Investigating the Determinants of Adverse Birth Outcomes

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Abstract

Investigating the Determinants of Adverse Birth Outcomes

This study sought to understand the determinants of low birth weight (LBW) and preterm birth (PTB), specifically across racial, ethnic and age groups. The research questions of this study were: (1) What is the relationship between age and adverse birth outcomes? (2) Is poor maternal health associated with higher rates of LBW and PTB? (3) Are these adverse birth outcomes (LBW and PTB) more associated with non-Hispanic black mothers than mothers of other races? The first hypothesis for this study is that rates of LBW and PTB will be highest among the youngest and oldest maternal age groups. The second hypothesis is that having a health condition prior to pregnancy will have a greater association with LBW and PTB than having a health condition only during pregnancy. The third and final hypothesis of this study is that the odds of having a low birth weight or preterm infant will be greater for non-Hispanic black women than the odds for women of other races.

The data used are from the Natality Data File, 2013 (United States), and the final analytic sample contained 3,897,884 cases of women who gave birth in 2013. Binary logistic regressions were performed to model low birth weight and preterm birth. Results revealed that rates of LBW and PTB were highest among older mothers of advanced and very advanced maternal age when compared to other maternal age groups. Another statistically significant finding was that gestational diabetes and gestational hypertension (respectively) increase the likelihood of having a LBW infant. For having a PTB, diabetes prior to pregnancy is a significant determinant of preterm birth when compared

to other conditions before or during pregnancy. Specific policy implications of this research may include tailored attention to risk factors of preterm birth, including health conditions during pregnancy, receiving welfare benefits, and advanced maternal age.

Table of Contents

List of Tables

Investigating the Determinants of Adverse Birth Outcomes

I. Introduction

Preterm birth is defined as being born before 37 weeks of gestation. Premature births often lead to low birth weight infants. Low birth weight is defined as an infant weighing less than 2,500 grams (5.5 pounds). In 2015, 8.1% of infants born were of low birth weight (CDC 2015). In 2015, 9.6% of infants were born preterm (CDC 2015). Although there have been some downward trends in the overall occurrence of these adverse birth outcomes, trends within race and ethnic groups and age groups persist. Although the overall rates of live births are higher for white women than black women (54% and 14.8% in 2012–2014, respectively), the rates of preterm birth and low birth weight are higher for black women than for white women (13.3% and 9.0% preterm, 13.1% and 7.0% low birth weight, respectively) (March of Dimes 2017). Being born preterm or with low birth weight can have lifelong implications for these infants, and for some, leads to death early in life (CDC 2017, Yao et al. 2014). Adverse birth outcomes, such as low birth weight and preterm birth, are known to be leading causes of infant morbidity and mortality. This is particularly problematic in regards to the racial disparities in health outcomes, setting up these infants of adverse birth outcomes for poorer health outcomes later in life. While prior research has attributed racial disparities in adverse birth outcomes to socioeconomic factors and related stressors, disparities by maternal age are typically attributed to more direct influences such as biological risk factors by age. As age-related determinants are centered around prime fertility periods, there are additional contextual factors such as stressors and other external factors, beyond physiological risk factors that still require additional explanation and research.

Prior researchers have studied adverse birth outcomes in aims to explain race and age disparities in the prevalence of low birth weight infant and preterm birth. Researchers believe that these birth outcomes stem from both physiological, health-related factors (Sparks 2009; Daniels 2011; Swamy et al. 2012; Cederbaum 2013; Brewin and Nannini 2014; Harelick et al. 2014; Witt et al. 2014) and socio-environmental factors (Oyspuk and Acevedo-Garcia 2008; Bryant et al. 2010; Kramer et al. 2011; Lisonkova et al. 2011; Place Matters 2012; Mendez et al. 2013; Meng et al. 2013), taking place both before and during pregnancy. Some explanations of racial disparities in low birth weight and preterm birth have been attributed to a race-gap in socioeconomic status, particularly between white and black mothers. Another explanation of racial disparities has been exposure to stressors and trauma, such as SES-level stressors as well as stress from discrimination and racism (Lu and Halfon 2003; Lu and Chen 2004; Bryant et al. 2010; Place Matters 2012; Earnshaw et al. 2013; Brewin and Nannini 2014; Yao et al. 2014). In regards to age disparities in adverse birth outcomes, the literature often refers to a U-shaped distribution of low birth weight and preterm birth, occurring among the youngest and oldest age groups (Ferré et al. 2016; Witt et al. 2014). The life-course perspective, or the accumulation of negative exposures increasing over time, as well as physiological development having a negative effect on pregnancy (that is not during the prime childbearing years) has explained this. The purpose of this study was to explore the influences of low birth weight and preterm birth. Specifically, this study tested the significance of quantifiable differences between younger and older mothers in their birth outcomes in terms of low birth weight and preterm birth. For this study, individual-level, physical determinants of adverse birth outcomes were explored. Birth outcomes of low birth weight and preterm birth were examined by exploring several mechanisms. The existing literature informed this study to believe that maternal age and race-ethnicity have significant relationships with adverse birth outcomes, and their respective mechanisms were examined by the analyses done in this study.

II. Literature Review

The existing literature on adverse birth outcomes has sought to explain persistent rates of low birth weight and preterm birth, as well as disproportionate rates among certain groups of women. Perspectives on adverse birth outcomes in research range from macro-level, socioeconomic mechanisms, to micro-level, individual-biological mechanisms. Both individual level and external factors can have an effect on a woman's health and infant birth outcomes, and although the literature has identified several risk factors for low birth weight and preterm birth, these factors often differentiate across groups of women such as by age or race, thus making it difficult to address.

The literature on adverse birth outcomes have several main categories of hypothesized determinants or influences on low birth weight and preterm birth. These categories are broadly (1) physical determinants of maternal health and infant outcomes, including age, health conditions and behaviors both before and during pregnancy, predispositions such as intergenerational low birth weight or preterm birth and race or ethnicity and (2) social determinants, including socioeconomic factors, neighborhood and environmental exposures, social ties and support especially during pregnancy, discrimination and stress both before and during pregnancy. The existing literature has mixed findings on the determinants of adverse birth outcomes, as well as mixed perspectives on influential periods in a woman's life that affect her infant's birth outcomes. Factors leading to low birth weight and preterm birth have been examined both during pregnancy and prior to conception, including an accumulation of factors throughout a woman's life-course.

Biological/Health-Related Determinants

One of the most direct determinants of health outcomes is a health-related determinant, consisting of either a biological or genetic predisposition, health condition, or behavior. These health-related determinants of adverse birth outcomes range from chronic health conditions such as hypertension, diabetes, or obesity, to health-related behaviors such as smoking or alcohol use. Other determinants of adverse birth outcomes could be biological, such as age- or race-related traits that can predispose women to higher risk of having a preterm birth or low birth weight infant. These biological determinants could be related to fertility across age groups or sensitivity to certain health conditions based on racial-ethnic background, or even intergenerational characteristics (which can also be traced back to high-risk age or racial-ethnic groups).

Age

According to the literature, the level of risk for adverse birth outcomes varies by age group. In particular, women at greatest risk for adverse birth outcomes are the youngest or oldest maternal age groups, while women of "prime childbearing years" in their 20s and early 30s have the least risk of adverse birth outcomes. Beyond that, the risk factors may differentiate between the "extreme", or, youngest and oldest maternal age groups, although their birth outcomes may be similar. As previous literature reveals, although young and older mothers do share some risk factors of preterm birth, some risk factors vary by age group such as chronic illness in older women or physical immaturity in younger women (Ferré et al. 2016). Similar evidence of these "extreme age groups" was found by Witt et al. (2014), who explained that a "well-known U-shaped relationship exists between maternal age and the risk of preterm birth, such that adolescents and older women have a higher risk" (2014: S73). While some of the literature describes a U-shaped relationship between maternal age and adverse birth outcomes, in that both the youngest and oldest maternal age groups have higher risks of adverse birth outcomes, other literature describes higher risks more exclusively among either younger or older maternal age groups. The study by Sparks (2009) found that advanced maternal age increases the likelihood of having a preterm birth for non-Hispanic white and non-Hispanic black women. Specifically, Sparks (2009) reported that maternal age greater than 34 years of age at time of child results in an increased likelihood of preterm birth, compared to women in their prime childbearing years (20 to 34 years of age). The literature has also found disproportionate rates of low birth weight among maternal extreme age groups. The study by Holzman et al. (2009) reported a negative relationship between maternal age and infant birth weight, or rather, as maternal age increases, infant birth weight decreases, but specifically within the poorest neighborhoods and especially among women who smoke.

