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The Association between Maternal Age and Low Birth Weight Offspring, NHANES 2007-2008

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B.S., Biology

GEORGIA STATE UNIVERSITY

A Thesis Submitted to the Graduate Faculty

of Georgia State University in Partial Fulfillment

of the Requirements for the Degree

MASTER OF PUBLIC HEALTH

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ATLANTA, GEORGIA

APPROVAL PAGE

The Association between Maternal Age and Low Birth Weight Offspring, NHANES 2007-2008

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ABSTRACT

Background: Low birth weight (LBW) is a public health issue in the United States and around the globe. Although Low birth weight is an important predictor of subsequent health outcomes, the role of maternal age as a LBW risk factor is poorly understood. Determining whether or not maternal age is a risk factor for low birth weight can help reduce the incidence of LBW and maximize the health of offspring.

Objective: This study examined the association between young mothers and LBW risk in a representative sample of Non-Hispanic Whites, Non-Hispanic Blacks and Hispanic American women. Factors such as mother's age, smoking status, level of education, income, and marital status were evaluated to assess their associations with LBW outcome.

Methodology: The selected study factors were analyzed using SPSS version 20. Data were obtained from the 2007-2008 National Health and Nutrition Examination Survey (NHANES). Young mothers were defined as females between the ages of 14 and19 years old that have a baby. A live born infant weighing less than 2,500 grams was considered to have LBW. Frequencies for the selected factors were created. Univariate and multivariate logistic regression analyses were also run to examine the association between young motherhood and LBW adjusting for maternal age, smoking, education, income and marital status.

Results: There was no statistically significant association between young mothers and LBW in Non-Hispanic Whites (OR=.51; 95% CI=.12-2.13), Non-Hispanic Blacks (OR=.21; 95% CI=.03-1.59), and Hispanic Americans (OR=1.48; 95% CI=.74-2.97)

women, after adjusting for maternal age, smoking, education, income and marital status.

Conclusion: Although, the results of this study indicating the lack of association between young mothers and LBW is consistent with findings by some investigators (Reichman et al., 1997), there are several studies that have reported contrary results (Okosun et al., 2000). In light of these mixed findings, further research is necessary to examine the impact of young mothers on adverse birth outcomes, including, LBW.

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CHAPTER 1

INTRODUCTION

1a. Background

Low birth weight (LBW) is an important indicator in public health because it can help to predict health outcomes later in life. A healthy start in life begins in utero and requires making sure that the mother goes through pregnancy and childbirth safely. For this reason, it is imperative that the incidence of low birth weight be minimized for optimal health. The World Health Organization and United Nations Children's Fund (UNICEF) published the first global, regional, and country estimates for low birth weight in 1992. Since then, the World Health Organization has set forth 8 Millennium Development Goals to be achieved by the year 2015. The purpose of these development goals is to help increase the health of billions of people around the world. Relevant to this study is Millennium Development goal number 4, neonatal causes, which is focused on the reduction of child mortality (WHO, 2013). Additionally, A World Fit for Children is the Declaration and Plan of Action adopted by the United Nations General Assembly in 2002 whose goal is to reduce low birthrate incidence by one third.

Across the world, 20 million low birth weights are recorded annually and this equates to 15.5% of all births (WHO, 2004). It is estimated that 8% of all babies born in the United States have low birth weight (Sachdeva et al., 2013). Although the majority of low birth weight babies are born in developing countries, low birth weight incidence continues to be a problem worldwide. The data on low birth weight babies are often underreported

because more than 40% of infants born in developing countries are not weighed and only approximately 60% of all births worldwide are registered (WHO, 2004). These babies, whose weights go unrecorded, are at a disadvantage because their birth weight, if low, associates them with fetal and neonatal mortality and morbidity, inhibited growth, cognitive development, and chronic diseases later in life (WHO, 2004).

The reasons why these babies are not weighed are varied including the lack of access to technology in some remote areas and offspring not born in facilities. The underreporting of births presents a problem in measuring the incidence of low birth weight offspring and impedes the ability to combat this important public health issue. In spite of these challenges, however, there is substantial evidence to link low birth rate babies to maternal age. Furthermore, research has shown that the complex nature of the body and its processes change over time and can have adverse effects on the health of offspring (Geronimus, 1996). Additionally, socioeconomic and behavioral factors such as smoking and the consumption of alcohol may be associated with differences in low birth baby rates between younger–aged and older-aged mothers (James, 1992, Stevens-Simon et al., 1988).

1b. PURPOSE OF STUDY

The purpose of this study is to assess whether young motherhood is associated with a low birth weight infant. This thesis will build upon previous research on the role of maternal age on low birth weight. There has been previous research completed which highlights several factors that can be major in determining the weight of an offspring.

While controlling for several variables, we will examine the association of maternal age with low birth weight in Non-Hispanic Whites, Non-Hispanic Blacks and Hispanic Americans using 2007-2008 NHANES data. Understanding race/specific association between maternal age and LBW is critical for prescribing race/ethnic specific interventions for averting the incidence of LBW in American populations.

1c. HYPOTHESIS

This study posits that young motherhood will be associated with greater odds of having low birth weight offspring. There are several factors that have influenced this hypothesis. One, young mothers are more likely to engage in risky behaviors that are linked to low birth weight babies such as smoking and alcohol use (Stevens-Simon et al., 1988). Two, these young mothers are also more likely to be unmarried, be of a lower socioeconomic status, earn less-wages, have less education, and inadequate prenatal care. These factors are precursors for delivering a baby who falls in the low birth weight category (Stevens-Simon et al., 1988). Three, young mothers are more likely to not be fully biologically developed, thus, inhibiting fetal intrauterine development, including low birth weight (Roth et al., 1998). The null hypothesis for this study is: there is no positive association between young motherhood and low birth weight offspring.

CHAPTER 2

LITERATURE REVIEW

The literature review will contain compiled research from various studies about low birth weight and maternal age. The review will be composed of several different risk factors that have been associated with giving birth to an offspring with low birth weight. These risk factors include maternal age, ethnicity, smoking, socioeconomic status, income, education, prenatal care and marital status. The literature is designed to understand the many factors and the way in which they are associated with low birth weight. There will be a review done of several studies concerning birth weight and the aforementioned risk factors. The results from those studies will be used to compile information.

