# SOCIOECONOMIC POSITION AND LOW BIRTH WEIGHT: AN EVALUATION OF SELECTED MEASURES ACROSS RACE IN MICHIGAN

By

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# A DISSERTATION

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#### ABSTRACT

# SOCIOECONOMIC POSITION AND LOW BIRTH WEIGHT: AN EVALUATION OF SELECTED MEASURES ACROSS RACE IN MICHIGAN

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Although evidence point to SEP being multidimensional, many studies that have used SEP in their analyses have used only a single, traditional measure of SEP without regard to how other SEP measures could influence findings. The aim of this study was to evaluate multiple and 'contextual' SEP measures in relation to Low Birth Weight (LBW) among black and white women in Michigan. Additionally, this study evaluated the association between a constructed composite variable and LBW.

Using data from the Michigan Pregnancy Risk Assessment Monitoring System (MI PRAMS 2000-2006), a stratified random sample of 10,859 postpartum mothers was utilized to investigate how different measures of SEP affect the association between SEP and LBW. Four SEP measures were evaluated: maternal education; Medicaid during pregnancy; Women, Infants, Children (WIC) enrollment during pregnancy; and Paternal Acknowledgement on infant birth certificates. Logistic regression was used to examine variations among SEP measures and LBW across racial groups. Additionally, using factor analysis, a composite measure of SEP was developed.

Associations between SEP and LBW vary depending on the indicator used, and the racial subpopulation. All four SEP measures show associations with LBW when age and race are held constant. There is no uniformity in how selected SEP indicators and low birth weight are

associated in the total sample. Variations in associations between the SEP indicators and LBW were also observed across racial groups.

Although there is a consistent picture of poorer health among more disadvantaged groups, however measured, in seeking to explain and reduce social inequalities in health we need to take a more differentiated approach that does not assume equivalence among SEP measures. In addition a broader definition of health should be adopted by researchers and policy makers. Copyright by CEDRIC ANDREW TAYLOR 2011

# DEDICATION

I dedicate this dissertation to my father Cedric, my sister Andrea, and to my late mother Dancel. I would not have achieved this milestone without your love and support.

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## KEY TO ABBREVIATIONS

- BIRB Biomedical and Health Institutional Review Board
- CDC Center for Disease Control
- DHEW Department of Health, Education and Welfare
- FPL Federal Poverty Line
- **GDP** Gross Domestic Product
- **GNP** Gross National Product
- IRB Institutional Review Board
- LBW Low Birth Weight
- MDCH Michigan Department of Community Health
- MI Michigan
- MSU Michigan State University
- NSFG National Survey of Family Growth
- OECD Organization for Economic Corporation and Development
- **OLS Ordinary Least Squares**
- PRAMS Pregnancy Risk Assessment Monitoring System
- SEP Socioeconomic Position
- SES Socioeconomic Status
- WIC Women, Infants, Children Program

#### **INTRODUCTION**

The United States has the highest gross national product (GNP) in the World and spends in excess of two trillion dollars per annum on health care. Despite this expenditure directed to health care – more than any other nation – Americans live shorter and often sicker lives compared to many other industrialized nations in the world (Michaud et al. 2011). By the end of 2009, compared with all other nations, the United States ranked 50<sup>th</sup> in life expectancy and 45<sup>th</sup> in infant mortality. In 2006, the total health care expenditure per capita in the state of Michigan was \$5058, more than entire countries such as Cuba and Sweden (World Health Organization 2006). The life expectancy at birth in Michigan however is lower than in Cuba, while Sweden enjoys lower infant mortality rates (Central Intelligence Agency World Factbook 2009; Organization for Economic Cooperation and Development 2011). This paradox at the state and national level demands the question as to why Michigan and by extension the United States spends so much on healthcare yet underachieves with respect to its overall population health.

There are a number of factors routinely implicated in explaining why overall population health is relatively poor. One explanation focuses on individual – based risk factors that are relatively proximal causes of disease such as diet, cholesterol and insufficient exercise (Link and Phelan 1995). Another explanation points to a fragmented, for – profit healthcare system that currently leaves millions of Americans without access to care (Rosenthal 2009). These factors undeniably have a role in overall population health, and merit intervention and reform. Link and Phelan (1995) argue however that there must be an examination of what put people "at risk of risks". Consequently, individual – based risk factors, as well as a lack of access to healthcare, must be socially contextualized.

