity and mortality mostly as a result of the increased risk of superimposed

preeclampsia (Mammaro et al., 2009). Women with hypertensive disorders are more likely to have adverse birth outcomes compared to women who do not have any health complications relating to hypertension. Measuring how susceptible women with hypertension disorders are to adverse birth outcomes helps quantify the risk that these disorders pose on expectant mothers.

Furthermore, these results confirm numerous studies highlighting the prevalence of adverse birth outcomes in the presence of hypertensive disorders during pregnancy (Bakker et al., 2011). Indeed, elevated blood pressure in pregnancy is associated with a higher risk for adverse birth outcomes. Adverse birth outcomes, such as reduced size at birth, reduced fetal growth, and shorter gestation, have a greater chance of happening when mothers experience greater increases in blood pressure (Lim et al., 2014; Macdonald-Wallis et al., 2014). Maternal hypertension is an important risk factor for this adverse birth outcome (Fang et al., 1999). Similarly, hypertension was found to be associated with a reduction in the birthweight of newborns in both whites and blacks (Jain et al., 1998). Hypertensive disorders during pregnancy have been implicated by previous research (Duley, 2009; Leeman & Fontaine, 2008; Steer et al., 2004) to play a contributory role in adverse birth outcomes and consequently in the observed rates for infant mortality.

The results showing the relationship between hypertensive disorders and PTB lend support to the study by Allen et al. (2004) which indicated that women with any hypertensive disorder in pregnancy were 1.6 times more likely to deliver infants who are small for their gestational age. It was also found that maternal hypertension in pregnancy was an important determinant of infant size at birth (Lim et al., 2014). In the current study, it was revealed that, indeed, hypertensive disorders do increase the chances of LBW among women in NYC.

However, it must be noted that while Allen et al.'s (2004) research provided statistics on hypertensive disorders in general, the present study offered a more nuanced explanation by showing the increased chances of LBW for women who experience hypertensive disorders during pregnancy.

While these significant results provide strong evidence on the relationship of hypertensive disorders and PTB and LBW, this does not explain how these relationships vary among different ethnic or racial groups. The absence of analysis based on demographics, particularly racial or ethnic, did not provide definitive answers regarding the role of race on adverse birth outcomes. Future researchers are recommended to consider this aspect to further contextualize these results.

In summary, results from research question one further contributed insight on the relationships between hypertensive disorders in pregnancy and adverse birth outcomes among women in New York City. The statistically significant findings quantified and compared the likelihood of PTB and LBW based on the presence of hypertensive disorders during pregnancy. Thus, the findings confirmed that women with hypertensive disorders have a greater risk of delivering underweight babies or experience PTB because of these disorders.

Modifying Effect of Neighborhood Membership (Poverty and Segregation) on Adverse Birth Outcomes

Research questions two and three sought to determine the possible moderating effect of neighborhood membership (poverty and segregation) on hypertensive disorders during pregnancy and adverse birth outcomes. In particular, research question two determined the direct relationship of neighborhood membership (poverty and segregation) on PTB and LBW,

while research question three explored the moderating role of neighborhood membership (poverty and segregation) on hypertensive disorders and the adverse birth outcomes of PTB and LBW. Drawing on the causal pathways of the life course perspective (Halfon & Hochstein, 2002), it was hypothesized that (a) for research question two, there is an association between neighborhood membership and adverse birth outcomes, and (b) for research question three, the neighborhood membership of expectant mothers moderates the possible association between hypertensive disorders in pregnancy and adverse birth outcomes.

Results of the research question two revealed that there was no significant association between neighborhood segregation and poverty and LBW. Neighborhood segregation was also not found to have be significantly associated with PTB. However, neighborhood poverty was found to be significantly associated with PTB. The results for research question three revealed that neighborhood segregation had significant moderating effects on the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW and PTB. Relative to neighborhood poverty, significant moderating effects were also confirmed for the association between prepregnancy hypertension, gestational hypertension, eclampsia and LBW and PTB.

The above results are in line with published research (Bell et al., 2006; Grady, 2006; Debbink and Bader, 2011) that found that neighborhood factors contributed to the association between hypertensive disorders during pregnancy and adverse birth outcomes. This findings for research question two offer additional evidence for the previous research on proposed pathways that explain the relationship between residential segregation and adverse birth outcome. This confirms that residential isolation in the form of poverty is a moderating factor that could explain

the occurrence of adverse birth outcomes (Bell et al., 2006). Much of the trends in racially disproportionate infant mortality rates at the national level have also been found at the community levels (Lu et al., 2010). In fact, as the results from the present study suggested, among these neighborhoods, infant mortality rates including the rates of LBW and PTB have steadily varied along racial and ethnicity lines. This could be explained by the notion that concentrated poverty, discrimination exposure, stress, and maladaptive behaviors tend to happen more frequently in segregated communities (Bell et al., 2006).

Isolation captures all the negative elements of segregation (i.e. poverty concentration, violent crime, reduced access to healthy food options, disenfranchisement, etc.) that results in deleterious health effects (Bell et al., 2006). As such, the racial gap in infant mortality among women of varying races and ethnicities in NYC may also be linked to the higher rates of PTB and LBW among these women. Thus, the possibly frequent exposure to these psychosocial stressors affects the occurrence of PTB and LBW among women.

In addition, the results from the third research question provide additional insights on findings from previous studies that focused mostly on low birth weight without considering other possible adverse birth outcomes. In comparison to the study by Osypuk and Acevedo-Garcia (2008) and Osypuk et al. (2010), which focused on low birth weight and racial residential segregation, these studies demonstrated the neighborhood-level factors such as existing ethnic and immigrant residential enclaves, social networks, neighborhood poverty, and violence; and individual-level factors such as socioeconomic status, social support, health behaviors (i.e. smoking, alcohol or drugs) and psychosocial factors (i.e. depression, maternal stress) are critical factors in understanding the occurrence of low birth weight among women in segregated

communities. Thus, the significant results found for PTB showcase the importance of considering all possible adverse birth outcomes that may be affected by neighborhood segregation and/or poverty.