2a. LOW BIRTH WEIGHT

Low birth weight is defined by the first weight of the fetus after birth. (WHO, 2004) For live births, it is suggested that the offspring's weight be taken within an hour before there is postnatal weight loss. (WHO, 2004) Low birth weight is when an infant weighs less than 5 pounds 8 ounces, which equates to less than 2,500 grams. This has been determined to be the cut off weight for LBW due to the increase in complications to offspring that do not possess this birth weight (WHO, 2004). A healthy and expected weight for an offspring is 2,500-3,999 grams. Weight has an impact on offspring mortality and morbidity and can be a good predictor of health problems later in the

child's life (Hussaini et al., 2011). Although the infant mortality rate has declined steadily over the past decades, the risk of infant mortality is 20 times higher for low birth weight babies when compared to normal weight babies (Hussaini et al., 2011). In addition, the infant mortality rate is 40 times higher in the first 28 days for LBW babies when compared to normal birth weight babies (Roth et al., 1998). Thirty eight percent of child mortality that occurs in the first month is directly related to birth weight (Nazari et al., 2013). Between 60-80% of all neonatal deaths can be attributed to low birth weight (Sachdeva et al., 2013).

Since the introduction of the neonatal intensive care (NICU) in the 1960's, however, low birth weight infants' outcomes have drastically improved (Hack et al., 2002). There are two processes that cause a child to be born with low birth weight and they are preterm birth (i.e., less than 37 weeks) and slow intrauterine growth (Hussaini et al., 2011). The underlying causes of LBW, however, are many. Research has shown that the mortality range can vary up to 100-fold across the spectrum of birth weight and rises continuously as the weight decreases (WHO, 2004). It is very difficult for researchers to get an accurate count of low birth weights because so many offspring are not weighed at birth. This means that low birth weight is more prevalent than the numbers suggest.

2b. MATERNAL AGE

For the purposes of this thesis and based upon previous research studies (Gibbs et al., 2012), the age range for young motherhood is considered to occur between the ages of 14-19 and 20-45 is considered older maternal age. Previous research has shown that

mothers, who are younger than 15 years of age, have the worst outcomes in relation to the health of their offspring (Reichman and Padilla, 1997). Each year, approximately 11% of all births worldwide are to mothers aged 15-19 years old (Gibbs et al., 2012). Research has shown an association of poor infant and child health with adolescent childbearing (Gibbs et al., 2012, Reichman et al., 1997, Stevens-Simon et al., 1988). These younger mothers are at a higher risk of having adverse birth outcomes such as low birth weight when compared to older mothers (Okosun et al., 2000). In a study conducted by Gibbs et al., 2012, there was a dose-response relationship between maternal age and low birth weight that decreased in magnitude as maternal age increased. It has been hypothesized that the underdeveloped body of an adolescent increases the risk of having a low birth weight offspring (Roth et al., 1998, Stevens-Simon et al., 1988). Young age is associated with a short cervix and a small uterine volume which is associated with preterm birth and consequently low birth weight (Gibbs et al., 2012). Adolescents typically gain more weight during pregnancy than older women but when the food supply is decreased, the mother's metabolic need will usually come before the fetuses growth needs (Gibbs et al., 2012). Additionally, glycine, an important amino acid necessary for many metabolic processes in the body including the proper growth of a fetus, may be compromised in young mothers and poor placental glycine transfer has been identified as a contributing factor in preterm and low birth weight offspring (Friesen et al., 2007).

2c. ETHNICITY

Several research studies have shown an association between low birth rate offspring and mothers ethnicity (DuPlessis et al., 1997). Study findings have revealed that Non-Hispanic Whites experience more favorable outcomes in pregnancy (Rich-Edwards et al., 2003), but what is unclear are the reasons why this is so. In the United States, the prevalence of low birth weight offspring is higher in Non-Hispanic Blacks and Hispanics Americans than it is in Non-Hispanic Whites (Okosun et al., 2000). Non-Hispanic Black adolescents aged 15-19 have the highest birthrate among White and Hispanics teens and they account for 23% of all births among African American women (DuPlessis et al., 1997). African American mothers in the United States also have twice the risk of having a baby with low birth weight when compared to White women (Edwards et al., 2003). When African American mothers who are born in the United States are compared to Black mothers that were born in foreign countries, the US born mothers have less favorable pregnancy outcomes (James, 1993). Additionally, Hispanic women that were born in Mexico are less likely to have low birth weight babies than Hispanics Americans that were born in the United States (James, 1993). The overall birthrates of Hispanic American women bearing low birth weight infants do not show that there is a significant increased risk of having low birth rate babies when compared to non-Hispanic Whites.

2d. SMOKING

For several years, it has been documented that smoking during pregnancy could have adverse effects on the health of the mother’s unborn child. Some of the effects have

been documented and include gestational bleeding, abuptio placentae (a condition when the placenta prematurely separates from the uterus), placenta previa (a condition when the placenta grows too close to the cervix), and premature rupturing of membranes (Horta et al., 1997). In 2003, maternal smoking history was added to birth certificates and this addition has led to more accurate data when researching topics such as LBW and maternal age. Although smoking rates among women in the U.S. have been decreasing, it is estimated that between 75-82% of women continue to smoke even after they have learned of their pregnancy (Batech et al., 2013). Maternal smoking is a modifiable risk factor and choosing to abstain from smoking once a pregnancy is discovered is the modification. The perceived stress reducing abilities of cigarette smoking is perhaps one reason why pregnant women continue to smoke. Maternal smoking, however, is a cause of intrauterine growth retardation (IUGR) which is a precursor for low birth weight (Horta et al., 1997). Furthermore, there is a dose-response relationship between the amount of cigarettes smoked and the risk of intrauterine growth retardation. The more cigarettes smoked daily, the greater the chance of giving birth to a low birth weight baby due to IUGR (Horta et al., 1997).

