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Racial Disparities in Periconceptual Folic Acid Levels

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Walden University
2020

Abstract

Racial Disparities in Periconceptual Folic Acid Levels

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Periconceptional folate level deficiencies are associated with birth defects of the brain and spinal cord, posing a significant public health problem. In 2009, Black and Hispanic women exhibited lower periconceptual folate levels and higher rates of folate-related birth defects compared with non-Hispanic White women, prior to enactment of the Affordable Care Act (ACA) of 2010. It is not known if improved access to prenatal care under the ACA narrowed the gap in mean periconceptual folate levels between non-Hispanic White, Black, and Hispanic women between 2009 and 2017. The purpose of this causal-comparative cross-sectional quantitative study was to determine whether there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017 pre- and post-ACA, after controlling for age, education, marital status, and income. Data from periconceptual women who participated in the blood draw portion of the National Health and Nutrition Examination Survey between 2009 and 2017 were analyzed using binary logistic regression. Hispanic White women were 6.317 times more likely than Black and Hispanic women to have higher folate levels, albeit not significant ($p = .335$); mean post-ACA folate levels were significantly different than pre-ACA ($p < .001$). Potential positive social change from this study includes policymakers examining the need for additional interventions to improve folic acid intake for underserved periconceptual women.

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Dedication

The dissertation is dedicated to my late father, Kelvin Sr. Although your time was only limited to the first 11 years of my life, the principles you have instilled in me have enabled me to preserve and tackle the challenges of life with humility and dignity. Although you are not here to give me strength and support, I have always felt your presence that motivated me to press forward to tackle all of my life goals. Also, my mother, Elizabeth, whom has always had confidence in me and taught me to live my creed. You have sacrificed so much just so that I can have a fair chance at a normal life. Whenever I felt like the world was getting too heavy to bear, you where my shield and protection. There is no way I could ever pay you back for everything you have provided me. However, I hope this dissertation is a step to show how much you are appreciated.

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Chapter 1: Introduction to the Study

Folic acid is a vitamin present in many foods and supplements ("New York State Department of Health," 2020). It is especially crucial for women who may become pregnant, as folic acid may help to prevent birth defects ("New York State Department of Health," 2020). However, it was not clear whether increased access to prenatal care under the Affordable Care Act (ACA) narrowed the difference between non-Hispanic White, Black, and Hispanic women in mean periconceptual folate rates between 2009 and 2017. This study was needed because the findings of this study may improve practice by clarifying whether an at-risk community needs gradual intervention for improvement of the consumption of folates. Based on the findings of this study, policymakers can examine the need for additional interventions beyond the ACA and medical community recommendations to improve folic acid intake for underserved periconceptual women.

Chapter 1 entails an overview of the study and background relevance. Next, the problem statement is elaborated as to the lack of knowledge about the importance of folic acid levels in females. Additionally, the purpose of the study, research question, limitations of the study, and implications for social change are also included. Chapter 1 also includes a definition of terms, theoretical foundation, nature of the study, and significance of the study.

Background

Many studies have been conducted that identified the importance of folic acid supplementation for females. Neural tube defects (NTDs) are a primary congenital abnormality in the United States capable of leading to a range of disabilities or death but

could be prevented by daily folic acid (Bibbins-Domingo et al., 2017). Community prevalence of birth defects has been related to folic acid and vitamin B12 deficiency (Murthy et al., 2016). Food fortification is the most effective way in the prevention of most folate-related NTDs, though many women remain at risk of having children with folate-related NTDs (Mills, 2017). In response to this, the U.S. government instituted mandatory food fortification with folic acid in 1996 (Honein, 2001). This strategy has been adopted by approximately 80 countries with success. Data from many countries showed a significant decline in NTD rates after mandatory fortification (Mills, 2017).

Research has indicated that factors like ACA coverage and socioeconomic status may be related to levels of folic acid. In on a study of nearly 3 million births among women aged 24 to 25 years versus those 27 to 28 years old, ACA dependent coverage provision was associated with increased private insurance payment for birth, increased use of prenatal care, and modest reduction in preterm births (Daw & Sommers, 2018). Additionally, research has shown that women of color and lower socioeconomic status were more likely to have complications during pregnancy. Folic acid supplementation in these demographics is also quite lower than recommended during pregnancy (Linhares & Cesar, 2017).

Despite the importance of folic acid and the identified lower levels among certain groups, there is a lack of literature on the relationships between folic acid concentration of periconceptual females, race (Black and Hispanic women versus non-Hispanic White women), pre- and post-ACA. This study is crucial because of the evidence that a deficiency in folic acid levels in females may interfere with normal cell division as well

as fetal and placenta development, leading to abnormalities in birth. In a case a woman did not get enough folate before and during pregnancy, her baby may end up developing severe NTDs. The results of this study may help determining whether there are significant differences in folic acid levels between Black and Hispanic women versus non-Hispanic White women.

Problem Statement

Periconceptual folate level deficiencies are associated with birth defects of the brain and spinal cord and pose a significant public health problem (Linhares & Cesar, 2017; Parr et al., 2017; van Gool, Hirche, Lax, & De Schaepdrijver, 2018). But controlled clinical trials worldwide have indicated that periconceptual folic acid supplementation prevented more than 50% of NTDs and reduced other brain and spinal cord birth defects (Linhares & Cesar, 2017; Parr et al., 2017; van Gool, et al., 2018). Empirical study findings led to universal folic acid fortification programs in the United States since 1996 and a folic acid supplementation recommendation for all reproductive aged women (Bibbins-Domingo et al., 2017; Mills, 2017; Murthy et al., 2016). However, NTDs occur very early in pregnancy, often before a woman knows that she is pregnant. Thus, the Centers for Disease Control and Prevention (CDC, 2019) recommended that all women of childbearing age use folic acid supplementation (see also Parr et al., 2017). All women of reproductive age should consume at least 400 micrograms of folic acid per day from foods high in folate for prevention of birth defects (Bibbins-Domingo et al., 2017; Mills, 2017; Murthy et al., 2016).

There is a racial gap in mean periconceptual folate levels despite minimum daily requirement levels by the CDC and the American Academy of Pediatrics (Bibbins-Domingo et al., 2017). Black and Hispanic women have exhibited lower periconceptual folate levels and higher rates of folate-related birth defects compared with non-Hispanic White women in 2009, prior to enactment of the ACA of 2010 (Cheng, Mistry, Wang, Zuckerman, & Wang, 2018). The ACA of 2010 included provisions to increase prenatal care access for lower socioeconomic populations, including young Black and Hispanic women (Daw & Sommers, 2018). One aim of the ACA was improvement prenatal care for underrepresented populations, including Black and Hispanic women who experienced NTDs at substantially higher rates than White women (Linhares & Cesar, 2017). However, tt is not known whether improved access to prenatal care under the ACA narrowed the gap in mean periconceptual folate levels between non-Hispanic White women, and Black and Hispanic between 2009 and 2017. The ACA was expected to decrease the racial gap in periconceptual folate levels by increasing Black and Hispanic women's access to prenatal care by expanding healthcare coverage (Cheng et al., 2018). Despite the importance of examining the efficacy of the ACA to reduce the racial gap improve healthcare outcomes, few studies have examined changes in the racial gap in periconceptual folic acid levels (Daw & Sommers, 2018).

Purpose of the Study

The purpose of this causal-comparative cross-sectional quantitative study was to determine whether there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for the years

2009-2017, pre- and post-ACA, after controlling for age, education, marital status, and income. The independent variable in this study was race (Black and Hispanic women and non-Hispanic White women). Covariates that were controlled included age, education, marital status, and income. The dependent variable was folic acid level (normal/abnormal). The study could play a significant role by bringing attention to the required amount of folic acid to be consumed at a given period by pregnant women. Findings from the study could also provide useful information related to folic supplements for women, healthcare practitioners, and researchers.

Research Questions and Hypotheses

The following research questions and hypotheses was addressed in this study:

Research Question 1: Is there a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income?

$H_0$1: There is no significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

H_a1: There is a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

Research Question 2: Is there a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income?

$H_0$2: There is no significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income.

H_a2: There is a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-201, after controlling for race, age, education, marital status, and income.

Conceptual Framework for the Study

The conceptual framework for the study was the Adnay and Andersen behavioral model of health care access and utilization (AAM; Aday & Andersen, 1984; Andersen, 1995). The AAM has been used extensively in studies examining health services access and use in general and racial disparities in prenatal care specifically (Bixenstine, Cheng, Cheng, Connor, & Mistry, 2015; Chen, Vargas-Bustamante, Mortensen, & Ortega, 2016; Weisman et al., 2008). For this study, prenatal services access and usage were a function of (a) predisposing factors, (b) enabling factors, and (c) need (Aday & Andersen, 1984). Predisposing factors for prenatal folate level included age, education, ethnicity/race, and health beliefs (Bixenstine et al., 2015). Enabling factors for periconceptual folate level included family support, access to affordable health insurance, and income (Daw & Sommers, 2018). Need refers to both perceived and actual requirements for health care services. The AAM was extended to examine the efficacy of the ACA to reduce the racial gap in periconceptual folic acid level. A more detailed explanation of the conceptual framework will be provided in Chapter 2.

Nature of the Study

A quantitative causal-comparative cross-sectional research design was employed to examine the gap in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women between 2009 and 2017. A quantitative approach was appropriate to answer the research questions because it provides insight on variables that can be quantified (McDonald, 2006). Additionally, a quantitative research method was appropriate for this study because hypotheses were tested, and more importantly, the method ensured research objectivity because the researcher is separated from research participants (McCusker & Gunaydin, 2015). Additionally, a quantitative method was appropriate in that the study intended to identify and evaluate the variables utilizing hypotheses. A quantitative method provides for justification due to reliability and validity testing in a controlled environment (Park & Park, 2016). The key tenants of quantitative research include controlled conditions, large base sizes, and the application of statistics to make inferences about the population (Barnham, 2015).

Causal comparative studies compare one or more variables between populations using inferential statistics (Leedy, Ormrod, & Johnson, 2019). Secondary data were obtained from the publicly available National Health and Nutrition Examination Survey (NHANES), a stratified multistage probability survey designed to represent the civilian, noninstitutionalized U.S. population each year (National Center for Health Statistics [NCHS], 2018). Periconceptual women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 were included in this study. The dependent variable for this study was folate level and the independent variables were race and

ethnicity. Covariates are age, education, marital status, and income. Data were analyzed using stepwise logistic regression.

Definitions

Affordable Care Act (ACA): The ACA was voted into law in 2010. ACA aimed to continue the obligations that were established with the Medicare Act of 1965 and its objectives constituting the offering of medical coverage to nearly 50 million Americans who were without medical coverage while accepting the realities of a system that was overextended financially (Rosenbaum, 2011).

Folic acid (Folate): Folate (vitamin B-9) is an important nutrient that is crucial in red blood cell formation and for healthy cell growth and function (Mayo Clinic, 2020). The nutrient is crucial during early pregnancy to reduce the risk of birth defects of the brain and spine (Mayo Clinic, 2020).

Neural Tube Defects (NTD): NTDs are birth defects of the brain, spine, or spinal cord ("Neural Tube Defects | MedlinePlus," 2020). The defects happen in the first month of pregnancy, often before a woman even knows that she is pregnant ("Neural Tube Defects | MedlinePlus," 2020).

Periconceptual: The term is defined as the period before and immediately after the time of conception and is a critical period during early development (Louis, Cooney, Lynch, & Handal, 2008).

Assumptions

This study had a few assumptions. The first assumption was that the participants in the NHANES survey provided honest and unbiased answers. Researchers had a

responsibility of protecting the privacy of study respondents and creating a sense of trust to attain responses that are not biased (Creswell, 2008). The second assumption was that the data obtained from the NHANES was reliable and valid data. A third assumption was that the sample was a representative of the study's target population.

Scope and Delimitations

The focus of the study was on the relationship between folic levels in periconceptual adult females and race, while controlling for age, education, marital status, and income. For this study, folic acid levels were categorized into normal or abnormal. In adults, this normal range usually between 2-20 ng/mL. The scope of the study was limited to data collection from the publicly available NHANES, a stratified multistage probability survey designed to represent the civilian, noninstitutionalized U.S. population each year (NCHS, 2018). Periconceptual women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 were included in this study.

Other models were considered for the conceptual framework of the study. One framework that I considered but did not use was Rosenstock's health belief model. The health belief model is a theoretical model that deals with health decision making (Rosenstock, 1966). The model attempts to clarify the circumstances under which an adult would participate in individual health behaviors such as preventive tests or finding care for a health condition (Rosenstock, 1966). Andersen's behavioral model was chosen because it focused on a combination of intrapersonal and external determinants of health care use (Aday & Andersen, 1998).

