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Comparison of Factors Responsible for the High Prevalence of Pregnancy-Induced Hypertension, Maternal Death, and Preterm Birth Among Black Women in Washington, DC and Massachusetts

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MSN, Grand Canyon University, 2016

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Pregnancy-induced hypertension (PIH) is a leading cause of poor pregnancy outcomes and is linked to maternal mortality, preterm birth, and premature babies. PIH accounts for 18% of maternal mortality in developed countries. PIH affects 8%–13% of pregnancies in the United States. The purpose of this cross-sectional quantitative study was to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington DC compared to Massachusetts. The socio-ecological model was used to frame the study. Secondary data were collected from the Centers for Disease Control and Prevention's 2018–2020 Pregnancy Risk Assessment Monitoring System survey. Findings from logistic regression analysis revealed no significant association between maternal education, maternal income, gestational age, and PIH among Black women in Washington, DC. In contrast the results showed a significant association between maternal education and prenatal care and PIH among Black women in Massachusetts. Implications for positive social change include providing equitable access to prenatal care Among black women that results in improved pregnancy outcome.

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Dedication

This doctoral study is dedicated to my loving mother and father resting in heaven. They always believed in me and encouraged me to seek knowledge further. Thank you. I love you very much.

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Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

Pregnancy-induced hypertension (PIH) affects women across all social classes but disproportionately affects women of color in poverty. Suggested demographic and socioeconomic risk factors for PIH include ethnicity, education, socioeconomic status, deprivation, and living environment (Ford et al., 2022). Maternal and newborn health are closely linked; therefore, caring for pregnant women from conception to the postpartum stage is important because timely management and treatment can make the difference between life and death for the mother and the newborn. One of the World Health Organization's (WHO's) sustainable development target goals is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births. In Washington, DC, the maternal mortality rate (MMR) is more than double the nation's rate, and among the maternal deaths recorded between 2014 and 2016 in Washington, DC, 75% were African American women. Studies have shown that Black women are more than twice as likely as their White peers to have uncontrolled high blood pressure during their childbearing years, raising their risk for pregnancy-related complications.

An extensive literature search showed no generally acclaimed definition of PIH. However, the National High Blood Pressure Education Program Working Group defined PIH as persistent systolic blood pressure of 140 mmHg and diastolic blood pressure of 90 mmHg (Berhe et al., 2020; Braunthal & Brateanu, 2019). PIH is seen as new hypertension with or without proteinuria at 20 weeks or more gestational age (Berhe et al., 2020). PIH is toxemia or preeclampsia, a type of high blood pressure during pregnancy. PIH is the second most prevalent medical condition seen during pregnancy

(Chandio et al., 2021; Umegbolu & Ogamba, 2017). PIH encompasses preexisting and gestational hypertension, preeclampsia, and eclampsia. PIH is believed to be a multifactorial health condition with poorly understood pathogenetic mechanisms (Kintiraki et al., 2015).

In the United States, PIH risk factors such as obesity, diabetes mellitus, and advanced maternal age have risen (Garovic et al., 2022), which may help explain the surge in PIH prevalence. Ford et al. (2022) revealed that the incidence of chronic hypertension grew from 2.0% to 2.3%, and the prevalence of PIH increased from 10.8% in 2017 to 13.0% in 2019. PIH is highest in non-Hispanic Black or African American women giving birth in hospitals in the South or the Midwest Census regions, non-Hispanic American Indian and Alaska Native (AI/AN) women, and women under the age of 35 who lived in zip codes with the lowest median household income quartile. Additionally, compared to White women, Black women are more likely to experience mortality and morbidity from cardiovascular disease and hypertension, raising the risk of PIH (Hoyert & Minimo, 2018; Lisonkova & Joseph, 2013).

PIH is a prevalent medical condition that affects both the mother and the fetus or newborn (Kintiraki et al., 2015). In the United States, hypertension complicates 10%–20% of pregnancies and is linked to postpartum maternal morbidity and mortality (Braunthal & Brateanu, 2019; Clapp et al., 2016; Hauspurg et al., 2020; Hoyert & Minimo, 2018). In 2020, non-Hispanic Black women's MMR was 55.3 deaths per 100,000 live births, which is 2.9 times higher than the rate for non-Hispanic White women (19.1). Non-Hispanic White and Hispanic women's rates were much lower than those for non-Hispanic Black women. The increases for non-Hispanic Black and Hispanic women from 2019 to 2020 were substantial, but the observed increase for non-Hispanic White women from 2019 to 2020 was insignificant (Donna, 2022).

In the United States, Boakye et al. (2021) analyzed the relationship between preeclampsia, maternal place of birth, and duration of residence among non-Hispanic black women using cross-sectional data from a birth cohort (1998–2016) in Boston, United States. In this racially diverse cohort of low-income women, non-Hispanic Black women had the highest age-adjusted prevalence of preeclampsia compared with Hispanic and non-Hispanic White women. Natalie et al. (2022) examined the incidence of new-onset hypertension-induced pregnancy in rural and urban areas of the United States using data from 51,685,525 live births among people between the ages of 15 and 44. Natalie et al. discovered that after 2014, the annual increase in newly diagnosed hypertension-induced pregnancies increased more rapidly in urban regions than in rural areas. Cameroon et al. (2022) emphasized the sustained increase in the incidence of new-onset hypertensive disorders of pregnancy from 2007 to 2019 in both rural (48.6%–83.9%) and urban (37.0%–77.2%) locations. Compared to rural areas, the annual increase in new-onset hypertensive disorders of pregnancy increased more quickly after 2014. New-onset hypertensive disorders of pregnancy rate ratios (95% CI) dropped from 1.31 in 2007 to 1.09 in 2019 when comparing incidences in rural and urban areas. Cameroon et al. researched the trends and disparities in PIH among women in rural and urban United States and found that women in rural areas had higher PIH baseline rates than urban women. However, the rates of maternal prepregnancy hypertension in non-Hispanic Blacks in rural and urban areas increased from 21.3 to 40.1 per 1,000 live births.

In urban America, such as Washington, DC with a 60% concentration of Black people (U.S. Census Bureau, 2000), Washington, DC has shown one of the worst pregnancy outcomes, especially for Black women. According to the United Health Foundation (2020), over five babies die in the first 27 days of life in Washington, DC, compared to less than four nationally. In the first year of life, over 8 of 1,000 babies born in Washington, DC die, compared to less than 6 in the rest of the country. Furthermore, newborns in Black Southeast Washington, DC have been shown to die at 10 times the rate of those in wealthier and Whiter Northwest Washington, DC (Vargas, 2018). Pregnant women in Washington, DC are over 4 times more likely to die during or after childbirth than in Nevada, with an MMR of approximately 7.6 per 100,000 live births, according to data analyzed from 38 states and Washington, DC. As a result, the U.S. MMR remains greater than most high-income countries (Hawkins, 2020).

Women begin pregnancy with other health issues, including initiating prenatal care too late and experiencing the stress of racism (Nirappil, 2018). As a result, there are increasing fetal, neonatal, and maternal complications caused by PIH. Compared to Washington, DC, the state of Massachusetts has the second lowest MMR in the United States with an MMR of 8.4 per 100,000 births. This favorable result did not happen accidentally; it started after a review of Massachusetts's maternal death. In 2014, a committee was set up to find a solution. It recommended that all hospitals have a procedure for hemorrhages and an inclusive policy favorable to all pregnant women.

Massachusetts is now one of the healthiest states for women and children, with low rates of uninsured women and the lowest teenage birth rate in the United States.

Despite reports of the unfavorable outcomes of pregnancy in Washington, DC, no study had addressed the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, delivery method, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. There was a need for a comparative analysis of the factors responsible for the high prevalence of PIH, maternal death, and preterm birth among Black women in Washington, DC and Massachusetts to understand the increased prevalence of PIH in Washington, DC and to improve health outcomes in this group. The findings may highlight the need for the introduction of creative strategies to reduce place-based disparities in PIH and pregnancy-related mortality. Chapter 1 presents the study's background, problem statement, purpose statement, research questions, research hypotheses, theoretical framework, nature of the study, literature search strategy, literature review, definitions of terms, assumptions, scope and delimitations, limitations, significance, and summary.

Background

PIH is one of the leading causes of poor pregnancy outcomes and is linked to maternal mortality, preterm birth, and premature babies. A recent report from the WHO (2022) showed that hypertensive disorders of pregnancy are the leading cause of maternal mortality. Globally, 2.73% of women suffer from hypertensive disorders of pregnancy, while the incidence of chronic hypertension, preeclampsia, and eclampsia are 0.29%, 2.16 %, and 0.28%, respectively (Gemechu et al., 2020). According to the Centers for Disease Control and Prevention (CDC, 2020), 800 to 900 women in the United States die yearly due to pregnancy complications. The MMR in the United States was 20.7 deaths per 100,000 live births in 2018 (CDC, 2019). PIH further accounts for increased preterm birth, intrauterine growth retardation, neonatal death, antepartum hemorrhage, postpartum hemorrhage, and maternal death (Brown et al., 2000; Hema et al., 2020; Kendrick et al., 2015; Patel et al., 2017; Preet & Palve, 2020; Umegbolu & Ogamba, 2017; United States National High Blood Pressure Education Program Working Group, 2000). The risk of preeclampsia was 37% lower among foreign-born non-Hispanic Black women who had lived in the United States for less than 10 years than among U.S.-born non-Hispanic Black women.

PIH is a significant public health concern worldwide because of its incidence, fatality, and complicated management (Houehanou et al., 2021; Preet & Palve, 2020). Globally, 4.4%–15% of all pregnancies are affected by hypertension (Baig & Jamal, 2020; Chandio et al., 2021; Chen et al., 2019; Firisa et al., 2021; Hema et al., 2020; Jackson & Gregg, 2017; Logan et al., 2020; Umegbolu & Ogamba, 2017). PIH is a leading cause of maternal and neonatal morbidity and mortality worldwide (Chen et al., 2019; Hema et al., 2020; Jackson & Gregg, 2017). PIH is estimated to be responsible for 14% of all deaths globally and significantly contributes to maternal and newborn morbidity and mortality (Preston et al., 2022; Say et al., 2014).

PIH accounts for 10%–15% of maternal mortality in underdeveloped countries and 18% in developed countries (Chandio et al., 2021; Maharjan et al., 2019). Owing to

PIH, approximately 2.9 million neonates die during the neonatal period each year, and 2.6 million babies are stillborn globally (Haque & Sarkar, 2020; Obada et al., 2021). In the United States, PIH affects 8%–13% of pregnancies (Haque & Sarkar, 2020; Mohan et al., 2013; Obada et al., 2021). PIH is a common cause of complications during pregnancy, accounting for 70% of cases and complicating 6%–17% of pregnancies in healthy nulliparous women and 2%–4% in multiparous women (Sibai, 2003). PIH risk varies depending on the pregnant woman's age and parity. Younger nulliparous pregnant women have a higher risk than older multiparous pregnant women (Umegbolu & Ogamba, 2017). After pregnancy, PIH is related to poorer postpartum maternal cardiovascular health (Khedagi & Bello, 2021; Mitro et al., 2020), an increased risk of cardiovascular illness, and premature mortality (Wang, Y.X. et al., 2021).

According to Hema et al. (2020), PIH is categorized into four types as recommended by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy: chronic hypertension, pre-eclampsia-eclampsia, pre-eclampsia with chronic hypertension, and gestational hypertension (transient hypertension of pregnancy or chronic hypertension discovered in the second part of pregnancy). According to Baig and Jamal (2020), chronic hypertension affects about 1% of pregnancies, gestational hypertension affects 5%–6% of pregnancies (without proteinuria), and pre-eclampsia affects 3%–6% of pregnancies. In the United States, chronic hypertension (1.9%), gestational hypertension (6.5%), and eclampsia (0.3%) are common during pregnancy, with an overall frequency of hypertension of 8.6% (Butwick et al., 2020; Kuklina, 2020).

Gestational hypertension occurs after 20 weeks of pregnancy without significant proteinuria, whereas preeclampsia (greater than 140 mm Hg systolic or over 90 mm Hg diastolic) occurs after 20 weeks of gestation with proteinuria (Baig & Jamal, 2020). Chronic hypertension occurs 20 weeks before pregnancy when the diagnostic criteria extended over 20 weeks of gestation or if the second qualifying event happened within 6 weeks of the first qualifying event (Bello et al., 2021). Pre-eclampsia is characterized by extensive vascular endothelial dysfunction and vasospasm that develops after 20 weeks of pregnancy and can manifest as late as 4–6 weeks after delivery (Baig & Jamal, 2020; Lagana et al., 2015). Furthermore, PIH might be mild or severe. Mild PIH is new-onset hypertension (systolic blood pressure $\geq$ 140 mmHg and diastolic blood pressure $\geq$ 90 mmHg). Most mild PIH cases emerge after 37 weeks of pregnancy, and pregnancy outcomes are comparable to those of normotensive pregnancies in these cases (Buchbinder et al., 2002; Hauth et al., 2000; Hema et al. 2020; Sibai, 2003).

PIH prognosis is not usually straightforward. It is challenging, especially when a pregnant woman is diagnosed for the first time after 20 weeks of gestation or without a blood pressure measurement record before 20 weeks of pregnancy (Umegbolu & Ogamba, 2017). Every pregnant woman's prognosis with PIH is different because some pregnant women might later have pre-eclampsia while others might not. The progression rate to preeclampsia depends on the pregnant woman's gestational age at the diagnosis time for those who will develop it. Between 24 and 35 weeks of pregnancy, 25%–50% of women with PIH develop proteinuria, which can lead to pre-eclampsia (Umegbolu & Ogamba, 2017; Sibai, 2003; Wagner, 2004).

According to the WHO, at least one woman dies every 7 minutes due to PIH illnesses (Patel et al., 2017; Preet & Palve, 2020). The illnesses, not hypertension, cause most PIH-related deaths (Patel et al., 2017). PIH is a significant public health concern in developed and developing countries, leading to high maternal and neonatal morbidity and mortality rates worldwide (Berhe et al., 2020; Patel et al., 2017; U.S. National High Blood Pressure Education Program, 2000). PIH is characterized by edema, hypertension, and proteinuria after 20 weeks of pregnancy (Jye, 2009; Preet & Palve, 2020).

Scholars argued that PIH etiology is unknown; however, some of the anticipated etiological factors include abnormal placental implantation, vasculopathy, inflammatory changes, immunological factors, genetic (maternal, paternal, and thrombophilia) factors, and nutritional factors (Parmar et al., 2012; Umegbolu & Ogamba, 2017). Oxidative stress, impaired angiogenesis, vascular endothelial damage, and poor vascular compliance due to volume expansion are needed for a healthy pregnancy (Parmar & Karumanchi, 2016). Maternal risk factors for PIH include young women with their first pregnancy, pregnant women younger than 20 years and older than 40, preexisting diabetes, preexisting hypertension, previous pregnancy with PIH, kidney illnesses, obesity, and high-normal blood pressure in early pregnancy (Chandio et al., 2021; Chen et al., 2019; Duckitt & Harrington, 2005; El-Deen et al., 2018; Patel et al., 2017; Pergialiotis et al., 2014).

Other PIH risk factors are new partner/paternity, age 35, Black race, obesity (body mass index 30), 10-year interpregnancy interval, and use of selective serotonin reuptake inhibitors beyond the first trimester. Placental or fetal risk factors include premature birth, fetal growth restriction, and placental abruption, an early detachment of the placenta due to poor oxygen supply (Khalil & Hameed, 2017). Placental/fetal risk factors are multiple gestations (a pregnancy with more than one baby at a time). Hydrops fetal is a condition in which large amounts of fluid build up in the baby's tissue and organs causing extensive swelling, and gestational trophoblastic illness occurs when a tumor develops inside the uterus from tissue that forms after conception (Bansode, 2012; Umegbolu & Ogamba, 2017).

Furthermore, PIH risk is increased twofold in women with a family member with a medical history of hypertension and sevenfold in women with a previous pregnancy affected by PIH (Chen et al., 2019; Duckitt & Harrington, 2005). Economic factors, nutritional transitions, changing lifestyles, and demographics are risk factors for PIH (Omar et al., 2020). Women with a history of hypertension, multifetal gestation, chronic hypertension, diabetes mellitus, renal disease, or an autoimmune condition are at high risk for hypertension (Baig & Jamal, 2020).