The substantial social and economic inequality inherent in the configuration of U.S. society affects population health profoundly more than any other factor (Wilkinson, 1992). Social factors are likely "fundamental causes" of disease because they embody access to key resources, affect multiple health outcomes through multiple mechanisms, and consequently maintain an association with disease even when intervening mechanisms change (Link and Phelan 2000). For instance, it has been consistently observed across time, space, demographic groups and most measures of health that the better off members of society are more likely to live longer, healthier lives (Lynch and Kaplan 2000). Other research findings indicate that the greater the degree of inequality in a society, the poorer the overall health status. For example between 1974 and 1994 the top 5 percent of United States households (ranked by income) increased their share of the nation's aggregate household income from 16 percent to 21 percent, and that of the top 20 percent rose from 44 percent to 49 percent. In contrast, the share among the bottom 20 percent fell from 4.3 percent to 3.6 percent (Danzinger and Gottschalk 1993; De Vita 1996). Reflecting this growing economic inequality, there are widening disparities in mortality by socioeconomic position comparing data from the 1960's to that of late 1970's and 1980s (Duleep 1995). If health is a reflection of social inequality, then attempting to understand the United States' relatively poor health requires a better understanding of the true context of social and economic inequality, and the potential implications for population health. Understanding how social and economic inequality affects population health requires conceptual clarity concerning the way in which socio-economic parameters are measured.

In epidemiological research the concept of "socioeconomic position" has been used to reflect and measure the context of inequality that may have consequences for health. Socioeconomic position refers to the position(s) individuals or groups hold within the social

structure that is influenced by social and economic factors (Lynch and Kaplan 2000). Its usage in health research refers to the social and economic factors that are the best indicators of location in the social structure that may have influences on health. The term 'socioeconomic status' (SES) has sometimes been used interchangeably in health research in a manner that belies its theoretical and conceptual roots, however, socioeconomic position (SEP) is preferable because it deliberately includes concepts with different conceptual, historical, and theoretical origins (Galobardes, Lynch and Davy Smith 2007). As a construct SEP reflects the breadth of economic and social inequality whereas SES blurs distinctions between two different aspects of SEP: (a) actual resources and (b) status, meaning prestige related characteristics.

## Conceptual Framework

In order to understand how social and economic inequalities affect overall population health, there must be an investigation of how SEP and health are associated. Lynch and Kaplan (2000) describe a general framework with which to understand association between SEP and health. The perspective contains three main elements. The first element maintains that social and structural relations between groups are mainly based on material circumstances determined by productive relations these groups have with the economy. Although SEP is measured at the individual level, it should be conceptualized as being external to the individual. The second element states that socioeconomic positions are important in determining risk factors, health behaviors, and psychological attributes. An individual's or group's SEP is related to behavior and lifestyle. Socioeconomic position is related to almost every aspect of life including diet and exercise. The third element asserts that control of society's resources is unequally distributed. This unequal distribution and control over resources may result in health damaging exposures

being socially patterned. Those members of society who do not control material, economic, social, political, and cultural resources are more likely to be exposed to things that cause poor health. Essentially people at the bottom of the social scale suffer social or material deprivation that directly or indirectly put them at risk for poor health. For example, women of lower social status for instance are at higher risk of poor reproductive outcomes (Parker, Schoendorf and Kiely 1994).

The framework described by Lynch and Kaplan (2000) has informed several approaches geared to understanding the SEP/health connection. Indicators of SEP such as education, occupation, and income have been utilized to reflect particular dimensions of social inequality. The indicator of SEP used in health research depends on assumptions of how socioeconomic position is linked to health damaging exposures, health protective resources and ultimately to health (Lynch and Kaplan 2000). For instance, is it a lack of resources or lack of prestige that causes poor health? Is it a combination of these things? The use of indicators (i.e. education, income or occupation) is not based on the belief that one is universally better than the others, but rather which is most appropriate in understanding the association between social and economic inequality and the health outcome in question as well as the stage of life in question.

#### Conceptual Issues

The association of low SEP with poor health status and outcomes has been established (Lynch and Kaplan 2000). However, Shavers (2007) suggests that "traditional" SEP indicators used in health research (i.e. occupation, income and education), provide limited insight into the association between inequality and population health. Ultimately public health research aims to investigate how levels of inequality and variation in social context affect health outcomes rather

than merely describing the structure of social stratification and identifying how it is generated and maintained (Blau and Duncan 1967).