Limitations

This study was limited in that it was a quantitative, nonexperimental design and could not determine a causal relationship. Although this study was a causal comparative, a further weakness was the inability to create random samples. There was no possibility of randomly choosing participants for the study and control groups because the events had already taken place. Casual-comparative studies provide much weaker evidence of a causal relationship than an experimental study. However, caution was used in making such causal relationship claims. Another challenge related to this study may be identifying and controlling for known confounding variables, such as smoking, and excessive alcohol consumption, which has been associated with poor health maintenance. The NHANES data also included more than 300,000 records annually. The dataset included missing data and outliers, which was addressed by using either listwise of pairwise deletion depending on the circumstances. Finally, generalizability of study findings could be limited due to unknown confounding variables.

Significance

Folic acid for pregnant women provides a wide range of benefits, which includes reducing birth defects associated with the brain and spinal cord (Linhares & Cesar, 2017). According to the CDC (2019), folic acid help in reduction of birth defects in infants. Women who are actively planning for pregnancy should consume 4,000 mcg of folic acid each day for at least 30 days prior to conception (Linhares & Cesar, 2017). Taking folic acid reduces risks of birth defects related to the brain and spinal cord and increases the chances of infant survival (Linhares & Cesar, 2017).

This study's original contribution was to determine the efficacy of the ACA for improvement of folic acid intake for periconceptual young Black and Hispanic women for use by public policy makers and medical community members concerned with reducing birth defects. The study could also help policy makers in examining the need for additional interventions beyond the ACA and medical community recommendations in improving folic acid intake for underserved periconceptual women. Study findings may also improve practice by clarifying whether at-risk group required incremental interventions to improve folate consumption. Despite continuing efforts, racial gaps in healthcare outcomes persist and deserve additional effort to improve social justice, so this study has a potential for positive social change.

Summary

The purpose of this quantitative study was to determine whether there was a significant difference in the gap in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for the years 2009-2017, after controlling for age, education, marital status, and income. Secondary data from the publicly available NHANES were analyzed. Chapter 2 includes a comprehensive literature review. The conceptual framework that guided this study will also be discussed.

Chapter 2: Literature Review

The purpose of this quantitative study was to determine whether there was a significant difference in the gap in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017. It was not known whether improved access to prenatal care under the ACA narrowed the gap in mean periconceptual folate levels between the demographics included in this research. Research has suggested that intake of multivitamins, which include folic acid, declined significantly within the pregnant female population (Wong et al., 2019). But there was a gap in research pertaining to the racial disparities between women's periconceptual folate levels despite the increased policy to improve folate intake (Chilukuri et al., 2018). The literature has shown that mental health, poverty, and poor health maintenance contribute to low levels of periconceptual folate levels in the United States regardless of race. However, findings have also suggested that there was a lack of awareness surrounding the importance of folic acid intake prior to and during pregnancy. These inconsistencies led to questions over whether there were specific individuals who were more likely to be disenfranchised in terms of folic acid intake. Though findings suggested that dietary intake of fruits and vegetables, higher levels of wealth, and an urban location all contributed to higher periconceptual folate levels, findings could not be generalized. This chapter contains a comprehensive review of relevant literature related to low folate levels among Black, Hispanic, and White women of lower socioeconomic status. In this chapter I provide my literature search strategy as well as the conceptual framework that guided this study.

Literature Search Strategy

To complete the review of relevant literature, a comprehensive review of recently published relevant data was conducted. The key library databases and search engines used included, but were not limited to, Google Scholar, Research Gate, Wiley Online, Elsevier, NCIB, Taylor & Francis, and Future Medicine. All the content published on these sites was described as peer reviewed. The additional benefit of using these sites was that any international studies are translated into English, meaning that no translation had to be done to complete this review of relevant literature.

In order to search these databases, keywords were identified and input. Key search terms included, but were not limited to, *folate levels, folate disparities, behavioral model of healthcare access and utilization, AAM folic acid, periconceptual folate levels, racial maternity disparities, racial minorities America maternity, racial minorities America women's healthcare, Black women folate levels, Black women access to healthcare, Black women maternity USA, Hispanic women maternity USA, Hispanic women access to healthcare, Hispanic women periconceptual folate levels, barriers to healthcare racial disparities, barriers to healthcare USA,* and *variables periconceptual folate levels*.

Other than for historical reference, the search was limited to studies published since 2016. The scope of the literature was broad but scientifically relevant to the course of study. Most of the data stemmed from peer-reviewed academic and scholarly research in the form of journal articles and books. Governmental data were limited. Though many studies had been conducted into periconceptual folate differences both nationally and

internationally, across a plethora of demographics and spatial areas, dominant paradigms tended to relate to the importance of folic acid. Generally, no major overarching patterns were found other than poverty, mental health, and poor health maintenance, which were either the focus of current investigation or were core contributors to lower levels of folic acid intake prior to and during pregnancy. In total, 39,500 articles were identified using the Google Scholar search engine. The data contained in this list of articles met all search criteria and articles were chosen from the first five pages of results reflecting the most current information available.

Conceptual Framework

The conceptual framework for the study was the AAM. The AAM has been frequently used in academic research on the topic of prenatal and maternity care. The model was originally used to focus on the family as the specific unit of analysis (Andersen, 2008). Since that time, it has evolved and been manipulated by a plethora of researchers, but the original model still stands as a paradigm for quantitative research into healthcare (Gelberg, Andersen, & Leake, 2000; Carillo et al., 2011; Kirby & Kaneda, 2005). However, most research on healthcare access focuses on individual-level factors such as income and insurance coverage (Kirby & Kaneda, 2005). Thus, within national and international research, the AAM has expanded to include the role of community-level factors that influenced individual availability to obtaining needed care (Tolera, Gebre-Egziabher, & Kloos, 2020). In doing so, researchers have found that living in disadvantaged neighborhoods significantly reduced the availability or access to care as

well as individual motivation into help-seeking for medical conditions (Tolera et al., 2020).

Despite the growth in scholarly investigation using the AAM, there has been a focus on international research, so the associations between poverty and access to healthcare have gone unexplained (Rocha et al., 2018; Shepherd- Banigan et al., 2017). In international studies, the focus has been on supplement intake among expectant mothers (Kirkpatrick et al., 2020) and access to healthcare along spatial areas (Ameyaw, Kofinti, & Appiah, 2017; Qureshi et al., 2016). Barriers to healthcare in developing nations have dominated the research utilizing the AAM (Shamaki, Yew, & Dahiru, 2017), with data suggesting that rural communities continue to be at risk of poor pregnancy care (Okonofua et al., 2018). Unlike most studies conducted in the United States focused on poverty and mental health, international examples have found that alternative behaviors such as female autonomy are a key driver in appropriate periconceptual pregnancy care. For example, Haider, Qureshi, and Khan (2017) used the AAM to identify that women participating in social and economic activities enhanced their autonomy, which drove maternal healthcare utilization. These findings suggested that policy that promoted female autonomy would lead to better help-seeking behaviors for women during pregnancy rather than just providing additional access to healthcare (Haider et al., 2017). This finding fits with the sixth iteration of the AAM that suggested that health outcomes are dictated by health beliefs and need.

Alternatively, studies that have been conducted in the United States on access to healthcare for lower socioeconomic status and racially diverse maternity and prenatal

care focus on issues related to mental healthcare (Shepherd- Banigan et al., 2017). Specifically, the focus has been on issues like substance abuse among expectant mothers (Stergiakouli, Thapar, & Smith, 2016). Similar studies in the United States have found that women are more likely to use the Internet than utilize healthcare services during prenatal care (Amaral Garcia et al., 2019). Promoting healthcare beliefs that align with great folic supplement intake and healthcare utilization via the availability of doula services has been discussed as an option for rural communities in the United States (Kozhimannil et al., 2016). Research using the AAM has also suggested disrupting the pathway of social determinants of health (Kozhimannil et al., 2016; Mendel, Sperlich, & Finucane, 2019). These studies have been concentrated on policy-change initiatives instead of evolving social practices (Andres et al., 2016). Therefore, studies on changing behaviors within pregnant female U.S. populations have been limited regarding health-seeking behaviors related to periconceptual folic intake levels (Marseille et al., 2018). Because the AAM was prevalent within studies attempting to determine health seeking behaviors, it was used in this study to form the conceptual framework.

Literature Review

Periconceptional Folate Levels

There have been consistent findings that folic acid supplementation prior to and during pregnancy could mitigate a number of birth defects and significantly aid with the healthy development of a child (Omotayo et al., 2017). In recent research, the concentration of data collection has been on developmental disorders that could arise without adequate periconceptual folate levels like autism (Meador, 2018). However,

awareness surrounding the importance of folic acid intake prior to and during pregnancy has remained low globally (Maraschini et al., 2017).

Connection to diseases. Research has shown that maternal folic acid and supplements used before and/or during pregnancy reduced the risk of autism (Levine et al., 2018). Children who had been exposed to folic acid supplements were significantly less likely to be born with autism, but those exposed to antiepileptic drugs were far more likely to see an association between using and their child developing autism (Bjork et al., 2018). Further, Degroote, Hunting, and Tasker (2018) argued that folates were essential for two major pathways—the synthesis of DNA and RNA precursors and DNA methylation—and that there was a growing body of evidence from epidemiological studies indicating an association between nutritional and functional deficiency in folates and autism spectrum disorders. Based on a study of rat offspring, Degroote et al., found that maternal periconceptional deficits in folate provoked alterations in the behavior of offspring relevant to the autistic-like phenotype, which had also been found to occur in humans. Such findings are important to policy, as a reduction in the prevalence of autism spectrum disorder would save healthcare costs for families for the life of their disabled child while also improving the quality of life for children across the United States (Bjork et al., 2018).

In low-income and developing countries, periconceptual folate levels have also been linked to asthma. Researchers such as Trivedi et al. (2018) found consistent indications that in countries where food is not fortified with folic acid, childhood asthma rates were significantly higher. However, there was a significant limitation within the

research pertaining to the long-term consequences and discrepancies within these trends, and how they impact society. In the United States, where food is often fortified with folic acid, childhood asthma rates were found to be significantly lower, but additional folic acid intake was still required to get expectant or to-be-expectant mothers to the levels considered appropriate to avoid developmental defects (Trivedi et al., 2018).

Research has also shown that low folic acid levels were also significantly linked to spina bifida (Kerr et al., 2017). Kerr et al. (2017) used data from the Slone Epidemiology Center Birth Defects Study between 1998–2015 to examine the impacts of folic acid on the relationship between maternal fever in the periconceptional period and spina bifida. In the study, the periconceptual period was defined as 28 days before and after the last menstrual period (Kerr et al., 2017). Kerr et al. used logistic regression models to calculate adjusted odds ratios and 95% confidence intervals. The data supported an association between maternal periconceptional fever and an increased risk for NTDs and provided evidence that this association was attenuated for mothers who reported consuming folic acid at recommended levels in the periconceptional period (Kerr et al., 2017).

Connection to pregnancy. As a result of the emphasis in research on the importance of folic acid intake prior to and during pregnancy, national and international researchers have attempted to address behaviors in expectant and soon-to-be expectant mothers. In developing countries, there was a significant gap in knowledge for women who wish to get pregnant and the importance of periconceptual folic acid intake (Albarder et al., 2019). The World Health Organization (WHO) attempted to fill this gap

in understanding through the promotion of data regarding dietary intake prior to and during pregnancy (Gomes, Lopes, & Pinto, 2016). WHO's recommendations for folic acid intake differed between countries, although almost 70% of nation states recommended a healthy diet plus a folic acid supplement of 400mg from preconception, which was roughly 4–12 weeks prior to getting pregnant, until the end of the first trimester of pregnancy, which is roughly 8–12 weeks (Gomes et al., 2016). Dosages for women at high risk of NTDs, autism, and other disorders associated with folic acid are recommended to be upped 4–5 mg/d (Gomes et al., 2016). The recommended intake for folate was in the range of 300–400 mg/d for women of childbearing age, regardless of pregnancy intentions, and 500–600 mg/d for currently pregnant women in all countries (Gomes et al., 2016). However, though different recommendations regarding folate and folic acid are available worldwide, most countries and WHO focused on a healthy diet and folic acid supplementation of 400 mg/d periconceptionally (Gomes et al., 2016).

European countries appeared to have the best recommendations, guidelines, and interventions ensuring that expectant mothers received folic acid levels prior to and during pregnancy. Evidence that folic acid prevents the majority of cases of NTDs had led to national organizations developing guidelines for women concerning periconceptional supplementation, but these continued to be strongest in Europe rather than the United States in creating actual behavioral change in at-risk populations (Cawley et al., 2016). But in Europe, there was still evidence of national variations in the incidence of NTDs, with countries that have some of the worst track records for equality for women being at the top of these variations (Cawley et al., 2016). For example, a

recent Irish study reported an increase in the rate of NTDs, suggesting that appropriate information was not being passed from doctor to mother (Cawley et al., 2016). For instance, some guidelines recommended that folic acid supplements be taken by women planning a pregnancy, but three recommended that they should be taken by all women of child-bearing age (Cawley et al., 2016). Other guidelines were found to recommend starting folic acid at least 4 weeks preconceptionally, but no country recommended starting folic at least 12 weeks preconceptionally (Cawley et al., 2016; Degroot et al., 2018).