Research has shown that mothers who stopped smoking during pregnancy had an increase in the weight of their babies by delivery, in comparison to mothers who smoked for the entirety of their pregnancy (Horta et al., 1997).

There are 3 different mechanisms by which smoking affects the intrauterine growth. The first is fetal hypoxia which reduces the maternal blood supply to the placenta and results in insufficient oxygen transfer between mother and baby (Horta et al., 1997). The second is vasoconstriction in the uterus which occurs when nicotine increases maternal

catecholamines causing a deficit of oxygen to the infant (Horta et al., 1997). The third mechanism is the cyanide that has the potential to interfere with the fetal oxidative metabolism (Horta et al., 1997). The prevalence of smoking tobacco, particularly cigarettes, increases for pregnant Black mothers with age while it decreases with age for pregnant White mothers (Rich-Edwards et al., 2003). In 2003, 9.7% of all pregnant mothers smoked and the prevalence of low birth weight babies increased from 7.6 to 8.2% (Batech et al., 2013). This is especially important because Non-Hispanic Black mothers already have increased odds of delivering a low birth weight baby without the contribution of a smoking risk factor. It should also be noted that mothers whose partners smoke, are also at an increased risk for intrauterine growth retardation (Horta et al., 1997). Additionally, alcohol and smoking are risk factors that are typically unison behaviors (Stevens-Simon et al., 1988). Furthermore, alcohol has been listed as a causal factor for delivering low birth weight babies but this risk factor will not be analyzed in this study because NHANES does not ask a survey question pertaining to drinking alcohol while pregnant. It was listed here for informational purposes only.

2e. EDUCATION

In almost every study concerning low birth weight infants, education as a risk factor has been mentioned as an important indicator for low birth weight. “Education is the strongest socioeconomic predictor of health status, when considered alone, and the most important determinant of birth weight in a population” (Silvestrin et al., 2013, p. 344). When a mother is able to finish high school, she has increased chances for more favorable outcomes in pregnancy. Additionally, a rising level of education is a protective

factor against low birth weight (Sachdeva et al., 2013). The lower the education level, the greater the vulnerability of delivering a baby with a low birth weight (Silvestrin et al., 2013) Mothers that have less than 12 years of education have an increased risk of delivering a low birth weight baby, while 12 or more years of education reduces that risk (Batech et al., 2013). There is a 33% protection effect against LBW for women that have a higher education and a 9% higher probability of having a LBW child if the mother has not finished high school (Silvestrine et al., 2013). Silvestrine also noted that mothers who have less than eight years of formal education are 1.5 times more likely to have a low birth weight baby. Women that are in the young mother aged group have typically attained a lower education status than mothers in the normal aged group because the average age for a high school graduate in the United States is 18 years old. With education, most women are able to find jobs that pay more and offer benefits such as medical insurance. These women are more inclined to take better care of themselves and to make more informed decisions about their care as well as the care of their unborn child. They will typically visit a prenatal care facility early in the pregnancy and will have at least six consultations than a mother with lower education (Silvestrin et al., 2013). A mother's education is a variable that has been considered to measure inequality in healthcare and to assess the outcome of pregnancy (Silvestrine et al., 2013). Education plays an important role in pregnancy and ties directly into many other risk factors such as socioeconomic status, income, prenatal care and the avoidance of risky behaviors. Therefore, an increase in education is vital for better access to necessary healthcare to ensure a healthy and safe delivery.

2f. INCOME & SOCIOECONOMIC STATUS

Poverty is usually the culprit and the physical demands on these mothers to earn wages can contribute to poor fetal growth (WHO, 2004). Mothers in deprived socioeconomic conditions frequently have low birth weight babies (WHO, 2004). These mothers typically do not receive the proper care or health to in turn, deliver a healthy offspring. Mothers, regardless of race who earn income less than the poverty level, typically do not have a job that offers benefits such as medical insurance. The lack of insurance can cause a delay in seeking medical attention and can ultimately lead to negative outcomes such as low birth weight. It is a common denominator in determining if a mother will ever seek prenatal care for her unborn infant. Mothers without insurance that consequently do not seek prenatal care show increased risk for low birth weight babies when they are compared to insured mothers who received prenatal care (Batech et al., 2013). Young mothers are usually in the lower income bracket and have a lower socioeconomic status when compared to older women. Typically, blacks have a rate of poverty that is three to four times that of whites (Reichman et al., 2008). In addition, members of most minority groups are more than likely to be poorer that non-Hispanic whites (Reichman et al., 2008).

2g. MARITAL STATUS

Previous research has found that marital status has an impact on low birth weight. In 2003, 34.6% of all births were to unmarried women and this number has increased 16.2% since 1980 (Reichman et al., 2008). There are more Hispanic American women

married than Non-Hispanic Blacks but that number is less than that for Non-Hispanic Whites (Leslie et al., 2003). Unmarried mothers are easily identifiable and typically economically disadvantaged (Reichman et al., 2008). It is important to identify the relationship that marital status has on low birth weight because of the large number of unmarried mothers giving birth to offspring. An understanding of this relationship will be one step closer to preventing babies from being born with a low birth weight.

2h. LONGTERM EFFECTS

There are several long term effects associated with LBW. As stated earlier in this thesis, a low birth weight baby is at a disadvantage and has an increased risk of developing several chronic diseases as well as other disorders. Low birth weight is a precursor for poor development and growth in childhood (WHO, 2004). It is also associated with a higher incidence of adulthood chronic illnesses such as hypertension, type 2 diabetes and cardiovascular disease (WHO, 2004). Infants who are born with low birth weight often have changed physiology and metabolism that could lead to chronic illnesses such as obesity, stroke, and diabetes (Okosun et al., 2000). They also have poorer cognitive function and academic performance when compared to normal birth weight offspring (Hack et al., 2002). In a study by Hack et al., 40% of low birth weight children had to repeat a grade versus 27% for normal birth weight children and only 16% of subjects in this cohort went on to post-secondary school versus the 44% of normal weight children. As this data suggest, being a low birth weight baby has health implications as well as other detrimental ramifications.