In public health research a practical approach to measuring SEP for the purpose of informing intervention involves considering the specific ways in which SEP potentially impacts health outcomes (Shavers 2007). Data related to specific factors such as transportation to medical appointments, type of health insurance, support systems and knowledge of appropriate care may be more useful in the development of interventions designed to reduce health disparities. In addition research that incorporates specific social and economic factors capture a more in-depth understanding of the social context which ultimately provides a more accurate representation of a demographic at a given stage in the life course.

In order to understand why the overall population health is the way it is, it is important for public health research to accurately represent the socio-economic context of different demographic groups. In other words, to determine why the U.S. is relatively unhealthy, the context of inequality experienced by racial/ethnic minorities must be considered. Socioeconomic position often has been the major explanation behind racial/ethnic health inequality. This comes as no surprise given substantial disparities in resources such as education, income and employment for African Americans as compared to whites (US Census Bureau, Occupations 2000). Blacks generally have a lower education level than whites (Newburger and Curry 2000), have higher unemployment rates (Thomas and Hughes 1986), and are more likely to experience poverty at all ages (Mckinnon 2003). Meanwhile data shows that blacks generally report higher levels of morbidity (Otten, Teutsch, Williamson and Marks 1990). One study found that 13.7 percent of non-Hispanic black infants were low birth weight, compared with 7.2 percent of non-Hispanic whites (Martin et al. 2010).

Some scholars have argued that health differences between black and white subpopulations would diminish or disappear if SEP differences were eradicated (Markides and Mindel 1987). Many scholars base such arguments on the erroneous assumption that the context of social and economic inequality as reflected by traditional indicators is uniform across racial/ethnic groups. This issue is further complicated by the social and economic diversity within racial/ethnic subpopulations. Studies show that racial/ethnic discrimination modifies the usual influence of specific levels of SEP such that racial/ethnic variations still exist within the same occupation, income and educational levels (Shavers, Fagan and Lawrence 2005).

The association between socioeconomic position (SEP) and health may vary across racial and ethnic subpopulations, which suggests that there is an interactive effect of race and SEP on health outcomes. According to Farmer and Ferraro (2005), there are two alternative hypotheses used to explain the interactive effect of race and SEP on health outcomes. First, the minority poverty hypothesis asserts that racial/ethnic minorities in poverty experience a unique disadvantage. Due to the effects of both poverty and racism, minority persons face considerable threats to health and well – being compared to their white counterparts (Willie 1989). The health gaps are largest between black and white people living in poverty and are smallest between those living in the upper social strata. This hypothesis supports the argument that social inequality and how it is measured may differ depending on the subpopulation. The second approach, the diminishing returns hypothesis, claims that racial/ethnic minorities do not experience the same returns as whites at higher levels of socioeconomic position. Consequently blacks experience diminishing returns on resources attained (Farmer and Ferraro 2005). The higher the social position achieved the less blacks have to show for it.

In addition to considering the importance of race, it also is important to take into account early life health. Studies have found that poor childhood health may have both direct and indirect negative impacts on adult health (Palloni 2006), and that people who experience poorer health outcomes such as low birth weight (LBW) have relatively worse health as adults (Case, Fertig, and Paxson 2005). While infant mortality often is viewed as an important measure of society or community health, understanding LBW within a broader health context is crucial because LBW has direct implications for infant mortality as well as long-term impacts on health outcomes in adult life (World Health Organization 2011; Gortmaker and Wise 1997). Therefore low birth weight is an important measure to investigate the larger question of why the United States spends so much on health care, yet in relative terms has little to show for it. Lewitt et al. (1995) estimated that 35% of all healthcare spending on newborn children in the United States is related to LBW children even though they make up less than 8% of newborns. Ultimately using LBW as a measure of societal health (as opposed to purely a biomedical condition) is important to getting to the root of social factors behind racial disparities and the relatively poor population in the United States.

### Methodological Issues

There are several methodological approaches used to understand the association between SEP and health disparities, particularly when considering the role of demographic characteristics as moderating factors. Many health studies by convention use a single indicator or measure of SEP (i.e. education or income), which though convenient, fails to consider how other ways of measuring SEP may influence findings (Gazmararian et al. 1996; Liberatos et al 1988). Conclusions emerging from studies using single measures erroneously suggest that SEP

indicators are interchangeable and reflect the same aspects of social or material disadvantage for different subpopulations (Macintyre et al. 2003). For example, education as a measure of SEP provides information about likelihood of success, however it has been found that the economic returns on education may differ across racial/ethnic and gender groups. Women and minorities realize lower returns for the same investment in their education than do white men (Oliver and Shapiro 1995).