The Canadian study by Lisonkova et al. (2011) compared adverse birth outcomes among 29,698 women 35 years and older between rural and urban areas of British Columbia from 1999 to 2003. Their findings reflect differences between urban and rural mothers, as well as by age group of mothers. The authors (Lisonkova et al. 2011) report that rural mothers of all ages were more likely to have more barriers to accessing adequate prenatal care and hospitals, while younger rural mothers aged 20–29 years were less likely to deliver preterm and less likely to have infants small for gestational age (SGA). According to their study sample, preterm birth to mothers aged 35 years and over was 8.1% among rural women (3.4% to women 20–29 years old) and 8.0% among urban women (4.9% to women 20–29 years old) (Lisonkova et al. 2011: 215–216). However, low birth weight or "small-for-gestational-age" (SGA) was 5.8% among rural women 35 years and over (5.7% to women 20–29 years old) and 6.7% among urban women 35 years and over (7.5% to women 20–29 years old), which reflects greater risk of SGA or low birth weight among younger women aged 20–29 years old compared with women 35 years and older (Lisonkova et al. 2011: 215–216).

In contrast, several other studies report a greater risk of adverse birth outcomes among younger, adolescent mothers. For example, the study by Cederbaum et al. (2013), in which 153,762 infants born to adolescent mothers were analyzed, found 7.1% to be of low birth weight (less than 2,500 grams), revealing that adolescent mothers having their first birth have an increased risk of preterm birth. However, as Cederbaum et al.'s study (2013) excluded adult mothers (aged 20 years or greater), it is unclear how their findings would differ if compared with older mothers. Beyond maternal age at first birth, parity has also been examined in the literature, referring to the birth order among several children to a mother. Also supporting the claim of greater risks of adverse birth outcomes existing among younger, adolescent mothers, the work by Swamy et al. (2012) reported that adolescent women with a greater birth order were more likely to have a low birth weight infant. Age and birth order are two physiological mechanisms of adverse birth outcomes that will be reexamined by this study As shown by the existing literature, there are mixed findings on the definitive age-related risk factors, especially with studies' contradictory findings on young versus older mothers and risk of adverse birth outcomes. Some reports state that there is increased risk for young mothers having a low birth weight infant or preterm birth, while other reports claim older women of advanced maternal age are at greater risk of adverse birth outcomes. This study seeks to clarify this contradiction in the literature by adding a new sample to compare with prior studies.

Health Conditions and Negative Health Behaviors

One additional risk factor that often differs across age groups is individual health behavior. Research has identified several health conditions and negative health behaviors as risk factors or determinants of poor health and birth outcomes. According to the March of Dimes (2015), smoking, binge alcohol use, and obesity are key physical determinants of adverse birth outcomes, specifically low birth weight and preterm birth. Although rates of smoking among women aged 18–44 years have been declining (from 22.8% in 2004 to 19.2% in 2014), there has been an increase in rates of obesity (from 20.2% in 2004 to 27.2% in 2014) (March of Dimes 2015). One of the most commonly found risk factors for adverse birth outcomes is smoking (March of Dimes 2015; Kramer et al. 2011; Brewin and Nannini 2014; Cederbaum et al. 2013). These are all factors that will be examined in this study.

Other studies have reported additional health-related determinants of birth outcomes, such as Brewin and Nannini (2014) in regard to risk factors of low birth weight. Based on data from the National Longitudinal Study of Adolescent to Adult Health, Brewin and Nannini reported predictors of low birth weight from health related to social context-related factors, although differences between white and black maternal factors were reported. For black women, biological- or health-related determinants of having a low birth weight infant included a history of hypertension and receiving treatment for a sexually transmitted disease during adolescence (Brewin and Nannini 2014: 424). For white women, reported physical determinants of having a low birth weight infant were low maternal body mass index (BMI) or being underweight during adolescence (prior to pregnancy), smoking during pregnancy, and beginning prenatal care after the first trimester of pregnancy (Brewin and Nannini 2014: 424–425). Similar results were found by Harelick, Viola, and Tahara (2011), such as "High-risk behaviors, conditions, and exposures were prevalent with 63% of women overweight or obese, 25% exposed to second-hand smoke, 20% drinking alcohol, and 59% reporting a need for dental care" (2011: 274). A limitation of their study, however, is only comparing risks and outcomes among black and Hispanic women, while excluding white women and other racial-ethnic backgrounds. This is a strength of the present study, which will compare outcomes across many racial-ethnic backgrounds, and of a large sample of women in the United States (all recorded U.S. births in 2013). The present study will also examine these factors identified by the literature as significant determinants of adverse birth outcomes, including BMI, smoking, and timing of prenatal care (as mentioned by Brewin and Nannini 2014), as well as maternal weight or obesity (as mentioned by Harelick, Viola, and Tahara 2011).

Social Determinants of Health

From a broader perspective, other studies have focused on additional contextual factors among women, and their role in adverse birth and health outcomes (Sparks 2009; Woods-Giscombe 2010; Umberson, Crosnoe, and Reczek 2010; Harelick et al. 2011; Place Matters 2012; Wakeel et al. 2013; Meng, Thompson, and Hall 2013; Brewin and

Nannini 2014; Klawetter 2014). According to the study by Kramer et al. (2011), "Such exposures could be epigenetic but could also be material in nature (such as access to health care or health promoting resources) … or environmental (such as socioeconomic and residential environment)" (2011: 1311). Several of these studies used social-level and personal-level risk factors to predict health and birth outcomes, such as socioeconomic variables and social capital on the one hand, and personal health behaviors, biological predispositions, and stress on the other hand.

Socioeconomic status (SES) has also been extensively discussed in the literature, but there has been a consensus over time that social determinants are more complex than solely SES as a determinant of adverse birth outcomes. Although not the sole influence on adverse birth outcomes, SES still plays a crucial role in these health outcomes. According to Colen et al. (2006), a study on the socioeconomic mobility of women by race found that upward mobility (increases SES) of white women resulted in decreased likelihood of having a low birth weight infant, while upward mobility of black women did not necessarily result in decreased likelihoods of having a low birth weight infant. According to Lu and Halfon's theory of the life-course perspective of health (2003), "past SES may be as important a determinant of birth outcomes as current SES … residual disparities after controlling for current SES may be partially attributable to unmeasured effects of past SES" (2003: 19). Specifically, in the case of adverse birth outcomes, a woman of high SES with a low birth weight and/or preterm infant may be explained by the woman's past SES, such as during infancy or adolescence that may have had a negative, long-term effect on the woman's health.

Social Ties and Capital

Social ties and support, when present, can have positive effects on an individual's health behaviors and reduce stress and anxiety. Social support, according to the theoretical work by Umberson, Crosnoe, and Reczek (2010), is defined as instrumental, informational, and emotional support or resources. Although pregnancy outside of marriage has been an increasing trend for some time in the United States, marriage is still one type of social support, as it will be used to measure (maternal) social support in this study. As defined by previous literature, marriage is a measure of emotional and financial support, and often results in greater paternal involvement during pregnancy which has been shown by literature to reduce the odds of adverse birth outcomes. In contrast, the work by Dole et al. (2003) revealed that social support did not decrease the risk of preterm birth specifically. In fact, findings by Dole et al. (2003) show that rates of preterm birth were highest among study participants who reported high social support and those who reported low social support, and those with high support still having more preterm births than those with low social support. Some research has found that social support can function as a "buffering effect," to counteract the influence of socioeconomic factors on adverse birth outcomes (Meng, Thompson, and Hall 2013). Similar evidence of these "buffering effects" was reported by McDonald et al. (2014), a Canadian study of 3,021 women, in which women who reported medium to high levels of social support or optimism did not show stress to be a risk factor of preterm birth, thus suggesting social support as a buffering effect of perceived stressors.

Another important mechanism of influence is social capital. Social capital, according to Brewin and Nannini (2014), "defined as resources, relationships, networks, and trust that work together, has been linked to improved health" (2014: 418). If given proper social ties and social support, one can have enough social capital to navigate successfully through life and have more opportunities than those who do not have these resources. Other studies have examined personal capital, defined by Wakeel et al. (2013) as “a multidimensional set of resources that may help women cope with or reduce their exposure to stress during pregnancy” (2013: 436). Two components of personal-social capital are education and marital status, serving as knowledge and access to resources, and support and trust through the marital relationship (respectively), which were used as the measurements of personal-social capital in this study.

Discrimination and Stress

One of the first major contributions to this field of literature was by Lu and Halfon (2003), in which they suggest a “life-course perspective” model to explain large racial disparities in birth outcomes. This model posited that “experiences and exposures that happen early in life and accumulate throughout the life course may lead to disparities in birth outcomes” (2003: 15). The importance of this perspective is health outcomes as a *process*, which occurs over time and place, and has many facets ranging from political, social, neighborhood-level, to individual determinants. The literature has examined maternal stressors and influences of health from both the life-course perspective and the historical-trauma approach, both using cumulative life events as explanations of adverse health and birth outcomes. Stressful life events over time, throughout the life-course, have often been lumped together in previous research, rather than isolating events to distinct and significant periods in a woman’s life. The work by Witt et al. (2014) categorized stressful life events by four significant periods of occurrence, namely (1) before pregnancy, (2) during the first trimester of pregnancy, (3) during the second trimester, and (4) during the third trimester, which was also implemented in this research specifically for measuring smoking (cigarettes). Another issue of consistency has been with research on adverse birth outcomes, typically investigating preterm birth or low birth weight, rarely both as simultaneous but separate outcomes. To fill these gaps in the literature, measurements of preterm birth *and* low birth weight were used in this study.