Significant risk factors for PIH include smoking during pregnancy, high blood pressure, collagen vascular disease, obesity, Black race, insulin resistance, diabetes mellitus, gestational diabetes, elevated serum testosterone levels, and thrombophilia (England et al., 2002; Koual et al., 2013; Roberts et al., 2003). Other risk factors for PIH include a personal and familial history of hypertension (Dalmaz et al., 2011; Melamed et al., 2012; Mostello et al., 2002). The autoimmune disorder antiphospholipid syndrome, characterized by recurrent thrombosis, raises the risk of several obstetric problems, including PIH. PIH affects about one third of women with antiphospholipid syndrome

(Clark et al., 2007; Danza et al., 2012). Reduced maternal vitamin D levels have been linked to an increased risk of PIH (Tabesh et al., 2013; Wei et al., 2013).

Prepregnancy maternal vascular dysfunction becomes more severe due to hypertension, diabetes, or obesity. Less severe placental pathology, and fewer fetal problems are linked to maternal preeclampsia (Garovic et al., 2022). Pregnancy is a physiological stress test that exacerbates underlying endothelial dysfunction in cases of maternal preeclampsia. The extremes of clinical categories (early versus late, mild versus severe, and presence or absence of fetal growth restriction) may represent different underlying mechanisms, underscoring the variability of PIH (Garovic et al., 2022; Staff et al., 2013).

In the United States, PIH risk factors have grown, including advanced maternal age, obesity, and diabetes mellitus (Garovic et al., 2022), which could account for the increase in PIH prevalence (Ford et al., 2020). Non-Hispanic Black women in the United States had a 3.4 times higher total pregnancy-related mortality ratio than non-Hispanic White women, making them the group with the highest risk of getting PIH (Creanga et al., 2017). Non-Hispanic Black women are also more likely to develop preeclampsia, and they are more likely to die from its consequences (CDC, 2020; Melillo, 2020; Shahul et al., 2015).

According to Yang et al. (2021), racial and ethnic disparities in PIH include a higher prevalence of PIH risk factors and variations in access to and the standard of care provided by health care facilities. The United States health care system's racial prejudice can influence all aspects of PIH care, including diagnosis and treatment (Breathett et al., 2018). Furthermore, persistent hypertension is related to psychosocial stress brought on by racism (Bautista et al., 2019). According to Petersen et al. (2019), Black and AI/AN women were significantly more likely to die from PIH complications than White women. This finding emphasizes the significance of addressing PIH to reduce pregnancy-related mortality disparities (Ford et al., 2022).

PIH is also related to a higher risk for fetal, neonatal, and maternal complications. Preterm birth, intrauterine growth retardation, neonatal death, antepartum hemorrhage, postpartum hemorrhage, and maternal death are among the dangers (Brown et al., 2000; Hema et al., 2020; Kendrick et al., 2015; Patel et al., 2017; Preet & Palve, 2020; National High Blood Pressure Education Program Working Group, 2000; Umegbolu & Ogamba, 2017). Maternal concerns include uncontrolled hypertension, preeclampsia, eclampsia, HELLP syndrome, severe renal or hepatic failure, pulmonary edema, abruption placentae, postpartum hemorrhage, and coagulopathy related to PIH (Baig & Jamala, 2020). The most adverse birth outcomes of PIH are stillbirth, preterm birth, low birth weight, intrauterine growth retardation, neonatal mortality, asphyxia, and admission to a neonatal intensive care unit (Allen et al., 2004; Garovic et al., 2020; Garovic et al., 2022; Magee et al., 2016; Tweet et al., 2017). Furthermore, neonates born by PIH mothers are more likely to be small for gestational age with a greater probability of low birth weight, preterm, increased morbidity, and higher neonatal intensive care unit admission rate than those born to normotensive mothers (Akhila & Jayalakshmi, 2019; Baig & Jamal, 2020).

There are significant racial/ethnic disparities in pregnancy-related mortality in the United States. According to an analysis of data from the CDC's Pregnancy Mortality

Surveillance System (PMSS) from 2007 to 2016, the total United States pregnancy related mortality ratio (PRMR) was 16.7 for every 100,000 live births. Non-Hispanic AI/AN and non-Hispanic Black women had higher PRMRs (40.8 and 29.7, respectively) than any other racial or ethnic group. This difference persisted across all age groups and time (Petersen et al., 2019). The prevalence of PIH in the United States has increased steadily over time, from 2.9% in 1989 to 5.6% in 2015, according to data from the National Vital Statistics System (Martin et al., 2017). PIH risk variables include food, cigarette use, and physical activity pattern. Poverty or access to care may vary by location, which could explain place-based variations in PIH prevalence. Rural counties have a higher pregnancy-related mortality risk (Merkt et al., 2021).

Hawkins (2020) found that in Washington, DC, maternal mortality was 59.7 per 100,000 live births among Black women. With a 60% concentration of Black people in America (U.S. Census Bureau, 2000), DC has shown one of the worst pregnancy outcomes, especially for Black women. Among the maternal deaths recorded between 2014 and 2016 in Washington, DC, 75% were Black. According to the United Health Foundation (2019), over five babies die in the first 27 days of life in Washington, DC, compared to less than four nationally. Black women in Washington, DC are twice as likely to die from pregnancy complications as the average American woman (Nirappil, 2018).

Furthermore, newborns in Black Southeast Washington DC die at 10 times the rate of those in wealthier and Whiter Northwest Washington DC (Vargas, 2018). PIH has a high potential of interfering with the health and outcome of the pregnant mother and baby through the delivery period to late infancy. With an infant mortality rate of 8.4 per 100,000 births, Massachusetts has the second lowest infant mortality rate in the nation (World Population Review, 2022). In 2019, Massachusetts recorded 258 child deaths before 1 year, with an infant mortality rate of 3.7 per 1,000 live births. Massachusetts's infant mortality rate decreased by more than 27% between 2009 and 2019 (March of Dimes, 2020).

To mitigate the high prevalence of PIH and its attendant factors among Black pregnant women in Washington, DC, a proper understanding of the underlying factors is needed. I sought to determine whether there is a significant association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. There was a need for a comparative analysis of the factors responsible for the high prevalence of PIH, maternal death, and preterm birth among Black women in Washington, DC compared to Massachusetts. The findings of this study may highlight the need for the introduction of creative strategies to reduce place-based disparities in PIH and pregnancy-related mortality. These innovative strategies may include strengthening regional networks of health care facilities that offer risk-appropriate maternal care using electronic communication and transferring delivery care of people with high-risk conditions to facilities that can provide specialty services.

Problem Statement

The issue that motivated this study was PIH. PIH is a leading cause of maternal and neonatal morbidity and mortality worldwide (Chen et al., 2019; Hema et al., 2020; Jackson & Gregg, 2017). PIH causes 10%–15% of maternal deaths in undeveloped countries, and 18% in developed countries (Chandio et al., 2021; Maharjan et al., 2019). PIH, which affects 6%–8% of pregnancies worldwide and 6%–10% of pregnancy complications, is the second most frequent medical condition (Madkar et al., 2018). Despite the development of PIH diagnostic criteria over the last 5 decades in the United States, scholarly findings revealed that PIH affects between 8% and 13% of pregnancies in the United States (Garovic et al., 2022; Ferranti et al., 2020; Haque & Sarkar, 2020; Malek et al., 2022; Obada et al., 2021; Roberts et al., 2013). PIH is linked to maternal morbidity and mortality throughout the postpartum period (CDC, 2019, 2022; Hoyert & Minino, 2018). PIH types such as chronic hypertension (1.9%), gestational hypertension (6.5%), and eclampsia (0.3%) are common during pregnancy, with an overall prevalence of hypertension in the United States being 8.6% (Butwick et al., 2020; Kuklina, 2020). According to the CDC (2022), PIH prevalence among delivery hospitalizations increased from 13.3% in 2017 to 16% in 2019, affecting 1 in every 7 deliveries. The prevalence of PIH is highest in non-Hispanic Black women giving birth in hospitals and women under the age of 35 who live in zip codes with the lowest median household income quartile (CDC, 2022).

Due to complications caused by PIH during pregnancy, there are increasing fetal, neonatal, and maternal complications. Over the last 10 years, maternal deaths in the

United States have increased. According to the CDC (2023, pregnancy complications claim the lives of 800 to 900 American women annually. In 2018, the MMR was 20.7 deaths per 100,000 live births (CDC, 2019). In 2020, 861 women died in the United States due to maternal causes, compared to 754 in 2019 (Hoyert & Minimo, 2022). The MMR increased from 20.1 in 2019 to 23.8 in 2020 (Hoyert, 2022). Non-Hispanic Black women contributed to the national MMR with an MMR of 55.3 deaths per 100,000 live births in 2020, 2.9 times that of non-Hispanic White women (19.1 per 100,000 live births).

In addition, PIH accounts for the increase in preterm birth, intrauterine growth retardation, neonatal deaths, antepartum hemorrhages, postpartum hemorrhages, and maternal deaths (Brown et al., 2000; Hema et al., 2020; Kendrick et al., 2015; Patel et al., 2017; Preet & Palve, 2020; Umegbolu & Ogamba, 2017; United States National High Blood Pressure Education Program Working Group, 2000). HELLP syndrome, uncontrolled hypertension, preeclampsia, eclampsia, severe renal or hepatic failure, pulmonary edema, abruptio placentae, postpartum hemorrhage, and coagulopathy are among the conditions that can occur (Baig & Jamala, 2020). Also, neonatal mortality, asphyxia, premature delivery, low birth weight, intrauterine growth retardation, and admission to a neonatal intensive care unit can occur (Allen et al., 2004; Garovic et al., 2020; Garovic et al., 2022; Magee et al., 2016; Tweet et al., 2017). Additionally, PIH can cause small gestational age, low birth weight, preterm delivery, increased morbidity and mortality, and a higher risk of admission to the critical care units (Akhila & Jayalakshmi, 2019; Baig & Jamal, 2020).

In Washington, DC, women are twice as likely to die during pregnancy compared to the average American woman. The MMR in Washington, DC (41 deaths per 100,000 live births) is more than double the national MMR (20 per 100,000 live births; Nirappil, 2018; Vargas, 2018). Non-Hispanic black women in Washington, DC account for its higher MMR of 59.7 deaths per 100,000 live births (Hawkins, 2020). Black women in Washington, DC constitute an increasingly national MMR, making the U.S. MMR more significant than most high-income countries (Hawkins, 2020).

The district's maternal care tragedy is not new; the CDC data from 1987 to 1996 showed that Washington, DC had an MMR of 22.8 per 100,000 live-born infants, the highest MMR of all 50 states. Studies showed that poor, uninsured Black women in Washington, DC. have low socioeconomic status, inadequate quality care, and poor access to equitable antenatal and intrapartum care (Community of Hope, 2023; MacDorman, & Declercq, 2002). Massachusetts, the 15th most populous state in the United States (U.S. Census Bureau, 2021), has a low maternal death rate. The fact that Massachusetts has a lower MMR (14.7 deaths per 100,000 live births) compared to Washington, DC (41 deaths per 100,000 live births; National Vital Statistics System, 2020) may indicate that health care inequality contributes to urban regions' high MMR.

Natalie et al. (2022) examined the incidence of new-onset hypertension-induced pregnancy in rural and urban areas of the United States using data from 51,685,525 live births among people between the ages of 15 and 44. Natalie et al. discovered that after 2014, the annual increase in newly diagnosed hypertension-induced pregnancies increased more rapidly in urban regions than in rural areas. Cameroon et al. (2022)

indicated that there was a sustained increase in the incidence of new-onset hypertensive disorders of pregnancy from 2007 to 2019 in both rural (48.6% to 83.9%) and urban (37.0% to 77.2%) locations. Compared to rural areas, the annual increase in new-onset hypertensive disorders of pregnancy increased more quickly after 2014 in urban areas. From 1.31 in 2007 to 1.09 in 2019, rate ratios (95% CI) of new-onset hypertensive disorders of pregnancy in rural and urban areas declined. Washington, DC is one of the areas with the country's largest concentration of Black and Black female populations; a policy change may lessen the prevalence of chronic conditions such as PIH. Studies showed that poor, uninsured Black women in Washington, DC have inequitable access to medical treatment and improved and equitable access to health care, leading to poorer health outcomes (Kaiser Family Foundation, 2020; Melillo, 2020; Shahul et al., 2015; Washington DC Health Department, 2021). No research focused on the association between PIH, preterm birth, and maternal death, controlling for maternal education, maternal income, health insurance coverage, access to care, and quality of care among non-Hispanic Black women age 15–49.

Many scholars argued that women beginning pregnancy with other health issues, mothers initiating prenatal care too late, and the stress of racism faced by Black communities are predictors (Nirappil, 2018). Further evidence showed that poor, uninsured Black women in Washington, DC have inequitable access to medical treatment and equitable health care access, leading to poorer health outcomes (National Partnership for Women and Families, 2022; Vargas, 2018). Despite the poor results, no research focused on comparing the factors responsible for the high prevalence of PIH, maternal death, and preterm birth among Black women in Washington, DC compared to Massachusetts. The current study addressed this gap by contributing to the public health literature related to the study topic.

Purpose of the Study

The purpose of this quantitative study was to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49.

Research Questions and Hypotheses

In this quantitative study, two research questions were examined:

RQ1: Is there a significant association between maternal education, maternal income, prenatal care, gestational age, birth weight, and PIH among Black women age 15–49 in Washington, DC. compared to the state of Massachusetts?

H_o1: There is no significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

H_a1: There is a significant association between maternal education, maternal income, prenatal care, gestational age, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

RQ2: Is there a significant association between diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts?

H_o2: There is no significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

H_a2: There is a significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

Theoretical Framework

This study focused on the socio-ecological model (SEM). This model is credited to the works of Urie Bronfenbrenner in the 1970s. It was developed into a theory in the 1980s (Bronfenbrenner, 1986, 1989). The model states that health is affected by the interaction between the characteristics of the individual, the community, and the environment, which includes the physical, social, and political components (Kilanowski, 2017). The SEM has four levels: microsystem, mesosystem, exosystem, and macrosystem (Bronfenbrenner, 1977).

The SEM framework is appropriate for this study because it provides a platform to explore the intrinsic constructs within an individual and extrinsic constructs that can influence events or outcomes from external sources (Bronfenbrenner, 1995). In this study, age (1549 years old), gender (women), and PIH are all intrinsic factors the SEM explain. This study presents preterm birth, maternal income, and maternal education levels using the SEM extrinsic factors or constructs. The intrinsic and extrinsic constructs described in SEM can promote or hinder the quality of life depending on how it manifests or impacts a given condition.

Applying the SEM framework to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of healthcare payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among black women age 15–49 in Washington, DC compared to Massachusetts is appropriate for this study. This framework provides a better construct to examine the study variables and it has been used in Public Health for many years.

Nature of the Study

In this quantitative study, the specific research design I used is the cross-sectional quantitative method. The SEM highlights how the intrinsic and extrinsic factors promote or hinder the quality of life depending on how it is shown or impacted within a given condition, such as PIH (Bamuya et al., 2021). Since SEM can be used to explain quantitative phenomena associated with social behavior or health outcomes of chronic conditions like hypertension or infectious disease, this study examined the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of healthcare payment, obesity, access to care, quality of care, and PIH among Black women age 15-49 in Washington, D.C, compared to the state of Massachusetts. Thus, the study's research problem is grounded on the SEM as the theoretical framework and model to explain the research problem.

The target population covered are Black women age 15–49 in Washington, DC and Massachusetts, who participated in the 2018 – 2020 Pregnancy Risk Assessment

Monitoring System (PRAMS) survey. The first research question (RQ1): Is there a significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 years in Washington, DC compared to the state of Massachusetts? The second research question (RQ2): Is there a significant association between diet and source of healthcare payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 years in Washington DC compared to the state of Massachusetts?

Based on the 2018 – 2020 PRAMS data dictionary, the questionnaires used in the 2018 – 2020 PRAMS survey contain questions that address the variables in the research questions. In other words, the survey has questions about maternal education, maternal income, and prenatal delivery method . The two research questions were estimated.

Literature Search Strategy

In searching for literature for this study, libraries, online databases, and search engines such as Walden Library – Thoreau, Taylor & Francis, Google, Google Scholar, PubMed, Medline, NCBI, Elsevier, Scopus, Science Direct, ProQuest, EBSCO, JSTOR, and AJOL were explored for peer-reviewed articles. Textbooks, published doctoral dissertations, and government bulletins were checked for relevant literature. The keywords and combination of keywords used in searching for literature include p*regnancy-induced hypertension, preterm birth, maternal death, maternal education, maternal age, marital status, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, physical activity, cigarette use, source of healthcare payment, obesity, access to care, quality of care, Washington DC, Massachusetts, and the United*

States. These keywords and its combinations were used to search peer-reviewed articles, scholarly dissertations, books, non-governmental and international reports, government bulletins, papers, news reports, and publications published within the last 5 years for literature related to the study. The literature search was extended beyond 5 years to have an in-depth review of literary debates because of the broad nature, the medical and historical contexts of the study phenomenon.