There is a need for further consideration of the duration of preconceptionally folic acid supplementation specifically and racial disparities continue to perpetuate inconsistencies in intake levels (Cawley et al., 2016). Overall, the wide variation in national guidelines concerning periconceptional folic acid supplementation might be in part explained by the differences in national rates of NTDs reported by EUROCAT as well as the inconsistencies identified to support this course of investigation (Cawley et al., 2016). National guidelines on folic acid supplementation should be standardized across the world, as this may mitigate racial and wealth disparities as well as limit the detrimental impact of no folic acid intake on mothers and society (Cawley et al., 2016).

Other findings. Thanks to studies on the link between folic acid intake and birth defects, policy has shifted in some areas suggesting that women who had already one child born with NTDs or other folic-acid related issues consume at least 4,000 mg of folic acid per day (Petersen et al., 2019). Overall, though, there was a significant limitation placed on current studies, as they all depended on using information from women who

already reported levels of folic acid intake or they were influenced by datasets from areas outside of the United States. In order to fill the gap in understanding how periconceptual folate levels vary within racial demographics, it was important that further research be conducted in order to understand this issue and mitigate its ongoing impact in the United States (Talaulikar & Arulkumaran, 2018). The following section continues with a discussion of racial disparities among women and maternity in the United States, with a focus on the literature surrounding supplement intake. There was a significant gap in the research pertaining to folic acid level intake, so the literature search strategy was broadened to gain a full understanding on the background of the problem.

Racial Disparities Among Women and Maternity

Within the research concerning racial disparities among women and their maternity experience in the United States, the concentration in academic study has fallen into areas like mortality rates (Cole, 2018), how insurance influences healthcare seeking behaviors (Vesco et al., 2020), policy and interventions (Flores et al., 2017), and the factors that intertwine with limited folic acid intake (Yan, Yeoman, & Ritenbaugh, 2018). The purpose of this section of the review is to provide a review of the recently published racial disparity research in the United States as it related to maternity and healthcare, especially studies that looked at folic acid. There was a gap in understanding why these racial disparities perpetuated despite ongoing policy to help improve access to healthcare for racially diverse women in the United States.

Medicaid and the ACA have consistently developed ongoing strategies to educate women on the importance of periconceptual folate intake, and how this could have a

long-term positive effect on the lived experience of a child. However, it is not known whether there is a significant difference in folic acid levels between periconceptual Black and Hispanic women, and non-Hispanic White women after controlling for various factors related to their personal lived experience pre and post- the ACA, one of the most significant healthcare initiatives in United States history. Though there was a deluge of data concerning the importance of folic acid levels prior to and during pregnancy, current research suggested that this information or lifestyle choice was not making its way to the most vulnerable populations, as minority women continued to present as receiving lower standards of care throughout the United States healthcare system (Wen et al., 2018). The first subsection within this review, therefore, discussed the literature on Black women.

Black women. Researchers have argued that, unlike any other racial group in American history, Black women have received the lowest standards of healthcare due to inherent racism and unconscious biases that plague the medical community (Cole, 2018). In the United States, Black mothers are four times as likely to die than their white counterparts, prior to, during, and after pregnancy (Arnett, 2017). Arnett (2017) attempted to understand this phenomenon by creating a model using deductive reasoning and the social ecological model to develop an understanding of the many factors that attributed to the drastic death of Black mothers. Arnett (2017) found five major areas where Black women are also disenfranchised, contributing significantly to the increased likelihood of their premature death: (1) social determinants, (2) adversely affected health, (3) institutional biases, (4) compounding national issues, and (5) culture identity.

Arnett's (2017) research found that this was an incredibly complex and deeply rooted problem within the United States and solutions continued to evade policy. One of the most significant findings was related to healthcare costs in the United States, which often exceeded six thousand dollars alone (Vesco et al., 2020). In most states, an uninsured woman could expect to be charged upwards of $10,000 for a childbirth procedure in a hospital, without a C-section or any type of significant pain relief medication (Vesco et al., 2020). Though these costs do not specifically impact Black women alone, the rates of wealth inequality along racial lines in the United States means that a Black woman is far more likely than a White woman to be uninsured and unable to afford a $10,000 child birth in hospital, and therefore significantly less likely to be able to afford any periconceptual care, such as increase folic acid intake (Wynn, 2019).

In addition to the inherently racial and wealth inequality faced by pregnant Black women, research also suggested that the top-down nature of intervention programs could also limit their access to specific information (Akter et al., 2019). Such findings also have a significant impact on infant health (Wolf, 2019). Being born Black in the United States has been said as being "bad for your health" as babies born to Black families are significantly less likely to see their first birthday (Wolf, 2019 p.6). However, there is continued gaps in the literature pertaining to the exact reasoning for these issues, other than the prevailing paradigm of inherent racism within the United States healthcare system (Vesco et al., 2020).

When researching specific studies on Black periconceptual women, no studies could be identified from the last five years of recently published research. This was, by

far, the most limited areas of research identified thus far in this study. Most of those studies identified on Black women came from international examples and were therefore not academically or scientifically relevant for this portion of the discussion. Those studies that did include Black women but did not concentrate on them found that they were definitely more likely to die than any other racial group during pregnancy and childbirth, but also that Black children were more likely to have behavioral disorders linkable to maternal supplement intake, but no results were significant enough to be considered a paradigm (Wolf, 2019).

Even when expanding the search to include African American women, the emphasis on research was placed on specific top-down interventions in improving healthcare and the understanding of different aspects of pregnancy (Chilukuri et al., 2018). There are no current studies utilizing the input from Black women in the United States and their periconceptual folate levels. This was just one gap in literature and understanding that the study aimed to fill. Though Black women and their healthcare access prior to and during pregnancy would be discussed in later sections of the chapter, I would continue with a discussion of Hispanic women.

Hispanic women. Research concerning Hispanic women's folic acid intake levels were more common than for other racial demographics, but most of these studies came from neighboring Latin American states to the United States or small-scale case studies. According to researchers like Rivera-Segarra et al. (2016), unplanned pregnancies were a significant issue for Hispanic women, meaning that appropriate folic acid intake was often impossible prior to pregnancy. Therefore, interventions have been conducted to

implement folic acid education within Hispanic communities, suggesting community-based programs are the best means of promoting positive health behaviors in relation to pregnancies (Rivera-Segarra et al., 2016).

A prime example of such a study was that conducted by Flores et al., (2017), who noted that NTD rates continued to be high for Hispanic mothers living in the US. Flores et al. (2017) promoted the use of the *Promotora de Salud* model, using community health workers in educating women on the importance of folic acid intake for their baby's health. Flores et al. (2017) argued that even though NTDs declined in the United States technically, disparities still existed with Hispanic women having the highest risk of giving birth to a baby with a NTD, more so than Black women. According to historical research on the topic, the *Promotora de Salud* model has been consistently shown to be a successful tool for teaching Hispanics about a variety of health topics (Flores et al., 2017). However, similarly to the arguments put forth in this research, Flores et al. (2017) noted that literature on the effectiveness of the model in folic acid interventions was limited. In order to fill this gap in the literature, Flores et al. (2017) conducted a comprehensive research study across four United States counties consisting of large populations of Hispanic women, finding statistically significant differences in general awareness about folic acid and vitamins and specific knowledge about the benefits of folic acid. By the time the study was complete, statistically significant changes were seen in (a) vitamin consumption, (b) multivitamin consumption, and (c) folic acid supplement consumption increased dramatically by the end of the study. Flores et al. (2017) championed the use of the *Promotora de Salud* model, stating that the fact it relied on

interpersonal connections, forged between *promotoras* and the communities they served, helped in inspiring positive health behaviors that have had real-world impacts on the improved health of citizens. This study was inherently important to this study, not because it found that interventions work, but that it showed that education on folic acid intake was low amongst Hispanic women living in the US, suggesting that there was continued gaps between policy and practice.

Even since the creation of the 2009 United States Preventive Services Task Force guidelines on folic acid intake, there has been continued to be a majority of minority women without adequate data and information on folic acid intake during their pregnancy (Bibbins-Domingo et al., 2017). However, further limitations presented within the literature, particularly for Hispanic women. One of the most significant limitations was the emphasis placed on small-scale localized studies that cluster around specific communities of Hispanic women (Bibbins-Domingo et al., 2017). Though such studies have proven successful in identifying gaps in access to care, as well as the behavioral aspects of healthcare, it was impossible to generalize along such results, and therefore the application of resulting data was limited to a small spatial area (Wong et al., 2019). A key example of such a study was that conducted by Grover et al. (2019). In their research, Grover et al. (2019) sought to describe the prescription medication, over-the-counter medication, vitamin, and herbal remedy use during pregnancy. Though not specifically about folic acid, Grover et al. (2019) study was important as it identified key behavioral and spending trends, along with healthcare utilization, amongst a unique population of Hispanic women in Utah County, Utah. The results of the survey data collected amongst

the target population (n=138) showed that more than 50 percent of women were taking prescription medication for their pregnancy, just under 30 percent use over-the-counter medications, almost 80 percent used prenatal vitamins, and 60 percent used herbal remedies. These results suggested that Hispanic women were more likely to use medications recommended to them by people they trusted, are healthcare professionals, or have had first-hand experience with the medications in the past (Grover et al., 2019).

Despite the plethora of research showing that education and community-based interventions worked for promoting positive health behaviors during and prior to pregnancy, limitations within the generalizability of studies had inherently stagnated the public education policies that could be implemented to quell this gap (Grover et al., 2019; Wong et al., 2019). One of the reasons for this could be that some of the Hispanic women in Grover et al. (2019) study did not receive any information on the importance of supplement intake and increased folic acid intake from their healthcare providers, nor their doctors. This was an alarming finding, suggesting that the root of this issue might be that doctors were unaware that that kind of information could lead to life-saving health choices on the part of Hispanic women and their unborn child (Wong et al., 2019). This finding led to the additional paradigm within research related to the prevalence of studies on Hispanic women and their supplement intake.

Unlike their Black counterparts, Hispanic women were studied extensively in relation to their supplement intake (Ergorova et al., 2020). These studies were extensive and shed light on the importance of community-based factors in influencing folic acid intake, particularly as they related to NTDs and public health knowledge. However, the

policy regarding healthcare in many Latin American places an emphasis on maternal health due to the staggering costs of raising a disabled child to both parents and the state (Ergorova et al., 2020). Therefore, preventive care was urged with the utmost importance. For example, in Brazil, a developing country, was one of fifty nations in the world that practice food fortification to control for malnutrition and folic acid intake for expectant mothers (Ergorova et al., 2020).

In Brazil, folate deficiencies are very low, and this finding was directly related to the practice of food fortification (Ergorova et al., 2020). The United States policy on this began in 1996, when the U.S. Food and Drug Administration (FDA) started to require all enriched cereal grains to be fortified with folic acid at a concentration of 1.40 μg/g (Redpath, Kancherla, & Oakley, 2018). Since 1996, a significant reduction in the prevalence of spina bifida and anencephaly was observed across the United States birthing rates (Redpath et al., 2018). However, these regulations did not extend to the fortification of corn masa flour, a staple food for many Hispanic families living and working in the United States (Redpath et al., 2018). As a result, those Hispanic women of reproductive age who lived in the United States were less likely to take prenatal folic acid supplements than their international counterparts (Redpath et al., 2020). As a result, these populations had lower blood folate concentrations, and had a higher prevalence of spina bifida and anencephaly than non-Hispanic women, a clear sample of inequality through policy on the part of the FDA (Redpath et al., 2018).

Once this irregularity was identified the FDA published regulations allowing voluntary fortification of corn masa flour and tortillas in April 2016, but the cost of

conducting such fortification often put off companies who supplied those food staples to the United States populations (Redpath et al., 2018). Twenty months after the FDA issued these national regulations that permitted the voluntary fortification of all soft corn tortillas and most corn masa flour products, most of these products identified in Atlanta grocery stores were not fortified with folic acid, suggesting that minority populations continued to receive unequal care in policy standards and planning on the part of governmental leadership who oversaw such policy (Redpath et al., 2018).