A substantial section of the literature has focused on women of racial and ethnic minority, specifically in examining racism as a traumatic life event or chronic stressor, in efforts to explain the racial-birth disparities (Bryant et al. 2010; Place Matters 2012; Earnshaw et al. 2013; Yao et al. 2014; Brewin and Nannini 2014). Lu and Halfon (2003) discussed the role of stressful life events and traumatic events, such as racism as a chronic stressor, as determinants of low birth weight and preterm births among certain racial-ethnic groups. Some literature has considered discrimination, particularly racial discrimination or racism, as a stressful life event and has studied the association between perceived discrimination or experienced stressful life events, and having a low birth weight or preterm infant. The study by Lu and Chen (2004) concluded that stressful life events did not contribute significantly to (racial) disparities in adverse birth outcomes, although they did note that black women reported more stressors than white women in their study. The study by Earnshaw et al. (2013) focused on young black mothers specifically, and the role of experienced racial (and gender or age) discrimination in determining low birth weight. Their findings revealed that "everyday discrimination was associated with greater odds of low birth weight" and preterm birth (Earnshaw et al. 2013: 18). The study by Yao et al. (2014) tests the significance of stress during pregnancy and across generations to predict preterm birth in rats, in efforts to understand better the persistent disparities in preterm birth in humans. Their findings revealed evidence of stress across generations having a negative effect on birth weight (i.e., as stress increases, birth weight decreases) both during and before pregnancy (gestational and prenatal stress) (Yao et al. 2014: 5). This intergenerational finding, also supported by Brewin and Nannini's study (2014), found intergenerational stress and low birth weight (LBW) as factors of increased risk for low birth weight, but only among white women in their study. The qualitative study by Woods-Giscombe (2010) attributed more responsibility to contextual factors than to personal habits, including a history of racial-gender stereotyping, knowledge passed down from mothers and other women, and a personal history of emotional and physical maltreatment or neglect. Woods-Giscombe (2010) called this the "superwoman role" of black women, which is the result of the racial-gender oppression of black women and mothers, and the effects it has on their lives and roles in society.

III. Theoretical Frameworks

Determinants of adverse birth outcomes, or more broadly maternal and infant health, may be examined through various theoretical lenses, including the life-course perspective (LCP; Lu and Halfon 2003), the weathering hypothesis (Geronimus 2001), or the superwoman schema (SWS) (Woods-Giscombe 2010). The life-course perspective and the weathering hypothesis have many similarities in conceptualization and application, particularly when applying to social affects on health and health outcomes. Both theories involve the accumulation of events or exposures having an affect on the human body, and thus a woman's health and birth outcomes. The third theory of the superwoman schema is slightly different from the others, partially because it has often been used to explain racial birth disparities specifically. The superwoman schema has been directly applied to black women, in aims to explain the unique socio-historical role of black women in America, and how this has real, durable effects on women's bodies and infant health outcomes. Both the life-course perspective and the weathering hypothesis informed the hypotheses of this study to expect an increase in adverse birth outcomes across maternal age, especially among those women exposed to more adversity. These theories also allowed this study to predict higher rates of exposed adversity, including socioeconomic exposures as well as physiological-health related conditions, among those women with adverse birth outcomes. While these theories support the relationships between age and adverse birth outcomes, the last theory of the superwoman schema supports the relationship between race and adverse birth outcomes, particularly among black women. The theoretical lens of the superwoman schema provides a rationale for the higher rates of preterm birth and low birth weight, as supported by the existing literature. Based on these three theoretical frameworks, this study expected to find higher rates of adverse birth outcomes among older women, and rates of adverse birth outcomes more evenly distributed across all ages among black women.

Life-Course Perspective

The life-course perspective, as explained by Lu and Halfon (2003), is a hybrid of the early programming model and the cumulative pathways model. The early programming model, as explained by Lu and Halfon (2003), "suggests that exposures and experiences during particular sensitive developmental periods in early life may encode the functions of organs or systems that become manifest in health and disease later in life" (2003: 16). This model emphasizes events or experiences during important developmental periods, such as in utero, during infancy and during adolescence, that set up an individual's development for the rest of their life, often affecting health outcomes in adulthood. The other component of the life-course perspective is the cumulative pathway model, which explains how effects are cumulative, adding up over time and producing a subsequent health outcome (Lu and Halfon 2003). One component of this is the "allostatic load" by McEwen (1998), suggesting that this cumulative build-up of stress over time has physiological consequences on the body, particularly the body's ability to respond to stress system. The first model of early programming acknowledged important developmental periods in affecting the body's health, while the second model of cumulative pathways posited a "gradual decline in reproductive potential" (Lu and Halfon 2003: 17). The life-course perspective acknowledges both a gradual effect over an individual's life on the body, as well as important developmental stages in an individual's life, both as factors of health outcomes (and birth outcomes) later in a woman's life. According to Lu and Halfon (2003), this theory provides a life-long explanation of the linkages between biological, behavioral, psychological, and social risk factors that together produce adverse birth outcomes.

The life-course perspective has many overlaps with the broader disadvantage theory, theorized by Crystal and Shea throughout the 1980s. This theory explained how disadvantage is a cumulative process, occurring throughout the life-course, and how disadvantage in early life persists into adulthood. This model described the accumulation of advantages and disadvantages over the life-course, including economic, educational and other forms of resources. The work by Crystal, Shea, and Reyes (2016), reinforced the previous work by Crystal and Shea, stating that "Increases in inequality observed among members of each cohort as it has aged, and persistently high inequality in late life, speak to the continuing pattern by which early advantages and disadvantages have effects that persist, and indeed are magnified, over the life course" (2016: 8).

Weathering Hypothesis

According to Geronimus (2001), "the weathering hypothesis" aimed to explain racial health and birth disparities among black women. This theory of weathering has many similarities to Lu and Halfon's (2003) theory of the life-course perspective, particularly the role of early-in-life negative experiences and cumulative adversity in adverse birth outcomes. As Geronimus (2001) explained, "weathering suggests that African-American women experience early health deterioration as a consequence of the cumulative impact of repeated experience with social, economic, and political exclusion" (2001: 133). The strength of this theoretical approach is the emphasis on intergenerational, historical effects on women's health, but particularly women of color. This theory is a reasonable explanation for the disproportionate adverse birth outcomes among black women, but not necessarily for groups of women beyond that. Several prior studies (Umberson, Crosnoe, and Reczek 2010; Brewin and Nannini 2014; Kramer et al. 2011; Witt et al. 2014; Swamy et al. 2012) have used this theory as a means of explaining the issue of adverse birth outcomes, especially those disproportionate outcomes among racial-ethnic or age groups. The weathering hypothesis has been especially useful in this realm of literature, as it gave a direct explanation for health outcomes through socioeconomic exposures.

Superwoman Schema

The “superwoman schema” (SWS), as posited by Woods-Giscombe (2010), also aimed to explain racial disparities in adverse birth outcomes, particularly among black women. This theoretical perspective claimed that the superwoman role of black women is a result of “the climate of racism, race- and gender-based oppression, disenfranchisement, and limited resources during and after legalized slavery in the United States” (Woods-Giscombe 2010: 2). Furthermore, Woods-Giscombe (2010) explained that the superwoman role of black women could result in strained interpersonal relationships and stress-related health behaviors. The qualitative study by Woods-Giscombe (2010) revealed themes of significant stress among black women and negative “coping” strategies with the stress that impacted their health in various ways. Based on the performed interviews with black women from Woods-Giscombe’s (2010) study, there were reports of positive consequences (preservation of self and family or community) and negative consequences (relationship strain, stress-related health behaviors, and stress embodiment) of the SWS in real application for these women. As both stress and negative health behaviors have been supported by the literature as determinants of adverse birth outcomes, the SWS is an appropriate theoretical approach to explaining racial disparities in adverse birth outcomes, but not necessarily for other groups of women. However, role strain among women of all race and ethnic groups, or women of certain age groups or geographic locations, may be useful to explain persistent adverse birth outcomes.

IV. The Current Study

This study sought to understand better the relationship between various physical and socioeconomic variables, and low birth weight and preterm birth. For this study, adverse birth outcomes imply having a low birth weight infant and/or a preterm birth (PTB). Low birth weight was defined as an infant born less than 2,500 grams in weight. Preterm birth was defined as a birth at less than 37 weeks of gestation or pregnancy. This study will align with the existing literature by examining LBW and PTB across racial-ethnic groups and age groups. Most of the variables used in the data analysis were health-related in nature, such as prior health conditions or health behaviors, although some socioeconomic contextual variables such as race, marital status, education level, and type of health insurance are included as well. The analyses of this study on age were based on the following categories of women who gave birth in 2013 in the United States, including adolescent women (15-19 years old), women in prime childbearing years (20-34 years old), women of advanced maternal age (35-40 years old), and women of very advanced maternal age (45-49 years old). The research questions for this study were as follows: (1) What is the relationship between age and adverse birth outcomes? (2) Is poor maternal health associated with higher rates of LBW and PTB? (3) Are these adverse birth outcomes (LBW and PTB) more associated with non-Hispanic black mothers than mothers of other races? As such, the hypotheses for this study were: (H1) Rates of LBW and PTB will be highest among the youngest and oldest maternal age groups. (H2) Having a health condition prior to pregnancy will have a greater association with LBW and PTB than having a health condition only during pregnancy. (H3) The odds of having a low birth weight or preterm infant will be greater for non-Hispanic black women than the odds for women of other races.