Theoretical Framework

The SEM was categorized as a theory in the 1980s (Bronfenbrenner, 1977, 1986, 1989). The model states that health is affected by the interaction between the characteristics of an individual, a community, and an environment, which includes the physical, social, and political components (Kilanowski, 2017). The SEM has four levels: microsystem, mesosystem, exosystem, and macrosystem (Bronfenbrenner, 1977). The first is microsystem which directly impacts a person through interactions and relationships in the immediate environment. The second circle mesosystem considers interactions with whom the person has direct contact with at workplace, school, place of worship, and neighborhood. The third, exosystem does not affect a person directly, it does interact with a person in harmful and beneficial ways through social networks and communal contexts. The fourth macrosystem includes social, religious, and cultural values and influences. It incorporates internal and external components related to time and historical material (Bronfenbrenner, 1986).

In the SEM, the health construct is specified broadly, and attention is given to key factors that may impact health. According to the SEM, the interaction between an individual, a community, and an environment covers the physical, social, and political factors that affects the person's health. The CDC modified SEM and used the model to support various health interventions in organizations, interpersonal, community, policy, and societal levels (CDC, 2017; Keifer, 2017; Sallis et al., 2008). SEM has evolved into a practical framework for describing a system's approach at different societal levels. This paradigm shift acknowledges and describes the interaction between a person and his environment. The original model recognized the factors that contribute to human development. Later revisions and adoptions have utilized the SEM to represent multilevel strategies in public health promotions, prevention programs, campus health programs, geriatric preventive health, and colorectal cancer prevention (CDC, 2015; Kilanowski, 2017).

In advancing the multilevel frameworks of Urie Bronfenbrenner (1977), McLeroy et al. (1988) provided five levels of influence specific to health behavior; intrapersonal, interpersonal, institutional, community, and public policy (Barbara et al., 2017). The first is individual level which focus on internal behavioral factors, such as knowledge, attitudes, beliefs, and abilities. The second is interpersonal level, which comprises external influences or a person's private support network, such as family, friends, partners, doctors, and influential people. These people have an influence on a person's behavior and experiences. At this level, social identity, role definition and norms develop and manifest which may affect lifestyle and healthcare decisions.

The third is community level which investigates the environments where people interact with one another, such as workplaces, schools, and neighborhoods. It pinpoints the features of these environments that influence a person's health care decisions. The rules and procedures that direct and encourage healthy behavior at workplace, schools, and social organizations are considered at the institutional or organizational level. The fourth is community level which examines sociocultural issues that either improve or harm health. These are social and cultural standards on health, economic, educational, and social policies that contribute to efforts in developing, maintaining, or reducing socioeconomic disparities across groups (CDC, 2007; Krug et al., 2002). The community is a network of people, institutions, and organizations. These are social structures such as the media and advocacy organizations that are categorized according to a person's location, membership, heritage, or affiliation. The final is the public policy level where decisions are made by a municipal, state, or federal governing body that has power to influence all other groups. For instance, a federal, state, municipal government representatives can assist in preventing and controlling chronic diseases by legislating by-laws, ordinances, rules, or proclamations.

Scholars have identified level-specific factors on health behavior and they described potential intervention approaches at each level of influence (McLeroy et al., 1988). They asserted that it is crucial to think about model levels more than the environment of interventions. The targeted individual and environmental changes helps in determining the extent of involvement. For instance, McLeroy et al. propose that treatments at the intrapersonal level seek to alter people's knowledge, beliefs, and skills. Contrarily, interventions at the interpersonal and institutional levels aim to transform social dynamics and work settings. They suggest that community interventions occurs through partnerships with organizations, churches, neighborhoods, and other intermediary institutions. Community-focused initiatives aim to improve health care or give vulnerable groups such as Black women accessibility to health care. The implementation of policies that have an impact on health behavior is the ultimate objective of public health interventions (Golden & Earp, 2012).

SEM presupposes several levels of influence and these levels interact and reinforce one another. According to Stokols (1992, 1996), an environment's social, physical, and cultural components work together to influence health care behavior. Furthermore, Stokols argues that an environment is multilayered since institutions and neighborhoods are part of a larger social and economic systems. Consequently, an environment may affect a person's (i.e., Black women's) health depending on their beliefs and attitudes. Addressing these elements may result in longer-lasting health outcomes. However, McLeroy et al. (1988) and Stokols (1996) emphasize that changing all aspects of a person's environment and behavior may be unrealistic. They suggest that treatments should focus on at least two levels of influence or a multilayer health promotion (Golden & Earp, 2012; Sallis et al., 2008; Winett, 1995).

This theoretical framework is appropriate for this study because it provided a framework that explored both the intrinsic and extrinsic structures that can improve or decrease a quality of life. According to the SEM, the intrinsic and extrinsic determinants can either improve or reduce a quality of life depending on how they express or impact a particular condition, such as PIH. Since the SEM can be used to explain quantitative phenomena associated with social behavior or health outcomes of chronic conditions like hypertension or infectious disease, this study examined the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of healthcare payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–-49 years in Washington, DC compared to Massachusetts. The study's research problem, purpose, and nature were grounded on the SEM as the theoretical framework for analyzing and explaining the research problem.

Literature Review Related to Key Variables and/or Concepts

Scholars have investigated PIH prevalence, risk factors, and adverse outcomes such as maternal death and preterm birth among Black women using diverse methodologies. Wang et al. (2021) conducted a comparative population-based survey of epidemiological trends of maternal hypertensive disorders of pregnancy at the global, regional, and national levels using data from the Global Burden of Disease 2019 which covers 204 countries and territories. They discovered a 10.92% global increase in the prevalence of hypertensive disorders during pregnancy, from 16.30 million to 18.08 million between 1990 and 2019. The age-standardized incidence rate declined with an estimated annual percent change of -0.68 (95% confidence interval [CI] -0.49 to -0.86). About 27.83 thousand women died in 2019 from hypertensive disorders of pregnancy, a 30.05% drop since 1990. According to incidence and prevalence, the age group of 30–34 years and 20–24 years had the highest number of deaths and years with disabilities, while the age group of 25–29 years had the lowest estimated incidence rate. The youngest and oldest groups had the highest incidence rates. For all countries and regions in 2019, there were positive correlations between incidence rates, sociodemographic index, and human development index. Age-standardized incidence rates were more significant in countries/regions with lower sociodemographic and human development indices.

In 2022, the CDC examined hypertensive disorders in pregnancy and mortality in the United States. The results showed that pregnancy-related hypertension increased from 10.8% in 2017 to 13.0% in 2019. Prevalence of hypertensive disorders in pregnancy was higher among women age 35–44 (18.0%) and 45–55 years (31.0%) than younger women, among Black (20.9%) and AI/AN native women (16.4%) than women of other racial and/or ethnic groups. Hypertensive disorders in pregnancy were documented in 31.6% of maternal deaths during delivery hospitalization, and 24.3% had pregnancy-associated hypertension, 7.4% deaths occurred due to chronic maternal hypertension.

Garovic et al. (2022) reviewed literature on the diagnosis and pharmacotherapy of PIH in the United States. They found that antihypertensive medicine reduces the risk of severe hypertension in pregnant women with hypertension. The United States documents a higher rate of hypertension-related maternal death from cardiovascular disease and cerebrovascular accidents among high-income countries. Using the same methodology, Braunthal and Brateanu (2019) reviewed literature on the pathophysiology and treatment of hypertension in pregnancy in the United States. The found variants of hypertension in pregnancy, including preexisting and gestational hypertension, pre-eclampsia, and eclampsia, which complicate about 10% of pregnancies and account for significant maternal and perinatal morbidity and mortality in the United States.

In the United States, Gunderson et al. (2022) examined blood pressure trajectory from 0 to 20 weeks gestation to determine PIH in a retrospective cohort of 174,925 Black, Hispanic, and Asian women with singleton birth deliveries between 2009 and 2019 at the Kaiser Permanente Northern California Hospital. They found that low-increasing, moderately stable, and elevated stable groups had adjusted odds ratios (95% confidence intervals) of 3.25 (2.7–3.9), 5.3 (4.5–6.3), and 9.2 (7.7–11.1) for pre-eclampsia/eclampsia, and 6.4 (4.9–8.3), 13.6 (10.5–17.7), and 30.2 (23.2–39.4) for gestational hypertension, respectively.

To examine racial and ethnic differences in pregnancy-related mortality in the United States, Petersen et al. (2019) analyzed data from the CDC's PMSS from 2007 to 2016. The total U.S. PRMR for the period was 16.7 pregnancy-related deaths per 100,000 live births. Non-Hispanic AI/AN and non-Hispanic Black women had higher PRMRs (40.8 and 29.7, respectively) than any other racial or ethnic group. Across age groups and time, this discrepancy remained. The PRMR for Black and AI/AN women was almost five times that of their White counterparts who were below 30 years. Other racial/ethnic groups with less than a high school diploma had PRMRs lower than those for Black and AI/AN women with at least college education. The PRMRs for Black and AI/AN women were 2.8–3.3 and 1.7–3.3 times higher than those for non-Hispanic White women. The discrepancy in PRMRs among White women was lowest among women under 20 years (1.5) and highest among age 30-34 (4.3). This indicates that the PRMR rose with maternal age. At all levels of education, there were racial and ethnic differences. Black women were more likely to have chronic conditions that raise the risk of pregnancy-related death (such as hypertension) and were less likely to control it. Racial disparities and pregnancy-related mortality are certainly related, and the quality of care plays a part in both.

Bello et al. (2021) used hospital-based dataset of a birth cohort of singleton deliveries between 2009 and 2014 at the Kaiser Permanente, South Carolina, to estimate the prevalence of PIH and preterm birth in the United States. They investigated whether the definition of regrouping hypertensive status, using the 2017 American College of Cardiology and American Health Association reveals women suffering from pre-eclampsia, eclampsia, and adverse fetal outcomes. They found a 14.3% prevalence of chronic hypertension and 13.8% of gestational hypertension, with an absolute increase of 17.8% documented for an overall prevalence of hypertension. An improvement of 3.8% was estimated for fetal or neonate risk.

The significance of apolipoprotein L1 variants in human pre-eclampsia in the United States was examined by Reidy et al. (2018). They used a case and control research method. They found that apolipoprotein L1 genetic variations are responsible for a higher risk of kidney disease in African American women with pre-eclampsia. Pre-eclampsia was linked to fetal apolipoprotein L1 high-risk genotype with odds ratios of 1.84 (95% CI 1.11, 2.93) and 1.92 (95% CI 1.05, 3.49) at the Einstein Montefiore and the University of Tennessee Health Sciences Center, respectively, but apolipoprotein L1 high-risk genotype was not linked to pre-eclampsia among African American women. The study's limitations center on the restricted case size due to the lack of availability of pre-eclampsia births with fetal deoxyribonucleic acid at the Einstein Montefiore affiliated hospitals in New York. The second approach concentrated on 93 and 793 control pregnancies without pre-eclampsia at the University of Tennessee Health Sciences Center, Memphis. They found two inconsistent results in two geographically populations of self-identified Black participants.

Singh et al. (2018) studied racial/ethnic, nativity, and sociodemographic variations in PIH in the United States. They found that maternal hypertension prevalence ranged from 2.2% for Chinese women and 2.9% for Vietnamese women to 8.9% for AIAN women and 9.8% for non-Hispanic Black women which indicate significant racial/ethnic variations. Petersen et al. (2019) studied racial/ethnic disparities in pregnancy-related deaths in the United States. The study showed a substantial difference in cause-specific proportionate mortality among racial/ethnic populations.

Ferranti et al. (2020) used nested case-control research design to study African American women sampled from the Emory University African American Vaginal, Oral, and Gut Microbiome in Pregnancy Cohort Study. They used high-resolution metabolomics on early (8–14 weeks) gestation blood samples to find metabolites and metabolic pathways that were altered in African American women with hypertension disorders of pregnancy (pre-eclampsia and gestational hypertension) compared to those who gave birth to their babies at term without complications. They found that hypertension disorder during pregnancy is more common in African American women in the United States. The findings suggested systemic metabolic abnormalities in pregnant African American women who develop pre-eclampsia and gestational hypertension can be detected early in pregnancy (8–14 weeks). The strategy employed assisted in identifying novel metabolites and metabolic pathways specific to pre-eclampsia and gestational hypertension in African American women and PIH's metabolic activities and pathways. However, the study findings were exploratory because of the limited sample size.

In a related study, Minhas et al. (2021) used logistic regression to analyze the 2016 to 2018 national inpatient sample data on racial inequalities in cardiovascular problems with PIH in the United States. Their results showed that pre-eclampsia was more common in African American women, and they had the most significant incidence of numerous complications (506 peripartum cardiomyopathy, 660 heart failure, 953 acute renal failure, and 418 arrhythmias, per 100,000 deliveries). The de-identified structure of the database made it difficult to corroborate diagnoses, which led to misclassification. Another issue is the restriction of all diagnoses to the ICD-10 codes. Additionally, they were short of data on pregnancies or re-admissions for pregnancy. This study is pertinent to the current research because it investigated other complications that Black women with pregnancy-induced hypertension can face.

Foo et al. (2022) conducted systematic review and meta-analysis of diabetes and hypertensive diseases after a miscarriage. They thoroughly evaluated every retrospective or prospective observational study, which include cross-sectional, case-control, nested case-control, case-cohort, and cohort studies that assessed the relationship between exposure and study phenomena outcomes. The study's shortcoming is that the systematic review was not thorough due to shortage of studies and targeted participants, and the meta-analysis was not conducted. However, they used narrative synthesis to analyze the studies.

Ford et al. (2022) estimated the annual prevalence of hypertensive disorder of pregnancy among delivery hospitalizations by maternal characteristics and the proportion of in-hospital deaths with hypertensive disorders of pregnancy diagnosis code recorded in the United States between 2017 and 2019. They analyzed the nationally representative data from the national in-patient sample. They discovered that the prevalence of hypertensive disorder of pregnancy among delivery hospitalizations increased from 13.3% to 15.9% between 2017 and 2019. While the incidence of chronic hypertension rose from 2.0% to 2.3%, the prevalence of pregnancy-associated hypertension increased from 10.8% in 2017 to 13.0% in 2019. The prevalence of hypertensive disorder of pregnancy was highest among non-Hispanic Black or African American women who gave birth in hospitals in the South or the Midwest region, non-Hispanic AI/AN women, and women below 35 years who lived in zip codes with the lowest median household income quartile. Mortality during hospitalization delivery was 31.6% more likely to have any hypertensive disorder of pregnancy documented. The study's strength is its accurate ICD-10-CM coding necessary to identify hospitalizations and hypertensive disorders in pregnancy. However, deaths determined by discharge disposition may understate deaths during labor and delivery hospitalization. As a result, the figures do not accurately reflect all pregnancy-related deaths. The CDC could not identify individuals who gave birth more than once during the study. The disaggregation of mortality attributed to less common hypertensive disorders of pregnancy and other maternal factors was impossible due to the small sample numbers.

To examine racial and ethnic differences in pregnancy-related mortality in the United States, Petersen et al. (2019) extracted and analyzed data from the CDC's PMSS from 2007 to 2016. For the study's weakness, it is difficult to detect pregnancy-related deaths, cancer-related deaths, or injury deaths caused by drug overdoses, suicides, or homicides, because these are frequently left out when computing PRMR using PMSS data. The small cohorts size prevented the reporting of several characteristics by race or ethnicity. Where death certificates were used for classification, there were discrepancies in the reporting of race or ethnicity.

Malek et al. (2021) conducted a retrospective cohort study of women age 12–49 years with a live singleton birth between 2004 and 2016 who had hypertensive disorders of pregnancy to determine the prevalence of maternal coronary heart disease, stroke, and mortality within 1 year, 3 years, and 5 years of delivery. They discovered that pregnancy-related hypertension was connected to adverse maternal outcomes for non-Hispanic Black and non-Hispanic White women in the last 5 years. Miller et al. (2021) analyzed the effect of race/ethnicity on stroke during delivery admission in women age 18–54 years who delivered in the United States hospitals from January 1, 1998, through December 31, 2014. They found that Black and Hispanic women with PIH had a greater risk of stroke than non-Hispanic White women (Blacks: aRR, 2.07; 95% CI, 1.86–2.30; Hispanic: aRR, 2.19; 95% CI, 1.98–2.43). Also, only Blacks had a higher risk of stroke among normotensive women (aRR, 1.17; 95% CI, 1.07–1.28). The study's strength is that live births in South Carolina for 13 years covered in the population-based analysis which create a sizable, diversified population that gave consideration to potential disparities by racial/ethnic group. However, they counted singleton live births only but did not consider miscarriages. Comparisons between groups with a limited number of events were challenging; therefore, the results could not be generalized. Lack of data on ischemic or hemorrhagic etiology of stroke prevented the examination of stroke subtypes. Lifetime pregnancy history and data on potential diagnoses before index pregnancy, including cardiovascular disease were not covered due to use of administrative data for the study.