2i. PREVENTION STRATEGIES

Modifying behaviors and the avoidance of risk factors can reduce the prevalence of low birth weight. One method for prevention of low birth weight is to delay motherhood until after the normal maternal age has been reached. If these adolescent women wait to have their babies later in life, they increase the chances of survival for the infant. By delaying pregnancy, these adolescent women would give their body time to mature internally and this makes for a better pregnancy and delivery.

Smoking while pregnant is definitely a behavior that should be modified to reduce the chances of delivering a low birth weight infant. There are several programs available to help people quit smoking who are having a hard time kicking this habit. A mother's level of education has been shown to be positively associated with pregnancy and the subsequent health of the offspring. The chances of earning more money are greater for those who are more educated than for those who are less educated. This increase in income yields better pregnancy outcomes as well and these mothers are less likely to have a low birth weight baby. The more positive pregnancy outcomes could be due to several reasons such as better insurance, access to better health care, less stress, etc. but education can impact several different aspects of a person's life. Finally, women should try to wait until they are married to have a child because married women have yielded better results with delivering normal weight babies than mothers who are unmarried. There are obviously some risk factors that cannot be avoided or modified (such as ethnicity) but all attempts to modify risk factors that have shown negative results should be avoided in an effort to deliver offspring who have normal weight and are healthy.

CHAPTER 3

METHODOLOGY

3a. Data Source

The data source for this thesis was the National Health and Nutrition Examination Survey (NHANES) years 2007-2008. NHANES is a major program of the National Center for Health Statistics (NCHS) which is part of the Centers for Disease Control and Prevention (CDC). In 1956, the National Health Survey Act was passed and it allowed for a survey that would collect statistical data on the amount, distribution and effects of illness and disability in the United States. Born from this law, the National Health and Nutrition Examination Survey is designed to assess the health of adults and children in the United States. It has been conducted since the 1960's and has surveyed over 140,000 people to date (www.cdc.gov). The participants are selected through a complex statistical process (stratified multistage probability sampling of the civilian non-institutionalized population of the U.S.) that uses information obtained in the census. Random households are selected and they are asked a short list of questions by interviewers to make sure they are eligible for the study. The actual survey consists of two parts, a home interview and a health examination. The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests administered by highly trained medical personnel. Each year, the

survey examines a nationally representative sample of about 5,000 persons located in counties across the country.

3b. Inclusion and Exclusion Criteria

The sample for this thesis consisted of 1434 mothers who had answered all the questions for the variables used in the analysis. Analysis was restricted to infants and children whose mothers had reported their age at the time of delivery, smoking status, years of formal education, marital status and income. The maternal age was restricted to 14-45 year olds. Subjects with missing values for any of the studied variables were excluded from this study.

3c. Studied Variables

The following variables were used in the analysis.

SEX: In NHANES, subject's gender was by self-report and only women were eligible for this investigation.

RACE/ETHNICITY: Although in NHANES subject's race/ethnicity included Mexican Americans, other Hispanics, non-Hispanic Whites, non-Hispanic Blacks, and a multiracial group, this study was restricted to Hispanic Americans, non-Hispanic Whites, non-Hispanic Blacks and coded as 1 for non-Hispanic Whites, 2 for non-Hispanic Blacks, and 3 for Hispanic Americans.

EDUCATION: In NHANES, subjects self-reported their years of schooling. However, in this study education was categorized as less than high school and greater than high school level of education. Education was coded as 1 for no high school diploma and 2 for high school diploma or greater.

MARITAL STATUS: Married and unmarried subjects were coded as 1 and 2, respectively.

ANNUAL FAMILY INCOME: Income was coded as 1 for subjects with family income of less than $20,000 family annual income and 2 for more than $20,000 family annual income.

SMOKING: Maternal smoking during pregnancy was determined, and categorized as smokers and non-smokers.

YOUNG MOTHERHOOD: Subject's age was coded as 1 and 2, representing ages 14-19 and ages 20-45, respectively. Subjects in the 14-19 age category were regarded as mothers who had babies at young age, and those in the 20-45 age category were regarded as mothers who had babies in older motherhood.

LOW BIRHT WEIGHT: Low birth weight variable was defined as birth weight less than 2500 grams (ref).

3d. Data Analysis

Statistical Package for the Social Sciences (SPSS) 20.0 was used for all data analysis. Descriptive statistics were used to summarize risk factors and look for trends among the

variables. Univariate logistic regression was performed and crude odds ratios were determined to ascertain the relative measure of effect. Variables were also included in a multivariate logistic regression model to control for each covariate. The model included low birth weight (dependent variable) as the binary outcome variable and the demographic and early childhood data (maternal age, smoking, education, income and marital status) as the exposures/risk factors. $P<.05$ and 95% CI were used to determine statistical significance.

Chapter 4

Results

4a. Descriptive Statistics

The total sample size for this study population was 1,434 mothers with 456 Non-Hispanic white, 357 Non-Hispanic black, and 621 Hispanic Americans making up the data set. As shown in table 1, non-Hispanic women had the lowest percentage of low birth weight babies among all ethnicities. However, their rate of smoking, not having a high school diploma, less than $20,000 annual income and not being married were higher when compared to non-Hispanic Blacks and Hispanic Americans. Table 1 lists the percentage of mothers that had low birth weight offspring and were exposed to the risk factor stratified by ethnicity.

Table 1. Percentage of Mothers exposed to risk factor associated with low birth by Race/Ethnicity.