To address this issue Shavers (2007), advocates a different approach involving multivariate analyses stratified by race/ethnicity, age or other demographic groups. This approach enables evaluating the effect of specific SEP measures across and within groups by examining the magnitude of the odds ratios produced from stratified multivariate analyses; thus allowing for the assessment of interactive effects between SEP and the stratification variable. This approach is based on the assumption that SEP indicators may not have the same meaning across race/ethnic or other demographic groups. Although measures of SEP are correlated, each measure emphasizes distinct aspects of social and economic inequality (Galobardes et al. 2007). Consequently, in the attempt to measure the association between SEP and health, many studies have found that the magnitude of the relationship depends on the SEP measure selected, the health outcome of interest, and the subpopulation under consideration (Braveman et al. 2005; Shavers 2007; Gazmararian et al, 1996).

#### Statement of the Problem

Based on the previous examination, the purpose of this study is to understand the context of inequality related to health and how this association is moderated by race. The association between low birth weight and socioeconomic position has been well established in health

research. Finch (2003) has found that income has a significant and curvilinear relationship with the probability of low birth weight, and that occupation grade has a marginally significant effect on the probability of being born low birth weight. Additional research indicates correlations between education and the odds of having a LBW infant (Parker, Shoendorf and Kiely 1994). A vast majority of research has utilized traditional indicators, such as income and education in investigating low birth weight. While existing research has garnered very important insights, questions remain regarding whether those traditional measures fully reflect the context of social and economic inequality in relation to low birth weight. For instance, to what extent do traditional measures reflect the socioeconomic context of women - before and during pregnancy - that may affect low birth weight? Furthermore, do these traditional measures have applicability across different subpopulations?

Figure 1 illustrates the general conceptual model that guides this study. This model assumes that SEP is an important determinant of health outcome (as measured by LBW). Four measures of SEP are included to reflect related but distinct dimensions of social and economic inequality. Maternal education is considered a traditional measure while Medicaid before pregnancy, Women, Infants and Children program (WIC) during pregnancy, paternal acknowledgement on the birth certificate, are less well-known, contextual indicators that reflect day to day social and economic experiences that may affect low birth weight. Separate models are explored with each SEP indicator. Additionally, a composite measure, which contains information from the other SEP measures, is created. The overall model posits that race has an independent effect on both on SEP and LBW, but also recognizes that not all the variation observed in LBW may be accounted for by race. Also, race has an interactive effect (denoted by the dashed arrow) on the association between SEP and LBW. Race modifies the usual influence of specific levels of SEP

such that variations still exist within the same selected SEP levels; maternal education, WIC, paternal acknowledgement on the birth certificate, Medicaid before pregnancy and the composite measure.



Figure 1: Proposed Conceptual Model

# Research Questions

The following research questions emerge:

- (1) What are the associations between contextual measures of SEP (maternal education, WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement a composite variable) and LBW?
- (2) What are the differences between associations of contextual measures of SEP (i.e., WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement) and traditional measures of SEP (i.e., education) with LBW? How do these differences reflect the socioeconomic context of the population under consideration?
- (3) How does race interact with SEP in determining variations in LBW?

Based on the previous discussion, this dissertation is organized in five chapters. Chapter 2 reviews relevant literature pertaining to; (i) the theoretical and sociological traditions behind SEP, (ii) the commonly utilized individual SEP measures (iii) paternal acknowledgment, WIC and Medicaid participation as indicators of SEP and (iv) a discussion of low birth weight as the health outcome under consideration. Literature related to the connection between SEP and health will also be reviewed followed by review of works concerning the effects of race on the relationship between SEP and health. Chapter 3 presents the study's methodology, research questions, hypotheses, the population and sample derived from Michigan Pregnancy Risk Assessment Monitoring System (MI PRAMS) 2000-2006, data collection /instrumentation and data analysis. Chapter 4 provides the analysis of data. Data analysis consists of several levels of statistical analysis; (i) handling of missing data and issues of multicollinearity, (ii) preliminary univariate analyses to determine the distribution of variables, (iii) binary and multinomial logistic regression modeling of data, (iv) principal component factor analysis to develop a composite measure of SEP. Finally, chapter 5 presents the findings, conclusions and implications, along with limitations of the study and possibilities for future research.