To track changes in the prevalence of chronic hypertension in pregnancy in the United States between 1971 and 2010, Ananth et al. (2019) conducted a population-based cross-sectional analysis of 151 million women with delivery-related hospitalization. They discovered that 0.63% of the women had chronic hypertension with Black women having a rate twice higher than White women’s (0.53%; rate ratio, 2.31; 95% CI, 2.30–2.32). From 0.11% in 1970 to 1.52% in 2010 (rate ratio, 13.41; 95% CI, 13.22–13.61), chronic hypertension increased significantly with increase in age and time. The average annual rate of hypertension increased by 6% (95% CI, 5–6), with White women significantly increase (7%; 95% CI, 6%–7%) than Black women (4%; 95% CI, 3%–4%). Influence of age and time was not considered when adjusting for changes in smoking and obesity rates. They found that the prevalence of chronic hypertension increased significantly with age and time and varied twice by race. The study’s strength is in the analysis of temporal variations in the prevalence rate of chronic hypertension in pregnancy (how age, period, and birth cohorts affect these trends) using 151 million delivery-related hospitalizations data in the United States. Although there were no data primary variables like smoking and pre-pregnancy body mass index, multilevel models were used to account for these factors using data from the National Health and Nutrition Examination Survey.

The impact of maternal race and nativity on the disparities in poor maternal and perinatal outcomes was investigated by Adegoke et al. in 2021. In the retrospective analysis, women who gave birth at the Boston Medical Center between January 2010 and March 2015 were evaluated for singleton pregnancies. They discovered that American-born women and their neonates had a higher risk of preterm birth, hypertensive disorders, low birth weight, and neonatal intensive care unit hospitalization than women born in abroad. Sociodemographic characteristics has no impact on these inequalities. White Hispanic women had a lower prevalence of complications than White women, Black women had a higher prevalence of maternal and newborn complications. Regardless of origin, Black women and infants have poorer outcomes. However, Hispanic women who were born in abroad had less disparate outcomes.

The study's strength is in its sample size which has significant statistical power to detect variations in the key variables. They collected data from patients' medical record to confirm diagnoses written in patient charts, used laboratory results to complement diagnosis codes and build the specific case for each research participant. The study's retrospective approach prevented conventional data collection. The retrospective approach did not enable them to collect data for primary variables they could not access on the medical record, such as income level and maternal education, and associated delivery outcomes (Acevedo-Garcia et al., 2005, 2007; Urquia et al., 2012).

To examine racial disparities in postpartum blood pressure trajectories among women with a hypertensive condition of pregnancy at the University of Pittsburgh Medical Center Magee Women's Hospital, Hauspurg et al. (2020) utilized mixed-effect regression model. They examined blood pressure for the first six postpartum weeks, using weeks postpartum as the time frame for all calculations. They also used stratified mixed effects regression models to explore gestational weight growth and body mass index at birth. Findings showed that blood pressure trajectory differed significantly by race. Black women's systolic and diastolic blood pressures dropped slowly than White women's (mean [S.D.] peak systolic blood pressure at one week postpartum). 126 out of 185 Black women (68.1%) satisfied the criteria for stage 1 or stage 2 hypertension, compared to 393 out of 764 White women (51.4%). The study's strengths is that the prospective cohort used in the study came from a tertiary care facility. Participants shared accurate time blood pressure readings using verified, calibrated blood pressure monitors. They employed standardized management protocols to lessen the effect of physician variability in management techniques. However, the study's limitation is that it was difficult to identify the study participants from non-participants in terms of gender or their participation was influenced by implicit bias or structural racism. The study's single-site design restricts the generalization of the findings.

Taylor et al. (2022) studied the correlation between the risk of hypertensive disorders during pregnancy and the prevalence of sexually transmitted diseases among 38,026 singleton pregnancies. They used log-binomial regression to analyze the relative risks of pregnancy with gestational hypertension, pre-eclampsia with severe characteristics, mild pre-eclampsia, and superimposed pre-eclampsia. They abstracted data from PeriBank, a biorepository and database that enrolls women at the Texas Children's Hospital Pavilion for Women and the Baylor College of Medicine, Houston, Texas, United States. They discovered that chlamydia was linked to severe pre-eclampsia (RRadj. 1.4, 95% CI 1.1, 1.9). The effect of the estimates varied depending persistent or recurrent infection or the diagnosis during the initial prenatal visit (RRadj. 2.0, 95% CI 1.1, 3.4). Women without a record of sexually transmitted infection treatment were more likely to develop pre-eclampsia with severe symptoms of chlamydia (RRadj. 2.0, 95% CI 1.3, 2.9) and gonorrhea (RRadj. 3.0, 95% CI 1.1, 12.2). Sexually transmitted diseases may be connected to pre-eclampsia with severe symptoms in a heterogeneous perinatal group. The study's strength is in the sensitivity analysis they carried out.

Additionally, Taylor et al. (2022) examined whether relationships were consistent for women who received the CDC-recommended treatments for sexually transmitted infection and those who did not. They examined relationships among women who received a second chronic or recurrent infection diagnosis in the third trimester and those with sexually transmitted infection diagnosis at the first prenatal visit. The study's weakness is that there was no data on a gestational age for sexually transmitted infection testing. Per hospital guidelines, women were tested at the first prenatal appointment. They evaluated correlations between first-trimester prenatal care patients and second-trimester prenatal care patients and third trimester was proxied.

Similarly, Kuklina (2020) reviewed evidence on hypertension in pregnancy in the United States and its variation by state. The result showed an overall prevalence of hypertension in pregnancy at 8.6% and variants of hypertension in pregnancy across States in the United States. While Hawaii had 1.0% lowest chronic hypertension, it was 3.4% highest in Alaska. Gestational hypertension was 4.3% lowest in Massachusetts but 9.3% highest in Louisiana. Also, eclampsia was low at 0.03% in Delaware but highest at 2.8% in Hawaii.

Natalie et al. (2022) examined the incidence of new-onset PIH in rural and urban areas of the United States using data from 51,685,525 live births among ages 15–44. After 2014, the annual increase in newly diagnosed PIH increased rapidly in urban areas than rural areas. Similarly, to examine trends in maternal pre-pregnancy hypertension among women in rural and urban areas of the United States, Cameroon et al. (2020) used serial cross-sectional research design to examine maternal data from CDC natality database on live births among women age 15–44 between 2007 and 2018. The study's strength is the use of CDC's Wonder Natality online tool, which provides high-quality vital statistics data for live births in the United States. The online tool gives significant sample data over a decade ago for ages, locations, and racial/ethnic groups. However, there were restrictions related to birth certificate registration, such as the risk of incorrect coding or ignorance of hypertensive pre-pregnancy diagnoses. The study's serial cross-sectional design allowed it to incorporate recurrent pregnancies that resulted in live babies for the same woman when assessing annual rates. This study is significant to the current study because they found out that there were significant associations between increasing parity, level of education, and reduction of maternal mortality, and ethnicity was significantly associated with maternal mortality.

Boakye et al. (2021) used cross-sectional data from a birth cohort (1998-2016) in Boston, Massachusetts, to examine the relationships between pre-eclampsia, maternal place of birth, and length of residency among non-Hispanic Black women. They used cross-sectional data from non-Hispanic Black women who gave birth in Boston between 1998 and 2016. After adjusting for potential confounders, a multivariate logistic regression analysis was done to investigate the relationships between pre-eclampsia, nativity, and time spent living in the United States. Pre-eclampsia was prevalent in 12.4% of US-born women and 9.1% of foreign-born women, respectively when age was adjusted. The risk of pre-eclampsia was 37% lower among foreign-born, non-Hispanic Black women who had lived in the United States for less than 10 years than among US-born non-Hispanic Black women. However, the Boston birth cohort samples contained excessive preterm babies, which caused the elevated rate of pre-eclampsia they observed. Due to unavailability of data, they adjusted for socioeconomic health determinants and pre-eclampsia risk factors such as previous pregnancies with pre-eclampsia. 325 foreign-born women were not included in the survey because they did not know their date of birth (Boakye et al., 2021). The study's strength lies in the Boston birth cohort data for researching adverse pregnancy outcomes like pre-eclampsia, preterm births, and low birth weight. This research is significant because it allows baseline assessment of the risk of pre-eclampsia among foreign-born and the U.S.-born non-Hispanic Black women.

Definitions

Maternal death: The annual number of female deaths from any cause associated with or aggravated by the pregnancy or its management (apart from accidental or incidental causes) during pregnancy and childbirth or within 42 days (about one and a half months) of termination, regardless of the length or location of the pregnancy.

Pregnancy-induced hypertension (PIH): A condition in which vasospasm of the body's minor and significant arteries happens during pregnancy. PIH is a type of elevated blood pressure that occurs during pregnancy. It is a disorder when both small and big arteries experience vasospasm during pregnancy. The resistance of blood arteries increases with increased blood pressure. This condition could reduce blood flow to the expecting mother's liver, kidneys, brain, uterus, and placenta, among other body organs.

Preterm birth: Babies delivered alive at 37 weeks of pregnancy. Preterm babies are categorized into three based on gestational age: extremely preterm (below 28 weeks), very preterm (28–32 weeks), and moderate to late preterm (32–37 weeks).

Assumptions

In this study, the PRAMS survey data represent samples taken from the total population in Washington, DC, and Massachusetts as respondents. As the nation's public health agency, the CDC primarily emphasizes scientific evidence for developing policies, guidelines, and recommendations. Central to this process is a commitment to transparency, honesty, and thorough consideration of the research outcomes. This approach is strengthened by maintaining high standards of professionalism, adhering to policies and systems for preserving the quality of information, rigorously evaluating data, research findings, and strictly adhering to policies that protect human subjects. It is believed that the PRAMS data obtained from the respondents were compiled, examined, and evaluated for generalization on the entire population of the study. For cases of PIH in the United States, the high-quality PRAMS survey data is expected to give larger sample for all ages, locations, and racial/ethnic groups, particularly Black women. Therefore, the PRAMS survey data is reliable because the instrument was tested through statistical reliability and procedural consistency tests, which aided in providing accurate results on the study phenomena. The PRAMS survey data yielded trustworthy responses.

Scope and Delimitations

This study focused on comparative analysis of the factors responsible for high prevalence of PIH, maternal death, and preterm birth among Black women in Washington, DC, compared to the state of Massachusetts to better understand the increased prevalence of PIH in Washington, DC, and how to improve health outcomes in this group. The target population covers Black women of 15–49 years in Washington, DC, and Massachusetts, United States, who participated in the 2018–2020 PRAMS survey. The SEM was used to analyze the intrinsic factors such as age (15–49 years), gender (women), and PIH.

External factors or constructs such as preterm birth, mother income, and maternal education levels can be analyzed using SEM. The intrinsic and extrinsic constructs described in SEM can promote or hinder the quality of life depending on how it manifests or impacts a given condition. Applying the SEM framework to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birthweight, diet, source of healthcare payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 years in Washington, DC compared to Massachusetts is appropriate for this study because it provides a better construct to examine the variables mentioned above, and it has been used in Public Health for years. I discussed the study findings using correlational inference**.**

Limitations

There was a selection bias because of the use of secondary data already collected by the CDC PRAMS. The data collection approach was not explicitly designed for this study, leading to lack of generalization of findings. The study's cross-sectional design did not infer causality in the conclusions, but correlational inferences were made. Permission for the de-identified 2018–2020 PRAMS dataset from the CDC was made and obtained approval from Walden University IRB for this study. Assessing PRAMS data was cumbersome, from when request for data collection was submitted, till the ethical board of the facility approves the request, and signing the bill of clearance of approved permission to collect the data. There was no way to get consent from the clients; however, confidentiality was still secured.

Significance

The significance of this study is that maternal well-being is paramount in quantifying the well-being of a fetus, neonate, or infant. The health outcomes of a fetus or neonate are predicted by the mother's health condition and social environment (Barbosa et al., 2015). Black maternal mortality is four times higher and it is a public health crisis. According to the WHO, maternal mortality is unacceptably high. About 295,000 women died during and following pregnancy and childbirth in 2017. Most of these deaths (94%) occurred in low-resource settings. The WHO further states that the United States' MMR has significantly increased since 2000. While the United States maternal deaths have leveled in recent years, the ratio remains higher, and significant racial disparities remain. Reducing Black maternal mortality will involve a different approach involving the patient, provider, and public health policy. Socioeconomic factors alone cannot describe Black women; other factors like access to care, the level of care, and other comorbidities could be investigated. Reducing Black maternal mortality may involve a different approach involving the patient, provider, and public health policy.

Through the lens of this study's findings, evidence-based results were generated to support and encourage change. Thus, the identification of relevant socioeconomic factors like income level and educational level among Black women in Washington, DC and awareness of the significant degree of racial/ethnic variation in PIH and associated adverse outcomes. Examining these variations would help formulate indigenous and contextual policy to combat such consequences and promote healthy pregnancy, delivery, and thriving babies for Black women in Washington, DC among other ethnicities. In addition, the findings inform PRAMS public health departments, and health practitioners specifically on the need to account for age, household size, and socioeconomic factors such as income and educational level to tailor prenatal, antenatal care, and other factors that promote a healthy pregnancy among medically and socially underserved women in the United States**.**

Summary and Conclusions

This Section introduced the study phenomenon and provided a background for the research study. The research questions and hypotheses with an abridged discussion of the theoretical framework for the study were present. Also, are the nature of the study, the literature search strategy, and a detailed explanation of the SEM. Further discussions focused on the study's definitions, assumptions, scope and delimitations, limitations, and significance.

A thorough literature search revealed that PIH prevalence is highest in non-Hispanic Black or African American women giving birth in hospitals in the South or the Midwest Census regions, non-Hispanic AI/AN women, and women below 35 years who lived in zip codes with the lowest median household income quartile (Ford et al., 2022). In 2020, non-Hispanic Black women's maternal mortality rate was 55.3 deaths per 100,000 live births, which is 2.9 times higher than the rate for non-Hispanic White women (19.1) (Donna, 2022). With a 60% concentration of Black people in Washington, DC (U.S. Census Bureau, Census 2000), Washington, DC has one of the worst pregnancy outcomes, especially for Black women in the United States (Hawkins, 2020). Despite the poor results, no research focused on comparing the factors responsible for the high prevalence of PIH, maternal death, and preterm birth among Black women in Washington, DC compared to Massachusetts. This study bridged the gap, contributed to the public health literature related to the study topic.

Section 2: Research Design and Data Collection

The purpose of this quantitative study was to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. Section 2 includes a description of the research design and the rationale for selecting the design, the study's methodology, the population of the study, the study's sampling procedures, operationalization for each variable description, data analysis plan, threats to validity, ethical procedures, and a summary.

Research Design and Rationale

In this quantitative study, PIH was the dependent variable. Maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care were the vector variables for independent variables. The research design was cross-sectional with a nested logistic regression method to examine the association between the independent and dependent variables. The study's target population was Black women age 15–49 in Washington, DC and Massachusetts who participated in the 2018–2020 PRAMS survey. I used the nested logit model (multivariate logistical regression model) to estimate. The nested logit model has been used for quantitative analysis and can account for similarities between alternatives via partial correlation of the error terms. The three basic assumptions underlying the use of the nested logit model are (a) it considers the human being as highly rational, (b) individuals are chosen sequentially, and (c) group alternative outcomes are suspected of sharing unobserved effects into the nest.

The study included two research questions. The first research question was the following: Is there a significant association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts? The second research question was the following: Is there a significant association between diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts? The nested logistic model was used to answer the two research questions (see Greene & Hensher, 2010).

The rationale for choosing the nested logit model was (a) the nested logit model extends or expands the use of logit modeling techniques to allow for dependences across responses by grouping alternatives into broader categories or nests, (b) the nested logit model allows for correlation between some variables, (c) the nested logit model allows for correlation among error terms, (d), the nested logit model estimates similar cluster variables in nests, (d) the structure of nested logit model allows nests to have different variances, and (e) the nested logit model can be decomposed into two more logit models.

RQ1: Is there a significant association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts?

I used the nested logit model to model the situation analysis in which pregnant women have been diagnosed with PIH. I assumed that a pregnant woman would visit prenatal care before being diagnosed with PIH. An individual pregnant woman who visits a prenatal clinic may be influenced by the level of maternal income and education, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care. The correlations among these variables were estimated.