Furthering their course of study, Redpath et al. (2018) even went so far as to testing the actual folic acid concentrations in those foods predominantly purchased by minority populations. The concentration of folic acid in unlabeled products, especially corn tortillas, was very low across all of those products samples (Redpath et al., 2018). The FDA aimed to achieve widespread fortification of corn masa products to prevent health disparities among Hispanic people. If the study findings were generally representative, achieving this goal would require complete fortification of corn masa products. Until then, Hispanic women of reproductive age were to eat only corn masa products and tortillas fortified with folic acid and take daily vitamin supplements containing 400 μg of folic acid, which they were more likely to do than their minority counterparts, but still to their detriment as an entire population (Redpath et al., 2018).

Despite that, health officials continued to be concerned about the weight-related issues with mothers in and from Latin American nation, which is now a public health crisis (Alvarado-Terrones et al., 2018). An additional paradigm in research was the emphasis placed on weight-related issues amongst Latin American expectant mothers,

which may have limited the amount of research conducted on Hispanic, US-based populations (Alvarado-Terrones et al., 2018). Still, birth outcomes tended to be better within cohorts of Hispanic women than other racial groups, even when controlling for things like obesity, poverty, education, and location of mother's birth (Hopkins et al., 2018).

These outcomes were higher even when compared to other United States racial demographics (Hopkins et al., 2018). Such consistent patterns led researchers to suggesting that there were many sociocultural factors exhibited by recent immigrants that had the potential to protect birth outcomes against the instability of minority and low socioeconomic status (Hopkins et al., 2018). To investigate potential sociocultural factors that led Hispanic women to having such increased health outcomes, a pilot qualitative study was carried out in Tucson, Arizona, with 18 Hispanic mothers (Hopkins et al., 2018). Again, this course of research was significantly limited as it was only conducted in a small spatial area that could not be generalized to the rest of the US.

The findings of Hopkins et al. (2018) study were twofold: (1) a healthy diet prepared at home from minimally processed ingredients, and (2) constant and comprehensive social support. Both findings were identified in previous research into Hispanic women health outcomes during pregnancy (Hopkins et al., 2018). When Hopkins et al. (2018) compared responses related to diet by interview language preference, a proxy for acculturation, there was very little difference between participants who interviewed in Spanish and those who interviewed in English, suggesting that the community-aspect of care was as important as public policy and education. Furthermore,

these results could also be explained by greater maternal social support and higher education levels among those who interviewed in English, but further investigation was needed to identify whether those factors were the same across the US-Hispanic population (Hopkins et al., 2018).

The community-education, social support paradigm related to Hispanic women and their pre- and during- pregnancy care appeared to be a significant predictor in their folic acid intake levels (Wen et al., 2018). This suggested that policy to improving folic acid intake was to concentrate on community-led education efforts, but that continued improvements to overall health within population needing a multi-pronged approach (Arinola et al., 2018). However, the gap in literature pertaining to how the ACA had influenced periconceptual folate levels continued to limit the understanding of this problem amongst Hispanic women.

Non-Hispanic White women. This demographic of women in the United States were broad, but included predominantly Caucasian-looking women, who were often perceived receiving greater access to healthcare due to unconscious racial biases by nurses and doctors (Neufeld et al., 2017). The reigning paradigms in research on non-Hispanic white women focus on their supplement intake, but they were also the typical population to study regarding health outcomes, and therefore data was richer than in previous sections. Despite this, research suggested that throughout the American population, only 50 percent of women adhered to folic acid intake when planning their pregnancy (Chitayat et al., 2016). However, these figures were developed after finding that 50 percent of women in the United States did not plan their pregnancy and cannot be

prepared for folic acid intake prior to conception (Chitayat et al., 2016). The closing of the neural tube is 28 days into conception, and therefore many of the women who did not have adequate information on the importance of folic acid intake and were likely to be taking supplements on a continuous basis, even if they are not planning on conceiving (Chitayat et al., 2016). On top of these limitations, many American women within the same demographic also limited their bread and cereal intake, therefore limiting their natural exposure to folic acid fortified foods (Chitayat et al., 2016). By avoiding gluten, many of these women were increasing their risk of NTDs, suggesting that large-scale educational policies surrounding the importance of folic may be some of the best to change that paradigm in findings (Chitayat et al., 2016).

Researchers also identified trends concerning antidepressant intake for non-Hispanic women during their attempts at getting pregnant (Freeman et al., 2019). This was of importance to this study as many women exhibiting depressive symptoms were less likely to be taking folic acid supplements in support of their attempts at conception (Freeman et al., 2019). However, such studies also distracted from the magnitude of the problem concerning folic acid intake within the American populous, instead concentrating on smaller policies related to the distribution of antidepressants and education on folic acid intake, but not on taking the supplements themselves (Freeman et al., 2019).

In addition to research on depression amongst periconceptual women, there was also a paradigm in research related to weight-related issues (Lee et al., 2017). Social science researchers argued that the prevalence of maternal obesity in the United States

was a significant factor in limiting the folic acid intake prior to conception, as obesity was a key indicator of poor health knowledge (Witkop, 2020). The impact of issues like depression and weight were said to distract expectant or soon-to-be expectant mothers from adhering to appropriate folic acid intake (Lee et al., 2017). What was important to note were the frequency of studies on non-Hispanic White women that took them as the general population. These findings suggested that might be why racial inequality was so prevalent within periconceptual folic acid education and intake: these populations were understudied, and therefore fewer scientifically accurate recommendations could be made to improve this problem (Lee et al., 2017).

Some researchers argued that, even within the demographic of non-Hispanic White women, the United States continued to fall behind other countries in communicating the importance of folic acid intake prior to and after pregnancy for mitigating some issues related to depression (Yan et al., 2017). Yan et al. (2017) research suggested that even when concrete scientific evidence contribute to educational and healthcare policy regarding folic acid and issues related to pregnancy such as depression are available, the data did not reach the target demographics either.

Overall, the concentration in research on non-Hispanic White women's periconceptual folate levels was limited. However, there were a plethora of studies dating back over the decades concerning the importance of folic acid intake for the populations, using them were the predominant target demographic of the study. The methodology used significantly limited the generalizability of results, meaning that appropriate policy for improving periconceptual folate levels amongst all women in the US, regardless of

race, was largely unsuccessful. A key example of this was the fortification of foods predominantly eaten by non-Hispanic White women, which led to significant decrease in NTDs and spina bifida, but not to the same extent within diverse populations (Redpath et al., 2018). Finally, a number of studies were identified and discussed racial inequality and potential variables associated with low folic acid knowledge and intake amongst America's diverse female populations. These would be discussed in detail in the following sections.

Potential Variables Associated with Racial Disparities in Healthcare

Most studies identified in the strategic search of recently published research concerning periconceptual folate levels amongst diverse female populations in the United States were comparative studies, either between folic acid intake and factors that hindered adoption of positive healthcare behaviors or two or more racial groups. Other than those studies concerning the importance of folic acid intake on infant health, (a) poor health maintenance, (b) poverty, and (c) mental health were the most prevalent throughout recent literature. These factors were considered barriers to adequate periconceptual folic acid intake but were also barriers to general healthcare by populations around the world.

Behavior change was a key purpose of recent research into positive health improvements for pregnant women (Singh et al., 2018). Most of those studies into how to break patterns of poor folic acid intake came from international data. For example, a study by Siekmans et al. (2018) sought to develop a large-scale supplementation program in improving access to iron and folic acid (IFA) supplements by pregnant women in

seven countries in Africa and Asia. Using data set from previous years, a methodology similar to the one in those study, Siekmans et al. (2018) analyzed IFA supplementation programs in Afghanistan, Bangladesh, Indonesia, Ethiopia, Kenya, Nigeria, and Senegal from formative research conducted between 2012–2013. In addition to those data sets, the researchers also used qualitative data derived from focus-group discussions and semi-structured interviews with local women and service providers. These data were used for the purpose of content analysis to elicit common themes on barriers and enablers at internal, external, and relational levels to IFA (Siekmans et al., 2018).

The study found several key themes, such as the fact that broad awareness and increased coverage of facility-based antenatal care (ANC) are an efficient delivery channel of IFA, but first trimester access to IFA was hindered by beliefs about when to first attend ANC and preferences for disclosing pregnancy status, which were often provided for free or low-cost in these nations (Siekmans et al., 2018) Such services often costed more than most women in the United States could afford throughout their entire pregnancy, particularly prior to pregnancy. Similar findings were realized in the research conducted by Siekmans et al. (2018), in that variables related to access and the poor quality of some ANC services, including insufficient IFA supplies and inadequate counselling to encourage consumption, were also barriers to both coverage and adherence of IFA.

A key finding that could support greater intake of IFA in the United States was that community-based delivery of IFA and referral to ANC could provide earlier, more frequent access and opportunities for improved periconceptual folic acid intake, and

additional supplement intake by all racial demographics of women experiencing pregnancy (Siekmans et al., 2018). Therefore, it was suggested that community-based delivery and counselling was imperative to address problems of timely and continuous access to supplements, as well as investments in training for service providers and effective behavior change designs were urgently needed to achieve the desired impact (Siekmans et al., 2018). Whether or not such interventions were possible in the United States were currently unknown, due to ongoing financial and wealth inequality.

With such an emphasis in research on the variables that influenced racial disparities being focused in international case studies, the rates of folic acid intake in many of these nations were comparable to the United States population (Sununtnasuk, D'Agostino, & Fiedler, 2016). Barriers to care and awareness were also comparable, often related to overall poor health maintenance, poverty, and issues related to mental health, such as addiction (Gebremariam et al., 2019; Sununtnasuk et al., 2016). These will be discussed in the following sections.

Poor health maintenance. Within the research concerning poor health maintenance related to folic acid deficiency argues that it could arise from multiple causes, but predominantly from inadequate dietary intake on the part of female patients (Khan & Jialal, 2019). Researchers argued that there was little information concerning the importance of folic acid intake, but that another issue was that most women were unaware of how to appropriately consume folic acid (Singh et al., 2018). For example, in a survey of pregnant women in the US, most were unaware that heating foods, particularly cereals, during cooking destroyed most of the folic acid (Khan & Jialal,

2019). On top of that, folate had been found to be present in an abundance of green leafy vegetables, which were often avoided by the general American population (Singh et al., 2018), citrus fruits, and certain, organic animal products (Khan & Jialal, 2019).

Within the body, folates were poorly stored, often leading to deficiencies in a matter of weeks to months in persons with folate-deficient diets (Singh et al., 2018). Despite that, folic acid deficiencies were easily treatable (Brown et al., 2016). Still, many women were left untreated, leading to multiple serious complications, as discussed in previous sections of this review of relevant literature. That had led some researchers to state that folic acid deficiency was a public health issue in the US, and the education of the importance of regular folic acid intake to the general public was vital within developing policy (Khan & Jialal, 2019). Khan and Jialal (2019) argued that healthcare workers at all levels could be encouraging patients to consistently consume folic acid-rich diets dominated by the intake of fresh fruits and vegetables. Furthermore, researchers had gone as far as arguing that pharmacists were to educate patients on eating these types of natural foods as opposed to consuming supplements, as those were often short in the appropriate amount of folic acid, and had been linked to different types of cancer (Khan & Jialal, 2019).

According to recent data, dietary counseling was on the rise in the US, and had been found to be preventing the development of deficiency and supplementing folic acid to high-risk individuals, but such studies were concentrated on a predominantly Caucasian, wealthy population who could afford to make the necessary lifestyle changes (Sutter, Gopman, & Leeman, 2017). Researchers had even gone so far as arguing that

folic acid deficiencies were ideally managed with a comprehensive interprofessional team, which included primary care physicians, internists, obstetricians, gastroenterologists, dieticians, pharmacists, and nurses for each individual patient (Khan & Jialal, 2019). Such teams of relevant stakeholders were considered important to cement the appropriate level of folic acid education in inspiring long-term behavior change in the individual patient (Khan & Jialal, 2019). The appropriateness of such interventions in the United States would be discussed in the section on poverty. What could be noted from above was that obesity and poor health maintenance was likely to cause and significant contributing factor to the low periconceptual folate levels observed in the United States population.

Many researchers argued that pregnancy was key opportunity for women to implement long-term healthcare changes as they were related to healthy diets (Hussein & Abbas, 2019). Unlike the majority of studies on the importance of diet, Hussein and Abbas (2019) took theirs step further, arguing that physical activity was also an essential part of the process of improving health maintenance to increase folic acid and other supplement intake, as reducing one's weight increases the amount of folic acid absorbed by the body. However, the confounding variable of poor mental health had been associated with an inability to adhere to positive health maintenance prior to and during pregnancy for women (Sattler et al., 2017).

Though the topic of mental health will be further explored in later sections as a significantly growing body of literature concerning folic acid intake, it was important to note how all the variables concerning poor folic acid intake were related to each other.