#### **REVIEW OF LITERATURE**

## Introduction

The United States underachieves with respect to its overall population health. The World Health Organization (2009) estimated U.S. healthcare spending at approximately 16% of GDP, greater than any other highly industrialized nation in the world. In 2006 the total healthcare expenditure per capita in the state of Michigan alone (\$5058), surpassed expenditure of entire countries like Cuba and Norway (World Health Organization 2006). However, this expenditure has not resulted in good health relative to many other industrialized nations. The United States ranked 50<sup>th</sup> in life expectancy and 45<sup>th</sup> in infant mortality. Furthermore the infant mortality rate of children is higher in Michigan (7.6 deaths per 1000 births) than in Cuba (5.12 deaths per 1000), while on average, people die younger in Michigan (76.3 years) compared to those living in Norway (80.2 years) (CIA World Factbook 2009; OECD 2011). This paradox has given rise to questions as to why in a nation of prosperity; United States citizens die prematurely.

There are several explanations behind the relatively poor overall population health. One explanation points to a fragmented, for-profit healthcare system that currently leaves millions of Americans without access to medical care (Rosenthal 2009). While medical care has a role in the overall population health and merits intervention and reform, health is affected not simply by the ease with which a doctor can be seen. Rather, it has been argued that the attention given to medical care is disproportionate to its importance as a determinant of health and that medical care can explain only 10 percent of the variation in health status (Williams 1990; U.S. Department of Health, Education and Welfare [DHEW] 1979). Another explanation focuses on individual-based risk factors (i.e. diet, cholesterol, and exercise) as relatively proximal causes of

disease (Link and Phelan 1995). However, Link and Phelan (1995) argue that there must be an examination of what put people at "risk of risks". Most behaviors are not randomly distributed in the population, but are socially patterned (Berkman and Kawachi 2000). In other words, the social environment influences behavior (Lynch et al. 1997). For example, people who are poor, have low levels of education, or are socially isolated, are more likely to engage in a wide range of risk-related behaviors and less likely to engage in health-promoting ones (Adler et al. 1994). Therefore to improve the United States' health, it is imperative that the social and economic context be closely examined.

# The Conceptualization and Operationalization of the Socioeconomic Inequality/Health Connection

Social factors are likely "fundamental causes" of disease because they embody access to key resources, affect multiple health outcomes through multiple mechanisms, and consequently maintain an association with disease even when intervening mechanisms change (Link and Phelan 1995). A general pattern of better health among those socioeconomically better off has been observed in a variety of social contexts, when using most measures of health and disease and various measures of socioeconomic position (Lynch and Kaplan 2000). More recent research show that men and women in families with incomes over four times the federal poverty line can expect to live more than 6.5 years longer after age 25 than those living at or below the poverty line (Kaplan 2004).

Furthermore, it has been found that the greater the degree of inequality in a society, the poorer the overall health status. Between 1974 and 1994, the top 5 percent of United States households (ranked by income) increased their share of the nation's aggregate household income

from 16 percent to 21 percent. Additionally the top 20 percent rose from 44 percent to 49 percent. In contrast, the share among the bottom 20 percent fell from 4.3 percent to 3.6 percent (Danzinger and Gottschalk 1993; De Vita 1996). In tandem with this growing economic inequality, there are widening disparities in mortality when comparing data from the 1960's to that of late 1970's and 1980s (Duleep 1995). Moreover, there is evidence that poorer people in more equal nations tend to be healthier and outlive wealthier people in more unequal nations. Middle-income people in Britain enjoy better health than wealthier Americans (Bowe 2008). In addition, a study by McCord and Freeman (1990), found that men in Bangladesh, one of the world's poorest nations, are more likely to reach age 65 than black men in Harlem, United States. Even though black men in Harlem have higher incomes than Bangladeshi men, the black men live in a more unequal society.

In health research the concept of socioeconomic position (SEP) has been used to reflect and measure how factors related to social position and socioeconomic inequality may have consequences for health. Socioeconomic position refers to the position(s) individuals or groups hold within the social structure that is influenced by social and economic factors (Lynch and Kaplan 2000). Terms such as social class, social position, social stratification and socioeconomic status (SES) have sometimes been used interchangeably with each other in health research in a manner that belies their theoretical and conceptual roots. In comparison socioeconomic position deliberately includes concepts with varying historical and theoretical origins therefore making it broader, more flexible and more conceptually sound when referring to different aspects of social inequality (Galobardes et al. 2007). The broad concept of socioeconomic position has its basis primarily in Marxian and Weberian theories of social inequality.