In the model, I grouped or clustered sets of j variables. These variables were grouped into sets because j is a set of variables used as a vector containing all independent variables in this model. The cluster sets of the j variable were grouped into the set because of the choice of nested logit model used for the estimation of our study. The j variables were maternal education and income as well as other variables such as prenatal care, gestational age, method of delivery, birthweight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care, which are the sets of B for individual pregnant woman n. The estimation allows correlation between the vector variable B by nesting them. Z represents the characteristics of the nests, and ϵ is the error term. Question 18 of the PRAMS survey, "During your most recent pregnancy, did you have any of the following health conditions?" was used to capture the PIH of respondents. Their likelihood of being diagnosed was either they have PIH or they do not. I also identified the deterministic factors formulated in RQ1 to estimate the correlation. I arrived at Equation 3.1:

$$U_{nj} = x_{nj}B + Z_s\alpha + \epsilon_{nj} \qquad (3.1)$$

U_{nj} represented the likelihood of PIH. Question 50 of the PRAMS survey analysis was used to measure maternal income. A scale of < $50,000, $50,000–70,000, and > $70,000 was to measure maternal income. To estimate maternal education, Question 34 was used ("Before or after your new baby was born, did you receive information about breastfeeding from any of the following sources? For each one, check No if you did not receive information from this source or Yes if you did"); the survey was used to control and measure the variable. This was important because income was one of the determinants.

RQ2: Is there a significant association between diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts?

$$U_{nj} = x_{nj}B + Z_s\alpha + \epsilon_{nj} \quad (3.1)$$

U_{nj} represented the likelihood of PIH. Question 50 of the PRAMS survey analysis was used to measure maternal income. A scale of < $50,000, $50,000–70,000, and > $70,000 was used. To estimate maternal education, I used Question 34 ("Before or after your new baby was born, did you receive information about breastfeeding from any of the following sources? For each one, check No if you did not receive information from this source or Yes if you did"). The survey was used to control and measure the variables.

Random samples of data from the PRAMS survey for Washington, DC and Massachusetts were obtained for the analysis. The resource constraint related to the research design was in its data sample. The PRAMS data sample was used because of the nonavailability of data collected from pregnant women, such as PIH, maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care. The PRAMS survey data were specific and collected from pregnant women in the United States.

The cross-sectional design and nested logistic regression used for this study were consistent with many studies conducted in the Public Health discipline. Scholars who used this research design included Boakye et al. (2021), who used cross-sectional data from a birth cohort (1998–2016) in Boston, Massachusetts to examine the relationships between preeclampsia, maternal place of birth, and length of residency among non-Hispanic Black women. Cameroon et al. (2020) used a serial cross-sectional design to study maternal data from all live births in women age 15–44 between 2007 and 2018 from the CDC's natality database. Also, Minhas et al. (2021) used logistic regression to analyze the 2016–2018 National Inpatient Sample data on racial inequalities in cardiovascular problems with PIH in the United States. Choosing cross-sectional data and nested logistic regression helped me achieve the study's objectives to fill a gap in the literature and to form a basis for a positive social change and advance knowledge in public health.

Methodology

Population

This study's target population was Black women age 15–49 in Washington, DC and Massachusetts who participated in the 2018–2020 PRAMS survey.

Sampling Procedure

In selecting data for the study, I used a random sampling technique to choose 1,442 participants: 721 each from Washington, DC and Massachusetts. PRAMS data were abstracted from the CDC institutional repository for PRAMS for both states. The study's inclusion criteria were pregnant women participating in the PRAMS survey data collection between 2018 and 2020 for Washington, DC and Massachusetts. I considered participants whose data were captured in full with a supplied response for all of the data fields for the randomization procedure to support the study with robust findings. I did not consider pregnant women who did not participate in the PRAMS data survey for Washington, DC and Massachusetts from 2018 to 2020. Also, participants who did not supply responses to all of the data fields in the survey were initially excluded from the study.

To abstract PRAMS survey data for Washington, DC and Massachusetts, I requested the PRAMS data by filling out and submitting an application form to the CDC. They demanded that I develop and submit a proposal of 350 words to introduce the study, including the problem statement, study objectives, and positive social change implications. The data-sharing agreement was signed, an obligation that made the document binding. After that, I reviewed the application and replied within 4 months of submission.

PRAMS data are reputable in that the PRAMS has been a surveillance project of the CDC since 1987, which is used by scholars and private and public institutions in addressing emerging issues on PIH and other reproductive health-related concerns in developing and making positive social change and encourage policy changes that are suitable for every race. The population-based data focused on maternal attitudes and experiences during and after pregnancy and captured about 81% of all births in the United States (see CDC, 2022). Data were being collected across all cities, counties, and states in the United States to plan and review policies and programs targeted toward reproductive health, especially for mothers and newborns. Currently, 46 states are captured in the PRAMS survey for annual data collection.

The PRAMS questionnaire focuses on areas including the attitudes and feelings of pregnant women regarding their most recent pregnancy, preconception care, content, and prenatal care, Medicaid and WIC participation, breastfeeding, cigarette smoking, alcohol use, health insurance coverage, physical abuse, infant health care, and contraceptive use. The data set provides reproductive health and/or pregnancy-related data unavailable from other United States sources (CDC, 2022). The total sample size calculated using power analysis was 721. The calculated sample size was selected to test whether the null hypotheses would be rejected. I sought to achieve a certain probability of being able to reject the null hypotheses if there was a significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birthweight, diet, live-birth order, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. Data from 721 participants abstracted for each state were used for the study (see Table 1 and Figure 1).

Table 1

Calculation of Total Sample Size Using Power Analysis

Item	Category	Value
Analysis	A priori	
Input	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)	0.80
	R^2 other X	0
	X distribution	Normal
	X parm μ	0
	X parm σ	1
Output	Critical *z*	1.9599640
	Total sample size	721
	Actual power	0.8001115

Figure 1

Minimum Sample Size Plot for Logistic Regression Analysis

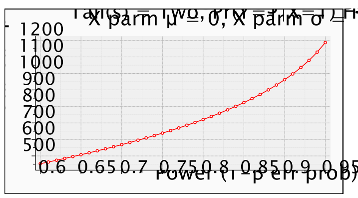

Table 1 was operationalized based on the research questions posed in this study. For this research design, the secondary data source was the 2018–2020 PRAMS. After conducting the G*Power analysis, I determined that the minimum sample size required to generate a statistical power of 80% and an effect size of 1.3 for a binary logistic analysis was 721. The data set was saved on a password-protected computer. The data set will be destroyed 5 years after completion of this study.

Variable Names, Measurement, and Description

Information regarding each variable’s code, type, name, description, and measurement is provided in Table 2.

Table 2

Tabulation of Variables, Measurements, and Descriptions

Code	Type	Name	Description	Measurement
U_{n1}	Independent	Maternal income	Income earned by pregnant women	Proportion of income earned by the pregnant women (wages and salaries, income on assets and investment, as well as transfer payment)
U_{n2}	Independent	Maternal education	Educational attainment of pregnant women	Educational attainment of the pregnant women (No education, primary, secondary, and tertiary education)
U_{n3}	Independent	Prenatal care	Visits after birth	Proportion of visits after birth
U_{n4}	Independent	Gestational age	First day of the pregnant person's last menstrual period (LMP) to the present day	Measure the first day of the pregnant person's last menstrual period (LMP) to the present day
U_{n5}	Independent	Method of delivery	Safe delivery	Probability of safe delivery
U_{n6}	Independent	Birth weight	Newborn baby to be weighed within an hour of birth	Measure of a newborn baby to be weighted within an hour of birth
U_{n7}	Independent	Diet	Child stunt and underweight	Measurement of child stunt and underweight
U_{n8}	Independent	Source of health care payment	Health care payment method utilized by pregnant women and/or newborn mothers for their maternal health care received	Out-of-pocket health care expenditure, private health care insurance, and public health care insurance
U_{n9}	Independent	Obesity	Number of women obese and got pregnant	Total number of women obese and got pregnant
U_{n10}	Independent	Diabetes mellitus	Number of pregnant women with diabetes	Total number of pregnant women with diabetes
U_{n11}	Independent	Access to care	Care services available	Proportion of care services available
U_{n12}	Independent	Quality of care	Care efficiency	Proportion of care efficiency
Z_s	Dependent	Pregnancy-induced hypertension	Number of pregnant women diagnosed with hypertension in pregnancy	Total number of pregnant women diagnosed with hypertension in pregnancy
x_{nj}		Autonomous variable		
B,α		Parameter for independent variables		
ϵ_n		Disturbance term		
j		Vector variable		

Data Analysis

I used Statistical Analysis Software for data analysis. I used the software to do data cleaning (look for outliers or inconsistent data)and perform the nested logistic regression proposed for this study. The Statistical Analysis Software accommodates large datasets for analyzing surveys and cross-sectional data for independent and dependent variables. I ensured that all the participants selected filled their data fields with responses. When using Statistical Analysis Software for data cleaning, the data was tabulated using the command “tab” space, and the variables were summarized by the command “sum” to reveal the observations, mean values, and standard deviation. Error from variables could be determined if the value in the standard deviation is greater than the mean value.

Through this means, a low standard deviation implied that the data were grouped around the mean, whereas a large standard deviation shows that the data were dispersed. In contrast, a high or low standard deviation indicates that the data points are above or below the mean. A standard deviation near zero implies that the data points are close to the mean. Participants with missing data fields or responses were removed from the selections. When I observed that the removal caused a shortfall in the sample size proposed for the study, I retain the participants.

The two research questions and hypotheses were analyzed. The research questions are: RQ1: Is there a significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 years in Washington, DC compared to the state of Massachusetts? RQ2: Is there a significant association between diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 years in Washington, DC compared to the state of Massachusetts?

In the study, running *t*-statistic and its *p*-value with Statistical Analysis Software assumed that the sample were selected from a normal distribution while *f*-statistics helped determine the hypothesis. The null and alternative hypotheses for the two research questions are H_o1: There is no significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49in Washington, DC compared to the state of Massachusetts. H_a1: There is a significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. H_o2: There is no significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. H_a2: There is a significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

In accounting for a statistical testing that is consistent with the nested logit model, Herriges & Kling (1996) stated that McFadden (1981) establishes the conditions under which a set of choice probabilities (i.e., Pi's) will be consistent with stochastic utility maximization. Pi must have non-negative even and non-positive odd mixed partial derivatives concerning components of v other than vi. The condition ensures that the implied probability density function was non-negative. Ascertaining that the model satisfies the two compatibility conditions I used Borsch-Supan's test. By organizing options into more significant categories or nests, the nested logit model widens the use of logit modeling approaches to consider reliance across responses. The outcome of a multi-level decision process is then the observable outcome. There are observed results and characteristics connected to particular choices at each stage. In addition, decision-makers may have certain traits that influence the results but are not outcome-specific. In this study, the choice attributable to PIH includes the choice of being pregnant (B_PREG), visitation for antenatal (V_ANTAL), and taking a diagnostic test (D_TEST). Outcomes were considered on two nest levels: the first decides to access treatment, and the second decides not to access treatment. The coefficient and *p*-values from the estimated regression results were used to determine the model's behavior. Where the variable's coefficient is negative, it means the variable was less likely to decide the outcomes of a dependent variable. In contrast, where positive, it was more likely to determine the outcomes of a dependent variable.

Threats to Validity

Validity is the extent to which a test accurately measures what it is supposed to measure. Reliability and validity are evidence that indicates a linkage between tests and performance. I used Cronbach Alpha statistic to test the reliability of the instrument and measure the internal consistency of the survey, which ranges from 0 to 1.70 is good, 80 and above is better, and 90 and above is best. Low alpha values may result from fewer questions, inadequate item interrelationships, or heterogeneous conceptions.

Ethical Procedures

In compliance with the Walden University Institutional Review Board, I abided by the data collection and data policies by ensuring no data were identified. I used an identifier to anonymize any participant captured during the PRAMS data survey. I downloaded the data set on a password-protected laptop that no one has access to and I will ensure it remain safe until demagnetized.

Summary

The nested logit model has been widely used for quantitative analysis. The nested logit model can account for similarities between alternatives via partial correlation of the error terms. Depending on the model specification, it can give equivalent results to other models, and the structural parameters can be recovered. To do this, the estimated coefficients must be rescaled, which must be considered for the hypothesis tests. I used the model to examine the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. Section 3 presents the data analyzed and discussions on the study findings.

Section 3: Presentation of the Results and Findings

These results offer insights into the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. In this quantitative study, two research questions were examined:

RQ1: Is there a significant association between maternal education, maternal income, prenatal care, gestational age, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts?

H_o1: There is no significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

H_a1: There is a significant association between maternal education, maternal income, prenatal care, gestational age, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

RQ2: Is there a significant association between diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts?

H_o2: There is no significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

H_a2: There is a significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

The independent variables were maternal income, maternal education, prenatal care, gestational age, delivery method, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care. The dependent variable was PIH. Section 3 included a description of how I abstracted the data set, the data analysis, the results, and a summary.

Accessing the Data Set for Secondary Analysis

I adopted a quantitative method in which the cross-sectional data of Black women age 15–49 in Washington, DC and Massachusetts who participated in the 2018–2020 PRAMS were collected. After my application to the CDC for the data set, the data were released after 4 months. The calculated sample size for the study was 721 participants each for Washington, DC and Massachusetts, for a total sample size of 1,442. However, after analyzing the data set, I discovered that many data were missing or left blank. To address potential biases resulting from missing data, I increased the sample size to 1,593 for Washington DC and 5,813 for Massachusetts and substituted the mean values where quantitative data were missing and zero where the binary variable was missing. These sample sizes covered all of the populations for each state as released for the PRAMS data set by the CDC for 2018–2020.

The variables in Table 3 represent the delivery method, maternal education, diabetes, and total number of pregnant women suffering from hypertension. The standard deviation was 10.48, suggesting some variability in the batches. DEL_1CS, DEL_FORC, DEL_RCS, DEL_VACM, DEL_VAG, and DEL_VCS represented different delivery methods or complications during childbirth. Most observations had values of 1, indicating the absence of complications. To further clarify Table 3, DEL_1CS means first C-section, DEL_FORC means forceps delivery, DEL_RCS means repeated C-section, DEL_VACM means vacuum delivery, DEL_VAG means vaginal delivery, DEL_VCS means vaginal delivery after C-section, MAT_ED means maternal education, MM_DIAB means diabetes, and MM_HBP means hypertension. The mean values for these variables were close to 1, suggesting that complications during childbirth were relatively low. MAT_ED represented maternal education levels, ranging from 0 to 5. These Black women had educational experiences of 0–8 years, 9–11 years, 12 years, 13–15 years, and 16 years or more. The mean maternal education level was 3.86, indicating that most women in the study had completed high school or some college education with experiences of 12 years. The standard deviation of 1.25 suggests some variations in educational attainment among the participants.

MM_DIAB and MM_HBP represented the presence of maternal diabetes and maternal hypertension. The mean values for both variables were close to 2, indicating that most women did not have diabetes or hypertension during pregnancy in Washington, DC. The standard deviation for MM_HBP was 0.35, suggesting some variability in the occurrence of hypertension. The variables PNC_VST_NAPHSIS, GRAM_NAPHSIS, LGA, SGA_10, SGA_2SD, and MACROSOMIA represented prenatal care visits, gestational age, growth assessments, and the occurrence of macrosomia (significant birth weight) in infants. The mean values indicated that most women had at least one prenatal care visit, and there were moderate occurrences of growth abnormalities and macrosomia. The standard deviations suggest some variability in these variables. PRE_HLTH_RAW represented various risk factors or indicators related to drinking habits, preexisting morbidities, and overall prepregnancy health.

Table 3

Descriptive Statistics on the Independent and Dependent Variables Among Black Women Age 15–49 in Washington, DC from 2018 to 2020

Variable	Count	*M*	Std	Min	25%	50%	75%	Max
DEL_1CS	1,593	1.238544	0.426327	1	1	1	1	2
DEL_FORC	1,593	1.008788	0.093363	1	1	1	1	2
DEL_RCS	1,593	1.110483	0.313590	1	1	1	1	2
DEL_VACM	1,593	1.019460	0.138179	1	1	1	1	2
DEL_VAG	1,593	1.611425	0.487579	1	1	2	2	2
DEL_VCS	1,593	1.039548	0.194956	1	1	1	1	2
MAT_ED	1,593	3.862524	1.251354	0	3	4	5	5
MM_DIAB	1,593	1.956058	0.205031	1	2	2	2	2
MM_HBP	1,593	1.859385	0.347733	1	2	2	2	2
PNC_VST_NAPHSIS	1,593	1.885122	0.906418	0	1	2	3	3
GRAM_NAPHSIS	1,593	2860.561833	795.882116	375	2375	3125	3375	4875
LGA	1,593	1.848713	0.465209	0	2	2	2	2
SGA_10	1,593	1.731952	0.533161	0	2	2	2	2
SGA_2SD	1,593	1.866918	0.450981	0	2	2	2	2
MACROSOMIA	1,593	1.995606	0.066164	1	2	2	2	2
VPP_DRNK_RAW	1,593	0.0	0.0	0	0	0	0	0
VPP_DRNK	1,593	0.0	0.0	0	0	0	0	0
PRE_MORB_RAW	1,593	0.903327	0.660779	0	0	1	1	2
PRE_HLTH_RAW	1,593	1.043315	0.765957	0	0	1	2	2

Note. Source: SAS, Author's Computation (2023).