In relation to the life course perspective, the statistically significant moderating effect of neighborhood segregation and poverty on hypertensive disorders and PTB and LBW confirms the second concept, which is related to the notion that exposures have damaging effects on the development of adverse health outcomes (Kuh et al., 2013). In this case, it is possible that the various challenges that women encounter in segregated and poorer communities served as mechanisms that impact PTB and LBW. The higher exposure on stressors accumulated over the life course poses greater risks in terms of PTBs (Lu & Chen, 2004).

Despite the significant results from research question three showing several moderating effects of neighborhood segregation and poverty on adverse birth outcomes, this still does not explain the racial disparities that several previous researches have noted when studying adverse birth outcomes. In addition, the disparity in infant mortality rates has been linked to higher rates of PTB in racial and ethnic groups (Paneth, 1995; Schempf et al., 2007; Wise, 2003). However, the present study did not include statistical analysis to analyze between-groups differences in terms of the impact of moderating effect of segregation and poverty on PTB and LBW. PTB and LBW may be important factors that could explain the racial gap in the United States infant mortality rates. Thus, it is not conclusive of how racial demographics impact on birth outcomes.

To summarize, neighborhood segregation and poverty were found to have moderating effects on hypertensive disorders during pregnancy and adverse birth outcomes. While this does not explain why there was no statistically significant relationship found between neighborhood

segregation and PTB or LBW and between neighborhood poverty and LBW, it informs that different factors may be in play when considering the nuances of PTB and LBW. These results provided insights on the relationships among the variables – that is, findings revealed that possible underlying factors related to segregation and poverty could explain the racial disparities on adverse birth outcomes. In the next subsection, the limitations of the study are discussed.

Limitations of the Study

The present findings must still be interpreted based on the limitations of the study. The main limitation of this study can be attributed to the fact that the data collected are archival data. While this can be utilized to understand the context of the topic being studied, this cannot explain the discrepancies in terms of the results and the current literature on neighborhood membership and adverse birth outcomes among women. There are still several years left unexplained that could have possibly shed light on some issues relating to the topic. To address this, a revision in the methodology entails using data collection method such as a survey to collect more recent data on adverse birth outcomes, segregation, and hypertensive disorders among women during pregnancy.

Another limitation is the operationalization of the variables being studied, particularly segregation. It cannot be ascertained that neighborhood membership of the participants fully captured the essence of segregation as a moderating variable. Racial disparity in the rates of PTB and LBW is an isolated case in one state. This disparity has been observed at the national level and has contributed to the disproportionate rates in infant mortality among infants of varying racial and ethnic groups. Thus, reliability tests must be done to ensure that the instrumentation used for this study accurately explains the construct or variable being studied or

used. Another way to address this is to utilize instrumentation tools that are already established as reliable and valid.

Additionally, the scarcity of research on the racial disparities in terms of adverse birth outcomes has limited the contextualization of the results of the study. Since there is little research on how segregation affects different racial minorities, it has been somewhat difficult to interpret the results in light of the literature on the said topic. In addition, the data collected for this study was from secondary sources. Secondary data are existing data available in historical records, database, and documents (Andrews et al., 2012). Underreporting of these medical reports may have limited my ability to fully assess the association between hypertensive disorders during pregnancy and adverse birth outcomes. Thus, future researchers should further study this phenomenon to develop a clearer context of the impact of neighborhood segregation on birth outcomes and health in general.

In summary, the results were discussed based on the limitations of the study, which consider the relevance of the results given the archival nature of data and the reliability of the instrumentation used for this study and the scarcity of research on the phenomenon. The results of the study however provided valuable and deeper understanding on the relationships between hypertensive disorders in pregnancy and adverse birth outcomes among expectant mothers. The study limitations discussed in this section can be addressed by utilizing a different approach and instrumentation tool for analysis. In the next sub-section, the recommendations for future research are enumerated based on the limitations and results of the current study.

Recommendations

Based on the results of the study, there are several recommendations for future research focusing on neighborhood membership, adverse birth outcomes, and hypertensive disorders in expectant mothers. First, further studies must be done to substantiate the moderating effect of neighborhood membership on adverse birth outcomes. This can be done by using different research methods, such as qualitative approaches, to understand the underlying psychological processes that affect these relationships.

In terms of reliability and validity of the results, future studies must utilize instrumentation tools that have been developed and established using similar studies that measure the same construct. This will help in developing a unified and comprehensive instrumentation or model to measure and understand the role of segregation on birth outcomes.

Another recommendation is to utilize a qualitative methodology to better understand the predominant experiences of pregnant women considering their neighborhood membership, and other factors that could impact birth outcomes. This may add knowledge on how racial disparities occur with regards to women with hypertensive disorders and adverse birth outcomes. Since the present study was not able to conclusively point out these links, further research must seek explanation regarding the link between racial disparities in birth outcomes and hypertensive disorders.

Future researchers are also recommended to consider other environmental factors that could possibly impact the birth outcomes of women residing in different segregated communities. Racial disparity in infant mortality rates is largely attributable to the higher incidence of PTB, LBW and other causes of infant mortality among infants of some racial and

ethnic groups (Hauck et al., 2011). This can be done by integrating another variable and measuring its effect on the experiences of women during pregnancy. Another interesting way to substantiate the results is to study the coping mechanisms of women who experience hypertensive disorders vis-à-vis neighborhood membership. This way, there would be knowledge of the different socio-psychological processes that expectant mothers undertake to cope with the stressors in their surroundings.