## Theoretical Origins

The works of social theorists Karl Marx and Max Weber have significantly influenced the understanding and measurement of socioeconomic position (Lynch and Kaplan 2000). For Marx (1848), society is stratified into classes that are defined by their relation to the "means of production" (factories, land, etc.). Historically, productive activity was the root of social change with each system of production establishing particular social relations between individuals and the productive process. Capitalism is the system of production that currently characterizes many societies. In capitalism there exists a system of commodity production in which people engage in a process that not only meets their needs but also produces surplus commodities, which can be exchanged in a market. Within this system a dichotomous class system emerges when a differentiated division of labor allows a small number of people (bourgeoisie/capitalists) to appropriate any accumulated surplus of production. The bourgeoisie, who control the means of production, exploit the subordinated non-propertied workers (proletariat), whose labor produces the surplus. In short, exploitation is an inherently structural element of the capitalist system (Wright 1985).

Weber (1958) suggested that society is hierarchically stratified along many dimensions (i.e. class, status, and political power). This stratification results in an unequal distribution of economic resources and skills. In a capitalist society certain groups are at a competitive disadvantage in the marketplace because they possess fewer goods, abilities and skills exchangeable for income. Weber therefore saw class as groups of people sharing "life chances" common sets of beliefs, values, and circumstances. Class position is not determined primarily by the relationship to the means of production. Rather, class position is largely determined by the choices or opportunities created by productive relations. Weber, like Marx, recognized that a

group's relationship to productive resources was important. However, Weber also believed this relationship was important mainly because it influenced the distribution of economic opportunities, knowledge assets and skills that actors brought to the market. Within capitalism, a 'class situation' referred to the likelihood that a particular assortment of economic goods, living conditions, and general life experiences were available to a particular group. Most epidemiological studies have been influenced by this Weberian focus and utilize indicators of "life chances" such as education, occupation and income. (Lynch and Kaplan 2000).

Lynch and Kaplan (2000) proposed an overarching Marxian-Weberian framework that features themes critical to understanding and measuring the association between socioeconomic position and health. This approach frames socioeconomic position in the context of its relationship to health through several elements. Firstly, the social and structural relations between groups within a society are based primarily on material circumstances determined by the relations these groups have with systems of economic production. The advantaged groups within a society, control resources (i.e. material, economic, political, social or cultural) in a way that excludes, exploits and dominates those in less advantaged positions (Wright 1985). Secondly, productive relations determine lifestyles and health behaviors within each group. This results in risk factors, health behaviors that are socially patterned (Lynch et al. 1997). Finally, although SEP is determined partly by structural relations between groups within a society it is measured at the individual level. In other words SEP while observable in individuals should be conceptualized as also existing outside the individual. For example, education level attained by an individual is constrained by educational opportunities available in a particular society and by family background (Galobardes 2007).

Several theories and concepts commonly used to understand the SEP–health association fall within the Marxian-Weberian perspective proposed by Kaplan and Lynch (2000); namely, the 'general susceptibility to disease' concept as well as the 'material deprivation/culture and behavior theory'. Early contributors to the general susceptibility to disease concept, Wade Hampton Frost (1937) asserted that at the turn of the 20<sup>th</sup> century there was nothing that changed "nonspecific resistance to diseases" as much as poverty and poor living conditions. He argued that it was not just increased risk of exposure among the poor that produced high prevalence rates of tuberculosis: it was something about their inability to fight off disease. The poor's increased susceptibility to disease once exposed was the main contribution to high rates of disease among that population. Cassel, Syme, and Berkmen (1979) further argued that many social conditions were linked to a broad array of diseases. In short, social factors influence disease processes by creating a vulnerability of susceptibility to disease in general rather than to any specific disorder.

Another theoretical approach falling under the Marxian-Weberian perspective is the 'material deprivation/culture and behavior theory' that builds on two assumptions (Rutter and Quine 1990). The first assumption is that material deprivation affects health directly, while the second maintains that material deprivation works indirectly, either through the individual's behavior, lack of medical services, or a poor diet. The material deprivation/ culture and behavior theory suggests that [SEP] has an effect on health outcomes because people at the bottom of the social scale suffer material deprivation and partake in a culture in which prevalent forms of health behavior are harmful (Kogan 1995).