Table 4 presents the frequency distribution of associations among maternal factors and health outcomes among Black women age 15–49 in Washington, DC. The interquartile range (IQR) was 1, suggesting that most observations were concentrated within a narrow range. The skewness value of -0.07 indicated a nearly symmetrical distribution. The kurtosis value of -1.23 indicated a slightly flatter distribution compared to a normal distribution. DEL_1CS, DEL_FORC, DEL_RCS, DEL_VACM, DEL_VAG, and DEL_VCS represented different delivery methods or complications during childbirth. The mode of 1 for each variable suggests that most observations indicated the absence of complications. The range of 1 for each variable meant no variation in the values. The skewness values showed positive skewness, indicating that the distribution was slightly skewed to the right. The kurtosis values suggest that the distributions had slightly heavier tails than normal distributions.

MAT_ED represented maternal education, with a mode of 5, indicating that the highest level of education among the participants was observed most frequently. The range of 5 indicated that the education levels ranged from 0 to 5. The IQR of 1 suggests that most observations fell within a narrow range of education levels. The skewness value of -0.79 indicated a slightly negative skewness, implying that the distribution was slightly skewed to the left. The kurtosis value of -0.26 suggests a distribution that was close to a normal distribution. MM_DIAB and MM_HBP represented the presence of maternal diabetes and maternal hypertension. The mode of 2 for both variables indicated that the absence of diabetes or hypertension was more frequent. The range of 1 for both variables indicated that there was no variation in the values. The skewness values suggest that the distributions were highly skewed, with negative skewness for MM_DIAB and slightly negative skewness for MM_HBP. The kurtosis values indicated that the distributions had heavier tails compared to a normal distribution, particularly for MM_DIAB.

MM_PCV, MOMCIG, PNC_MTH, and YY4_PCV were related to diet, smoking habits, prenatal care, and access to care. The mode represented the most frequent value observed for each variable. The ranges indicated the span of values observed. The skewness values suggest the distributions were positively skewed, indicating a tail toward higher values. The kurtosis values indicated distributions with heavier tails than a normal distribution, particularly for MOMCIG and YY4_PCV. Other variables such as TYP_DOCT_RAW, TYP_OBGN_RAW, TYP_ILLN_RAW, TYP_INJR_RAW, TYP_BC_RAW, TYP_MH_RAW, TYP_DDS_RAW, and TYP_OTHR_RAW represented access to health care. INCOME8 represented maternal income, PRE_VIST represented quality of care and various health indicators, and improved healthcare (PRE_HLTH_RAW) provided insights into the statistical analysis associated with maternal factors and health outcomes among Black women age 15–49 in Washington, DC. This analysis indicated the prevalence of PIH during childbirth, the varying levels of maternal education, the occurrence of diabetes and hypertension, and other factors related to diet, access to care, and quality of care.

Table 4

Statistical Analysis of Associations Among Maternal Factors and Health Outcomes Among Black Women Age 15–49 in Washington, DC

Variable	Mode	Range	IQR	Skewness	Kurtosis
DEL_1CS	1.0	1.0	1.0	1.228095	-0.492402
DEL_FORC	1.0	1.0	1.0	10.535824	109.140607
DEL_RCS	1.0	1.0	1.0	2.487366	4.192253
DEL_VACM	1.0	1.0	1.0	6.964069	46.556708
DEL_VAG	2.0	1.0	1.0	-0.457628	-1.792829
DEL_VCS	1.0	1.0	1.0	4.729589	20.394612
MAT_ED	5.0	5.0	1.0	-0.790454	-0.260036
MM_DIAB	2.0	1.0	1.0	-4.454263	17.862886
MM_HBP	2.0	1.0	1.0	-2.069612	2.286164
MM_PCV	1.0	88.0	1.0	6.411319	44.433054
MOMCIG	0.0	20.0	1.0	11.040698	158.695293
PNC_MTH	2.0	88.0	1.0	7.400646	54.030776
SEX	1.0	1.0	1.0	0.003770	-2.002501
YY4_PCV	2019.0	8888.0	1.0	5.541434	39.951662
PRE_VIST	2.0	2.0	1.0	-1.239667	0.359332
TYP_DOCT_RAW	2.0	2.0	1.0	-0.373438	-1.461896
TYP_OBGN_RAW	2.0	2.0	1.0	-0.473677	-1.458125
TYP_ILLN_RAW	1.0	2.0	1.0	0.102572	-0.446430
TYP_INJR_RAW	1.0	2.0	1.0	-0.268712	-0.210970
TYP_BC_RAW	1.0	2.0	1.0	0.109139	-0.796338
TYP_MH_RAW	1.0	2.0	1.0	0.011378	-0.246523
TYP_DDS_RAW	2.0	2.0	1.0	-0.447176	-1.468947
TYP_OTHR_RAW	1.0	2.0	1.0	0.066903	-0.336872
PRE_VIT_RAW	1.0	2.0	1.0	-0.062042	-1.268284
PNC_1STU	1.0	3.0	1.0	0.885803	2.393000
MORB_BP8	1.0	2.0	1.0	1.073951	0.876947
VPP_VIT_RAW	1.0	2.0	1.0	-0.484025	-0.804684
VPP_EAT_RAW	2.0	2.0	1.0	-0.829340	-0.535585
INCOME8	22.0	22.0	1.0	0.376321	-1.697731
VPP_EAT	2.0	2.0	1.0	-0.797524	-0.634521
PNC_VST_NAPHSIS	1.0	3.0	1.0	-0.177194	-1.054629
GRAM_NAPHSIS	3375.0	4500.0	1.0	-0.584596	0.085006
LGA	2.0	2.0	1.0	-3.117849	8.717020
SGA_10	2.0	2.0	1.0	-1.877409	2.601662
SGA_2SD	2.0	2.0	1.0	-3.421427	10.582825
MACROSOMIA	2.0	1.0	1.0	-14.999983	223.279806
VPP_DRNK_RAW	0.0	0.0	1.0	0.000000	0.000000
VPP_DRNK_RAW	0.0	0.0	1.0	0.000000	0.000000
PRE_MORB_RAW	1.0	2.0	1.0	0.106891	-0.724158
PRE_HLTH_RAW	1.0	2.0	1.0	-0.073474	-1.291883

Note. Source: SAS, Author's Computation (2023).

Several performance metrics were calculated to assess the performance of predicting PIH among Black women in Washington, DC (see Table 5). The metrics provided insights into the accuracy and effectiveness of the predictive model used. The accuracy metric indicated the overall correctness of the model's predictions. In this case, the accuracy was calculated as 0.884. This meant the predictive model correctly predicted PIH in 88.4% of the cases. Precision measures the proportion of accurate positive predictions among all optimistic predictions made by the model. A precision score of 0.6667 indicated that 66.7% of the predicted cases of PIH were actual positive cases. The precision score is important because it evaluates how precisely the model makes predictions for the study. The precision score takes care of imbalance classifications.

Recall, also known as sensitivity or true positive rate, represented the proportion of actual positive cases the model correctly identified. With a recall score of 0.4898, the predictive model perfectly placed 48.98% of the confirmed cases of PIH. The F1-score is a combined metric that considers both precision and recall. The F1-score provides a balanced measure of the model's accuracy by considering the trade-off between precision and recall. The F1-score, in this case 0.5647, indicated a moderate performance of the predictive model in predicting PIH. This study showed that the predictive model for PIH among Black women in Washington, DC achieved a relatively high accuracy rate. However, the precision and recall scores indicated room for improvement in correctly identifying true positive cases and capturing a higher proportion of actual positive cases.

Table 5

Performance Metrics for Predicting Pregnancy-Induced Hypertension Among Black Women in Washington, DC: Accuracy, Precision, Recall, and F1-Score Tests

Metric	Value
Accuracy	0.8840125391849529
Precision	0.6666666666666666
Recall	0.4897959183673469
F1-score	0.5647058823529412

Note. Source: SAS, Author's Computation (2023).

Table 6 shows the descriptive statistics of the maternal factors of Black pregnant women in Massachusetts. The mean maternal education level (MAT_ED) was 4.01, indicating that, on average, women had completed education up to the fourth category in Massachusetts. The standard deviation of 1.24 suggests moderate variability in education levels. The minimum and maximum values of 0 and 5 indicated that the education levels ranged from the lowest to the highest category. The median of 4 suggests that 50% of Black pregnant women in Massachusetts had completed education up to the fourth or higher category, at least 13–15 years.

The mean number of prenatal visits (PNC_VST_NAPHSIS) was 2.38, indicating that, on average, women in this population had visited the hospital at least three times for prenatal visits. The standard deviation of 0.76 suggests some variation in prenatal visits. The minimum and maximum values of 0 and 3 indicated that the number of visits ranged from no visits to a maximum of 3. The median of 3 suggests that 50% of women had three or fewer prenatal visits. The mean value of PIH (MM_HBP) was 1.93, which indicated that at least one of the women in this population had PIH. The standard deviation of 0.27 indicated little variability in PIH. The minimum and maximum values of 0 and 2 suggest that the variable was binary, where 0 represented the absence of PIH and 2 represented its presence. The median of 2 indicated that 50% of women had PIH.

Table 6

Descriptive Analysis of Maternal Characteristics and Pregnancy Outcomes Among Black Women Age 15–49 in Massachusetts

Variable	Count	*M*	Std	Min	25%	50%	75%	Max
DEL_1CS	7267	1.19	0.39	0	1	1	1	2
DEL_FORC	7267	1.00	0.09	0	1	1	1	2
DEL_RCS	7267	1.13	0.34	0	1	1	1	2
DEL_VACM	7267	1.03	0.17	0	1	1	1	2
DEL_VAG	7267	1.65	0.48	0	1	2	2	2
DEL_VCS	7267	1.02	0.16	0	1	1	1	2
MAT_ED	7267	4.01	1.24	0	3	4	5	5
MM_DIAB	7267	1.92	0.27	0	2	2	2	2
MM_HBP	7267	1.93	0.27	0	2	2	2	2
PNC_VST_NAPHSIS	7267	2.38	0.76	0	2	3	3	3
GRAM_NAPHSIS	7267	3270.66	592.07	0	2875	3375	3625	5125
LGA	7267	1.86	0.40	0	2	2	2	2
SGA_10	7267	1.86	0.40	0	2	2	2	2
SGA_2SD	7267	1.95	0.30	0	2	2	2	2
MACROSOMIA	7267	1.99	0.13	0	2	2	2	2
VPP_DRNK_RAW	7267	0.0	0.0	0	0	0	0	0
VPP_DRNK	7267	0.0	0.0	0	0	0	0	0
PRE_MORB_RAW	7267	0.87	0.60	0	0	1	1	2
PRE_HLTH_RAW	7267	1.01	0.72	0	0	1	2	2

Note. Source: SAS, Author's Computation (2023).

The statistics in Table 7 offer insights into the frequency distribution among maternal factors, outcomes, and PIH among Black women age 15–49 in Massachusetts. The mode of maternal education (MAT_ED) was 5.0, indicating that the highest level of education among Black women in Massachusetts was 16 years or more. The range was 5.0, suggesting that the educational levels vary from the lowest to the highest category. The skewness value of -1.313 indicated that the distribution was negatively skewed, implying that more women have higher education levels. The kurtosis value of 1.223 indicated a normal distribution with mild weakness.

The mode of maternal income (INCOME8) was 12.0, suggesting that the highest income earner among the Black pregnant women received $85,001 or more. The range was 12.0, indicating variation in income levels among the participants. The skewness value of -0.174 suggested a slight negative skew, indicating that the distribution was slightly left-skewed. The kurtosis value of -1.63 indicated a flat distribution with light tails. The mode of prenatal care (PNC_VST_NAPHSIS) was 3.0, meaning that the most frequent number of prenatal visits was 3. The range was 3.0, suggesting that the number of prenatal visits varied from the minimum to the maximum value. The negative skewness value of -0.943747 suggested a slightly left-skewed distribution, indicating that more women tend to have more prenatal visits. The kurtosis value of -0.086604 indicated a relatively normal distribution with a flatter shape.

The mode of PIH (MM_HBP) was 2, suggesting that at least a Black woman had not experienced PIH. The range was 2.0, indicating that the variable has a binary distribution with two outcomes (0 or 2). The negative skewness value of -3.471024 indicated a highly left-skewed distribution, suggesting that many women did not have PIH. The kurtosis value of 10.983360 indicated a leptokurtic distribution with heavy tails. The mode of the frequency distribution of diet (VPP_DRNK_RAW, VPP_DRNK) and range for diet-related variables were 0.0, meaning that most women did not consume alcoholic beverages during pregnancy. The skewness and kurtosis values, were 0, which suggested a perfectly symmetrical distribution for these variables.

The mode of access to healthcare (TYP_OBGN_RAW) was 2.0, indicating that at least a woman was checked up by a Gynecologist. The range was 2.0, suggesting a binary distribution. The skewness value of -0.315578 indicated a slightly left-skewed distribution. The kurtosis value of -1.415947 suggested a relatively normal distribution with lighter tails. The mode of diabetes mellitus (MM_DIAB) was 2.0, indicating that at least a woman said no;she did not have diabetes mellitus. The range was 2.0, suggesting a binary distribution. The highly negative skewness value of -3.297429 means a highly left-skewed distribution, indicating that many women did not have diabetes mellitus. The kurtosis value of 9.694769 indicated a leptokurtic distribution with heavy tails.

Table 7

Statistical Analysis and Distributions of Maternal Characteristics Among Black Women Age 15–49 in Massachusetts

Variable	Mode	Range	IQR	Skewness	Kurtosis
DEL_1CS	1.0	2.0	1.549944	1.549944	0.631931
DEL_FORC	1.0	2.0	7.190009	7.190009	126.041443
DEL_RCS	1.0	2.0	2.065465	2.065465	2.657808
DEL_VACM	1.0	2.0	4.874020	4.874020	27.419289
DEL_VAG	2.0	2.0	-0.670598	-0.670598	-1.448429
DEL_VCS	1.0	2.0	5.201514	5.201514	32.531119
MAT_ED	5.0	5.0	-1.313155	-1.313155	1.222775
MM_DIAB	2.0	2.0	-3.297429	-3.297429	9.694769
MM_HBP	2.0	2.0	-3.471024	-3.471024	10.983360
MM_PCV	8.0	88.0	8.703439	8.703439	112.526925
MOMCIG	0.0	33.0	11.455686	11.455686	164.708281
PNC_MTH	2.0	88.0	14.459356	14.459356	221.491762
SEX	1.0	1.0	0.007432	0.007432	-2.000495
YY4_PCV	2018.0	8888.0	12.648776	12.648776	198.549089
PRE_VIST	2.0	2.0	-1.152952	-1.152952	-0.083186
TYP_DOCT_RAW	2.0	2.0	-0.552567	-0.552567	-1.353137
TYP_OBGN_RAW	2.0	2.0	-0.315578	0.315578	-1.415947
TYP_ILLN_RAW	1.0	2.0	0.026738	0.026738	-0.262411
TYP_INJR_RAW	1.0	2.0	-0.396142	-0.396142	-0.260186
TYP_BC_RAW	1.0	2.0	0.108729	0.108729	-0.534078
TYP_MH_RAW	1.0	2.0	-0.012317	-0.012317	-0.213448
TYP_DDS_RAW	2.0	2.0	-0.424892	-0.424892	-1.446261
TYP_OTHR_RAW	1.0	2.0	-0.015407	-0.015407	-0.202582
PRE_VIT_RAW	1.0	2.0	-0.102585	-0.102585	-1.204228
PNC_1STU	1.0	3.0	1.334193	1.334193	2.893045
MORB_BP8	1.0	2.0	1.553368	1.553368	3.718080
VPP_VIT_RAW	1.0	2.0	-0.698064	-0.698064	-0.629947
VPP_EAT_RAW	2.0	2.0	-0.801310	-0.801310	-0.494461
INCOME8	12.0	12.0	-0.174139	-0.174139	-1.633597
VPP_EAT	2.0	2.0	-0.787946	-0.787946	-0.553416
PNC_VST_NAPHSIS	3.0	3.0	-0.943747	-0.943747	-0.086604
GRAM_NAPHSIS	3375.0	5125.0	-1.100899	-1.100899	3.932490
LGA	2.0	2.0	-2.931315	-2.931315	8.293977
SGA_10	2.0	2.0	-3.011418	-3.011418	8.806545
SGA_2SD	2.0	2.0	-5.860936	-5.860936	33.764233
MACROSOMIA	2.0	2.0	-11.402449	-11.402449	142.851454
VPP_DRNK_RAW	0.0	0.0	0.000000	0.000000	0.000000
VPP_DRNK_RAW	0.0	0.0	0.000000	0.000000	0.000000
PRE_MORB_RAW	1.0	2.0	0.063713	0.063713	-0.345229
PRE_HLTH_RAW	1.0	2.0	-0.014154	-0.014154	-1.073486

Note. Source: SAS, Author’s Computation (2023).