In summary, future studies should enhance the methodological limitations presented in the present study. This can be done by using comprehensive instrumentation tools, refocusing and reevaluation of variables being used to study the construct, and increasing the demographics of the participants. In addition, future researchers should also expand the context being studied and include different constructs, such as coping mechanisms, to understand the relevant experiences of expectant mothers who live in segregated communities. In the next sub-section, the implications of the study are discussed.

Implications

The present study offered substantial empirical data on the relationship between hypertensive disorders and adverse birth outcomes and the moderating impact of neighborhood segregation on birth outcomes among women living in NYC. Hypertensive disorders during pregnancy are well documented and have been acknowledged to complicate approximately 7% of all pregnancies (Buchbinder et al., 2002). Findings from this study can be used to develop different interventions and treatment programs to minimize or fully prevent adverse birth outcomes specifically in segregated communities.

For organizations and social workers that work with expectant mothers from poor and/or segregated neighborhoods, these findings may contribute to the improvement of programs aimed to achieve optimal health outcomes not only for the women but also for their infants. In this way, social workers will have empirical knowledge on the different factors that could adversely affect the health of expectant mothers and their unborn children, so that the number of adverse birth outcomes such as PTB and LBW can be reduced. Social workers and organizations must be able to recognize and consider the increased impact of neighborhood settings and other environmental factors on the overall well-being of pregnant women.

In terms of policies, these results support the need to reexamine our current policies and government programs that focus on the health and well-being of expectant mothers and their babies. Given that neighborhood factors play a moderating role on adverse birth outcomes, policy-makers must revisit current laws and policies related to housing and urban development to ensure it is made robust to impact positive social change for all residents. Particularly, policies must consider how segregation can lead to negative birth outcomes for women residing in these communities and aim to reverse these outcomes. The disproportionality in the rates of PTB and LBW is believed to fuel the persistent racial gap in infant mortality rates in the US. In addition, changes in policies must also reflect the prioritization of health outcomes of those in poverty-stricken neighborhoods.

For researchers, the present study contributed to the theoretical knowledge on the relationships among hypertensive disorders, birth outcomes, and neighborhood memberships. The findings may help substantiate and develop a model that could encompass the different socio-psychological processes that occur in the context of expectant mothers. It is quite

important to understand how external factors such as neighborhood membership may explain health outcomes.

For individuals, especially mothers who live in segregated or poor neighborhoods, these findings may help them understand their context vis-à-vis the prevalence of adverse birth outcomes for women exposed to residential segregation and poverty. Being able to recognize these disparities might help them better navigate the system to seek additional support as needed for the prevention of adverse birth outcomes and onset of hypertensive disorders during pregnancy.

To summarize, these results are helpful for organizations and social workers especially in providing comprehensive intervention and treatment programs for mothers and their infants who are born underweight or pre-term. Policy-makers may use these insights to create regulations and change policies to highlight the immediate and long-term needs of expectant women, especially those residing in poor neighborhoods. These results provide support to the current literature on the relationship between hypertensive disorders in pregnancy and birth outcomes, and contribute to theoretical and practical knowledge for the development of treatment and prevention programs and changes in policies.

Conclusion

Studies have shown a link between neighborhood membership and prevalence of LBW and PTB. However, little is known about the impact of neighborhood segregation on hypertensive disorders and adverse birth outcomes among women from racial and ethnic groups. The purpose of the present study was to determine the relationship between hypertensive disorders in pregnancy and adverse birth outcomes, specifically PTB and LBW. Additionally,

this study aimed to determine how the neighborhood membership of expectant mothers impacts the association between hypertensive disorders in pregnancy and adverse birth outcomes. Results further confirmed the significant relationship between adverse birth outcomes and hypertensive disorders. In addition, findings showed that neighborhood membership has a moderating effect on PTB and LBW among women living in NYC. This provided insights on the specific role that neighborhood segregation and poverty plays on PTB and LBW. It is recommended that future researchers develop a comprehensive and reliable tool to measure the extent to which each variable affect birth outcomes of women in racially and ethnically segregated neighborhoods. Policies must be changed to prioritize the health outcomes of pregnant women and their infants so as to minimize adverse birth outcomes particularly pre-term birth and low birth weight. Doing so will begin to address the racial and ethnic disparities in the United States with regards to the rates of infant mortality. Doing so will also contribute to social change by tackling disparities in birth outcomes that continue to persist in the United States.

References

Acevedo-Garcia, D. (2000). Residential segregation and the epidemiology of infectious diseases. *Social Science & Medicine, 51,* 1143–1161. doi:10.1016/S0277-9536(00)00016-2

Albu, A. R., Anca, A. F., Horhoianu, V. V., & Horhoianu, I. A. (2014). Predictive factors for intrauterine growth restriction. *Journal of Medicine and Life*, *7*(2), 165-171. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4197512/pdf/JMedLife-07-165.pdf

Allen, V. M., Joseph, K. S., Murphy, K. E., Magee, L. A., & Ohlsson, A. (2004). The effect of hypertensive disorders in pregnancy on small for gestational age and stillbirth: A population based study. *BMC Pregnancy and Childbirth*, *4*(1), 17. doi:10.1186/1471-2393-4-17

Almond, D., Chay, K. Y., & Lee, D. S. (2005). The costs of low birth weight. *The Quarterly Journal of Economics*, *120*(3), 1031-1083. doi:10.3386/w10552

Ananth, C. V., & Basso, O. (2010). Impact of pregnancy-induced hypertension on stillbirth and neonatal mortality in first and higher order births: A population-based study. *Epidemiology*, *21*(1), 118-123. doi:10.1097/EDE.0b013e3181c297af