V. Data and Methods

For the purposes of this study, a quantitative secondary data analysis was performed to examine relationships between low birth weight and preterm birth with additional independent variables. The sample for this study was derived from the publicly accessible 2013 US Natality Detail File of women who a registered live birth in 2013. The original sample included 3,940,764 cases of women who gave birth in 2013. The final analytic sample was composed by excluding extreme cases of age and birth order, and invalid or missing data, leaving the sample size in this study to be 3,897,884 cases of women. Data were produced by the Department of Health and Human Services, Centers for Disease Control and Prevention, and the National Center for Health Statistics. Data were accessed through and distributed by the Inter-University Consortium for Political and Social Research. The dataset included all registered certificate births from 2013, in the 50 states of the United States. The Centers for Disease Control and Prevention's National Center for Health Statistics received these data as electronic files, prepared from individual records processed by each registration area, through the Vital Statistics Cooperative Program (ICPSR 2016). The dataset used for the current study was chosen because it captures specific birth outcome data, as well as numerous indicators of maternal health and background that may serve as determinants of these adverse birth outcomes. This dataset was also a large, diverse sample of women in the United States, capturing all registered live births in the U.S. for the year 2013.

The following were the measurements for this analysis of adverse birth outcomes. The dependent variables are, in respective analyses, low birth weight and preterm birth. The independent variables for this study included maternal age, race, Hispanic ethnicity, marital status, level of education, timing of prenatal care, current birth order, mother's weight gain during pregnancy, mother receiving WIC benefits, maternal history of smoking before and during pregnancy, payment method at time of birth, sex of infant, length of gestation, infant birth weight, mother having an induced birth, mother having a previous preterm birth, and being diagnosed with various health conditions, including diabetes pre-pregnancy, gestational diabetes, pre-pregnancy hypertension, gestational hypertension, eclampsia, gonorrhea, syphilis, chlamydia, hepatitis B, and hepatitis C. The statistical software package used in this study to perform analytic tests was IBM SPSS. Various tests were performed for both birth weight and gestation, including descriptive statistics, cross tabulations with each low birth weight and preterm birth (respectively), and binary logistic regressions.

VI. Results

Of the women in this study's sample, the mean age was 28 years (28.2), while the age range of subjects was 15 to 49 years. Furthermore, 54.5% of these women are non-Hispanic white, 14.9% are non-Hispanic black, 7.4% non-Hispanic other, and 23.2% identified as Hispanic. Married women were 59.5% of the sample. There were 38.8% of women reportedly receiving Medicaid benefits, while 39.8% reported receiving WIC (Women, Infant, and Children) benefits, both of which are a form of government assistance or welfare. The women in this sample had an average of some college education, but less than a Bachelor's degree. Furthermore, of the women in the sample, 15.7% had less than a high school diploma, 25% had a high school diploma as their highest level of education, 29.4% had some college education but no Bachelor's degree, 19% had up to a Bachelor's degree, and 10.8% had a gradate or professional degree. There were 7.3% of women that reported smoking cigarettes, while 10.1% of these women reported smoking some amount before pregnancy, 7.4% during the first trimester of pregnancy, 6.3% during the second trimester, and 5.8% during the third trimester. The average maternal weight gain during pregnancy was 30.3 pounds, with a reported range of zero to 98 pounds gained. First pregnancy included 32.6% of women, while the range for birth order of this sample was one to eight total births. This sample included 8% of infants born to be of low birth weight, that is, weighing less than 2,500 grams. Of this sample, 11.4% of births were preterm (less than 37 weeks of gestation).

Table 1. Descriptive Statistics

Measure	Mean or Percent	Standard Deviation	Range	
Dependent Variables				
Low Birthweight	8.00%	0.27	0	1
Normal Birthweight	92.00%	0.27	0	1
Preterm Birth	11.40%	0.32	0	1
Full Term Birth	88.60%	0.32	0	1
Independent Variables				
Maternal Age	28.16	5.93	15	49
Month Prenatal Care Began	3.03	1.54	0	10
Gestation (Weeks)	38.65	2.49	17	47
Infant Birth Weight (Grams)	3279	624	227	8165
Maternal Pregnancy Weight Gain (Pounds)	30.33	14.92	0	98
Birth Order	2.48	1.57	1	8
Control Variables				
Race				
Hispanic	23.20%	0.42	0	1
Non-Hispanic White	54.50%	0.49	0	1
Non-Hispanic Black	14.90%	0.36	0	1
Non-Hispanic Other	7.40%	0.26	0	1
Maternal Education				
Less than High School	15.70%	0.35	0	1
High School Diploma/GED	25.00%	0.42	0	1
Some college	29.40%	0.44	0	1
Bachelor's Degree	19.00%	0.38	0	1
Graduate/Professional Degree	10.80%	0.29	0	1

Married	59.50%	0.49	0	1
Female Infant	48.80%	0.5	0	1
Induced Birth	23.00%	0.421	0	1
Ever Had Hepatitis B	0.20%	0.05	0	1
Ever Had Hepatitis C	0.30%	0.05	0	1
Ever Had Chlamydia	1.60%	0.13	0	1
Ever Had Syphilis	0.10%	0.03	0	1
Ever Had Gonorrhea	0.20%	0.13	0	1
Diagnosed with Eclampsia	0.30%	0.15	0	1
Diagnosed with Pre-Pregnancy Hypertension	1.50%	0.12	0	1
Diagnosed with Pre-Pregnancy Diabetes	6.00%	0.24	0	1
Diagnosed with Gestational Hypertension	4.80%	0.21	0	1
Diagnosed with Gestational Diabetes	4.70%	0.21	0	1
Ever Smoked	7.30%	0.26	0	1
Medicaid (Public Health Insurance)	38.80%	0.49	0	1
Received WIC Benefits	39.80%	0.49	0	1

Source: NATALITY DETAIL FILE, 2013 [UNITED STATES]

Table 2. CROSSTABS WITH BIRTH WEIGHT

Measure	Low Birth Weight	Normal Birth Weight
	Percent	Percent
Independent Variables		
Maternal Age		
15-19 years	9.30%	90.70%
20-34 years	7.60%	92.40%
35-44 years	9.10%	90.90%
45-49 years	18.60%	81.40%
Time Prenatal Care Began		
None	18.60%	81.40%
1st Trimester (1-3 Months)	7.50%	92.50%
2nd Trimester (4-6 Months)	8.30%	91.70%
3rd Trimester (7-10 Months)	8.00%	92.00%
Preterm	45.90%	54.10%
Birth Order		
1st Child	8.10%	91.90%
2nd Child	7.20%	92.80%
3rd Child	7.50%	92.50%
4th Child	8.30%	91.70%
5th Child	9.30%	90.70%
6th Child	10.40%	89.60%
7th Child	11.00%	89.00%
8th Child	11.70%	1.50%
Control Variables		
Maternal Education		
Less Than HS	9.00%	91.00%
HS Diploma or GED	8.70%	91.30%
Some College or Associate's Degree	7.90%	92.10%
Bachelor's Degree	6.50%	93.50%

Graduate or Professional Degree	7.00%	93.00%
Race		
Non-Hispanic White	6.90%	93.10%
Non-Hispanic Black	13.00%	87.00%
Non-Hispanic Other	8.20%	91.80%
Hispanic	7.00%	93.00%
Female Infant	8.60%	91.40%
Married	6.90%	93.10%
Induced Birth	8.70%	91.30%
Ever Had Hepatitis B	8.50%	91.50%
Ever Had Hepatitis C	16.20%	83.80%
Ever Had Chlamydia	10.40%	89.60%
Ever Had Syphilis	12.10%	87.90%
Ever Had Gonorrhea	13.40%	86.60%
Ever Had Previous Preterm Birth	20.90%	79.10%
Diagnosed with Eclampsia	36.10%	63.90%
Diagnosed with Pre-Pregnancy Hypertension	19.00%	81.00%
Diagnosed with Gestational Hypertension	20.50%	79.50%
Diagnosed with Pre-Pregnancy Diabetes	9.70%	90.30%
Diagnosed with Gestational Diabetes	9.20%	90.80%
Ever Smoked Cigarettes	12.60%	87.40%
Have Private Health Insurance	7.10%	92.90%
Have Medicaid Health Insurance	9.00%	91.00%
Received WIC Benefits	8.50%	91.50%