Variable Name	Non-Hispanic White	Non-Hispanic Black	Hispanics
Mothers Age			
-Young Age 14-19	9.2% (42)	12.3% (44)	13.0% (81)
Mother Smoked			
-Yes	26.8% (122)	10.1% (36)	5.6%(35)
Education			
-No HS diploma	27.2% (124)	24.1% (86)	27.5% (171)
Income			
-Less than 20K	22.6% (103)	20.7% (74)	18.7% (116)
Marital Status			
-Not married	25.4% (116)	24.4% (87)	23.3% (145)
Low Birth Weight			
-Yes	8.6% (39)	9.0% (32)	10.1% (63)

4b. Univariate Analysis

Univariate logistic regression analysis was performed using the data set to examine the influence of each risk factor on low birth weight. The first univariate analysis was not stratified by ethnicity. As shown in table 2, young mothers (n=167) were .875 times less likely to deliver a low birth weight offspring compared to older mothers (OR=.875; 95% CI=.49-1.56 p=0.76). Mothers who smoked (n=193) were 1.143 times more likely to deliver a low birth weight offspring than those mothers who did not smoke while pregnant (OR=1.14; 95% CI=.69-1.89 p=0.70). Mothers who did not obtain a high school diploma (n=381) were 1.017 times more likely to deliver a low birth weight baby

when compared to mothers who had a high school diploma (OR=1.02; 95% CI=.68-1.52 p=1.00). Mothers who did not have an income of twenty thousand or greater (n=293) were 1.137 times more likely to have a low birth weight offspring than mothers who earned more than twenty thousand annually (OR=1.14; 95% CI=.74-1.75 p=0.63). Finally, mothers who were not married (n=348) were at a .897 decreased odds for having a low birth weight offspring (OR=.90; 95% CI=.60-1.35 p=0.68). All p-values were not significant at >0.05.

In race-specific univariate logistic regression models, non-Hispanic whites in the young mothers group were .509 times less likely to have a low birth weight baby compared to other non-Hispanic whites in the older mother age group (OR=.51; 95% CI=.12-2.20 p=0.53). Non-Hispanic whites who smoked while pregnant were .939 times less likely to have a low birth weight baby compared to other non-Hispanic whites who did not smoke during pregnancy (OR=.94; 95% CI=.44-1.99 p=1.00). Non-Hispanic whites who did not have a high school diploma were .917 times less likely to have a low birth weight baby compared to other non-Hispanic whites who have received their high school diploma (OR=.92; 95% CI=.43-1.94 p=0.97). Non-Hispanic whites in the low income group were 1.031 times more likely to have a low birth weight baby compared to other non-Hispanic whites who made more than twenty thousand annually (OR=1.03; 95% CI=.47-2.25 p=1.00). Non-Hispanic whites who were in the non-married group were .656 times less likely to have a low birth weight baby compared to other non-Hispanic whites that were married (OR=.66; 95% CI=.33-1.32 p=0.32).

-Non-Hispanic blacks in the young mothers group were .212 times less likely to have a low birth weight baby compared to other non-Hispanic blacks in the older mothers group

(OR=.21; 95% CI=.03-1.60 p=0.17). Non-Hispanic blacks who smoked while pregnant were 1.756 times more likely to have a low birth weight baby compared to other non-Hispanic blacks who did not smoke during pregnancy (OR=1.76; 95% CI=.63-4.89 p=0.43). Non-Hispanic blacks who did not have a high school diploma were .872 times less likely to have a low birth weight baby compared to other non-Hispanic blacks who have received their high school diploma (OR=.87; 95% CI=.36-2.10 p=0.93). Non-Hispanic blacks in the low income group were 1.078 times more likely to have a low birth weight baby compared to other non-Hispanic blacks who made more than twenty thousand annually (OR=1.08; 95% CI=.45-2.60 p=1.00). Non-Hispanic blacks who were in the non-married group were 1.439 times more likely to have a low birth weight baby compared to other non-Hispanic blacks that were married (OR=1.44; 95% CI=.57-3.62 p=0.58).

- Hispanic Americans in the young mothers group were 1.475 times more likely to have a low birth weight baby compared to other Hispanic Americans in the older mothers group (OR=1.48; 95% CI=.74-2.96 p=0.37). Hispanic Americans who smoked while pregnant were 1.517 times more likely to have a low birth weight baby compared to other Hispanic Americans who did not smoke during pregnancy (OR=1.52; 95% CI=.57-4.06 p=0.58). Hispanic Americans who did not have a high school diploma were 1.153 times more likely to have a low birth weight baby compared to other Hispanic Americans who have received their high school diploma (OR=1.15; 95% CI=.65-2.04 p=0.73). Hispanic Americans in the low income group were 1.277 times more likely to have a low birth weight baby compared to other Hispanic Americans who made more than twenty thousand annually (OR=1.28; 95% CI=.68-2.40 p=0.56). Hispanic Americans who were

in the non-married group were .883 times less likely to have a low birth weight baby compared to other Hispanic Americans that were married (OR=.88; 95% CI=.49-1.61 p=0.80). All p values were >0.05 so all results were not statistically significant.

Table 2. Univariate Association with mothers and other selected independent variables associated with low birth weight.

	All		NHW		NHB		Hispanics	
	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI
Mothers Age	0.875	.490-1.560	0.509	.118-2.193	0.212	.028-1.590	1.475	.735-2.961
Smoking	1.143	.692-1.887	0.939	.443-1.989	1.756	.631-4.888	1.517	.567-4.062
Education	1.017	.681-1.519	0.917	.433-1.941	0.872	.363-2.093	1.153	.653-2.038
Income	1.137	.741-1.745	1.031	.473-2.248	1.078	.447-2.600	1.277	.679-2.402
Marital	0.897	.598-1.346	0.656	.325-1.324	1.439	.572-3.619	0.883	.485-1.610

Multivariate Analysis

Multivariate logistic regression analysis was performed using the data set. The purpose of the multivariate analysis is to assess the impact a risk factor has on the low birth weight outcome while adjusting for all the other variables (age, smoking, education, income and marital status). The multivariate analysis results that were not stratified by ethnicity are as follows: Mothers in the young mothers group (n=167) group were .860 times less likely to deliver low birth weight off spring compared to older mothers in this

study population (OR=.86; 95% CI=.48-1.54 p=0.61). Mothers who smoked during pregnancy were 1.234 times more likely to deliver a low birth weight baby than those who did not smoke during pregnancy (OR=1.23; 95% CI=.73-2.09 p=0.43). Those who did not earn a high school diploma were 1.005 times more likely to have a low birth weight baby than mothers who earned a high school diploma (OR=1.01; 95% CI=.67-1.50 p=0.98). If their income was less than twenty thousand, they were 1.130 times more likely to have a low birth weight baby (OR=1.13; 95% CI=.74-1.74 p=0.58). Mothers who were not married were .908 times less likely to have a low birth weight baby than married mothers (OR=.91; 95% CI=.60-1.37 p=0.64). All p-values were not significant at >0.05.