Ananth, C. V., Peedicayil, A., & Savitz, D. A. (1995). Effect of hypertensive disorders in pregnancy on birthweight, gestational duration, and small-or-gestational-age births. *Epidemiology*, *6*(4), 391-395. doi:10.1186/1471-2393-4-17

Andrews, L., Higgins, A., Andrews, M., & Lalor, J. G. (2012). Classic grounded theory to analyze secondary data: Reality and reflections. *Grounded Theory Review*, *11*(1), 12-26. Retrieved from http://groundedtheoryreview.com/2012/06/01/classic-grounded-theory-to-analyse-secondary-data-reality-and-reflections/

Anthopolos, R., James, S. A., Gelfand, A. E., & Miranda, M. L. (2011). A spatial measure of neighborhood level racial isolation applied to low birthweight, preterm birth, and birthweight in North Carolina. *Spatial and Spatio-Temporal Epidemiology, 2,* 235-246. doi:10.1016/j.sste.2011.06.002

Babbie, E. R. (2012). *The practice of social research*. Belmont, CA: Wadsworth.

Bakker, R., Steegers, E. A. P., Hofman, A., & Jaddoe, V. W. V. (2011). Blood pressure in different gestational trimesters, fetal growth, and the risk of adverse birth outcomes. The generation R Study. *American Journal of Epidemiology, 174*(7), 797-806. doi:10.1093/aje/kwr151

Behrman, R. E., & Butler, A. S. (Eds). (2007). *Preterm Birth: Causes, consequences and prevention*. Washington, D.C. National Academies Press.

Bell, J. F., Zimmerman, F. J., Almgren, G. R., Mayer, J. D., & Huebner, C. E. (2006). Birth outcomes among urban African-American women: A multilevel analysis of the role of racial residential segregation. *Social Science & Medicine, 63,* 3030-3045. doi:10.1016/j.socscimed.2006.08.011

Braveman, P., Heck, K., Egerter, S., Marchi, K. S., Dominguez, T. P., Cubbin, C., & Curtis, M. (2015). The role of socioeconomic factors in Black-White disparities in preterm birth. *American Journal of Public Health, 105*(4), 694-702. doi:10.2105/AJPH.2014.302008

Braveman, P., & Barclay, C. (2009). Health disparities beginning in childhood: A life-course perspective. *Pediatrics, 124*(3), S163-S175. doi:10.1542/peds.2009-1100D

Browne, J. L., Vissers, K. M., Antwi, E., Srofenyoh, E. K., Van der Linden, E. L., Agyepong, I. A., & Klipstein-Groubusch, K. (2015). Perinatal outcomes after hypertensive disorders in

pregnancy in a low resource setting. *Tropical Medicine & International Health*, *20*(12), 1778-1786. doi:10.1111/tmi.12606

Buchbinder, A., Sibai, B. M., Caritis, S., MacPherson, C., Hauth, J., Lindheimer, M. D., & Thurnau, G. (2002). Adverse perinatal outcomes are significantly higher in severe gestational hypertension than in mild preeclampsia. *American Journal of Obstetrics and Gynecology*, *186,* 66-71. doi:10.1067/mob.2002.120080

Buekens, P., Notzon, F., Kotelchuck, M., & Wilcox, A. (2000). Why do Mexican Americans give birth to few low-birth-weight infants? *American Journal of Epidemiology*, *154*(4), 347-351. doi:10.1093/aje/152.4.347

Cervantes, A., Keith, L., & Wyshak, G. (1999). Adverse birth outcomes among native-born and immigrant women: Replicating national evidence regarding Mexicans at the local level. *Maternal and Child Health Journal, 3*(2), 99-109. doi:10.1023/A:1021805427469

Chen, A., Oster, E., & Williams, H. (2016). Why is infant mortality higher in the United States than in Europe? *American Economic Journal: Economic Policy*, *8*(2), 89-124. doi:10.1257/pol.20140224

Chien, L. Y., Ohlsson, A., Seshia, M. M., Boulton, J., Sankaran, J., & Lee, S. K. (2002) Variations in antenatal corticosteroid therapy: A persistent problem despite 30 years of evidence. *Obstetrics & Gynecology*, *99*(3), 401-408. doi:10.1016/S0029-7844(01)01732-X

Cleary-Goldman, J., Malone, F. D., Vidaver, J., Ball, R. H., Nyberg, D. A., Comstock, C. H., & D'Alton, M. (2005). Impact of maternal age on obstetric outcome. *Obstetrics & Gynecology*, *105*(5 Pt 1), 983-990. doi:10.1097/01.AOG.0000158118.75532.51

Collins, C. A., & Williams, D. R. (1999). Segregation and mortality: The deadly effects of racism? *Sociological Forum, 14*(3), 495–523. doi:10.1023/A:1021403820451

Collins, J. W., & David, R. J. (2004). Pregnancy outcome of Mexican-American women: The effect of generational residence in the United States. *Ethnicity & Disease, 14*(3), 317-321. doi:10.1097/01.ogx.0000154429.92315.3c

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* New York, NY: Lawrence Erlbaum Associates Publishers.