Source: NATALITY DATA FILE, 2013 [UNITED STATES]

Table 3. CROSSTABS WITH GESTATIONAL LENGTH

Measure	Preterm Birth	Full Term Birth
	Percent	Percent
Independent Variables		
Maternal Age		
15-19 years	12.90%	87.10%
20-34 years	10.80%	89.20%
35-44 years	13.20%	86.80%
45-49 years	23.80%	76.20%
Time Prenatal Care Began		
None	25.00%	75.00%
1st Trimester (1-3 Months)	11.10%	88.90%
2nd Trimester (4-6 Months)	10.70%	89.30%
3rd Trimester (7-10 Months)	11.10%	88.90%
Low Birth Weight (LBW)		
Birth Order		
1st Child	10.30%	89.70%
2nd Child	10.40%	89.60%
3rd Child	11.40%	88.60%
4th Child	12.90%	87.10%
5th Child	14.40%	85.60%
6th Child	15.70%	84.30%
7th Child	16.40%	83.60%
8th Child	17.50%	82.50%
Control Variables		
Maternal Education		

Less than HS Diploma	13.30%	86.70%
HS Diploma or GED	12.20%	87.80%
Some College and Associates	11.20%	88.80%
Bachelor's Degree	9.30%	90.70%
Graduate or Professional Degree	9.60%	90.40%
Race		
Non-Hispanic White	10.10%	89.90%
Non-Hispanic Black	16.20%	83.80%
Non-Hispanic Other	10.40%	89.60%
Hispanic	11.20%	88.80%
Female Infant	10.80%	89.20%
Married	10.10%	89.90%
Induced Birth	12.70%	87.30%
Ever Had Hepatitis B	11.60%	88.40%
Ever Had Hepatitis C	18.40%	81.60%
Ever Had Chlamydia	14.10%	85.90%
Ever Had Syphilis	16.70%	83.30%
Ever Had Gonorrhea	17.00%	83.00%
Ever Had Previous Preterm Birth	29.70%	70.30%
Diagnosed with Eclampsia	41.10%	58.90%
Diagnosed with Pre-Pregnancy Hypertension	23.70%	76.30%
Diagnosed with Gestational Hypertension	24.70%	75.30%
Diagnosed with Pre-Pregnancy Diabetes	16.20%	83.80%
Diagnosed with Gestational Diabetes	14.90%	85.10%
Ever Smoked	14.40%	85.60%
Have Private Health Insurance	10.10%	89.90%
Have Medicaid Health Insurance	12.60%	87.40%
Received WIC Benefits	12.00%	88.00%

Source: NATALITY DATA FILE, 2013 [UNITED STATES

Table 4. Binary Logistic Regression with Low Birth Weight

Measure	Odds Ratio
Dependent Variables	
Low Birthweight	
Independent Variables	
Maternal Age	1.006***
Month Prenatal Care Began	1.130***
Maternal Pregnancy Weight Gain	0.988***
Birth Order	0.931***
Gestation (Weeks)	0.650***
Control Variables	
Married	0.939***
Education	
1.00 Less Than High School Diploma	0.848***
2.00 High School Diploma	0.881***
4.00 Bachelor's Degree	0.921**
5.00 Graduate or Professional Degree	1.002

Race	
2.00 Non-Hispanic Black	1.217***
3.00Non-Hispanic Other	1.068*
4.00 Hispanic	0.801***
Female Infant	1.439***
Induced Birth	1.046***
Ever Had Syphilis	0.877
Ever Had Gonorrhea	1.129**
Ever Had Chlamydia	0.966
Diagnosed with Eclampsia	2.674***
Diagnosed with Pre-Pregnancy Hypertension	1.808***
Diagnosed with Gestational Hypertension	2.358***
Diagnosed with Pre-Pregnancy Diabetes	0.634***
Diagnosed with Gestational Diabetes	1.312***
Had previous preterm birth	1.552***
Ever Smoked	1.816***
Receiving WIC Benefits	1.006
Medicaid (Public Health Insurance)	1.038***

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College); Race (1.00=NH White)

Table 5. Binary Logistic Regression with Preterm Birth

Measure	Odds Ratio
Dependent Variables	
Preterm Birth	
Independent Variables	
Maternal Age	1.005***
Month Prenatal Care Began	0.742***
Maternal Weight Gain	1.004***
Birth Order	1.088***
Birth Weight (grams)	0.997***
Control Variables	
Married	0.904***
Education	
1.00 Less Than High School Diploma	1.217***
2.00 High School Diploma	1.130***
4.00 Bachelor's Degree	0.987
5.00 Graduate or Professional Degree	0.971
Race	
2.00 Non-Hispanic Black	0.874***
3.00 Non-Hispanic Other	0.708***
4.00 Hispanic	0.860***
Female Infant	0.695***
Induced Birth	1.754***
Ever Had Syphilis	1.115
Ever Had Gonorrhea	1.046
Ever Had Chlamydia	1.082***
Diagnosed with Eclampsia	2.212***

Diagnosed with Pre-Pregnancy Hypertension	1.460***
Diagnosed with Gestational Hypertension	1.824***
Diagnosed with Pre-Pregnancy Diabetes	2.968***
Diagnosed with Gestational Diabetes	0.514***
Had a Previous Preterm Birth	1.901***
Ever Smoked	0.829***
Receiving WIC Benefits	0.953***
Medicaid (Public Health Insurance)	1.022***

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College); Race (1.00=NH White)

Table 6. Binary Logistic Regression with Preterm Birth, NH Black

	NH Black	NH White
Measure	Odds Ratio	
Dependent Variables		
Preterm Birth		
Independent Variables		
Maternal Age	1.006***	1.002*
Month Prenatal Care Began	0.780***	0.693***
Maternal Weight Gain	0.998***	1.005***
Birth Order	1.085***	1.079***
Birth Weight (grams)	0.998***	0.997***
Control Variables		
Married	0.929***	0.907***
Education		
1.00 Less Than High School	1.048	1.151**
2.00 High School Diploma	0.966	1.130**
4.00 Bachelor's Degree	0.850**	1.023
5.00 Graduate or Professional Degree	0.829**	1.022
Female Infant	0.758***	0.666***
Induced Birth	1.598***	1.938***
Ever Had Syphilis	1.210*	0.906
Ever Had Gonorrhea	1.081	1.05
Ever Had Chlamydia	1.072**	1.075**
Diagnosed with Eclampsia	2.101***	2.357***
Diagnosed with Pre-Pregnancy Hypertension	1.413***	1.474***
Diagnosed with Gestational Hypertension	1.708***	1.888***
Diagnosed with Pre-Pregnancy Diabetes	2.444***	3.758***
Diagnosed with Gestational Diabetes	0.665***	0.407***
Had a Previous Preterm Birth	1.579***	2.072***
Ever Smoked	0.840***	0.810***
Receiving WIC Benefits	0.898***	0.987
Medicaid (Public Health Insurance)	1.039**	1.031***

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College)

Table 7. Binary Logistic Regression with Low Birth Weight, NH Black

	NH Black	NH White
Measure	Odds Ratio	
Dependent Variables		
Low Birth Weight		
Independent Variables		
Maternal Age	0.998	1.017***
Month Prenatal Care Began	1.078***	1.190***
Maternal Weight Gain	0.988***	0.989***
Birth Order	0.959***	0.923***
Gestation (Weeks)	0.702***	0.627***
Control Variables		
Married	0.874***	0.937***
Education		
1.00 Less Than High School	0.924	1.027
2.00 High School Diploma	0.937	0.945
4.00 Bachelor's Degree	0.931	0.938
5.00 Graduate or Professional Degree	0.989	0.991
Female Infant	1.456***	1.488***
Induced Birth	1.006	1.090***
Ever Had Syphilis	0.825	1.146
Ever Had Gonorrhea	1.086	1.056
Ever Had Chlamydia	0.995	0.989
Diagnosed with Eclampsia	2.323***	2.682***
Diagnosed with Pre-Pregnancy Hypertension	1.784***	1.667***
Diagnosed with Gestational Hypertension	2.296***	2.188***
Diagnosed with Pre-Pregnancy Diabetes	0.737***	0.543***
Diagnosed with Gestational Diabetes	0.942	1.539***
Had a Previous Preterm Birth	1.640***	1.442***
Ever Smoked	1.634***	1.814***
Receiving WIC Benefits	1.01	1.046***
Medicaid (Public Health Insurance)	1.037**	1.032**

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College)

Table 8. Binary Logistic Regression with Low Birth Weight, Maternal Age

	Adolescence	Very Advanced Maternal Age
Measure	Odds Ratio	
Dependent Variables		
Low Birth Weight		
Independent Variables		
Month Prenatal Care Began	1.053***	1.180**
Maternal Weight Gain	0.978***	1.101**
Birth Order	0.996	0.925***