Those women experiencing poor health maintenance like obesity had lower folic acid levels than nonobese women, but the pressure placed on them to lose weight could often had the adverse effect, and further limit their ability to practice positive healthcare (Sattler et al., 2017). Such behaviors had not been investigated to the extent that any generalizations could be made about the impact of obesity, mental health, and folic acid intake in the United States population, a significant limitation in research that had a direct negative impact on policy and intervention implementation (Sattler et al., 2017).

Negative mental health as a result of obesity and other poor health choices had been found to limit individual help-seeking behaviors and healthcare utilization, meaning that many mothers were not educated or aware of the importance of folic acid intake on the health of their infant (Olander, Smith, & Darwin, 2018). Olander et al., (2018) concurred with the argument put forward by Hussein and Abbas (2019), that pregnancy had consistently been described as a key period for change in a woman's life as it related to health behavior, but that healthcare guidelines failed to appreciate the impact those changes had on an individual's life, and therefore fall short on making any positive change. Of course, these guidelines were only available to those women who searched for it in the US, whereas those who did not were left without any of the relevant data to support the health intake of folic acid (Olander et al., 2018).

On top of this consistent finding, it was also noted that the cost of receiving adequate healthcare to promote such changes in behavior often fell outside of what the average United States woman could afford, introducing the variable of poverty to the discussion of health maintenance (Olander et al., 2018). Unlike most developing and

developed country, the United States did not provide universal healthcare for its tax-paying citizens, leading to a plethora of social issues that could be traced back to issues of poverty, poor health maintenance, and mental health in general, not just in relation to folic acid intake (Khan & Jialal, 2019; Olander et al., 2018). The significant cost of healthcare in the United States led to many women avoiding seeking out education and awareness on ways of improving their health during pregnancy (Singh et al., 2018). That could influence rates of obesity and poor health choices that contribute to the malnutrition of women too (Singh et al., 2018).

In conclusion, it could be argued that poverty and mental health and poor health maintenance work in a feedback loop within the United States population, contributing to low periconceptual folate levels amongst racially diverse populations. Further research was requested to observe whether the relationship was causal or cyclical. What could be drawn from the literature was the importance of recommending high vegetable and fruit-based diets to women across the US, regardless of their intention to conceive as 50 percent of those women who would fell pregnant would do so unplanned. Improving their folic acid levels might be the only way to adequately ensure appropriate periconceptual folate levels (Kirkpatrick et al., 2020). Even still, barriers to improving health maintenance were essential to policy. The following section continued with a discussion of the literature related to poverty.

Poverty. Most of the literature related to poverty and folic acid intake came from developing countries, where large-scale intervention programs could be implemented under socially led healthcare systems (Schulze et al., 2019). By not charging their citizens

for healthcare, countries like Australia and the United Kingdom were able to educate their female population on the importance of periconceptual folate levels, but limitations still existed in how to reach rural and lower socio-economic demographics (Mahomed & Stanton, 2018). In developing countries, where women often made less than a dollar a day, food sources could be rich in folic acid as such communities depended on at-home gardens to grow fruits and vegetables and rear animals (Schulze et al., 2019). However, in developed countries like the United States and the Commonwealth states, foods and supplements rich in folic acid were often priced too high for the average consumer (Charlton, 2016).

In research conducted by Charlton (2016), which focused on how the poorest members of America survive on just $2 a day, it was found that adequate folic intake was often half of the recommended 4000mg/day. Charlton (2016) noted that, had she been pregnant, she would not have been able to afford any of the folic acid needed to both prepare for pregnancy and stay healthy throughout. Such a finding was significant, as the increased pressure of having long-term negative consequences from low folic acid intake in the form of NTDs or other folic-acid deficiency-related disorders would further compound financial pressures on the mother and child (Charlton, 2016).

A reigning paradigm in the research related to poverty linked low folic acid intake to poor food choices and dietary issues, rather than health behaviors and maintenance. The trend in research was likely due to people living below the poverty line in the United States being unable to afford to see any doctors who could recommend ongoing treatments (Ashraf, Ashraf, & Ozturk, 2018). Some researchers had gone so far as to

arguing that the relationship between poverty and poor dietary standards could be broken by improving food intake quality, as most Americans were forced under the poverty line due to unexpected or chronic illness, either to themselves or a family member (Ashraf et al., 2018). By reducing the instances of unexpected or chronic illness through improvements to diet, families would spend less on healthcare costs, and could instead gradually move out of the poverty cycle (Ashraf et al., 2018).

In terms of folic acid intake, a British study found that women living below the poverty line in London often did not understand the benefits or optimal time to take folic acid in the periconceptual stage of pregnancy (Garcia et al., 2018). However, unlike many areas of understanding in this research, appropriate intervention programs were developed and tested to improve periconceptual folic acid intake amongst women from deprived neighborhoods. For example, in 2011, Gootjes et al. (2019) launched the Smarter Pregnancy mobile health (mHealth) coaching program in the Netherlands. The mHealth coaching program has consistently been found to have a positive effect on improving inadequate nutrition and lifestyle behaviors in women before and during pregnancy (Gootjes et al., 2019). Gootjes et al. (2019) used international evidence and data to discover that in deprived neighborhoods, risk factors for negative pregnancy outcomes, such as inadequate nutrition and lifestyle behaviors, could accumulate quickly through normalized community ignorance and access to affordable healthcare.

Gootjes et al. (2019) performed a quantitative analysis on data from women who used the Smarter Pregnancy program between the years of 2011 to 2016 in understanding the nature of its effectiveness in deprived neighborhoods. The program was inherently

comprehensive, being comprised of 24 weeks of coaching on five different nutrition and lifestyle behaviors, of which adequate intakes or lifestyle behaviors were defined as an intake of 200 grams or above of vegetables, 2 pieces of fruit, daily folic acid supplement use of 400 µg per day, and no smoking or alcohol consumption.

It was found that overall daily vegetable intake was inadequate at the start of the study, but further findings related to the following section on mental health. For example, Gootjes et al. (2019) found that women from non-deprived neighborhoods smoked less often, consumed alcohol more often, and were less likely to complete the 24 weeks of coaching. These results were significant, suggesting that the relationship between poverty and help-seeking behaviors prior to and during pregnancy might be more prevalent for poorer demographics (Gootjes et al., 2019). Though the current study found that the Smarter Pregnancy Health coaching program could and continued to empower women into improved nutrition and lifestyle behaviors prior to pregnancy, whether such an intervention would work in the United States was currently unknown.

Unexpectedly, the program seemed more effective in women living in deprived neighborhoods, which might shed light on the importance of free healthcare and information on folic acid intake for women living below the poverty line on rates of consumption. As a result of these findings, Gootjes et al. (2019) argued that it was important to unravel differences in needs and behaviors of specific target groups to further tailor the mHealth program based on demographic characteristics like neighborhood deprivation. Some researchers had taken such findings a step further,

noting that folic acid intake has a drastic impact on a child's psychosocial development (Henry et al., 2018).

In a sample of children aged 6-7 whose mothers received folic acid throughout pregnancy and those who only received it during their first trimester, findings suggested a significant relationship between folic acid intake and emotional intelligence and resilience (Henry et al., 2018). Those children whose mothers only receive folic acid during their first trimester had significantly lower emotional intelligence scores, suggesting that in poverty-stricken neighborhoods where expectant mothers were unable to receive adequate periconceptual folic acid intakes, cycles of deprivation may be linked to physical disparities in developmental emotional intelligence (Henry et al., 2018). However, Henry et al. (2018) argued that significant further research was needed in order to draw any policy developments from such a finding. What could be argued from the finding was that there might be a significant relationship between folic acid and mental and emotional capabilities health that transcended the barrier for maternal periconceptual consumption. The following section continued with a discussion of the literature related to mental health as a potential variable for limited access and/or intake of folic acid.

Mental health. Women's mental health during and prior to pregnancy was a significant factor that limited healthcare and help-seeking behaviors (Franks et al., 2017). One of the most significant contributors to declining mental health was socio-economic deprivation and poverty, suggesting that a lack of financial resources led women to developing poor mental health, and therefore did not evolve their lifestyle choices to accommodate their new physical state (Franks et al., 2017). Within the research on

pregnant women in the United States, and racial disparities in care, most of the recent research had focused on the evolution in macro-mental health being experienced across the United States.

Pregnant women who had been found to be negatively affected by mental health issues, often in the form substance abuse, often encountered other barriers to treatment, including “housing insecurity, poverty, mental health issues, social stigma, and access to health care” (Sutter et al., 2017, p. 5). That led many researchers to argue that healthcare providers might lack the resources needed to provide quality care, and that those women most in need of such periconceptual care were unable to afford it, if they were aware of it in the first place (Sutter et al., 2017). Sutter et al. (2017) argued that clinicians who offered prenatal care to women with mental health and substance use disorders and addiction disorders were also to be encouraged to support family-centered, multidisciplinary care to women and their infants, focusing on harm reduction via increased access to folic acid supplements. However, in the United States, such care is almost impossible for women with mental health issues, as they were the least likely demographic to afford them or have any appropriate healthcare coverage (Brown et al., 2016).

Interventions for mental health were desperately needed across the US, as suicide was found as one of the leading causes of death amongst pregnant women (Zhong et al., 2018). Rates of suicidal behavior amongst expectant mothers was largely unquantified and not understood within academic or scientific literature to any significant degree (Zhong et al., 2018). What was known was that women with opioid use, prescription drug

use, and with adverse living situations (ie: poverty, abusive partner) were more likely to suffer from suicidal tendencies and therefore had negative health outcomes during pregnancy for both them and their infant, often related to a lack of appropriate dietary intake (Gonzales et al., 2019). Substance abuse in nonpregnant adults was associated with increased intake in calories and decreased intake of nutrient-dense foods; however, studies examining dietary intake in opioid-using and alcohol-using pregnant women are lacking.

Research that focused on evaluating dietary intake in opioid-using pregnant women with or without concurrent light-to-moderate alcohol use as compared to abstaining controls found that the negative impact that the substances had on one's mental health led directly to lesser levels of folate intake (Shrestha et al., 2018). That was identified in one study that used a prospective birth cohort of 102 pregnant women who had been classified into four different study groups: (1) controls, (2) medication-assisted treatment, (3) alcohol, and (4) concurrent use of both substances. In order to identify the impact, the different demographics had on dietary intake and mental health, percentage differences in macro- and micronutrient intake were estimated from the food frequency questionnaire and compared among the study groups (Shrestha et al., 2018).

Individuals exhibiting negative mental health as a result of their opioid and/or alcohol addiction were found to have micronutrient intakes below the estimated average requirements, based on diet and diet with supplements were estimated, suggesting that addiction had a physical impact on the way the body could absorb micronutrients like folic acid (Shrestha et al, 2018). What was also important about the research conducted

by Shrestha et al. (2018) was that the three exposed groups each had lower prevalence of multivitamin use in periconceptional period than controls, making it one of the few studies to look at a disadvantaged population during the periconceptual period of pregnancy. Furthermore, participants in all study groups had dietary intake below the recommended amount for vitamin E, iron, and folic acid, suggesting that folic acid was generally low in the population (Shrestha et al., 2018). Discerning between the two findings was a core requirement for ongoing research, as it might be that either (a) opioid and alcohol issues had a physical impact on the ability of the body to absorb folates and other micronutrients, (b) that the general population had low folic acid and micronutrient levels and need to be targeted as a whole, or (c) both were true, and needed to be addressed appropriately.

Discerning between general population trends and those associated with the macro-mental health decline of the United States population in general were desperately needed to fill the gap in research (Krans et al., 2018). Some researchers argued that the loops between mental health, poverty, and poor health lifestyles related to addiction were so intertwined at this point in our development that researchers were to concentrate on normalizing folic acid intake amongst the general population as a consistent, daily habit (Krans et al., 2018; Yusuf et al., 2019). To limit such education to pregnant women seemingly had not worked through scientific research, whereas community-based interventions tended to have far higher success rates than individual approaches.

Summary

To conclude the literature review, it was first important discussing the key findings and paradigms identified throughout the literature. They included: (a) the use of the AAM are a core conceptual framework in guiding the study; (b) the importance of folic acid within the dietary intake of all women across the US, as levels were seemingly low regardless of any specific demographic variables; (c) the continued prevalence of systemic racism and unconscious biases in the United States healthcare system (Vesco et al., 2020) and evidently within the research conducted in the topic as studies into Black women's periconceptual folate levels were few and far between; (d) the emphasis of studies seeking to reduce the weight-related issues of pregnant women, particularly amongst Latinas living in the United States and abroad; (e) the importance of community support and education (Wen et al., 2018); (f) a focus on supplement intake and the best means of improved access to supplements high in folic acid; (g) the importance of awareness and education of folic acid and its impact on physical health and functioning of women in general, globally; (h) poverty as key factor that limited American women's access to healthcare education and folic acid.