There is by no means consensus regarding how socioeconomic position is associated with health. 'Artifact theory' and 'social selection theory' offer alternate explanations to the material

deprivation/ culture and behavior theory. Artifact theory suggests that reported inequalities in health are 'artifacts' or errors of the ways in which both social class and health are defined (Kogan 1995). Artifact theory suggests that since it is difficult to measure both social class and health, it is difficult to demonstrate any link between the two. Social selection theory states that people who are unhealthy or potentially unhealthy are selected for low status occupations while healthy people are selected upwards. For instance, an individual who is chronically ill or disabled may move down the social scale because they are unable to find employment or are underemployed. Studies that have examined the relationship between social class and health have contradicted both these theories. Firstly, a number of longitudinal studies that have used different measures of SEP and health have shown a similar pattern: those in lower social classes always show poorer health (Rutter and Quine 1990). The artifact explanation cannot account for all these different studies. Other studies refute the social selection theory arguing that the possible effects of social selection are too small to explain the size of the observed inequities in health (Townsend, Davidson and Whitehead 1988).

Generally, many health studies have been influenced by the material deprivation/ culture and behavior theory, and have utilized indicators of life chances such as education, occupation, and income under the assumption that they constitute fundamental links between social stratification and health. Most SEP indicators are, to varying degrees, correlated with each other, but each individual indicator reflects a particular dimension of social stratification (Galobardes 2007). Individual-level indicators are typically used to measure some type of individual resource or asset even though they are derived from larger social and economic processes (Lynch and Kaplan 2000). Commonly used individual indicators include (1) education, (2) occupation, (3) income and wealth.

## Overview of Commonly Used SEP Indicators

## (1) Education

Education reflects knowledge related assets and is among the most frequently used indicators of SEP in epidemiological studies (Liberatos et al. 1998; Shavers 1990; Lynch and Kaplan 2000). Education is commonly used because it includes persons not counted in the labor force (e.g. homemakers, unemployed), and because it does not fluctuate over adult lifespan regardless of health status (Liberatos et al. 1998). Alder and Newman (2002) argue that it is the "most basic" component of SEP because it influences future occupational opportunities and earning potential. Education captures socioeconomic position from childhood to adulthood, as well as reflects the knowledge and skills acquired that may affect an individual's cognitive functioning, which ultimately may protect health (Ross and Wu 1995). Since education is usually completed before detrimental health effects occur, using education as an indicator reduces the likelihood of reverse causation or social selection, which can be a problem with other traditional SEP measures (Stewart et.al. 2001). Education can be measured as a continuous variable (total years of completed education) or as a categorical variable by assigning milestones such as completion of primary or high school, higher education diplomas, or degrees. Measuring education as a continuous variable assumes that every year of education contributes similarly to a person's attained SEP and that time spent in education is more important than specific educational achievements (Shavers 2007).

## Strengths and Limitations of Education as an SEP Indicator

In research, education is relatively easy to measure using self-administered questionnaires, and garners high response rates (Galobardes 2007). Unlike certain other SEP indicators, it excludes few members of the population and can be obtained from everybody

independently of age or working circumstances (Liberatos et al. 1998). However, there are also disadvantages associated with the use of education as an indicator of socioeconomic position. Education level does not have a universal meaning with respect to race/ethnicity or gender (Kreiger et al. 1997). For example, studies have shown that the economic returns for a given level of education are higher for men and whites as compared to women and blacks (Oliver and Shapiro 1995; US Bureau of Census 1991).

Educational success has an important social dimension, as well as material value. Therefore, shortcomings are evident when education is measured as 'number of years' because the importance of credentials achieved with the attainment of certain educational milestones (i.e. high school diploma, college degree) are ignored. Also, measuring education as either 'number of years' or educational level of attainment both fail to provide information regarding the quality of the education experienced and how it is socially or economically valued (Lynch and Kaplan 2000).

#### (2) Occupation

Occupation is often operationalized as employment status (i.e.,

employed/unemployed/retired), in terms of graded hierarchies, specific occupational groups according prestige or skills (i.e. chief executive officers, town clerks, tenant farmers) or aggregate occupation groups (i.e. blue-/white-collar workers) (Shavers 2007). Studies typically use the current or longest held occupation of a person to characterize their adult socioeconomic position. However, there are studies that have examined the role of SEP throughout the life course and used 'parental occupation' as an indicator of childhood SEP in conjunction with the individual's occupations at different stages in adulthood (Smith et al. 2004). Often occupational measures are treated as transferable. Measures from one individual or combinations of several

individuals can be used to characterize the SEP of others connected to them. For example the occupation of the "head of household" can be used as an indicator of the socioeconomic position of a spouse, children or the household as a unit (Galobardes et al. 2004).