Gestation (Weeks)	0.720***	0.628***
Control Variables		
Married	0.973	0.989
Race		
2.00 Non-Hispanic Black	1.587***	0.897
3.00 Non-Hispanic Other	0.982	0.66
4.00 Hispanic	1.093	0.695
Education		
1.00 Less Than High School	0.772**	0.776
2.00 High School Diploma	0.806*	1.217
4.00 Bachelor's Degree	0.542	1.229
5.00 Graduate or Professional Degree	0	1.2
Female Infant	1.332***	1.386***
Induced Birth	1.043	1.944***
Ever Had Gonorrhea	1.086	0
Ever Had Syphilis	0.907	0
Ever Had Chlamydia	0.95	0.04
Diagnosed with Eclampsia	2.607***	2.433
Diagnosed with Pre-Pregnancy Hypertension	2.256***	2.192***
Diagnosed with Gestational Hypertension	2.677***	2.023***
Diagnosed with Pre-Pregnancy Diabetes	0.564***	0.393**
Diagnosed with Gestational Diabetes	1.530**	2.354*
Had a Previous Preterm Birth	2.055***	1.537*
Ever Smoked	1.654***	1.663
Receiving WIC Benefits	0.939**	0.988
Medicaid (Public Health Insurance)	1.061**	0.662**

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College); Race (1.00=NH White)

Table 9. Binary Logistic Regression with Preterm Birth, Maternal Age

	Adolescence	Very Advanced Maternal Age
Measure	Odds Ratio	
Dependent Variables		
Preterm Birth		
Independent Variables		
Month Prenatal Care Began	0.801***	0.768***
Maternal Weight Gain	0.997***	1.004
Birth Order	1.161***	1.016
Birth Weight (grams)	0.998***	0.998***
Control Variables		
Married	0.880***	1.03
Race		
2.00 Non-Hispanic Black	0.828	1.377
3.00 Non-Hispanic Other	0.938	1.07
4.00 Hispanic	0.728**	1.045
Education		
1.00 Less Than High School	1.152	1.497
2.00 High School Diploma	0.991	1.334
4.00 Bachelor's Degree	0.733	1.085
5.00 Graduate or Professional Degree	3.787	1.168

Female Infant	0.745***	0.784**
Induced Birth	1.616***	1.638***
Ever Had Syphilis	1.224	0
Ever Had Gonorrhea	1.023	1.23
Ever Had Chlamydia	1.080**	1.463
Diagnosed with Eclampsia	1.982***	3.093*
Diagnosed with Pre-Pregnancy Hypertension	1.443***	1.141
Diagnosed with Gestational Hypertension	1.705***	1.757***
Diagnosed with Pre-Pregnancy Diabetes	3.467***	2.725***
Diagnosed with Gestational Diabetes	0.477***	0.359***
Had a Previous Preterm Birth	1.798***	1.317
Ever Smoked	0.755***	0.853
Receiving WIC Benefits	0.889***	0.951
Medicaid (Public Health Insurance)	0.972	0.866

Source: NATALITY DATA FILE, 2013 [UNITED STATES]
Note: * p<0.05; ** p<0.01; *** p<0.001.
Reference Categories: Education (3.00=Some College); Race (1.00=NH White)

The mean infant birth weight was 3,279 grams (where less than 2,500 is low birth weight). Of the U.S. live births included in this sample, 92% were classified as normal birth weight (NBW, weighing 2,500 grams or more at birth), 8% were low birth weight (weighing less than or equal to 2,499 grams at birth) (see Table 1). Of infants born, 48.8% were female, and 51.2% were male (see Table 1). Relationships between each independent variable and control variables were calculated for both birth weight and gestation. For infant birth weight in this sample, 9.3% of adolescent mothers had low birth weight infants, while 7.6% of women in their prime childbearing years (20-34 years of age) had a low birth weight infant, 9.1% of women of advanced maternal age (35-44 years of age), and 18.6% of women of very advanced maternal age (45-49 years of age) had a low birth weight infant (see Table 2). For time that prenatal care began, 7.5% of women who began prenatal care in the first trimester of pregnancy (within the first 1-3 months) had a low birth weight infant, with increasing rates of having a low birth weight infant as beginning prenatal care is delayed, especially for those women without any prenatal care. Of preterm births, 45.9% were to low birth weight infants. All relationships between these independent variables and the dependent variable of birth weight were controlled for the variables of maternal education, race-ethnicity, infant's sex, marital status, having an induced birth, ever having various sexually transmitted infections, having various diagnosed health disorders (before or during pregnancy), ever smoking cigarettes, and receiving public assistance in the form of Medicaid or WIC benefits.

The average length of gestation (pregnancy until birth) was 38.65 weeks (where less than 37 weeks is preterm) (see Table 1). Of all births included in the sample, 11.4% of births were preterm (see Table 1). There were 12.7% of women induced into labor that gave birth prematurely, which could (but not necessarily) attribute to some preterm births. Of women in this sample, 12.9% of adolescent mothers had a preterm birth, 10.8% of women in their prime childbearing years, 13.2% of women of advanced maternal age, and 23.8% of women of very advanced maternal age had a preterm birth based on this study's sample. Comparing high-risk age groups, older women of very advanced maternal age shared a much larger proportion of preterm births compared to young, adolescent women. Of women with less than a high school diploma, 13.3% had a preterm birth, while 12.2% of women with a high school diploma or equivalency had a preterm birth. For women who had completed some college without a Bachelor's degree, 11.2% had a preterm birth, while 9.3% of women with a Bachelor's degree had a preterm birth, and 9.6% of women with a graduate or professional degree. Based on these results, occurrence of preterm birth appears to decline with education. Of women who gave birth prematurely, 25% of women who received no prenatal care had a preterm birth, while women who began prenatal care in their first, second, or third trimester of pregnancy all had roughly the same rates of preterm birth. All relationships between these independent variables and the dependent variable of gestation were controlled for the variables of maternal education, race-ethnicity, infant's sex, marital status, having an induced birth, ever having various sexually transmitted infections, having various diagnosed health disorders (before or during pregnancy), ever smoking cigarettes, and receiving public assistance in the form of Medicaid or WIC benefits.

Several statistical tests were performed to evaluate significant relationships between variables having a low birth weight infant or a preterm birth. Binary logistic regressions were run for both low birth weight and preterm birth. For low birth weight, for every one year of age, the odds of having a low birth weight infant increase by 0.6%. For every one month delay in beginning prenatal care, the odds of having a low birth weight infant increase by 13%. For every one pound mothers gained during pregnancy, the odds of having a low birth weight infant decrease by 98.8%. For every additional one week of gestation, the odds of having a low birth weight infant decrease by 65%. For every one increase in birth order, the odds of having a low birth weight infant decrease by 93.1%. Non-Hispanic white women are 80.8 times less likely to have a low birth weight infant than non-white (non-Hispanic Black, non-Hispanic other, or Hispanic) women. Non-Hispanic black women are 21.7 times more likely to have a low birth weight infant than non-black women. Hispanic women are 80.1 times less likely to have a low birth weight infant than non-Hispanic women. Female infants are 43.9 times more likely to be of low birth weight than male infants. Women who are induced into labor are 4.6 times more likely to have a low birth weight infant than women who are not induced into labor. Women who have tested positive for Hepatitis B are 88.5 times less likely to have a low birth weight infant than women who are Hepatitis B negative. Women who are Hepatitis

C positive are 51.6 times more likely to have a low birth weight infant than women who are Hepatitis C negative. Women who have tested positive for chlamydia are 96.6 times less likely to have a low birth weight infant than women who have not had chlamydia. Women who have tested positive for syphilis are 87.7 times less likely to have a low birth weight infant than women who have not tested positive for syphilis. Women who have tested positive for gonorrhea are 12.9 times more likely to have a low birth weight infant than women who have not tested positive for gonorrhea. Women who have been diagnosed with eclampsia are 167.4 times more likely to have a low birth weight infant than those who do not have eclampsia. Hypertensive women prior to pregnancy are 80.8 times more likely to have a low birth weight infant than women who are not hypertensive before pregnancy. Diabetic women prior to pregnancy are 63.4 times less likely to have a low birth weight infant than women who are not diabetic prior to pregnancy. Women with gestational hypertension are 135.8 times more likely to have a low birth weight infant than women without gestational hypertension. Women with gestational diabetes are 31.2 times more likely to have a low birth weight infant than women without gestational diabetes. Women who have had a previous preterm birth are 55.2 times more likely to have a low birth weight infant than women who have not had a previous preterm birth. Finally, women with a history of smoking cigarettes are 81.6 times more likely to have a low birth weight infant than women who have never smoked cigarettes. Women receiving WIC benefits are 0.6 times more likely to have a low birth weight infant than women who are not receiving WIC benefits. Women who do not receive prenatal care are 184 times more likely to have a low birth weight infant than women who do receive prenatal care. Women receiving Medicaid benefits are 3.8 times more likely to have a low birth weight infant than women without Medicaid. Married women are 93.9 times less likely to have a low birth weight infant than unmarried women.