Coy, C. (2008). Sampling knowledge: The hermeneutics of snowball sampling in qualitative research. *International Journal of Social Research Methodology. International Journal of Social Research Methodology, 11*(4), 327-344. doi:10.1080/13645570701401305

Davis, A. M., Vinci, L. M., Okwuosa, T. M., Chase, A. R., & Huang, E. S. (2007). Cardiovascular health disparities: a systematic review of health care interventions. *Medical Care Research and Review*, *64*(5), 29S-100S. doi:10.1177/1077558707305416

Debbink, M. P., & Bader, M .D. M. (2011). Racial residential segregation and low birth weight in Michigan's metropolitan areas. *American Journal of Public Health, 101*(9), 1714-1720. doi:10.2105/AJPH.2011.300152

Diez Roux, A.V., Merkin, S. S., Arnett, D., Chambless, L., Massing, M., Nieto, F. J., & Watson, R. L. (2001). Neighborhood of residence and incidence of coronary heart disease. *New England Journal of Medicine*, *345*(2), 99-106. doi:10.1056/NEJM200107123450205

Duley, L. (2009). The global impact of pre-eclampsia and eclampsia. *Seminars in Perinatology*, *33*, 130-137. doi:10.1053/j.semperi.2009.02.010

Dunlop, A. L., Salihu, H. M., Freymann, G. R., Smith, C. K., & Brann, A. W. (2011). Very low birth weights in Georgia, 1994-2005: trends and racial disparities. *Maternal and Child Health Journal, 15,* 890-898. doi:10.1007/s10995-010-0590-y

Elder, T. E., Goddeeris, J. H., Haider, S. J., & Paneth, N. (2014). The changing character of the black–white infant mortality gap, 1983–2004. *American Journal of Public Health*, *104*(S1), S105-S111. doi:10.2105/AJPH.2013.301349

Fang J., Madhavan, S., & Alderman, M. H. (1999). The influence of maternal hypertension on low birth weight: differences among ethnic populations. *Ethnicity & Disease, 9*(3), 369-376.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using g*power 3.1: Tests for correlation and regression analysis. *Behavior research methods, 41*(4), 1149-1160. doi:10.3758/BRM.41.4.1149

Fox, J. (2008). *Applied regression analysis and generalized linear models* (2nd ed.). Thousand Oaks, CA: Sage.

Fox, J. (2016). *Applied regression analysis and generalized linear models* (3rd ed.). Thousand Oaks, CA: Sage.

Gold, D. R., & Wright, R. Population disparities in asthma. (2005). *Annual Review of Public Health, 26,* 89-113. doi:10.1146/annurev.publhealth.26.021304.144528

Goldenberg, R. L., & Culhane, J. F. (2007). Low birth weight in the United States. *American Journal of Clinical Nutrition, 85*(2), 584S-90S. doi:10.1093/ajcn/85.2.584S

Goldenberg, R. L., Iams, J. D., Mercer, B. M., Meis, P. J., Moawad, A. H., Cooper, R. L., & Bottoms, S. F. (1998). The preterm prediction study: the value of new vs standard risk

factors in predicting early and spontaneous preterm birth. *American Journal of Public Health, 88,* 233–238. doi:10.2105/AJPH.88.2.233

Grady, S. C. (2006). Racial disparities in low birth weight and the contribution of residential segregation: A multilevel analysis. *Social Science & Medicine*, *63*(12), 3013-3029. doi:10.1016/j.socscimed.2006.08.017

Guendelman, S., & English, P. B. (1995). Effect of United States residence on birth outcomes among Mexican immigrants: an exploratory study. *American Journal of Epidemiology*, *142*(9), S30-S38. doi:10.1093/aje/142.Supplement_9.S30

Halfon, N., & Hochstein, M. (2002). Life course health development: An integrated framework for developing health, policy, and research. *The Milbank Quarterly*, *80*(3), 433-479. doi:10.1111/1468-0009.00019

Hamilton, B. E., Martin, J. A., Osterman, M. J. K., & Curtin, S. C. (2014). Births: preliminary data for 2013. *National Vital Statistics Reports*, *63*(2), 1-20. Retrieved https://www.cdc.gov/nchs/data/nvsr/nvsr63/nvsr63_02.pdf

Hauck, F. R., Tanabe, K. O., & Moon, R. Y. (2011). Racial and ethnic disparities in infant mortality. *Seminars in Perinatology*, *35*, 209-220. doi:10.1053/j.semperi.2011.02.018

Heron, M. (2010). Death: leading causes for 2006. *National Vital Statistics Reports*, *58*(14). Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_14.pdf.

Hilbe, J. M. (2009). *Logistic regression models*. CRC Press: Kindle Edition.

Howell, E.A., Hebert, P., Chatterjee, S., Kleinman, L.C., & Chassin, M.R. (2008). Black/White differences in very low birth weight neonatal mortality rates among New York City hospitals. *Pediatrics, 121*(3), e407-e415. doi:10.1542/peds.2007-0910

Hutchison, E. D. (2008). A life course perspective. Dimensions of human behavior: the changing life course (pp. 1-38). Los Angeles: Sage.

Iams, J. D., Goldenberg, R. L., Meis, P. J., Mercer, B. M., Moawad, A., Das, A.,…Roberts, J. M. (1996). The length of the cervix and the risk of spontaneous premature delivery. *New England Journal of Medicine*, *334*, 567–572. doi:10.1056/NEJM199602293340904

Jain, L., Ferre, C., & Vidyasagar, D. J. (1998). Racial differences in outcome of pregnancies complicated by hypertension. *The Journal of Maternal-Fetal Medicine, 7(*1), 23-27. doi:10.1002/(SICI)1520-6661(199801/02)7:1<23::AID-MFM6>3.0.CO;2-T

Janevic, T., Stein, C. R., Savitz, D. A., Kaufman, J. S., Mason, S. M., & Herring, A. H. (2010). Neighborhood deprivation and adverse birth outcomes among diverse ethnic groups. *Annals of Epidemiology, 20*, 445-451. doi:10.1016/j.annepidem.2010.02.010

Kershaw, K. N., Diez Roux, A. V., Burgard, S. A., Lisabeth, L. D., Mujahid, M. S., & Schulz, A. J. (2011). Metropolitan-level racial residential segregation and black-white disparities in hypertension. *American Journal of Epidemiology, 174*(5), 537-545. doi:10.1093/aje/kwr116