The most notable finding from the review of relevant literature was the prevalence of the relationships between poverty, mental health, and poor health maintenance. Suicide was then one of the leading causes of maternal mortality, a concern for doctors across the United States (Zhong et al., 2018) suggesting that, in general, mental health was a paradigm of concern for physicians in general. However, within the research related to folic acid, most studies pointed to either lack of awareness or lack of access as the only

reasons why women were limited in their folate levels. Whether or not the lack of access was perpetuated in its entirety by the levels of poverty experienced in the United States was currently unknown, as poor mental health could be triggered and/or trigger women to fell into poverty (Zhong et al., 2018). As appropriate levels of periconceptual folate levels mitigated the potential for a plethora of disorders and NTDs that had a high cost associated with them under the United States system, it could be argued that by increasing periconceptual folate levels nationally, the healthcare systems currently in the place in the United States would alleviate the cost to consumer then, potentially impacting racial diverse demographics.

Using the research conducted by Bibbins-Domingo et al. (2017), it was clear that all of the negative impacts of low periconceptual folate levels could be mitigated, but the barriers to awareness, understanding, and healthcare utilization were still largely misunderstood, conflated within research, and highly diverse in their regional findings, suggesting that it might be a States issue, not a Federal concern. Understanding the very nature of the gap was of utmost importance to developing intervention strategies to increase positive healthcare outcomes for women across the US. It was hoped that then the study would fill the gap in understanding and allowing for programs to be developed that followed the findings of Bibbins-Domingo et al. (2017).

Another key finding that could be drawn from the literature in the section was that Black women continued to be identified as the most at-risk group for low periconceptual folate levels across the US. Again though, the exact reason for the finding could not be identified throughout the strategic search of recently published literature. Those

assumptions that could be made regarding the finding suggested that the disproportionate number of Black women experiencing poverty and/or cycles of decline and mental health in the United States were significantly higher than for any other racial demographic. However, further research was needed to truly understand the nature of the same relationship. Finally, the AAM would be extended through the same course of research as no prior studies had used the model to test the efficacy of the ACA in reducing the racial gap in periconceptual folic acid levels. Chapter 3 continued with a discussion of the methodology to be employed in the study.

Chapter 3: Research Method

The purpose of this quantitative study was to determine whether there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017 pre- and post-ACA, after controlling for age, education, marital status, and income. Chapter 3 includes an overview of the methodology used for the study. The overview includes the study design, population, sampling method, sample size, instrumentation, and data analysis methods. Ethical considerations and study limitations are also described.

Research Design and Rationale

I employed a nonexperimental quantitative study with a correlational design to determine whether there were relationships between folic acid concentration and periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017. A qualitative approach was not appropriate because the study did not focus on exploring a phenomenon or establishing a theory, model, or definition (Allwood, 2012). In contrast, quantitative research methodology involves numerical data that allow for statistical analyses, help reduce biases, and based on an objectivity paradigm (Bowers, 2017). Quantitative research measures include statistical, mathematical, or numerical analyses of data collected through questionnaires and surveys or by the manipulation of pre-existing statistical data using computational techniques.

A nonexperimental quantitative methodology with a correlational design was most appropriate for several reasons. First, the study included numerical data that were analyzed to test hypotheses (McCusker & Gunaydin, 2015). Second, the choice of a

nonexperimental quantitative method with a correlational design ensured research objectivity, as the researcher was separated from the research participants (McCusker & Gunaydin, 2015). Third, there was no manipulation of independent variables; thus, the study was a nonexperimental quantitative method with a correlational design (McCusker & Gunaydin, 2015). Additionally, a nonexperimental quantitative method with a correlational design was suitable for the study because the objective was to identify and evaluate the relationship between the dependent variable and the independent variables. The dependent variable folic acid levels was measured at the nominal level of measurement. The independent variable for the first research question was race (Black and Hispanic or and non-Hispanic White) and the covariates were age, education, marital status, and income. The independent variable for the second research question was time period measured at the nominal level of measurement and covariates were race, age, education, marital status, and income. There were no anticipated time or resource constraints in conducting this study.

Methodology

Population

In 2018, the total number of women in the United States between the ages of 15 and 44 was 64.16 million (U.S. Census Bureau, 2020). Data were utilized from the publicly available NHANES. NHANES is a stratified multistage probability survey designed to represent the civilian, noninstitutionalized U.S. population each year (NCHS, 2018).

Sampling and Sampling Procedures

The study involved purposive sampling, which is a nonprobability sampling technique in which the researcher relies on his or her own judgment when choosing members of population to participate in the study based on characteristics of a population and the objective of the study (Yang & Banamah, 2014). Purposive sampling was chosen because it had certain advantages applicable for the study. These included greater accessibility, faster speed, and lower costs associated in recruiting samples for the study (Coy, 2008). A purposive sampling strategy was also chosen for the study because participants needed to meet a specific set of inclusion criteria to be eligible to participate in the study (Yang & Banamah, 2014). The inclusion criteria of the study were periconceptual women who participated in the blood draw portion of the NHANES studies between 2009 and 2017.

A priori power analysis was originally conducted using G*Power v 3.1.9.2 to determine the required minimum sample size for the study. Four factors were considered in the power analysis: significance level, effect size, the power of the test, and statistical technique. The significance level, also known as Type I error, refers to the chance of rejecting a null hypothesis given that it is true (Haas, 2012). Most quantitative studies make use of a 95% confidenece level because it adequately provides enough statistical evidence of a test (Creswell & Poth, 2017). The effect size refers to the estimated measurement of the relationship between the variables being considered (Cohen, 1988). Cohen (1988) categorized effect size into small, medium, and large. Researchers like Berger, Bayarri, and Pericchi (2013) have suggested that a medium effect size is better,

as it creates a balance between being too strict (small) and too lenient (large). The power of test refers to the probability of correctly rejecting a null hypothesis (Sullivan & Feinn, 2012). In most quantitative studies, an 80% power is usually used (Sullivan & Feinn, 2012). The statistical test used for the study was binary logistic regression. In order to conduct binary logistic regression to detect a medium effect size of odd ratio (OR) = 1.72, at the 5% level of significance with 80% power, a sample size of at least 196 was required. The G*Power parameters and estimate of minimum sample size required to conduct binary logistic regression are shown in Table 1.

Table 1

Logistic Regression for Sample Size

Input	Tail(s)	Two
	Odds ratio	1.72
	Pr(Y=1|X=1) H0	.2
	α err prob	0.05
	Power (1-β err prob)	.80
	R^2 other X	.1
	X distribution	Normal
	X parm μ	0
	X parm σ	1
Output	Critical z	1.9599640
	Total sample size	196
	Actual power	0.8004803

Note. Large sample *z* test, Demidenko (2007) with var corr. A priori to compute required sample size

The calculation of a minimum sample size for logistic regression required previous knowledge such as the expected OR (effect size), a proportion of observations in either group of the dependent variable, and the distribution of each independent variable. If they were not known, it was best to use an estimate to determine an appropriate sample size. Hosmer, Lemeshow, and Sturdivant (2013) suggested a minimum sample of 10

observations per independent variable in the model could be used but cautioned that researchers should seek 20 observations per variable if possible. But LeBlanc and Fitzgerald (2000) suggested a minimum of 30 observations per independent variable. Using the calculation suggested by Leblanc and Fitzgerald, I calculated a minimum sample size as 30 times the number of total independent variables calculated as 30 x 6 = 180 participants. Taking both estimates of minimum sample size into account from G*Power and the recommended rules of thumb provided by Hosmer, Lemeshow, and Sturdivant, 200 cases were sought.

Data Collection

Secondary data were obtained from the publicly available NHANES, a stratified multistage probability survey designed to represent the civilian, noninstitutionalized U.S. population each year (NCHS, 2018). Periconceptual women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 were included in the study. The NHANES population sample was selected through a random statistical process based on U.S. Census information by the CDC. The NHANES combined health interviews and physical examinations to evaluate the health and nutritional status of the noninstitutionalized civilian U.S. population. Data collected from the NHANES were used to develop public health and safety policies, create health programs and services, and deepen the understanding of health for the Nation. National standards for height, weight, and blood pressure were believed to be benchmarked on the data collected by the NHANES. The data are also used to assess the incidences of major diseases and the risk factors for diseases. Lastly, the NHANES data are also used to establish U.S. residents'

nutritional status and its effect on promoting health and mitigating the development of diseases (CDC, 2016).

To gain access of the data from the NHANES, the CDC's website was accessed and was directed to the subsection on the NHANES where the datasets were available for download. NHANES is publicly available data set, thus, no permission is required for access. The NHANES was considered a very reliable data source. The NHANES surveys have been widely used in epidemiological research. The NHANES has been conducted periodically since the early 1960's and became a continuous survey with data released every two years since 1999 (CDC, 2016). Honda (2014) evaluated the test-retest reliability of the NHANES 2011–2014 protocol involving 77 adults at baseline and 2.5 weeks. Intraclass correlations ranged from $r = 0.47$ to $r = 0.71$ (moderate to strong). The findings indicated that the NHANES protocol had acceptable or good levels of test-retest reliability. Women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 would be included in our study. The variables that would be included in the data set included age, race, education, marital status, income, and folic acid levels.

Operationalization of Variables

Categorical variables (i.e., nominal variables) would be dummy coded for the purpose of regression (Field, 2013). As an example, the nominal variable race had two categories: Black and Hispanic, and non-Hispanic White. The variable would be dummy coded where a value of "0" signified Black and Hispanic and "1" signified non-Hispanic White. Highest education level measured in the NHANES were categorized into the

following categories: Less than 9th grade education, 9-11th grade education (included 12th grade and no diploma), High school graduate/graduate equivalence degree (GED), some college or associates degree, and college graduate or higher. Marital status had the following categories: married, living with partner, widowed, divorced, separated, never married. Lastly, income was categorized into the following annual household income: 0 - $4,999; $5,000 – $9,999; $10,000 - $14,999; $15,000 to $19,999; $20,000 to $24,999; $25,000 to $34,999; $35,000 to $44,999; $45,000 to $54,999; $55,000 to $64,999; $65,000 to $74,999; $75,000 to $99,999; and $100,000 and Over. Table 2 provides information about the variables that were used in this study.

Table 2

Variable Definitions

Variable	Description	NHANES Variable Name	Normal Range or Expected Values	Variable Type
Independent Variable	Race	NA	0=Black and Hispanic 1=Non-Hispanic White	Categorical
Dependent variable	Red Blood Cell folate level(ng/mL)	LBDRFO	1=Normal (2-20 ng/mL) 2=Abnormal	Binary
Covariate	Age	RIDRETH1	Numeric	Continuous
Covariate	Education	RIDEDUYR	1 = No HS Diploma 2 = HS Grad 3 = Some College 4 = College Degree 5 = Degree Plus	Categorical
Covariate	Ethnicity	RIDRETH1	1 = Mexican American 2 = Other Hispanic 3 = Non-Hispanic White 4 = Non-Hispanic Black 5 = Other	Categorical
Covariate	Marital Status	DMDMARTL	0 = Single (Divorced; Separated; Never Married) 1 = Not single (Married; Living with Partner)	Categorical

Covariate	Income	RIDINCYR	Twelve income categories (0 - $4,999; $5,000$9,999…$100,000 and Over)	Categorical

Data Analysis

Descriptive statistics of the data for the predictor and dependent variables would be reported. Frequency and percentages summary were obtained for categorical variables while the measure of central tendencies of means and standard deviations and minimum and maximum values would be conducted for continuous demographic variables, such as age.

Analysis of the resulting quantitative data would be conducted using the statistical software suite Statistical Package for the Social Sciences (SPSS) version 23. The data would be cleaned by examining the dataset for missing data (Field, 2013). If a value missed, the entire case was to be removed from the analysis (listwise deletion). In listwise deletion, a case was dropped from an analysis because it had a missing value in at least one of the specified variables. The analysis was only run on cases which had a complete set of data.

The following research questions and hypotheses were addressed in the study:

Research Question 1: Is there a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income?

$H_0$1: There is no significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

H_a1: There is a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

Research Question 2: Is there a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income?

$H_0$2: There is no significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income.

H_a2: There is a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income.