Table 8 presents the performance of predicting PIH on the associations between maternal education, maternal income, prenatal care, gestational age, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, and quality of care among Black women age 15–49 in Massachusetts. The performance metrics for the analyzed data in Massachusetts suggested that the accuracy of the analysis was 0.924, indicating that the model's predictions were correct at 92.4% of the cases. This showed that the study is reliable in determining the presence or absence of PIH among Black women age 15–49 in Massachusetts.

The precision value was 0.786, representing the proportion of accurate optimistic predictions among all positive predictions made by the model. This signifies the accuracy of identifying cases of PIH among Black women. A higher precision indicated a lower rate of false positives, implying that the model effectively identified women with PIH. The recall, or sensitivity, was 0.683, representing the proportion of accurate positive predictions among all actual positive cases in the data set. This analysis reflected the model's ability to accurately identify all PIH cases. A higher recall indicated a lower rate of false negatives, implying that the model effectively captures most cases of PIH among Black women.

The F1 score combines precision and recall, providing a metric that balances their trade-offs. The F1-score was 0.686, which indicated a good balance between precision and recall. A higher F1 score suggested that the model identified positive cases and minimized false positives and negatives. These results revealed that the analysis has a high accuracy rate, indicating its reliability. The precision and recall values suggested that the model performed well in identifying cases of PIH among Black women. The F1-score showed a good balance between precision and recall, indicating the model's effectiveness in correctly classifying positive cases while minimizing false predictions.

Table 8

Performance Metrics for Predicting Pregnancy-Induced Hypertension Among Black Women Age 15–49 in Massachusetts: Accuracy, Precision, Recall, and F1-Score Tests

Metric	Value
Accuracy	0.9243466299862448
Precision	0.7858962904133161
Recall	0.683202533388407
F1-score	0.686283053828277

Note. Source: SAS, Author's Computation (2023).

Results

Table 9 presents the correlation results for the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. The range coefficient of correlation from +1 to -1 indicated a perfect positive or negative linear relationship. The Pearson correlation result showed that variables including diabetes mellitus (MM_DIAB (0.014)), access to health care (TYP_OBGN_RAW and TYP_MH_RAW (0.054 and 0.167 respectively)), prenatal care visit (PNC_ISTU (0.100)) and maternal income (INCOME8 (0.091)) were statistically significant. The results showed that there was no linear relationship among diabetes mellitus (-0.42), access to health care (-0.074 and -0.26), prenatal care visits (0.285), maternal income (-0.02), and PIH in Massachusetts. Diabetes mellitus, access to health care, prenatal care visits, and maternal income showed no statistical significance and linear relationship in Washington DC, as all variables measured have no association with PIH.

Table 9

Pearson Associations Between Maternal Factors, Access to Care, and Pregnancy-Induced Hypertension Among Black Women Age 15–49 in Washington DC and Massachusetts: A Comprehensive Analysis

Variable	MA coefficient	MA *p*	MA *t*	DC coefficient	DC *p*	DC *t*
Const	0.619	0.100	1.131			
MAT_ED	0.075	0.223	1.217	0.072474	3.8021	0.91016
MM_DIAB	0.429	0.014	2.447	0.019003	4.4848	0.093494
MOMCIG	0.052	0.458	0.741	0.008045	7.4831	0.862340
MOMSMOKE	-0.065	0.913	-0.109	0.022055	3.7903	-0.51631
PAY	0.048	0.482	0.703	0.008099	7.4668	-0.77482
PNC_MTH	0.003	0.953	0.058	0.029688	2.3631	-0.99213
SEX	-0.022	0.848	-0.191	0.020908	4.0432	0.721109
YY4_PCV	0.0003	0.694	0.392	0.035401	1.5787	0.272218
VITAMIN	-0.018	0.683	-0.40	0.030645	2.2153	0.265253
PRE_VIST	0.0108	0.952	0.059	-0.019264	4.4229	-0.22172
TYP_DOCT_RAW	-0.096	0.532	-0.625	-0.064656	9.8446	-0.04951
TYP_OBGN_RAW	-0.274	0.054	-1.920	-0.008162	7.4479	1.159074
TYP_ILLN_RAW	0.0445	0.821	0.226	0.003792	8.7980	1.931044
TYP_INJR_RAW	-0.009	0.975	-0.030	-0.007078	7.7774	0.582627
TYP_BC_RAW	-0.070	0.674	-0.420	-0.009105	7.1651	-0.45951
TYP_MH_RAW	-0.263	0.168	-1.379	-0.019104	4.4607	1.744783
TYP_DDS_RAW	0.113	0.421	0.804	-0.028757	2.5134	-1.70322
TYP_OTHR_RAW	0.129	0.563	0.579	-0.001657	9.4730	0.079065
PNC_1STU	0.285	0.100	1.644	0.025389	3.1119	1.251618
INCOME8	-0.026	0.091	-1.688	0.086229	5.7036	0.762768
VPP_EAT	-0.477	0.486	-0.696	-0.052301	3.6867	-1.54350

Note. Source: SAS, Author's Computation (2023).

Hypothesis Testing

The two research hypotheses are H_o1: There is no significant association between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts. H_o2: There is no significant association between diet, physical activity, cigarette use, source of health care payment, obesity, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

In addressing research H_o1, Table 9 showed that in Massachusetts, the *t*-test results showed that the critical value of maternal education was 0.223 while the *t*-value was (1.217*). Since the *t*-value was greater than the critical *t*-value, a significant association exists between maternal education and PIH. For prenatal care visits, the *t*-value was greater than the critical *t*-value of (1.644*) and 0.100. There exists a significant association between prenatal care visits and PIH. In contrast, maternal income (-1.68*) 0.091; gestational age (0.315*) 0.75; and birth weight had *t*-value (-0.547*) and critical *t*-value of 0.883 in Massachusetts. The null hypothesis was accepted since the critical *t*-value exceeds the *t*-value. Therefore, maternal income, gestational age, and birth weight had no significant association with PIH in Massachusetts.

In Washington DC Table 9 showed that maternal education (0.910*) 3.8021, income (0.7627*) 5.7036, prenatal care visit (1.252*) 3.111, gestational age (-0.996*) 7.294 and birth weight (-1.387*) 3.009 had no significant association with PIH. The null hypothesis was accepted. In the analysis, the results of maternal education, maternal income, prenatal care visit, gestational age, and birth weight showed that the *t*-value (*) was less than the critical value. In Washington, DC the null hypothesis was accepted and concluded that there was no significant association among maternal education, maternal income, prenatal care visit, gestational age and birth weight and PIH.

In summary, findings revealed that there was no significant association between maternal education, maternal income, prenatal care visit, gestational age, birth weight and PIH among Black women age 15–49 in Washington, DC. In contrast, the result showed a significant association with maternal education, maternal income, prenatal care visit, gestational age, birth weight and PIH in the state of Massachusetts among Black women age 15–49.

In addressing research H_o2, Table 9 presents that in Massachusetts, the *t*-test results showed that physical activity (0.644*) 0.519, use of cigarettes (0.741*) 0.458 and payment method for health care (0.703*) 0.482 had a significant association with PIH. The result revealed that the *t*-value of physical activity of the pregnant women, diet (use of cigarettes), and payment method for health care were significant than the critical *t*-value. The null hypothesis was accepted and concluded that there was no significant relationship between physical activity, diet, method of payment of health care and PIH among Black women age 15–49 in Massachusetts.

The results of the *t*-test for Washington, DC were presented in Table 9. In this result, the *t*-value and critical *t*-value were diet (0.862*) 7.454; physical activity (1.786*) 4.784; cigarette use (-0.516*) 3.790; source of healthcare payment (-0.774*) 7.466; access to care (0.26*) 2.215 and quality of care (1.931*) 8.798. These findings implied that since the critical *t*-value is greater than the *t*-value, the null hypothesis was accepted and concluded that there was no significant relationship between diet, physical activity, cigarette use, source of health care payment, access to care, and quality of care and PIH among Black women age 15–49 in Washington, DC.

Logistic Regression Results

This section presents the nested logistic regression results for the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, obesity, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to the state of Massachusetts.

Table 10

Logistic Regression Analysis of Maternal Factors and Pregnancy-Induced Hypertension Among Black Women Age 15–49 in Massachusetts and Washington DC

Variable	MA Coefficient	MA *SD*	MA *p*	DC Coefficient	DC *SD*	DC *p*
Const	0.6191	9.47e+06	1.000			
BATCH	-3.51e-05	0.003	0.992	-0.0225	0.009	0.014
DEL_1CS	0.7139	1.09e+06	1.000	7.9852	1.05e+04	0.999
DEL_FORC	0.8053	0.789	0.308	-0.4519	1.026	0.660
DEL_RCS	0.6095	1.09e+06	1.000	0.5176	1.05e+04	0.999
DEL_VACM	0.4963	0.415	0.233	0.6700	1.091	0.539
DEL_VAG	0.7442	1.09e+06	1.000	0.2200	1.05e+04	0.999
DEL_VCS	1.0277	1.09e+06	1.000	0.1487	1.05e+04	0.999
MAT_ED	0.0749	0.062	0.223	0.0969	0.106	0.363
MM_DIAB	0.4286	0.172	0.014	0.0393	0.420	0.926
MM_PCV	-0.0188	0.016	0.253	0.0449	0.027	0.095
MOMCIG	0.0520	0.070	0.456	0.1272	0.148	0.389
MOMSMOKE	-0.0646	0.592	0.913	-0.2033	0.394	0.606
PAY	0.0478	0.068	0.482	-0.0726	0.094	0.438
PNC_MTH	0.0028	0.048	0.954	-0.0339	0.032	0.321
SEX	-0.0218	0.114	0.848	0.1365	0.189	0.471
YY4_PCV	0.0003	0.001	0.694	7.501e-05	0.001	0.785
VITAMIN	-0.0183	0.045	0.683	0.0197	0.074	0.791
PRE_VIST	0.0100	0.181	0.952	-0.1239	0.559	0.825
TYP_DOCT_RAW	-0.956	0.153	0.532	-0.0197	0.216	0.961
TYP_OBGN_RAW	-0.2743	0.143	0.055	0.2479	0.214	0.246
TYP_ILLN_RAW	-0.0445	0.143	0.821	0.5880	0.304	0.053
TYP_INJR_RAW	-0.0090	0.318	0.975	0.2531	0.434	0.560
TYP_BC_RAW	-0.0702	0.167	0.674	-0.1159	0.252	0.646
TYP_MH_RAW	-0.2631	0.191	0.168	0.5700	0.327	0.081
TYP_DDS_RAW	0.1135	0.141	0.421	-0.3771	0.221	0.089
TYP_OTHR_RAW	0.1293	0.223	0.563	0.0227	0.287	0.937
PRE_VIT_RAW	0.1416	0.154	0.356	0.0466	0.231	0.840
PNC_1STU	0.2850	0.173	0.100	0.2532	0.202	0.211
MORB_BP8	-2.6065	0.119	0.001	-3.0540	0.196	0.002
VPP_VIT_RAW	-0.0434	0.127	0.735	-0.3100	0.187	0.097
VPP_EAT_RAW	0.4407	0.684	0.519	1.0505	0.588	0.074
INCOME8	-0.0264	0.016	0.091	0.0129	0.017	0.446
VPP_EAT	-0.4778	0.686	0.486	-0.0716	0.569	0.123
PNC_VST_NAPHSIS	-0.0128	0.087	0.883	-0.1688	0.122	0.165
GRAM_NAPHSIS	2.252e-05	0.009	0.850	0.0006	0.005	0.003
LGA	-0.0076	0.223	0.973	-0.0063	0.295	0.983
SGA_10	0.0076	0.223	0.753	-0.2693	0.270	0.319
SGA_2SD	-0.5287	0.541	0.329	0.0643	0.369	0.861
MACROSOMIA	0.3676	0.608	0.546	-18.0291	2.62e+04	0.999
PRE_MORB_RAW	-0.8026	0.163	0.009	-0.9787	0.226	0.007
PRE_HLTH_RAW	0.1844	0.157	0.241	-0.0066	0.219	0.976

Note. Source: SAS, Author’s Computation (2023)

I used DEL_ICS, DEL_FORC, DEL_RCS, DEL_VACM, DEL_VAG, and DEL_VCS to represent the delivery method. For prenatal care visits, I used PNC_MTH, PNC_VST_NAPHSIS, and PNC_ISTV, GRAM NAPHSIS captured birth weight, and LGA, SGA_10 represented gestational age. To capture accessibility to health care and quality of health care, I captured access to health care with TYP_DOCT_RAW, TYP_OBGN_RAW, TYP_ILLN_RAW, TYP_INJR_RAW, TYP_BC_RAW; TYP_MH_RAW and the quality of health care was captured by VITAMIN, VPP_VIT_RAW, and PRE_HLTH_RAW. Diet was captured by MOMSMOKE, MOMCIG, and VPP_EAT.

The result on maternal education (MAT_ED) showed no significance at 0.363 for Massachusetts and at 0.223 for Washington, DC. This finding suggested no relationship between maternal education and PIH, implying that educational attainment played no protective role against PIH among Black women age 15–49. This finding conformed with the coefficient of correlation found earlier in section (3.3.2). In addition, this result described the attitude to care and knowledge of educated Black women during pregnancy. The finding means that being educated did not substitute for taking preventive measures against poor health or the health condition (PIH). The result on maternal income (INCOME8) showed and -0.02 coefficient and 0.091 significance level in Massachusetts. This finding indicated that maternal income had a strong relationship with PIH. The result implied that an increase in maternal income of Black pregnant women was less likely to increase PIH by 2%. In contrast, maternal income results had no significance with PIH in Washington, DC.

Prenatal care visit (PNC_ISTV, PNC_VST_NAPHSIS, and MM_PCV) had *p*-value of (0.100), which showed that the prenatal care visit was significant at 10%. The coefficient (0.28) suggested that increased prenatal care visits were more likely to increase the likelihood of PIH. The result expressed pregnancy outcome for Black pregnant women who visited hospitals in Massachusetts. This result implied that there was a probability that pregnant women who visited hospital frequently (weekly/monthly) might have developed PIH. Findings from Washington, DC showed that prenatal care visit was significant at 5% and 10%. The coefficient (-0.16) implied that an increased prenatal care visit made by Black pregnant women was less likely to increase the risk of PIH in Washington, DC. Gestation age refers to the length of the pregnancy after the first day of the last menstrual period. In other words, it is the length of time that a fetus grows inside the mother's uterus. The findings showed that gestational age has no significant association with PIH in Massachusetts and Washington, DC.

I proxied access to health care by **(**TYP_OBGN_RAW, TYP_MH_RAW, TYP_ILLN_RAW, and TYP_DDS_RAW**)**The results showed that four levels of accessibility were significant at 5% and 10% in Massachusetts and Washington, DC. The *p*-value for checkup (TYP_OBGN_RAW) with a gynecologist was 0.055 and visit for depression and anxiety (TYP_MH_RAW) was 0.168 in Massachusetts. This result meant that reducing the number of visits to gynecologists was more likely to increase the risk of

PIH. The *p*-value for a visit for illness (TYP_ILLN_RAW) was 0.053, visit to a dentist and psychiatrist were 0.089 and 0.081, respectively, in Washington, DC.

MORB_BP8 and PRE_MORB_RAW represented the improved health care. The MORB_BP8 that captured health problems during pregnancy was significant at (0.001, 0.002), and PRE_MORB_RAW that controlled for medical conditions was significant at (0.009, 0.007) in Massachusetts and Washington, DC respectively. These findings showed an inverse relationship between health problems during pregnancy, control medical conditions, and PIH. The result implied that at 1% increase in health problems during pregnancy, PIH reduced by approximately 200%.