When the multivariate analysis was stratified for ethnicity and adjusted for all other variables, the results were as follows:

-Non-Hispanic whites in the young mothers group were .501 times less likely to have a low birth weight baby compared to other non-Hispanic whites in the older mothers group (OR=.50; 95% CI=.12-2.19 p=0.36). Non-Hispanic whites who smoked while pregnant were .935 times less likely to have a low birth weight baby compared to other non-Hispanic whites who did not smoke during pregnancy (OR=.94; 95% CI=.44-2.01 p=0.86). Non-Hispanic whites who did not have a high school diploma were .929 times less likely to have a low birth weight baby compared to other non-Hispanic whites who have received their high school diploma (OR=.93; 95% CI=.44-1.97 p=0.85). Non-Hispanic whites in the low income group were .984 times less likely to have a low birth weight baby compared to other non-Hispanic whites who made more than twenty thousand annually (OR=.98; 95% CI=.45-2.15 p=0.97). Non-Hispanic whites who were

in the non-married group were .642 times less likely to have a low birth weight baby compared to other non-Hispanic whites that were married (OR=.64; 95% CI=.32-1.31 p=0.22).

-Non-Hispanic blacks in the young mothers group were .224 times less likely to have a low birth weight baby compared to other non-Hispanic blacks in the older mothers group (OR=.22; 95% CI=.03-1.69 p=0.15). Non-Hispanic blacks who smoked while pregnant were 1.655 times more likely to have a low birth weight baby compared to other non-Hispanic blacks who did not smoke during pregnancy (OR=1.66; 95% CI=.59-4.63 p=0.34). Non-Hispanic blacks who did not have a high school diploma were .850 times less likely to have a low birth weight baby compared to other non-Hispanic blacks who have received their high school diploma (OR=.85; 95% CI=.35-2.06 p=0.72). Non-Hispanic blacks in the low income group were 1.062 times more likely to have a low birth weight baby compared to other non-Hispanic blacks who made more than twenty thousand annually (OR=1.06; 95% CI=.44-2.58 p=0.90). Non-Hispanic blacks who were in the non-married group were 1.342 times more likely to have a low birth weight baby compared to other non-Hispanic blacks that were married (OR=1.34; 95% CI=.53-3.42 p=0.54).

- Hispanic Americans in the young mothers group were 1.499 times more likely to have a low birth weight baby compared to other Hispanic Americans in the older mothers group (OR=1.50; 95% CI=.74-3.03 p=0.26). Hispanic Americans who smoked while pregnant were 1.450 times more likely to have a low birth weight baby compared to other Hispanic Americans who did not smoke during pregnancy (OR=1.45; 95% CI=.54-3.90 p=0.46). Hispanic Americans who did not have a high school diploma were 1.121

times more likely to have a low birth weight baby compared to other Hispanic Americans who have received their high school diploma (OR=1.12; 95% CI=.63-1.99 p=0.70). Hispanic Americans in the low income group were 1.298 times more likely to have a low birth weight baby compared to other Hispanic Americans who made more than twenty thousand annually (OR=1.30; 95% CI=.69-2.46 p=0.42). Hispanic Americans who were in the non-married group were .900 times less likely to have a low birth weight baby compared to other Hispanic Americans that were married (OR=.90; 95% CI=.49-1.65 p=0.73). All p values were >0.05 so all results were not statistically significant.

Table 3. Association between mothers age and low birth weight adjusted for all independent variables.

	All		NHW		NHB		Hispanics	
	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI
Mothers Age	0.86	.480-1.538	0.501	.115-2.187	0.224	.030-1.694	1.499	.741-3.029
Smoking	1.234	.730-2.087	0.935	.435-2.009	1.655	.592-4.631	1.45	.539-3.902
Education	1.005	.672-1.503	0.929	.438-1.973	0.85	.351-2.062	1.121	.632-1.986
Income	1.13	.735-1.740	0.984	.449-2.154	1.062	.437-2.579	1.298	.685-2.461
Marital	0.908	.603-1.366	0.642	.315-1.307	1.342	.526-3.422	0.900	.492-1.647
NHW	Reference							
NHB	0.908	.551-1.497	p value 0.71					
Hispanics	0.781	.504-1.210	p value 0.27					