Kramer, M. R., Cooper, H. L., Drews-Botsch, C. D., Waller, L. A., & Hogue, C. R. (2010). Metropolitan isolation segregation and black-white disparities in very preterm birth: A test of mediating pathways and variance explained. *Social Science & Medicine, 71*(2), 2108-2116. doi:10.1016/j.socscimed.2010.09.011

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J., & Power, C. (2003). Life course epidemiology. *Journal of Epidemiology & Community Health*, *57*, 778-783. doi:10.1136/jech.57.10.778

Kuklina, E. V., Ayala, C., & Callaghan, W. M. (2009). Hypertensive disorders and severe obstetric morbidity in the United States. *Obstetrics & Gynecology*, *113*(6), 1299-1306. doi:10.1097/AOG.0b013e3181a45b25

Lain, K. Y., & Roberts, J. M. (2002). Contemporary concepts of the pathogenesis and management of preeclampsia. *JAMA*, *287*(24), 3183-3186. doi:10.1001/jama.287.24.3183

Landrine, H., & Corral, I. (2009). Separate and unequal: residential segregation and black health disparities. *Ethnicity & Disease*, *19*, 179–184. Retrieved from https://www.researchgate.net/publication/26302127_Separate_and_Unequal_Residential_Segregation_and_Black_Health_Disparities

Leedy, P. D., & Ormrod, J. E. (2010). *Practical research planning and design*. Upper Saddle River, NJ: Pearson Education

Leeman, L., & Fontaine, P. (2009). Hypertensive disorders in pregnancy. *American Family Physician*, *78*(1), 93-100. Retrieved from https://www.aafp.org/afp/2008/0701/p93.html

Leviton, L. C., Goldenberg, R. L., Baker, C. S., Schwartz, R. M., Freda, M. C., Fish, L. J., & Raczynski, J. M. (1999). Methods to encourage the use of antenatal corticosteroid therapy for fetal maturation: a randomized controlled trial. *Journal of the American Medical Association*, *6*(281), 46-52. doi:10.1001/jama.281.1.46

Lie, K. K., Groholt, E., & Eskild, A. (2010). Association of cerebral palsy with apgar score in low and normal birthweight infants: population-based cohort study. *British Medical Journal*, *341*, c4990. doi:10.1136/bmj.c4990

Lim, W. Y., Lee, Y. S., Tan, C.S., Kwek, K., Chong, Y. S., Gluckman, P. D.,…Pan, A. (2014). The association between maternal blood pressures and offspring size at birth in Southeast Asian women. *BMC Pregnancy and Childbirth, 14*, 403. doi:10.1186/s12884-014-0403-1.

Logan, J. R. (2011). *Separate and unequal: The neighborhood gap for Blacks, Hispanics and Asians in metropolitan America.* Retrieved from http://www.s4.brown.edu/us2010/Data/Report/report0727.pdf.

Lu, M. C. & Chen, B. (2004). Racial and ethnic disparities in preterm birth: The role of stressful life events. *American Journal of Obstetrics and Gynecology*, *191*(3), 691-699. doi:10.1016/j.ajog.2004.04.018

Lu, M. C. & Halfon, N. (2003). Racial and ethnic disparities in birth outcomes: A life- course perspective. *Maternal and Child Health Journal, 7*(1), 13-30. doi:10.1023/A:1022537516969

Lu, M. C., Kotelchuck, M., Hogan, V., Jones, L., Wright, K., & Halfon, N. (2010). Closing the black-white gap in birth outcomes: A life-course approach. *Ethnicity & Disease, 20(1 Suppl 2),* S2-62-76. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4443479/

Luo, Z. C., Wilkins, R., & Kramer, M. S. (2006). Effect of neighbourhood income and maternal education on birth outcomes: a population-based study. *Canadian Medical Association Journal*, *174*, 1415–1420. doi:10.1503/cmaj.051096

Macdonald-Wallis, C., Tilling K., Fraser, A., Nelson, S. M., & Lawlor, D. A. (2014). Associations of blood pressure change in pregnancy with fetal growth and gestational age

at delivery: findings from a prospective cohort. *Hypertension*, *64*(1), 36-44. doi:10.1161/HYPERTENSIONAHA.113.02766

Magee, L. A., Pels, A., Helewa, M., Rey, E., & von Dadelszen, P. (2014). Diagnosis, evaluation, and management of the hypertensive disorders of pregnancy. *Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health*, *4*, 105-145. doi:10.1016/S1701-2163(16)32776-1

Mammaro, A., Carrara, S., Cavaliere, A., Ermito, S., Dinatale, A., Pappalardo, E. M.,…Pedata, R. (2009). Hypertensive disorders in pregnancy. *Journal of Prenatal Medicine*, *3*(1), 1-5. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279097/

Marian F., MacDorman, M. F., Hoyert, D.L., & Mathews, T. J. (2013). Recent declines in infant mortality in the United States, 2005–2011. Retrieved from http://www.cdc.gov/nchs/data/databriefs/db120.pdf

Markides, K. S., & Coreil, J. (1986). The health of Hispanics in the southwestern United States: an epidemiologic paradox. *Public Health Reports*, *101*(3), 253-256. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1477704/

Marshall, C., & Rossman, G. B. (2011). Managing, analyzing, and interpreting data. In *Designing Qualitative Research (5th ed., pp.* 205-227). Los Angeles, California: Sage.