Due to the nature of the research questions, binary logistic regression was the best fit for data analysis for the study. Binary logistic regression analysis was used to predict a dichotomous dependent variable, folic acid level (normal or abnormal) in the case, based on independent variables, race and time period (Mertler & Vannata, 2013). Additionally, binary logistic regression analysis also determines the overall fit and the relative contribution of each of the predictors to the total variance explained (Mertler & Vannatta, 2013). In binary logistic regression, covariates might be added to the model to control for

the effects they may had. The odds ratio was calculated for each independent variable which was interpreted as the odds of the having the folic acid level (normal or abnormal) based on the category of each independent variable. However, prior to conducting binary logistic regression, there were assumptions that had to be met. They included linearity between the continuous independent variables and the logit transformation of the dependent variable, absence of multicollinearity, and absence of significant outliers (Laerd Statistics, 2019). Linearity was tested using the Box-Tidwell procedure (Laerd Statistics, 2019). Multicollinearity was tested by calculating variance inflation factors (VIF) and any VIF over 9 was considered evidence of multicollinearity (Laerd Statistics, 2019). Standardized residuals were calculated to test for outliers. Any residual over 2.0 was considered an outlier (Laerd Statistics, 2019). Once the assumptions were tested, to explore the first research question, the independent variables of age, education, marital status, income, and race were entered in SPSS. The dependent variable folic acid level was then entered. Significance was assessed at the 5% level, thus any *p*-value less than or equal to 0.05 was deemed significant. To test the second research question, the independent variables of age, education, marital status, income, race, and time were entered in SPSS. The dependent variable folic acid level was then entered. Significance was also assessed at the 5% level.

Threats to Validity

Validity consists of two types: external and internal validity. External validity refers to the degree in which the results of the study can be generalized to the population. Studies utilizing convenience sampling present challenges to external validity (Etikan,

2016). Studies that involve purposive samples may have issues with the generalizability of the study findings to broader populations of interest (Etikan, 2016). The use of random sampling by the NHANES program allowed for generalizability and high external validity (Kukull & Ganguli, 2012). The results of the study was generalized to the larger population of adult females.

Internal validity refers to the validity of the findings within the research study. Testing hypotheses can involve threats to the validity of interpretation for quantitative researchers. Quantitative research may involve rejecting null hypotheses or failing to reject null hypotheses (Martin & Bridgmon, 2012). Consequently, threats to conclusive findings occur when quantitative researchers encounter a Type I error, which involves rejecting a valid null hypothesis (Ibrahim, Ghani, & Embat, 2013). In the study, the assumptions of binary logistic regression were tested to make sure that there were no violations. Ensuring the assumptions were met and was threat to statistical conclusion validity which resulted in increased power of the statistical test, which refers to the probability of correctly rejecting a null hypothesis (Sullivan & Feinn, 2012).

Ethical Considerations

Before initiating the study, I obtained IRB approval from Walden University (approval no. 05-15-20-0658113). Because an existing dataset was used, the study did not require informed consent procedures. Data was retrieved from the publicly available NHANES. The NHANES survey personnel collected informed consent forms from the study participants and no names were collected during the data collection process. Because participants were not identifiable in the data, no special precautions were

required to safeguard anonymity of participants. The electronic information was stored in a password protected computer. All the information relating to the study was to be discarded five years after the completion of the study. At that point, the electronic data would be permanently deleted from the computer. I was the only person who had access to the data.

Summary

The purpose of this quantitative study, using binary logistic regression, was to determine if there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women, and non-Hispanic White women for the years 2009-2017, pre- and post-ACA, after controlling for age, education, marital status, and income. A convenience sample of women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 were used. The chapter provided a comprehensive description of the quantitative correlational research design used for my study. The results and findings from the data analysis are presented in Chapter 4, along with the tables and graphics providing the descriptive results and inferences regarding the underlying connection between the study variables.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to determine whether there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017 pre- and post-ACA, after controlling for age, education, marital status, and income. The research questions addressed whether there is a significant difference in folic acid levels and whether there is a significant difference in the gap in folic acid levels, after controlling for race, age, education, marital status, and income. In this chapter, I discuss the study's population and sample as well as a demographic description of the sample. Demographic descriptions include frequencies and percentages for categorical (nominal) variables and descriptive statistics of minimum, maximum, mean, and standard deviation for variables measured at the interval level of measurement. Also presented are the testing of parametric assumptions for the statistical analysis and results of hypothesis testing. The chapter concludes with a discussion of the results of this study.

Data Collection

Secondary data were obtained from the publicly available NHANES, a stratified multistage probability survey designed to represent the civilian, noninstitutionalized U.S. population each year (NCHS, 2018). Periconceptual women who participated in the blood draw portion of the NHANES studies between 2009 and 2017 were included in the study. The NHANES population sample was selected through a random statistical process based on U.S. Census information by the CDC. The NHANES combines health

interviews and physical examinations to evaluate the health and nutritional status of the non-institutionalized civilian U.S. population. The data were downloaded from the CDC's website. NHANES is publicly available data set, thus, no permission was required for access.

The variables for folate level (low/high), race (Black and Hispanic women and non-Hispanic White), age, education level, income, and marital status were re-coded for the purpose of analysis. Categorical variables (i.e., nominal variables) were dummy coded for the purpose of regression (Field, 2013). As an example, the nominal variable race had two categories: Black and Hispanic, and non-Hispanic White. The variable was dummy coded where a value of "0" signified Black and Hispanic and "1" signified non-Hispanic White. Highest education level measured in the NHANES were categorized into the following categories: less than ninth grade education, ninth-11th grade education (includes 12th grade and no diploma), High school graduate/GED, some college or associates degree, and college graduate or higher. Marital status had the following categories: married, living with partner, widowed, divorced, separated, never married. Lastly, income was categorized into the following annual household income: $0 to $4,999; $5,000 to $9,999; $10,000 - $14,999; $15,000 to $19,999; $20,000 to $24,999; $25,000 to $34,999; $35,000 to $44,999; $45,000 to $54,999; $55,000 to $64,999; $65,000 to $74,999; $75,000 to $99,999; and $100,000 and over.

Due to low frequencies in several of the categories for the nominal variables of education level, annual income, and marital status, the variables had to be re-coded for the purpose of logistic regression. Regarding education level, it was categorized into low

(coded as 0) or high (coded as 1), where low education level was high school or less and high education level was college or greater. Income level was dichotomized as well into low (coded 0) or high (coded 1), where low was considered below $55,000 and high was considered greater than or equal to $55,000. Lastly, marital status was either single (coded as 0) or not single (coded as 1). Not single included categories of married or living with partner, and single was any other situation.

Table 3 depicts demographic information regarding race, education level, marital status, and annual household income. The age of participants had a mean of M = 31.90 years and standard deviation of *SD* = 24.77. Most were non-Hispanic White, 3,066 (30.7%). Regarding education level, most had a college degree, 1,692 (17.0%), though 4,257(42.7%) did not provide a response. Most people were married, 2,886 (28.9%), though 4,255 (42.7%) did not provide a response. Lastly, annual income was stratified into 12 categories in the original data set. Most participants had an annual household income over $100,000, 1,634 (16.4%). It was followed by $25K to $34, 999, 1,017 (10.2%). The remaining categories had percentages less than 10%.

Table 3

Demographic Variables

Demographic	Frequency	Percentage
Race/Hispanic Origin		
Non-Hispanic White	3,066	30.7
Non-Hispanic Black	2,129	21.4
Mexican	1,921	19.3
Other	1,547	15.5
Other Hispanic	1,308	13.1
Total	9,971	100.0
Education Level		
College degree	1,692	17.0
College degree plus	1,422	14.3
Some college	1,236	12.4
No High school diploma	688	6.9
HS Grad	676	6.8
Missing	4,257	42.7
Total	9,971	100.0
Marital Status		
Married	2,886	28.9
Never Married	1,048	10.5
Divorced	614	6.2
Living with partner	555	5.6
Widowed	421	4.2
Separated	192	1.9
Missing	4,255	42.7
Total	9,971	100.0
Annual Household Income		
$100,000 and Over	1,634	16.4
$25,000 to $34,999	1,017	10.2
$35,000 to $44,999	960	9.6
$75,000 to $99,999	920	9.2
$45,000 to $54,999	789	7.9
$55,000 to $64,999	629	6.3
$20,000 to $24,999	627	6.3
$15,000 to $19,999	600	6.0
$10,000 to $14,999	537	5.4
$65,000 to $74,999	498	5.0
$5,000 to $9,999	373	3.7
$0 - $4,999	250	2.5
Missing	1,137	11.4
Total	9,971	100.0

The dependent variable was level of folate measured in nmol/ml. Folate levels ranged from 196.00 nmol/ml to 1080.00 nmol.ml (*M* = 552.91, *SD* = 207.09; see Table 4). Skewness and kurtosis statistics were within -3 to +3, indicating that the levels were normally distributed. A non-significant Shapiro-Wilk's test of normality also supported the normality assumption (*p* = .383; see Table 5). A histogram (Figure 1) also suggested an approximate normal distribution.

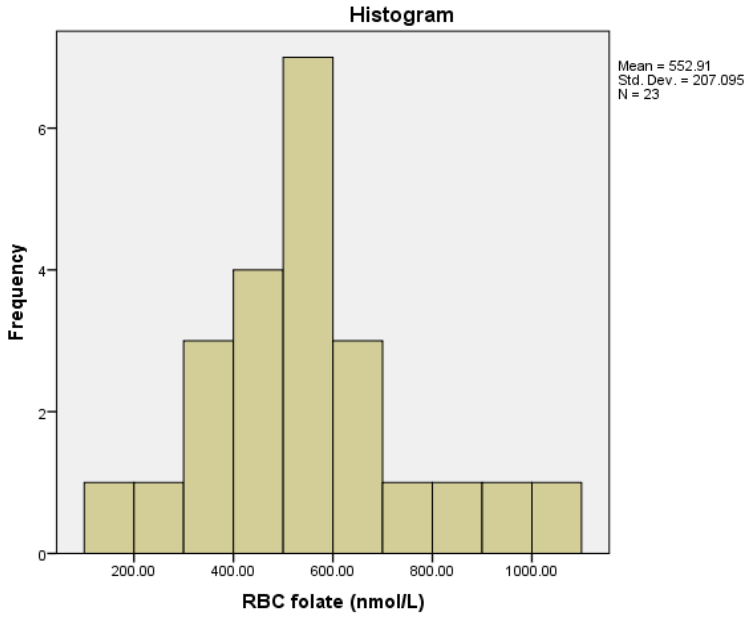

Figure 1. Distribution of folate levels measured in nmol/ml).

Table 4

Folate Levels

	Min	Max	*M*	*SD*	Skewness	Kurtosis
RBC folate (nmol/L)	196.00	1080.00	552.91	207.09	.790	1.048

Table 5

Shapiro-Wilk's Test of Normality

	Statistic	Df	*P*

RBC folate (nmol/L)	.956	23	.383

Results

The relationship between race, age, education, marital status, and income with folate levels were analyzed. One-way ANOVAs were conducted in order to determine if there were any significant differences in mean folate levels based on race, education, marital status, and income. Only marital status was found to be statistically significant, $F(5, 15) = 4.353$, $p = .023$. The mean folate level for married females was greater than all other categories ($M = 881.25$, $SD = 175.81$). The results of ANOVA are summarized in Table 6. Table 7 provides descriptive statistics of folate levels by marital status.

Table 6

ANOVA Results Based on Race, Educational Level, Marital Status, and Income

Demographic	df_1	df_2	F	p
Race	4	18	.102	.980
Education level	4	11	.169	.950
Marital status	5	10	4.353	.023*
Income	8	14	1.237	.348

Note: df_1 = degrees of freedom between subjects; df_2 = degrees of freedom within subjects *Significant at the 5% level

Table 7

Folate Level by Marital Status

Marital status	*M*	*SD*
Married	881.25	175.81
Widowed	728.00	0.00
Divorced	391.33	185.45
Separated	456.50	109.60
Never Married	493.67	207.51
Living with partner	455.67	76.25

Additionally, a Pearson correlation was conducted to determine any relationship between age and folate levels. There was no significant correlation (r = .318, p = .140). For the variables race, age, education, marital status, and income, only marital status was found to be significantly related to folate levels, thus it was kept in the analysis as a covariate. Non- single females (married or living together) had a higher mean folate level (M = 698.86, SD = 262.95) compared with single (M = 477.33, SD = 178.05). Additionally, non-Hispanic White females had a greater mean folate level (M = 563.78, SD = 249.63) compared with Black or Hispanic (M = 527.63, SD = 160.87).

Research Question 1

Binary logistic regression was conducted to address the first research question and hypotheses:

Research Question 1: Is there a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income?

$H_0$1: There is no significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

H_a1: There is a significant difference in folic acid levels between periconceptual Black and Hispanic women and non-Hispanic White women in 2017, after controlling for age, education, marital status, and income.

A binomial logistic regression was performed to ascertain the effects of race (Black and Hispanic women and non-Hispanic White women) on folic acid levels while controlling for marital status. The overall logistic regression model was statistically significant, $\chi 2(2) = 8.235$, $p = .016$. The model explained that 62.7% (Nagelkerke R^2) of the variance in folate levels and correctly classified 84.6% of cases. Although the model was significant, the individual predictors were non-significant. Although Non-Hispanic White women were more likely than Black and Hispanic women to have higher folate levels, the results were not statistically significant ($p = .335$). Tables 8 and 9 depict this information.