Chapter 5

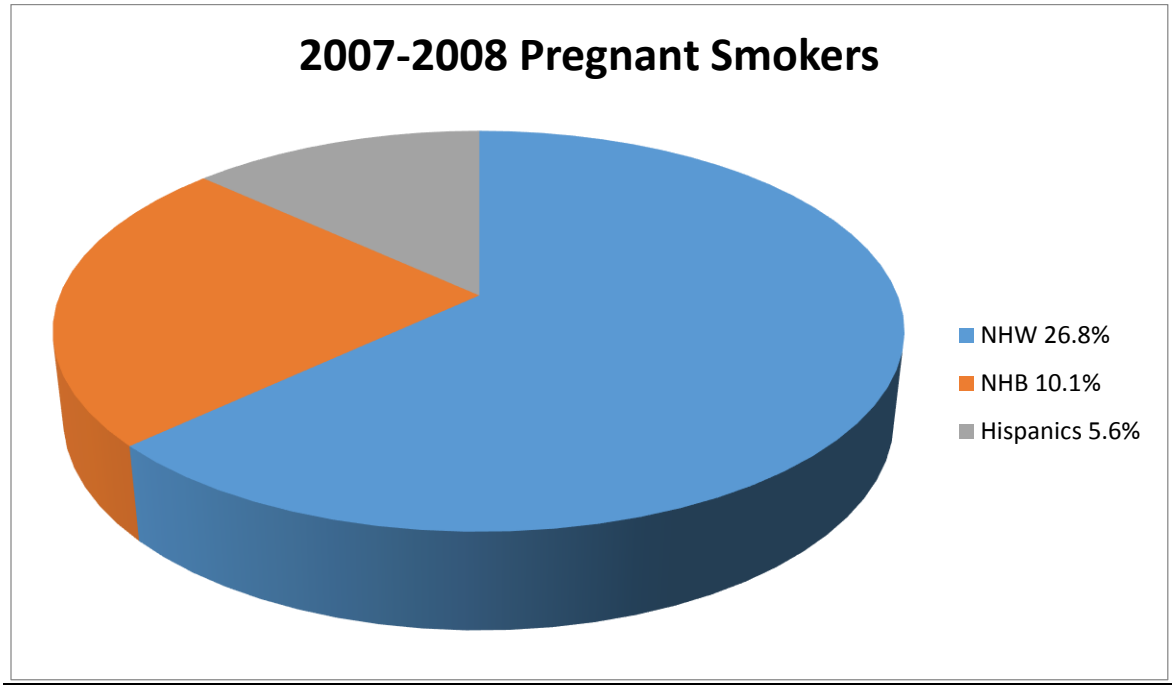
Discussion

The purpose of this study was to examine the association of maternal age and low birth weight. Maternal age was not associated with increased odds of low birth weight offspring. While controlling for age, other variables such as smoking, education, income, and marital status were included in the analysis due to previous studies about low birth weight risk factors. The data set was further stratified by ethnicity to determine how a risk factor affected low birth weight within the race. According to literature review, it was expected that age would be significantly associated with increased odds of having a low birth weight offspring (Okosun et al., 2000). The odds ratio in Non-Hispanic Whites and Non-Hispanic Blacks suggests that young mother's age may be a protective factor. The results of the analysis were odds ratios greater than 1 in Hispanic Americans, but it was not statistically significant. The lack of association may be explained by conflicting studies that suggest low birth weight increases with increasing maternal age. Rich-Edwards et al., 2003 presented the results of a study of 887 births where mothers in the 20-45 year aged group had a higher prevalence of low birth weight in comparison to the younger aged mothers. A study in Poland determined that normal maternal age was an associated factor for low birth weight (Nazari et al., 2013). A study conducted in Taiwan yielded results that suggested mothers aged 40 plus can be a strong risk factor for low birth weight (Nazari et al., 2013). The risk of low birth weight among older mothers could possibly be related to several factors such as cardiovascular disease, hypertension, diabetes, and other diseases that can be associated with older age (Nazari et al., 2013). Another theory for explaining the increase of low birth weight with maternal age is the

weathering effect. Social inequality on health, compounds with age and can ultimately affect fetal health and birth weight (Geronimus, 1996).

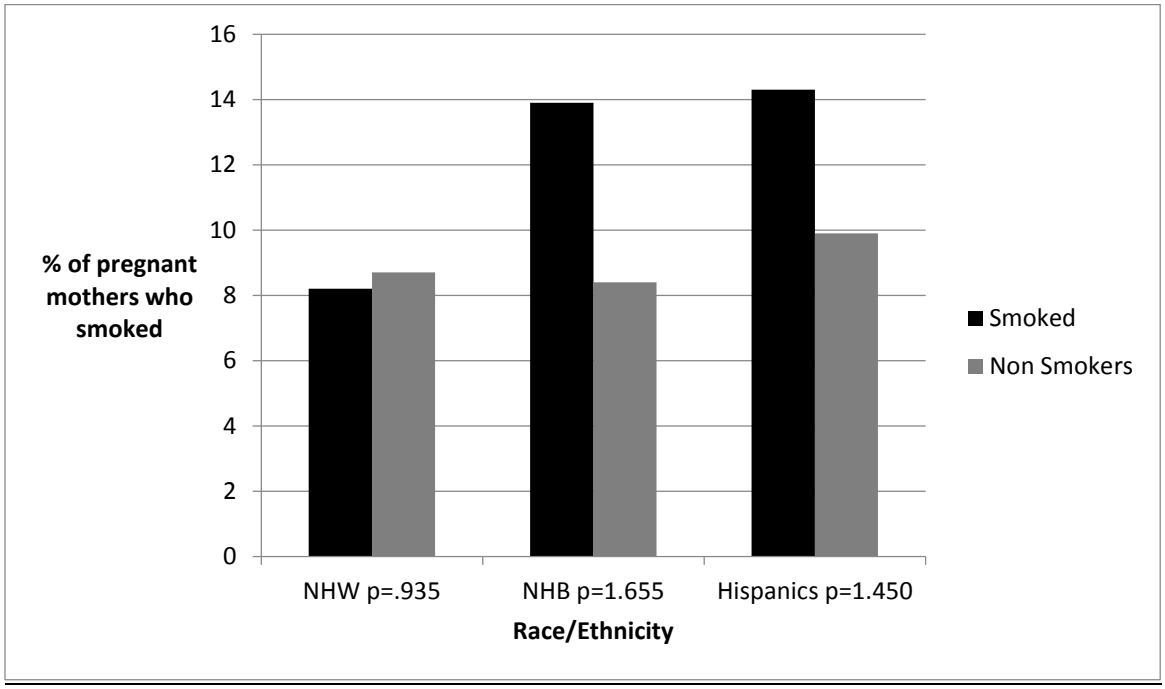
There was a lack of association between smoking during pregnancy and low birth weight. Previous studies have determined that smoking was not a risk factor that increased the odds of having a low birth weight offspring. Studies have shown that smoking cessation during pregnancy increased the birth weight similar to mothers who never smoked (Horta et al., 1997). In the NHANES survey, if a mother had smoked one cigarette and answered yes, she was placed in the “smoked during pregnancy” category. NHANES does not specify how many cigarettes were smoked during pregnancy. It was a dichotomous variable and could not be stratified by the amount. If a mother smoked one cigarette while pregnant and had a normal weight baby, the results could be skewed to appear that smoking during pregnancy is not a risk factor low birth weight. As shown in figure 1, the sample population used for this analysis had characteristic differences between the non-Hispanic whites and the minority groups. The below pie chart shows that the non-Hispanic blacks and Hispanic American mothers did not have near as many pregnant smokers as the non-Hispanic whites which is also in contrast to literature review.