Massey, D. S., & Denton, N. A. (1988). The dimensions of residential segregation. *Social Forces*, *67*(2), 281-315. doi:10.2307/2579183

Mathews, T. J., & MacDorman, M. F. (2013). Infant mortality statistics from the 2009 period linked birth/infant death data set. *National Vital Statistics Reports*, *61*(8). Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_08.pdf

Mazzucco, W., Cusimano, R., Macaluso M., La Scola, C., Fiumano, G., Scondotto, S.,…Vitale, F. (2011). A retrospective follow up study on maternal age and infant mortality in two Sicilian districts. *BMC Public Health, 11*. doi:10.1186/1471-2458-11-817.

McBride, C. A., Bernstein, I. M., Badger, G. J., Horbar, J. D., & Soll, R. F. (2015). The effect of maternal hypertension on mortality in infants 22, 29 weeks gestation. *Pregnancy Hypertension, 5*(4), 362-366. doi:10.1016/j.preghy.2015.10.002

Mertens, D. M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Thousand Oaks, CA: Sage Publications.

Michielutte, R., Moore, M. L., Meis, P. J., Ernest, J. M., & Wells, H. B. (1994). Race differences in infant mortality from endogenous causes: a population-based study in North Carolina. *Journal of Clinical Epidemiology, 47*(2), 119-130. doi:10.1016/0895-4356(94)90017-5

Mujahid, M. S., Diez Roux, A. V., Cooper, R. C., Shea, S., & Williams, D. R. (2011). Neighborhood stressors and race/ethnic differences in hypertension prevalence (the multi-ethnic study of Atherosclerosis). *American Journal of Hypertension, 24*(2), 187-193. doi:10.1038/ajh.2010.200

Murphy, S. L., Xu, J., & Kochanek, K. D. (2012). Deaths: Preliminary data for 2010. *National Vital Statistics Reports, 60*(4). Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60_04.pdf

Mustafa, R. F. (2011). The P.O.E.Ms of educational research: A beginners' concise guide. *International Education Studies, 4*(3), 23-30. doi: 10.5539/ies.v4n3p23

New York City Department of Health and Mental Hygiene (NYC DOHMH) Bureau of Vital Statistics. (2011a). *Low birthweight: live births in New York City, 2000-2009*. [Data file]. Retrieved from http://www.nyc.gov/html/doh/downloads/pdf/ms/bimt-low-birthweight.pdf

New York City Department of Health and Mental Hygiene (NYC DOHMH) Bureau of Vital Statistics. (2011b). *Preterm births: live births in New York City, 2000-2009*. [Data file]. Retrieved from http://www.nyc.gov/html/doh/downloads/pdf/ms/bimt-preterm-births.pdf

New York City Department of Health and Mental Hygiene (NYC DOHMH) Bureau of Vital Statistics. (2011c). *Causes of infant deaths: infant deaths in New York City, 2000-2009*. [Data file]. Retrieved from http://www.nyc.gov/html/doh/downloads/pdf/ms/bimt-causes-of-infant-mortality.pdf

New York City Department of Health and Mental Hygiene (NYC DOHMH). (2014). *Infant mortality overview: Infant deaths in New York City, 2000-2009*. [Data file]. Retrieved from http://www.nyc.gov/html/doh/downloads/pdf/ms/bimt-infant-mortality-overview.pdf

New York State Department of Health (NYS DOH). (2013). *Hypertensive disorders in pregnancy: guideline summary.* Retrieved from https://www.health.ny.gov/professionals/protocols_and_guidelines/hypertensive_disorders/2013_hdp_guideline_summary.pdf

Odegard, R. A., Vatten, L. J., Nilsen, S. T., Salvesen, K. A., & Austgulen, R. (2000). Preeclampsia and fetal growth. *Obstetrics & Gynecology*. *96*(6), 955-955. Retrieved from https://journals.lww.com/greenjournal/Fulltext/2000/12000/Preeclampsia_and_Fetal_Growth.16.aspx

Osypuk, T. L., Bates, L. M., & Acevedo-Garcia, D. (2010). Another Mexican birthweight paradox? The role of residential enclaves and neighborhood poverty in the birthweight of Mexican-origin infants. *Social Science & Medicine, 70*(4), 550-560. doi:10.1016/j.socscimed.2009.10.034

Paneth, N. S. (1995). The problem of low birth weight. *The Future of Children*, *5*(1), 19-34. doi:10.2307/1602505

Pearl, M., Braveman, P., & Abrams, B. (2001). The relationship of neighborhood socioeconomic characteristics to birthweight among 5 ethnic groups in California. *American Journal of Public Health*, *91*(11), 1808-1814. doi:10.2105/AJPH.91.11.1808

Pedhazur, E. J., & Schmelkin, L. P. (2013). *Measurement, design, and analysis: An integrated approach.* Hillsdale, NJ: Lawrence Erlbaum.

Peek, M. E., Cargill, A., & Huang, E. S. (2007). Diabetes health disparities: a systematic review of health care interventions. *Medical Care Research and Review*, *64*(5), 101S-156S. doi:10.1177/1077558707305409

Perni, U., Sison, C., Sharma, V., Helseth, G., Hawfield, A., Suthanthiran, M., & August, P. (2012). Angiogenic factors in superimposed preeclampsia: A longitudinal study of women with chronic hypertension during pregnancy. Hypertension, *59*, 740-746. doi:10.1161/HYPERTENSIONAHA.111.181735

Reichman, N. E., Hamilton, E. R., Hummer, R. A., & Padilla, Y. C. (2008). Racial and ethnic disparities in low birthweight among urban unmarried mothers. *Maternal and Child Health Journal*, *12*, 204-215. doi:10.1007/s10995-007-0240-1

Reichman, N. E. (2005). Low birth weight and school readiness. *The Future of Children*, *15*(1), 91-116. doi:10.1353/foc.2005.0008

Roberts, J. M., Pearson, G. D., Cutler, J. A., & Lindheimer, M. D. (2003). Summary of the NHLBI working group on research on hypertension in pregnancy. *Hypertension, 41*, 437-445. https://doi.org/10.1081/PRG-120016792

Salkind, N. J. (2011). *Statistics for people who (think they) hate statistics*. Thousand Oaks, CA: Sage.