The findings implied that Black pregnant women in Massachusetts and Washington, DC suffered from hypotension as low hypertension implies high hypotension. However, by controlling for medical conditions for PIH, there was a significant increase in PIH, given a substantial decline from 200% to 80% in Massachusetts and 300% to 98% in Washington, DC. The result on diet and physical activities (eating and exercise) showed (-0.716) negative and significant (0.123) relationship with PIH in Washington, DC. The coefficient (-0.716) indicated that an increase in healthy eating and good exercise was less likely to increase the likelihood of PIH by 71%.

Summary

The descriptive statistics provided insights into the demographic characteristics, maternal health factors, and pregnancy outcomes among Black pregnant women of age 15-49 in Washington, D.C. The analysis showed that most women had completed high school or some college education, and PIH was relatively low. These findings highlighted less importance of maternal education as a potential protective factor against hypertension during pregnancy among Black pregnant women of age 15-49. This implied that being educated may not prevent Black pregnant women in the age group from developing PIH. Most Black pregnant women in Washington, DC, had an education level of 3 to 5, with 5 being the highest educational attainment. The range (3-5) of education levels suggested a diverse educational background among Black pregnant women. The negative skewness indicated that more Black women had higher education levels while fewer had lower level of education. However, the distribution was close to normal, showing a moderate spread of education levels.

The statistical description of maternal diabetes (MM_DIAB) and maternal hypertension (MM_HBP) in Massachusetts revealed that the prevalence of diabetes and hypertension among Black women was relatively higher in Massachusetts than Washington, DC, with most participants having hypotension conditions. The negative skewness suggested that most Black women were affected by diabetes or hypertension. The kurtosis values indicated distributions with heavier tails, implying a slight clustering of participants without these health issues. Findings on prenatal care visits (PNC_MTH) and access to care indicated that Black women in Washington, DC had a relatively high number of prenatal care visits. The positive skewness suggested that many Black pregnant women had a higher frequency of prenatal care visits, indicating a proactive approach to maternal health. The findings suggested that access to prenatal care services was relatively good as characteristics of control medical condition (PRE_MORB_RAW) which showed an improved condition for Black pregnant women with PIH in Massachusetts and Washington, DC.

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

This quantitative study examined the association between maternal education, maternal income, prenatal care, gestational age, method of delivery, birth weight, diet, source of health care payment, diabetes mellitus, access to care, quality of care, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. The findings indicated that diabetes mellitus, access to care, prenatal care visits, and maternal income showed a strong linear relationship (correlation) with PIH in Massachusetts and Washington, DC. The logistic regression results showed that 4 out of 5 women had developed hypotension in Massachusetts than in Washington, DC.

Interpretation of the Findings

In answering the research hypotheses, I conducted a nested logistic analysis to determine the relationship between maternal education, maternal income, prenatal care, gestational age, delivery method, birth weight, and PIH among Black women age 15–49 in Washington, DC compared to Massachusetts. The logistic regression model revealed a high predictive power with an accuracy of 0.9204. The coefficients obtained from the regression results showed the impact of maternal variables on the likelihood of developing PIH. These findings underscore the importance of maternal education, gestational age, and birth weight in determining the likelihood of PIH in Massachusetts and Washington, DC.

The results suggested that educational attainment, gestational age, and birth weight are not potential risk factors for PIH among Black women. Higher maternal income was associated with a decreased likelihood of PIH in Massachusetts only, emphasizing the role of socioeconomic factors in mitigating PIH risk. This finding highlights the need for addressing economic disparities and ensuring access to resources for Black women to reduce their vulnerability to PIH.

There was no significant relationship among other variables of diet such as MOMSMOKE and their association with the risk of PIH except for mothers who ate and engaged in exercise (VPP_EAT) in Washington, DC. The *p* value of eating and exercise was 0.122, while 0.606 was reported for mothers who smoked cigarettes in Washington, DC. The result of MOMSMOKE and VPP_EAT showed no significance in Massachusetts. This finding implies that there was no significant association between diet and PIH in Massachusetts, which meant that dietary factors examined in this analysis may not play a substantial role in PIH among Black women in Massachusetts. The variable PAY represented the method of payment for health care services. This variable addressed all types of payment for health care services, such as out-of-pocket and various forms of health insurance, and the results showed no significant relationship between the payment method and PIH in Washington, DC and Massachusetts. This suggested that the health care payment method was not significantly associated with the risk of PIH among Black women.

Diabetes mellitus (MM_DIAB) is associated with high or low sugar levels in the body. Evidence from the current study showed a strong positive relationship between diabetes and the risk of PIH. With a *p* value of 0.014 in Massachusetts, the results suggest that a mother with diabetes is 42% more likely to develop PIH. The finding indicated that diabetes mellitus impacts the possibility of PIH. Further analysis would be needed to explore the nature and extent of this association. This study showed a positive significant association between access to health care and PIH. Related studies such as Fang and Wang et al. (2017) and Brasoveanu and Serbånescu et al. (2019) support this finding that patients who did not see a doctor in the past 12 months, had no health insurance, and had no place to see a doctor when needed had increased likelihood of hypertension.

The results suggested that access to health care, quality of health care, and ability to exercise control of medical conditions can be associated with PIH in Massachusetts and Washington, DC. This finding can be linked to the theoretical framework (SEM), which posits that health is affected by the interaction between the characteristics of the individual, the community, and the environment, including the physical, social, and political components. I tested this theory and found evidence that most Black pregnant women in Massachusetts and Washington, DC suffered from hypotension, another element of PIH. Increased efforts to improve their medical conditions through frequent prenatal visits may result in reduced risk of PIH. These are important findings that emphasize the relevance of this research.

Limitations of the Study

There were several limitations to this study. The sensitivity of the data made it difficult to investigate other areas. In this study, many relevant variables were unavailable in the data set. Most of these variables were sourced by providing a proxy to capture them. Because the data sources for this research depended on data collected by the CDC, most of the coding was conducted using SAS, which was different from the proposed software of STATA. This research was limited to investigating the correlation between maternal factors and PIH. Further studies will be needed on the level of hypertension and the quality of life of pregnant women.

Recommendations

Findings revealed maternal income may play a role in PIH in Massachusetts. It is crucial to investigate the underlying mechanisms and potential socioeconomic disparities that may contribute to this association. Policies should be considered to reduce financial barriers to health care access and improve overall socioeconomic conditions for pregnant Black women.

There was a high association between obesity and PIH in both states; interventions to prevent and reduce obesity among Black women of reproductive age are crucial. Implementing community-based interventions that promote healthy eating habits, regular physical activity, and access to affordable, nutritious food may mitigate obesity-related hypertension risks.

Findings showed that diabetes increases the possibility of PIH among Black pregnant women in Massachusetts. The government may set up a framework for controlling diabetes by educating Black pregnant women on how to manage eating disorders and proper care to reduce the chances of developing diabetes during pregnancy. Ensuring access to regular screenings, diabetes education, and appropriate health care services could mitigate the risks associated with diabetes-related hypertension.

Addressing health care disparities and providing equitable access to prenatal care among Black women is crucial. This may be accomplished by encouraging policymakers to develop an inclusive policy that will increase access to care for pregnant women by encouraging prenatal, antenatal, and postnatal care. The government could make clinicians available to travel to remote areas to educate pregnant women on healthy living and why they should see their doctors during and after pregnancy. Improving the availability and affordability of prenatal care services, reducing barriers to health care access, and enhancing the quality of care provided could positively impact maternal and fetal health outcomes.

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Appendix: Logistic Regression Analysis

Logistic Regression Analysis of Maternal Factors and Pregnancy-Induced Hypertension Among Black Women in Washington, DC

Logit Regression Results

Dep. Variable:	MM_HBP	No. Observations:	1593
Model:	Logit	Df Residuals:	1551
Method:	MLE	Df Model:	41
Date:	Sun, 18 Jun 2023	Pseudo R-squ.:	0.3591
Time:	22:14:44	Log-Likelihood:	-414.59
converged:	False	LL-Null:	-646.88
Covariance Type:	nonrobust	LLR p-value:	3.628e-73

	coef	std err	z	P>|z|	[0.025	0.975]
BATCH	-0.0225	0.009	-2.453	0.014	-0.040	-0.005
DEL_1CS	7.9852	1.05e+04	0.001	0.999	-2.06e+04	2.06e+04
DEL_FORC	-0.4519	1.026	-0.440	0.660	-2.463	1.560
DEL_RCS	8.5174	1.05e+04	0.001	0.999	-2.06e+04	2.06e+04
DEL_VACM	0.6700	1.091	0.614	0.539	-1.469	2.809
DEL_VAG	8.2208	1.05e+04	0.001	0.999	-2.06e+04	2.06e+04
DEL_VCS	8.1487	1.05e+04	0.001	0.999	-2.06e+04	2.06e+04
MAT_ED	0.0969	0.106	0.910	0.363	-0.112	0.306
MM_DIAB	0.0393	0.420	0.093	0.926	-0.784	0.862
MM_PCV	0.0449	0.027	1.668	0.095	-0.008	0.098
MOMCIG	0.1272	0.148	0.862	0.389	-0.162	0.416
MOMSMOKE	-0.2033	0.394	-0.516	0.606	-0.975	0.568
PAY	-0.0726	0.094	-0.775	0.438	-0.256	0.111
PNC_MTH	-0.0319	0.032	-0.992	0.321	-0.095	0.031
SEX	0.1365	0.189	0.721	0.471	-0.235	0.508
YY4_PCV	7.501e-05	0.000	0.272	0.785	-0.000	0.001
VITAMIN	0.0197	0.074	0.265	0.791	-0.126	0.166
PRE_VIST	-0.1239	0.559	-0.222	0.825	-1.219	0.971
TYP_DOCT_RAW	-0.0107	0.216	-0.050	0.961	-0.433	0.412
TYP_OBGN_RAW	0.2479	0.214	1.159	0.246	-0.171	0.667
TYP_ILLN_RAW	0.5880	0.304	1.931	0.053	-0.009	1.185
TYP_INJR_RAW	0.2531	0.434	0.583	0.560	-0.598	1.105
TYP_BC_RAW	-0.1159	0.252	-0.460	0.646	-0.610	0.379
TYP_MH_RAW	0.5700	0.327	1.745	0.081	-0.070	1.210
TYP_DDS_RAW	-0.3771	0.221	-1.703	0.089	-0.811	0.057
TYP_OTHR_RAW	0.0227	0.287	0.079	0.937	-0.540	0.585
PRE_VIT_RAW	0.0466	0.231	0.202	0.840	-0.406	0.499
PNC_1STU	0.2532	0.202	1.252	0.211	-0.143	0.650
PNC_1ST	-0.0052	0.022	-0.233	0.816	-0.049	0.038
MORB_BP8	-3.0540	0.196	-15.587	0.000	-3.438	-2.670
VPP_VIT_RAW	-0.3109	0.187	-1.660	0.097	-0.678	0.056
VPP_EAT_RAW	1.0505	0.588	1.786	0.074	-0.102	2.203
INCOME8	0.0129	0.017	0.763	0.446	-0.020	0.046
VPP_EAT	-0.8716	0.565	-1.543	0.123	-1.978	0.235
PNC_VST_NAPHSIS	-0.1688	0.122	-1.387	0.165	-0.407	0.070
GRAM_NAPHSIS	0.0006	0.000	4.026	0.000	0.000	0.001
LGA	-0.0063	0.295	-0.021	0.983	-0.584	0.572
SGA_10	-0.2693	0.270	-0.997	0.319	-0.799	0.260
SGA_2SD	0.0643	0.369	0.175	0.861	-0.658	0.787
MACROSOMIA	-18.0291	2.62e+04	-0.001	0.999	-5.15e+04	5.14e+04
PRE_MORB_RAW	-0.9787	0.226	-4.323	0.000	-1.422	-0.535
PRE_HLTH_RAW	-0.0066	0.219	-0.030	0.976	-0.435	0.422

Logistic Regression Analysis of Maternal Factors and Pregnancy-Induced Hypertension Among Black Women in Massachusetts

```
Optimization terminated successfully.
         Current function value: 0.202695
         Iterations 10
Logistic Regression Results:
```

Logit Regression Results

Dep. Variable:	y	No. Observations:	5813
Model:	Logit	Df Residuals:	5771
Method:	MLE	Df Model:	41
Date:	Wed, 21 Jun 2023	Pseudo R-squ.:	0.2010
Time:	17:07:15	Log-Likelihood:	-1178.3
converged:	True	LL-Null:	-1474.6
Covariance Type:	nonrobust	LLR p-value:	6.109e-99

	coef	std err	z	P>|z|	[0.025	0.975]
const	0.6191	5.47e+06	1.13e-07	1.000	-1.07e+07	1.07e+07
BATCH	-3.561e-05	0.003	-0.010	0.992	-0.007	0.007
DEL_1CS	0.7139	1.09e+06	6.52e-07	1.000	-2.15e+06	2.15e+06
DEL_FORC	0.8053	0.789	1.020	0.308	-0.742	2.352
DEL_RCS	0.6095	1.09e+06	5.57e-07	1.000	-2.15e+06	2.15e+06
DEL_VACM	0.4963	0.415	1.196	0.232	-0.317	1.309
DEL_VAG	0.7442	1.09e+06	6.8e-07	1.000	-2.15e+06	2.15e+06
DEL_VCS	1.0277	1.09e+06	9.39e-07	1.000	-2.15e+06	2.15e+06
MAT_ED	0.0749	0.062	1.218	0.223	-0.046	0.195
MM_DIAB	0.4286	0.175	2.447	0.014	0.085	0.772
MM_PCV	-0.0188	0.016	-1.143	0.253	-0.051	0.013
MOMCIG	0.0520	0.070	0.742	0.458	-0.085	0.189
MOMSMOKE	-0.0646	0.592	-0.109	0.913	-1.225	1.096
PAY	0.0478	0.068	0.703	0.482	-0.085	0.181
PNC_MTH	0.0028	0.048	0.058	0.954	-0.092	0.097
SEX	-0.0218	0.114	-0.192	0.848	-0.245	0.201
YY4_PCV	0.0003	0.001	0.393	0.694	-0.001	0.002
VITAMIN	-0.0183	0.045	-0.409	0.683	-0.106	0.070
PRE_VIST	0.0108	0.181	0.060	0.952	-0.344	0.365
TYP_DOCT_RAW	-0.0956	0.153	-0.626	0.532	-0.395	0.204
TYP_OBGN_RAW	-0.2743	0.143	-1.921	0.055	-0.554	0.006
TYP_ILLN_RAW	0.0445	0.197	0.226	0.821	-0.342	0.431
TYP_INJR_RAW	-0.0098	0.318	-0.031	0.975	-0.634	0.614
TYP_INJR_RAW	-0.0098	0.318	-0.031	0.975	-0.634	0.614
TYP_BC_RAW	-0.0702	0.167	-0.421	0.674	-0.397	0.257
TYP_MH_RAW	-0.2631	0.191	-1.379	0.168	-0.637	0.111
TYP_DDS_RAW	0.1135	0.141	0.804	0.421	-0.163	0.390
TYP_OTHR_RAW	0.1293	0.223	0.579	0.563	-0.308	0.567
PRE_VIT_RAW	0.1416	0.154	0.923	0.356	-0.159	0.442
PNC_1STU	0.2850	0.173	1.644	0.100	-0.055	0.625
PNC_1ST	0.0098	0.017	0.575	0.565	-0.024	0.043
MORB_BP8	-2.6065	0.119	-21.939	0.000	-2.839	-2.374
VPP_VIT_RAW	-0.0434	0.127	-0.341	0.733	-0.293	0.206
VPP_EAT_RAW	0.4407	0.684	0.644	0.519	-0.900	1.782
INCOME8	-0.0264	0.016	-1.688	0.091	-0.057	0.004
VPP_EAT	-0.4778	0.686	-0.697	0.486	-1.821	0.866
PNC_VST_NAPHSIS	-0.0128	0.087	-0.147	0.883	-0.183	0.157
GRAM_NAPHSIS	2.252e-05	0.000	0.190	0.850	-0.000	0.000
LGA	-0.0076	0.223	-0.034	0.973	-0.445	0.429
SGA_10	0.0658	0.208	0.316	0.752	-0.343	0.474
SGA_2SD	-0.5287	0.541	-0.977	0.329	-1.590	0.532
MACROSOMIA	0.3676	0.608	0.604	0.546	-0.825	1.560
PRE_MORB_RAW	-0.8026	0.163	-4.933	0.000	-1.122	-0.484
PRE_HLTH_RAW	0.1844	0.157	1.174	0.241	-0.124	0.492