For every one year of age, the odds of having a preterm birth increase by 0.5%. For every one month delay in starting prenatal care, the odds of having a preterm birth decrease by 74.2%. For every one pound gained by mothers during pregnancy, the odds of having a preterm birth increase by 0.4%. For every one gram of infant birth weight, the odds of having a preterm birth decrease by 99.7%. For every one birth order, the odds of having a preterm birth increase by 8.8%. Non-Hispanic white women are 91.5 times less likely to have a preterm birth than non-white (non-Hispanic black, non-Hispanic other, and Hispanic) women. Non-Hispanic black women are 87.4 times less likely to have a preterm birth than non-black women. Hispanic women are 86 times less likely to have a preterm birth than non-Hispanic women. Women who give birth to a female infant are 69.5 times less likely to give birth prematurely than women who give birth to a male infant. Women who have an induced labor are 75.4 times more likely to have a preterm infant than women who are not induced into labor. Women who have tested positive for gonorrhea are 4.6 times more likely to have a preterm birth than women who do not have gonorrhea. Women who have tested positive for syphilis are 11.5 times more likely to have a preterm birth than women without syphilis. Women who have tested positive for chlamydia are 8.2 times more likely to have a preterm birth than women without chlamydia. Women who are hypertensive prior to pregnancy are 46 times more likely to have a preterm birth than women who are not hypertensive prior to pregnancy. Women with gestational hypertension are 82.4 times more likely to have a preterm birth than women without gestational hypertension. Women who are diabetic prior to pregnancy are

196.8 times more likely to have a preterm birth than women who are not diabetic prior to pregnancy. Women with gestational diabetes are 51.4 times less likely to have a preterm birth than women without gestational diabetes. Women who have had a previous preterm birth are 90.1 times more likely to have a preterm birth than women who have never had a previous preterm birth. Women diagnosed with eclampsia are 121.2 times more likely to have a preterm birth than women without eclampsia. Women receiving WIC benefits are 95.3 times less likely to have a preterm birth than women not receiving WIC benefits. Women receiving Medicaid benefits are 2.2 times more likely to have a preterm birth than women not receiving Medicaid benefits.

Regressions were also run specifically by race and age groups. For non-Hispanic black women, several variables have greater odds of having a low birth weight infant and preterm birth than for non-Hispanic white women. However, there were many cases where non-Hispanic white women had greater odds of having a low birth weight infant or preterm birth. Based on the analyses performed in this study, non-Hispanic white women are at greater odds of having a preterm birth based on the variables of pre-pregnancy diabetes, pre-pregnancy hypertension, gestational hypertension, eclampsia, previous preterm birth, chlamydia-positive, maternal weight gain during pregnancy, all levels of maternal education, and induction of labor (see Table 6). Non-Hispanic white women who are diabetic prior to pregnancy are 275.8 times more likely to have a preterm birth than those who are not. Non-Hispanic white women with hypertension prior to pregnancy are 47.4 times more likely to have a preterm birth than those women non-hypertensive prior to pregnancy. Non-Hispanic white women with gestational hypertension are 88.8 times more likely to have a preterm birth than non-Hispanic white women without gestational hypertension. Non-Hispanic white women with eclampsia are 135.7 times more likely to have a preterm birth than non-Hispanic white women without eclampsia. Non-Hispanic white women who have had a previous preterm birth are 107.2 times more likely to have a preterm birth than those who have not. Non-Hispanic white women who have tested positive for chlamydia are 7.5 times more likely to have a preterm birth than those non-Hispanic white women negative for chlamydia. Among non-Hispanic white women, for every one pound gained by a woman during pregnancy, the odds of having a preterm birth increase by 0.5%. Non-Hispanic white women with less than a high school diploma are 15.1 times more likely to have a preterm birth than those with more education; those with a high school diploma are 13 times more likely to have a preterm birth than those with more education; those with some college credit without a Bachelor's degree are 12.8 times more likely than those with more education; those with a Bachelor's degree are 2.3 times more likely than those with more education, and finally, non-Hispanic white women with a graduate or professional degree are 2.2 times more likely to have a preterm birth than non-Hispanic white women of other educational levels. Non-Hispanic white women who are induced into labor are 93.8 times more likely to have a preterm birth than those who were not induced into labor.

Similarly, non-Hispanic white women are at greater risk for having a low birth weight infant, based on the variables of having a female infant, history of smoking cigarettes, gestational diabetes, eclampsia, syphilis-positive, hepatitis C, receiving WIC benefits, timing of prenatal care at all stages of pregnancy and no prenatal care at all, maternal age, having less than a high school diploma, having a preterm birth, and induction of labor (see Table 7). Among non-Hispanic white women, the odds of having a low birth weight infant increase by 1.7% with every one year of maternal age. The odds of having a low birth weight infant increase by 19% percent with every one month delay of beginning prenatal care. Non-Hispanic white women with less than a high school degree are 2.7 times more likely to have a low birth weight infant than those with more education. Non-Hispanic white women who are induced into labor are 9 times more likely to have a low birth weight infant than those who are not induced into labor. Non-Hispanic white women who test positive for syphilis are 14.6 times more likely to have a low birth weight infant those who test negative for syphilis. Non-Hispanic white women with eclampsia are 168.2 times more likely to have a low birth weight infant than non-Hispanic white women without eclampsia. Non-Hispanic white women with gestational diabetes are 53.9 times more likely to have a low birth weight infant than non-Hispanic white women who are non-diabetic during pregnancy. Non-Hispanic white women with a reported history of smoking cigarettes are 81.4 times more likely to have a low birth weight infant than non-Hispanic white women who have never smoked cigarettes. Finally, non-Hispanic white women receiving WIC benefits are 4.6 times more likely to have a low birth weight infant than non-Hispanic white women not receiving WIC benefits.

In contrast, non-Hispanic black women have greater odds of having preterm birth based on the variables of syphilis-positive, hepatitis C, maternal age, receiving Medicaid benefits, induction of labor, and total birth order (see Table 6), when compared to non-Hispanic white women. For non-Hispanic black women, there are greater relationships with low birth weight and the independent variables of pre-pregnancy hypertension, gestational hypertension, previous preterm birth, gonorrhea-positive, receiving Medicaid benefits, and induction of labor (see Table 7). Overall though, results show that non-Hispanic black women do not have greater odds of having a preterm birth or a low birth weight infant when compared to non-Hispanic white women.

Similar relationships were found based on age group when comparing adolescent mothers (15-19 years of age) to mothers of very advanced maternal age (45-49 years of age). The odds of having a low birth weight infant (less than 2,500 grams in weight) are greater for adolescent women based on the variables of race of non-Hispanic white, non-Hispanic black, and Hispanic ethnicity, eclampsia, pre-pregnancy hypertension, gestational hypertension, previous preterm birth, and receiving Medicaid benefits (see Table 8). For instance, adolescent women with eclampsia are 160.7 times more likely to have a low birth weight infant than those without eclampsia. Adolescent women that are hypertensive prior to pregnancy are 125.6 times more likely to have a low birth weight infant than adolescent women who are not hypertensive prior to pregnancy. Adolescent women with gestational hypertension are 167.7 times more likely to have a low birth weight infant than adolescent women who are not hypertensive during pregnancy. Adolescent women who have had a previous preterm birth are 105.5 times more likely to have a low birth weight infant than adolescent women who have not had a previous preterm birth. Finally, adolescent women receiving Medicaid benefits are 6.1 times more likely to have a low birth weight infant than adolescent women who are not receiving Medicaid benefits.

The top risk factors of having a preterm birth, as identified in this sample for adolescent women, are birth order, pre-pregnancy hypertension, pre-pregnancy diabetes, and previous preterm birth. Findings show that among adolescent women, the odds of having a preterm birth increase 16.1% with every one increase in birth order. Adolescent women with hypertension prior to pregnancy are 44.3 times more likely to have a preterm birth than adolescent women who are not hypertensive prior to pregnancy. Additionally, adolescent women with diabetes prior to pregnancy are 246.7 more likely to have a preterm birth than adolescent women who are not diabetic prior to pregnancy. Finally, adolescent women who have had a previous preterm birth are 79.8 times more likely to have a preterm birth than adolescent women who have not had a preterm birth.

As shown by this study, older women of very advanced maternal age also have several greater risk factors of having a low birth weight infant or preterm birth than adolescent women. The odds of having a low birth weight infant are greater for mothers of very advanced maternal age based on the variables of gestational hypertension, eclampsia, hepatitis B, hepatitis C, maternal weight gain during pregnancy, maternal education of a Bachelor's degree, some college without a Bachelor's degree, high school completion, and less than completing high school, all races including Hispanic ethnicity, and induction of labor (see Table 8). For instance, older mothers of female infants are 38.6 times more likely to have a low birth weight infant than older mothers of male infants. Older women who are induced into labor are 94.4 times more likely to have a low birth weight infant than those that are not induced into labor. Older women who have a history of smoking cigarettes are 66.3 times more likely to have a low birth weight infant than older women who have never smoked cigarettes.