Samadi, A. R., & Mayberry, R. M. (1998). Maternal hypertension and spontaneous preterm birth among black women. *Obstetrics and Gynecology*, *91*(6), 899-904. doi:10.1016/S0029-7844(98)00087-8

Schempf, A. H., Branum, A. M., Lukacs, S. L., & Schoendorf, K. C. (2007). The contribution of preterm birth to the Black-White infant mortality gap, 1990 and 2000. *American Journal of Public Health*, *97*(7), 1255-1260. doi:10.2105/AJPH.2006.093708

Sibai, B. M. (2003). Diagnosis and management of gestational hypertension and preeclampsia. *The American College of Obstetricians and Gynecologists*, *102*(1), 181-192. doi:10.1016/S0029-7844(03)00475-7

Singh, G. K., & Yu, S. M. (1996). Adverse pregnancy outcomes: differences between US- and Foreign-born women in major US racial and ethnic groups. *American Journal of Public Health*, *86*(6), 837-843. Retrieved from https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.86.6.837

Singhal, S. R., Deepika, Anshu, & Nanda, S. (2009). Maternal and perinatal outcome in severe pre-eclampsia and eclampsia. *South Asian Federation of Obstetrics and Gynecology*, *1*(3), 25-28. doi:10.18203/2320-1770.ijrcog20162086

Steegers, E. A. P., von Dadelszen, P., Duvekot, J. J., & Pijnenborg, R. (2010). Pre-eclampsia. *The Lancet*, *376*, 631-644. doi:10.1016/S0140-6736(10)60279-6

Steer, P. J., Little, M. P., Kold-Jensen, T., Chapple, J., & Elliott, P. (2004). Maternal blood pressure in pregnancy, birth weight, and perinatal mortality in first births: prospective study. *British Medical Journal*, *329*(7478), 1312-1314. doi:10.1136/bmj.38258.566262.7C

Stein, C. R., Savitz, D. A., Janevic, T., Ananth, C. V., Kaufman, J. S., Herring, A. H., & Engel, S. M. (2009). Maternal ethnic ancestry and adverse perinatal outcomes in New York City. *American Journal of Obstetrics and Gynecology*, *201*(6), 584.e1–584.e9. doi:10.1016/j.ajog.2009.06.047

Subramanian, S. V., Acevedo-Garcia, D., & Osypuk, T. L. (2005). Racial residential segregation and geographic heterogeneity in black/white disparity in poor self-rated health in the US: A multilevel statistical analysis. *Social Science & Medicine*, *60*(8), 1667–1679. doi:10.1016/j.socscimed.2004.08.040

Walton, E. (2009). Residential segregation and birth weight among racial and ethnic minorities in the United States. *Journal of Health and Social Behavior*, *50*(4), 427-442. doi:10.1177/002214650905000404

Williams, D. R., & Collins, C. (2001). Racial residential segregation: A fundamental cause of racial disparities in health. *Public Health Reports*, *116*, 404-416. doi:10.1093/phr/116.5.404

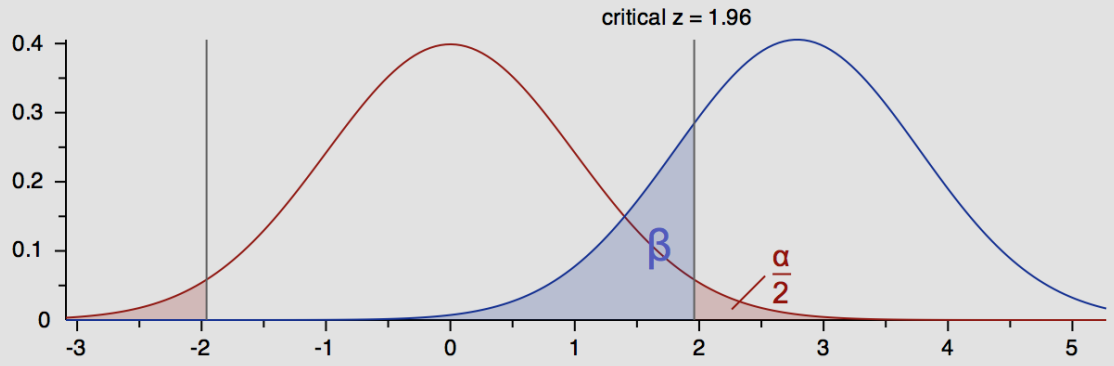
Wise, P. H. (2003). The anatomy of a disparity in infant mortality. *Annual Review of Public Health, 24*, 341-362. doi:10.1146/annurev.publhealth.24.100901.140816

Zoldi, V., Sutherland, M. R., Lim, K., Gubhaju, L., Zimanyi, M. A., & Black, M. J. (2012). Low birth weight due to the intrauterine growth restriction and/or preterm birth: effect on nephron number and long-term renal health. *International Journal of Nephrology*. Retrieved from http://dx.doi.org/10.1155/2012/136942

Appendix A: G*Power Sample Size Computation Using Regression Analysis

G*Power 3.1

Central and noncentral distributions | Protocol of power analyses



Test family: z tests

Statistical test: Logistic regression

Type of power analysis: A priori: Compute required sample size - given α, power, and effect size

Input parameters

Determine

Tail(s)	Two
Odds ratio	1.3
Pr(Y=1|X=1) H0	0.2
α err prob	0.05
Power (1-β err prob)	0.8
R² other X	0
X distribution	Normal
X parm μ	0
X parm σ	1

Output parameters

Critical z	1.9599640
Total sample size	721
Actual power	0.8001115