Table 8

Research Question 1 Classification Table

Observed		Predicted		
		FolateLevelCat		Percentage Correct
		Low	High	
Folate	Low	6	1	85.7
	High	1	5	83.3
Overall Percentage				84.6

Table 9

Variables in the Equation

	B	S.E.	Wald	*df*	*p*	*OR*	95% C.I.for EXP(B)	
							Lower	Upper
Marital Status*	-1.217	.647	3.535	1	.060	.296	.083	1.053
Race**	1.843	1.911	.930	1	.335	6.317	.149	267.635
Constant	.927	2.924	.100	1	.751	2.526		

Note. * Marital Status = "single" is the reference category
**Race = "Black and Hispanic" is the reference category

Research Question 2

Binary logistic regression was conducted to address the second research question and hypotheses:

Research Question 2: Is there a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income?

$H_0$2: There is no significant difference in the gap in folic acid levels in periconceptual women for the years 2009-2017, after controlling for race, age, education, marital status, and income.

H_a2: There is a significant difference in the gap in folic acid levels in periconceptual women for the years 2009-201, after controlling for race, age, education, marital status, and income.

Not all demographic information was available in the data sets from 2009-2017. Only marital status was controlled for in the analysis. Pre-ACA mean folate levels (*M* =

479.12, *SD* = 207.30) were lower than post-ACA (*M* = 502.73, *SD* = 212.57). Table 10 depicts this information.

Table 10

Folate Levels by Pre-Post Affordable Care Act

Affordable Care Act Pre-Post		*N*	Min	Max	*M*	*SD*
Pre-ACA	RBC Folate(ng/mL)	8,764	87.40	3,125.80	479.12	207.30
Post-ACA	RBC Folate(ng/mL)	24,426	50.30	2,980.00	502.73	212.57

This mean difference was statistically significant as indicated by a significant independent *t* test, $t(33188) = -8.978$, $p < .001$. Folate levels were dichotomized into low (coded as 0) or high (coded as 1) as before to conduct binary logistic regression. Controlling for marital status, the overall model was not found to be statistically significant, $\chi2(2) = 0.353$, $p = .838$. However, compared with post-ACA, folate levels pre-ACA had decreased odds of exhibiting higher levels of folate. In other words, pre-ACA folate levels had increased odds of lower folate levels. That, however, was not found to be significant when folate levels where dichotomized (*B* = -.145, *OR* = .865, *p* = .838). Table 11 provides this information.

Table 11

Logistic Regression for Research Question 2

	B	*S.E.*	Wald	*df*	*P*	*OR*	95% CI for OR	
							Lower	Upper
ACAPre_Post(1)	-.145	.256	.322	1	.570	.865	.523	1.429
Marital Status	.011	.059	.032	1	.859	1.011	.900	1.135
Constant	-.384	.256	2.254	1	.133	.681		

Note. OR = Odds ratio; *SE* = Standard error; *B* = coefficient

*The overall model was not found to be significant, $p = .838$.

Summary

The purpose of the quantitative study was to determine if there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women, and non-Hispanic White women for the years 2009-2017, pre- and post-ACA, after controlling for age, education, marital status, and income. Binary logistic regression was performed to address the research questions. Regarding the first research question, Hispanic White women were 6.317 times as likely than Black and Hispanic women to have higher folate levels ($B = .927$, $OR = 6.317$, $p = .335$). Although by itself race was not significant, the model collectively was significant indicating that race, age, education, marital status, and income improved the model accuracy. The second research question investigated folate levels between pre and post ACA time periods. There were statistically significant differences between pre and post ACA periods. Mean post-ACA folate levels were significantly greater than pre-ACA. After controlling for marital status, the effect was not significant, however, post-ACA individuals had a greater likelihood of higher levels of folate compared with pre-ACA. Chapter 5 includes a discussion of the results of the study interpreted in the context of the theoretical framework. Any limitations of the results of the study are provided. Additionally, recommendations for future research are discussed.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative study was to determine whether there was a significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017, pre- and post-ACA, after controlling for age, education, marital status, and income. After performing binary logistic regression analyses of the data, non-Hispanic White women were 6 times as likely than Black and Hispanic women to have higher folate levels. Although by itself race was not significant, the model collectively was significant, indicating that in addition to race, age, education, marital status, and income improved the model accuracy. The results showed no significance differences between pre- and post-ACA periods. Despite the mean post-ACA folate levels being significantly greater than pre-ACA folate levels, after controlling for marital status, the effect was not significant. However, post-ACA individuals had a greater likelihood of higher levels of folate compared with pre-ACA individuals.

Interpretation of Findings

The results of this study showed that there was no significant difference in folic acid concentration between periconceptual Black and Hispanic women and non-Hispanic White women for 2009-2017 post-ACA. This study confirms previous research that revealed that despite the implementation of ACA, there was no significant change in folate levels among the periconceptual Black and Hispanic women (Wong et al., 2019). Despite the hypothesis that improved access to affordable care would lead to greater intake of folic supplements among pregnant women in the United States, research has

suggested that intake of multivitamins like folic acid declined significantly within the pregnant female population among the disparities group (Wong et al., 2019). This means that there is still a gap in research pertaining to the racial disparities between women's periconceptual folate levels despite the increased policy to improve folate intake (Chilukuri et al., 2018). However, this study provides evidence that within the research related to folic acid, lack of access stood out as major reasons why women were limited in their folate levels. Whether the lack of access was perpetuated in its entirety by the levels of poverty experienced in the United States is currently unknown, as poor mental health could be triggered and/or trigger women to fall into poverty (Zhong et al., 2018). But it is arguable that by increasing periconceptual folate levels nationally, the healthcare systems currently in the place in the United States would alleviate the cost to consumers, potentially impacting racial diverse demographics.

In relation to the conceptual framework, the findings of this study corresponded with the AAM. The model is frequently used in academic research on prenatal and maternity care focused on the family as the specific unit of analysis (Andersen, 2008). For instance, researchers have found that living in disadvantaged neighborhoods significantly reduced the availability or access to care as well as individual motivation into help-seeking for medical conditions (Tolera et al., 2020). However, despite the growth in scholarly investigation using the AAM, there has been a focus on international research, so the associations between poverty and access to healthcare have gone unexplained as there was a widening supply of healthcare providers (Rocha et al., 2018; Shepherd-Banigan et al., 2017). The studies that have been conducted in the United

States on access to healthcare for lower socioeconomic status and racially diverse maternity and prenatal care focus on issues related to mental healthcare (Shepherd-Banigan et al., 2017). Specifically, the focus has been on substance abuse amongst expectant mothers (Stergiakouli et al., 2016). Alternatively, in international studies, the focus was on supplement intake amongst expectant mothers (Kirkpatrick et al., 2020), and access to healthcare along with spatial areas (Ameyaw et al., 2017; Qureshi et al., 2016). Barriers to healthcare in developing nations dominated the research utilizing the AAM (Shamaki et al., 2017), with data suggesting that rural communities continued to be at risk of poor pregnancy care (Okonofua et al., 2018). Unlike most studies conducted in the United States focused on poverty and mental health, international examples showed that alternative behaviors such as female autonomy were a key driver in appropriate periconceptual pregnancy care.

Research has revealed the existence of differential patterns in health service use and access by race/ethnicity and gender with many results confirming non-Hispanic Whites having the greatest gains in health service use and access in studies that involved Hispanic, non-Hispanic, and Black Americans. Various results have also identified significant progress of access to the services among Hispanic respondents from 2012 onwards. Consequently, various studies did not identify any significant changes pre-post health care reform, which indicated access might have been worsened before improving for this group.

The racial and ethnic disparities existence in health services use and access was well established. Studies have consistently indicated a lower likelihood of having a usual

source of care, fewer physician visits, and fewer health expenditures among racial/ethnic minority groups (Gallo et al.,1995; Swartz et al.,1998; Wells et al., 2001; Young et al., 2001; Alegria et al., 2002). Among specific racial/ethnic minority groups, research has suggested that Hispanic and Black individuals were less likely to initiate or receive outpatient mental health care or any other illness compared to White individuals.

Limitations of the Study

This study was limited in that it was a quantitative nonexperimental design and could not determine a causal relationship. Although the study was causal-comparative, further weakness was the inability to create random samples. There was no possibility of randomly choosing participants for the study and control groups because the events had been already taken place. Casual-comparative studies provided much weaker evidence of a causal relationship than an experimental study. Caution had been used in making such causal relationship claims. Another challenge related to the study could be to identify and control for known confounding variables, such as smoking, and excessive alcohol consumption, which had been associated with poor health maintenance. Second, the NHANES data included more than 300,000 records annually. The dataset included missing data and outliers, which would need to be addressed using either listwise of pairwise deletion depending on the circumstances. Finally, the generalizability of study findings could be limited due to unknown confounding variables.

Recommendations

The findings of this study may play a significant role by bringing attention to the required amount of folic acid to be consumed at a given period by pregnant women. The

findings could also provide useful information related to folic supplements for women, healthcare practitioners, and researchers. Education campaigns on a community-wide basis to encourage women of childbearing age to take folic acid supplements are recommended. This recommendation aligns with the approval of folic acid fortification of corn masa flour by the U.S. FDA, allowing manufacturers to voluntarily add folic acid to corn masa flour at consistent levels to those found in other enriched cereal grains. It is also recommended that the exploration of the quality of health care services studies be conducted from the perspectives of the service users in informing strategies of reducing long-standing disparities. In relation to the findings of this study, future research should include an exploration in understanding the role lack of awareness plays into decrease folate levels, and longer-term policy impacts of the ACA on a low-income, vulnerable **population**. Based on these findings, any future repeal of Medicaid expansion (ACA) and the removal of the individual mandate penalty may widen the disparities that were narrowed by the ACA, especially due to rise of insurance premiums. It is also important to study how coverage changes influence pregnant mothers and how changes may affect newborn babies at the individual level, as this study provides information about the larger population.

Implications

Individual Level

The study was essential to scientific research as it could play a significant role by bringing attention to the required amount/levels of folic acid to be consumed at a given period by pregnant women (4,000 mcg of folic acid each day for at least thirty days prior

to conception). The findings also create an awareness of the health importance/benefits of folic acid to the periconceptual and pregnant mothers such as providing them with a wide range of benefits, which includes reducing birth defects associated with the brain and spinal cord (Linhares & Cesar, 2017).

Family Level

According to the CDC (2019), folic acid helped in reducing birth defects in infants. Women who were actively planning for pregnancy were required to consume 4,000 mcg of folic acid each day for at least thirty days prior to conception (Linhares & Cesar, 2017). Taking folic acid reduced risks of birth defects related to the brain and spinal cord and increased the chances of infant survival (Linhares & Cesar, 2017).

Organizational Level

The study's original contribution could be to determine the efficacy of the ACA in the improvement of folic acid intake for periconceptual young Black and Hispanic women for use by public policymakers and medical community members concerned with reducing birth defects.

Societal Level

The study could also help policy makers in examining the need for additional interventions, beyond the ACA and medical community recommendations in improvement of folic acid intake for underserved periconceptual women. Study findings could also improve practice by clarifying whether at-risk group required incremental interventions to improve folate consumption. An opportunity for social change based on

study findings was that despite continuing efforts, racial gaps in healthcare outcomes persisted and deserve additional effort to improve social justice.

Social Change

The study supports the existence of the disparity between women's periconceptual folate levels despite the increased policy to improve folate intake. From the study results, it is evident that despite the implementation of policies, the racial disparity in healthcare is an ongoing issue that will remain relevant until a holistic understanding of the factors that contribute to this problem is considered. Potential positive social change could result if policymakers examine the need for additional interventions to improve folic acid intake for underserved periconceptual women.

Conclusion

In this study, I examined folic acid concentration between periconceptual Black and Hispanic women, and non-Hispanic White women for the years 2009-2017, pre- and post-ACA, after controlling for age, education, marital status, and income. The results of the study demonstrated that statistically significant differences in periconceptual folic acid levels between pre and post ACA periods in that the mean post-ACA folate levels were significantly greater than pre-ACA. After controlling for marital status, the effect was not significant, however, post-ACA individuals had a greater likelihood of higher levels of folate compared with pre-ACA. This study confirmation of the existence of differential patterns in health service use and access by race/ethnicity and gender with many results confirming Non-Hispanic Whites having the greatest gains in health service use and access in studies that involved Hispanic, Non-Hispanic and Black Americans. In

addition, the results confirmed significant progress of access to the health care services use and access among Hispanic and Black Americans respondents after ACA implementation. The findings of this study may add to the available research on racial disparities in periconceptual folic acid levels, however, there still exists ethnic/racial and gender disparities in post-health care reforms.

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