Figure 1. Pregnant smokers in the 2007-2008 NHANES Data



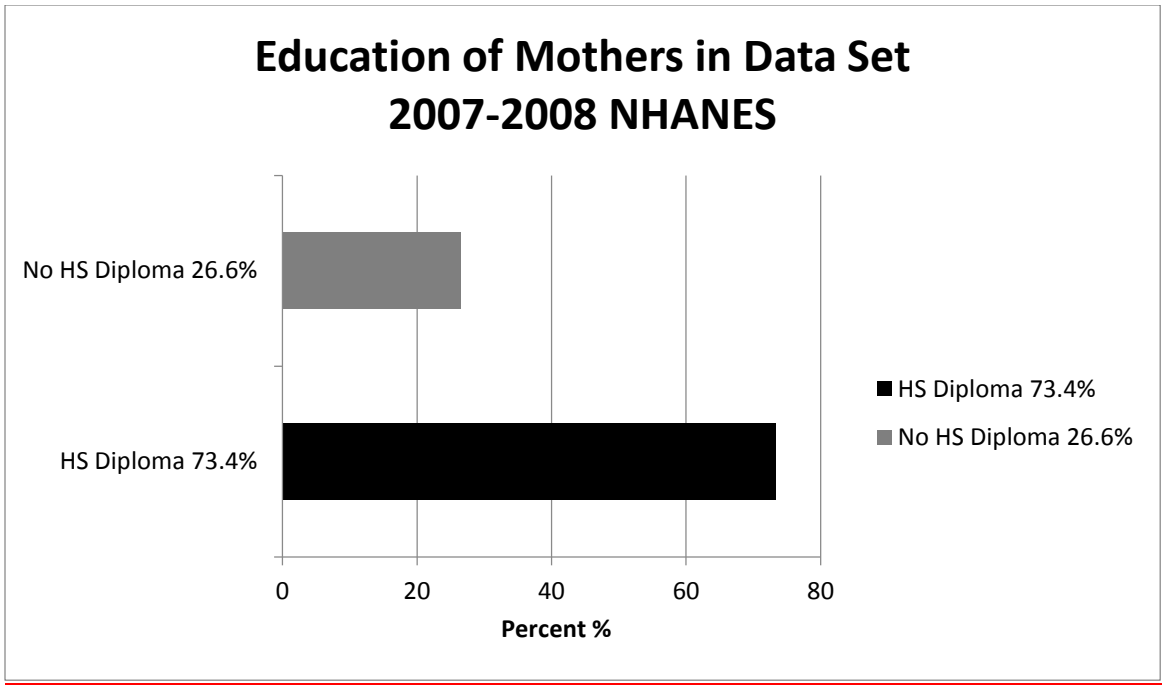
Because smoking was shown as a protective factor in non-Hispanic whites, figure 2 below displays that the smokers had a lower percentage of low birth weights when compared to nonsmokers. As suggested by the odds ratio of non-Hispanic blacks and Hispanic Americans although not significant, the percentage of low birth weight babies increased in the smoking mothers versus the nonsmokers.

Figure 2. The percentage of mothers who smoked and had low birth weight babies.



As of 2014, there have only been 4 studies identified where the causal effects of education on low birth weight have been estimated. Those studies yielded conflicting results (Grytten et al., 2014). McCrary and Royer (2011) completed a study in which they found that one additional year of education was associated with increased probability of low birth weight by 0.014 (Grytten et al., 2014). In this study, education is a protective factor of low birth weight. The data set was comprised of a large number of mothers that had obtained their high school diploma. Figure 3 below shows the education level for this data set.

Figure3. Education level of mothers in the study population



Studies that have been conducted on low birth weight have taken into account the marital status of the mother at the time of delivery. NHANES did not ask the question of marriage at the time of delivery. The marital status question was concerning their marital status at the time of the survey. The survey question should include marriage status at the time of delivery and the length of marriage in years. This would allow for stratification to determine if length affects the probability of having a low birth weight baby. NHANES should also incorporate the number of times the participant has been married and determine the effect this may have on the low birth weight outcome.

In this study, income was positively associated with low birth weight across all ethnicities, although it was not statistically significant.

It is imperative that we are distributing accurate information to the public so that they can make better decisions regarding their health and the health of their offspring. It is vital that we are collecting accurate information and disseminating truths to the public in regards of their health. As in this case, we would not want to let mothers know that it is better to wait until later in reproductive years to bear children if it is in fact, more detrimental or vice versa. Ramifications of this could cause an increase in low birth weight babies with possible long-term effects that could potentially be a burden on our already burdened health care system. It is clear that we need a standard when studying low birth weight and its causes as well as a survey directed at ascertaining information that is pertinent to the success of finding the variables that increase the odds of delivering a low birth weight baby.

MAJOR STRENGTHS

There are major strengths associated with using NHANES data.

1. It is a national data set that is person based.
2. The data is representative of the entire population making it generalizable.
3. There are repeated variables making it consistent content over time.
4. The questionnaires are standard.

LIMITATIONS

There were several limitations to this study and this can help to explain why the results observed were different from most studies but compare to others.

1. The first limitation is the fact that this study was completed using secondary data. The questions asked by the NHANES surveyors were not relevant to this study. This could have introduced bias into the sample.
2. The data is self-reported by the study population and there may be bias introduced such as recall or selection bias.
3. The sample size used for this study was smaller than the overall NHANES study population. This was due to excluding missing variables and the cleaning of the data. When there is an increase the sample size, you increase the probability of being able to generalize your results.
4. This study did not account for the number of births that were preterm.

FUTURE STUDY

Future studies could benefit from having more accurate data collected in surveys. As mentioned previously, the NHANES question regarding smoking during pregnancy did not provide information of the number of cigarettes smoked per day and duration. NHANES questions should be reworded to gain more information during the actual pregnancy. In reference to the higher prevalence of low birth weights in minority groups, studies need to account for acculturation. This could introduce new variables that affect low birth weight.

Chapter 6

CONCLUSION

The results of this study did not indicate young maternal age increases odd of low birth weight. It is at variance with many studies but consistent with some investigators findings. Due to the results, future study is warranted to determine the role that young maternal age has on birth outcomes, including low birth weight which continues to be a public health issue.

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