For older women of very advanced maternal age, the top risk factors of having a preterm birth were maternal weight gain during pregnancy, all races, all maternal education except for those with graduate or professional degrees, induction of labor, eclampsia, and gestational hypertension. Older women with less than a high school diploma are 49.7 times more likely to have a preterm birth than older women with more education. Older women that have completed some college without a Bachelor's degree are 18.4 times more likely to have a preterm birth than older women with more education. Older women who are induced into labor are 63.8 times more likely to have a preterm birth than older women who are not induced into labor. Older women with eclampsia are 209.3 times more likely to have a preterm birth than older women without eclampsia. Finally, older women with gestational hypertension are 75.7 times more likely to have a preterm birth than older women without gestational hypertension.

VII. Discussion and Conclusion

Rates of low birth weight and preterm birth are persistent and troubling issues in the United States and globally. Adverse birth outcomes have direct and indirect lifelong implications on these infants (Yao et al. 2014, CDC 2017). This study explored the mechanisms of low birth weight and preterm birth by examining the attributes of women who gave birth to low birth weight and/or preterm infants. The first hypothesis for this study (H1) was that rates of LBW and PTB will be highest among the youngest and oldest maternal age groups, reflecting a U-shaped distribution. Although this sample did not show a U-shaped distribution of low birth weight or preterm birth, this study did reveal several relationships with age and various risk factors of having a low birth weight or preterm born infant. Findings reveal that rates of low birth weight were slightly higher for adolescent women than women of advanced maternal age, although rates of low birth weight for women of very advanced maternal age were double that of adolescent women (see Table 2). However, rates of preterm birth were higher overall across all age groups when compared to rates of low birth weight. Still, rates of preterm birth were highest among women of very advanced maternal age, at nearly double the rate of preterm birth for adolescent women. For preterm birth rates were actually higher among women of advanced maternal age than adolescent women. All extreme age groups (adolescence, advanced maternal age, and very advanced maternal age) had significantly higher rates of low birth weight and preterm birth than those for women in their prime childbearing years (see Tables 2-3). Based on these findings, there is a U-shaped distribution of both preterm birth and low birth weight, although this distribution is slightly skewed to the right, as maternal age increases. Thus, the first hypothesis (H1) is supported by the results of this study.

(H2) Having a health condition prior to pregnancy will have a greater association with LBW and PTB than having a health condition only during pregnancy. This study found mixed findings on health conditions before and during pregnancy, as it is associated with having a LBW or PTB infant. The health conditions measured were hypertension (pre-pregnancy and gestational) and diabetes (pre-pregnancy and gestational). For women diagnosed with hypertension before pregnancy, 19% had a LBW infant compared with 20.50% for those with gestational hypertension. Similarly, 9.7% of those diagnosed with diabetes before pregnancy had a LBW infant, compared with 9.2% with gestational diabetes. Mixed results were consistent for preterm birth as well, as 23.7% of women with hypertension before pregnancy had a LBW infant, compared with 24.7% of mothers with gestational hypertension. For diabetes, 16.2% of women who had diabetes before pregnancy had a preterm birth, compared with 14.9% with gestational diabetes. The performed binary logistic regressions revealed that the odds of having a low birth weight infant are greater for women with gestational diabetes and gestational hypertension than women with diabetes or hypertension prior to pregnancy (see Table 4). Contradictory results were found for the odds ratios with having a preterm birth, as mothers that are hypertensive during pregnancy have greater odds of having a preterm birth when compared to mothers hypertensive prior to pregnancy, while mothers with diabetes prior to pregnancy have greater odds of preterm birth than those with only gestational diabetes(see Table 5). Based on the overall findings of this study, this hypothesis (H2) is to be rejected, as the results of this study suggest that conditions during pregnancy such as gestational hypertension, gestational diabetes, and eclampsia are associated with greater odds of having an adverse birth outcome than those conditions prior to pregnancy, when controlled for both race and age group.

(H3) The odds of having a low birth weight or preterm infant will be greater for non-Hispanic black women than the odds for women of other races. This hypothesis was informed by the existing literature, almost entirely supporting that black women are at greater risk for having a low birth weight or preterm infant when compared to women of other races, especially white women. Overall, the binary logistic regressions performed in this study revealed that non-Hispanic white women are at greater risk for both having a low birth weight infant and a preterm birth when compared to non-Hispanic black women. When more specific regressions were performed by race, results revealed that when compared to non-Hispanic black women, non-Hispanic white women are more likely to have a preterm birth based on many independent and control variables, with extremely similar results for the odds of having a low birth weight infant. Based on these analyses, non-Hispanic black women are not at greater risk for having a preterm birth based on the characteristics of maternal weight gain during pregnancy, birth order, almost all levels of education (less than a high school diploma, having a Bachelor's degree, and having a graduate or professional degree), history of syphilis or gonorrhea, eclampsia, diabetes prior to pregnancy, gestational diabetes, previous preterm birth, and receiving Medicaid benefits (see Table 6). Based on the analysis with race and low birth weight, non-Hispanic black women are also not at greater risk for having a low birth weight infant, based on the same characteristics (see Table 7). Taking these findings into consideration, the third hypothesis (H3) of this study can therefore be rejected, as the results do not support the claim of non-Hispanic black women being at greater risk for having a low birth weight infant or a preterm birth.

Overall, the significant findings of this study revealed risk factors of infant birth weight such as advancing maternal age, delayed timing of prenatal care, advanced education (specifically holding a graduate or professional degree, most likely referring to women waiting to begin having children in advanced maternal age after completing post-college education), races of non-Hispanic black and non-Hispanic other, having a female infant, induction of labor, eclampsia, hypertension before and during pregnancy, gestational diabetes, previous preterm birth, history of smoking cigarettes, and receiving WIC benefits or Medicaid benefits (see Table 4). The most notable findings of this study suggest that significant risks of having a preterm birth include advancing maternal age, maternal weight gain during pregnancy, increasing birth order, obtaining less than a college degree, induction of labor, testing positive for a sexually transmitted disease, hypertension before or during pregnancy, diabetes before pregnancy, previous preterm birth, and receiving Medicaid benefits (see Table 5).

Applying the theory of the life-course perspective to this study's findings only enhanced our overall understanding of the mechanisms and distribution of adverse birth outcomes. As explained by the life-course perspective, rates of preterm birth and low birthweight, the measures of adverse birth outcomes for this study, increase with age. The life-course perspective explains that adverse birth outcomes are an accumulation of adverse exposures to the mother, which increase in impact over time. Thus, older women would be expected to have poorer birth outcomes than younger women that have not yet had as much negative exposures and effects on their body, as the results of this study show. Additional strengths of this study included a highly representative sample of women who gave birth in 2013 in the United States, and an evaluation of various maternal factors of adverse birth outcomes. Limitations of this study included factors restricted to individual health-related factors, rather than broader socioeconomic factors such as income, region, urban or rural residence, or exposure to adversity or stressors. Another limitation of this study is contradictory measurements when compared to the existing studies, such as age groups not aligned with the literature. Although this study aimed to examine the adverse birth outcomes of both low birth weight and preterm birth, the relationships with these outcomes and the independent variables analyzed were found to be unique. Future research should continue to approach low birth weight and preterm birth as interrelated birth outcomes with separate and unique determinants, particularly when examined among age and race groups. Although low birth weight and preterm birth were highly inter-correlated, the relationships with each variable were different and at times contradictory, particularly across racial-ethnic groups and age groups. Beneficial future research may include more socioeconomic variables to get a complete picture of determinants of maternal health and infant outcomes, as evident by the existing literature, while simultaneously filling the gaps in the literature such as socioeconomic determinants such as region, rural or urbanness, and maternal exposures before *and* during pregnancy. Future research should also implement more qualitative methods, such as in-depth interviews, to better-understand women's experiences and exposures as it may affect their health and infant birth outcomes, which also serves as a gap in the existing literature's methodology. The implications of this study include insightful contributions to the existing literature, as well as political and health practice implications, in better addressing low birth weight as a public health issue that can be intervened with policy or health practices. Broad implications of this research may include the continued treatment of low birth weight and preterm birth as related yet unique issues with specific and different risk factors. Specific policy implications of this research may include tailored attention to high-risk populations, especially older women, as well as to specific racial-ethnic groups, such as facilitating comprehensive preparation for healthy pregnancy to first-time mothers. Another common theme from the results of this study is the significance of having a previous preterm birth leading to future adverse birth outcomes, for both low birth weight and preterm birth, across race and ethnic groups and age groups. Focusing on preventing preterm birth in the first place, as this outcome appears to have more risk factors across all age and race categories, will be the best approach to reduce all future adverse birth outcomes, including cases of low birth weight infants. This study should be used to challenge the existing literature, as this study's sample is a large portion of registered live births in the United States in 2013, and gives a better representation of the U.S. population's adverse birth outcomes than other studies with smaller, more homogenous sample sizes. It should be noted, however, that this work serves as a measuring tool to see the big picture of adverse birth outcomes, and should require further and more complex analyses between preterm birth across age and race.

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