In general, there are several mechanisms that explain the association between occupation and health outcomes. Firstly, occupation is strongly related to income and therefore any association between occupation-based SEP and health may indicate there is a direct association between material resources that determine living standards and health. Secondly, occupations reflect social standing or status and may be related to health outcomes because of certain privileges (e.g. easier access to better health care, access to education, and healthier housing) that are more easily attainable by those of higher standing. Thirdly, occupation may reflect social networks, work-based stress, control, and autonomy and thereby affect health outcomes, through psychological risks/psychosocial processes. Finally, occupation also may reflect specific toxic environmental/ physical hazards characterized by substantial physical stress (Galobardes et al 2004; 2007). Generally, these links are consistent with material deprivation/culture and behavior/social causation theory. However it should be noted that the social selection theory offers a countervailing explanation, whereby healthy people are more able to obtain and retain employment (Ross and Mirowsky 1995).

#### Strengths and Limitations of Occupation Measures

A major weakness regarding occupational indicators is that they cannot be readily assigned to all members of a population. Unemployed people are frequently in occupation-based classifications that result in socioeconomic differentials being underestimated, particularly if these occupation classifications are the sole source of SEP information (Martikainen and Valkonen 1999). Other groups excluded are retired people, people whose work is inside the

home (mainly affecting women), the chronically unemployed, students, and people working in unpaid, informal or illegal jobs (Braveman et al. 2005). Although 'previous occupation' can be assigned to those who are retired and to some unemployed people, and husband's occupation is often used to assign women's SEP, this may provide an inadequate reflection of their current socioeconomic circumstances. Further, groups engaged in illicit and/or stigmatizing activities may be less willing to disclose the occupation. There may also be problems classifying the self-employed.

In addition, occupation may have different meanings in different contexts making international comparisons or comparisons across different birth cohorts problematic. Using occupation-based classifications and assigning a husband's SEP to his wife may be appropriate for older cohorts, but not younger generations given that higher female participation rates in the labor market make this method problematic (Galobardes et al. 2004). Braveman et al. (2005), argued that broad occupational classifications may result in the loss of information regarding important differences in how occupation related prestige or power could affect health. Further, the constant transformation of the occupational structure within contemporary economies may render these broad classifications irrelevant. For instance in many societies, the decrease in manual occupations, with a simultaneous increase in low-level service occupations, has transformed the stratification that occupation generates in terms of socioeconomic position. Consequently, the manual and non-manual classifications may lose some of their meaning in economies that include a large number of low-paid non-manual service jobs.

#### (3) Income and Wealth

Income and wealth are SEP indicators that most directly measure material circumstances. Income can be understood as the availability of economic resources to individuals or groups over

a period of time. Many public health studies ask people to either report their gross annual income at a given point in time or to place themselves within predefined categories. Typically annual household income, rather than annual individual income, is measured. Although individual income captures material characteristics, household income may be useful regarding women who may not be the main earners in the household. Using household income information to apply to all the people in the household assumes an even distribution of income according to needs within the household, which may or may not be true. Information pertaining to income is often obtained without regard to the number of persons being supported by this income (Galorbades et al. 2007). In order for income to be comparable across households, more information regarding family size or dependents should be elicited (Kreiger et al. 1997). In addition to measuring income at the individual and household level in absolute terms, income also may be measured as a relative indicator establishing levels of poverty. For example, income can be measured as a percentage above or below the official poverty level in a given year (Lynch et al. 1997).

Income can influence a wide range of material circumstances with direct implications for health (Liberatos et al. 1988). Individuals with higher incomes are more likely to have the ability to pay for healthcare and to afford better nutrition, housing, clothing, transportation, medical care and schooling (Adler and Newman 2002). Although increasing income is likely to produce diminishing returns on the health impact of these material conditions, differences in health related material conditions still exist across all levels of income (Lynch and Kaplan 2000). In addition, income helps determine self-esteem and social standing by providing the outward material characteristics relevant to participation in society. Wealth is the physical and financial assets (value of housing, cars and investments) plus income minus debt (Muntaner et al. 1998). Income captures the resources that are available at particular periods of time, whereas wealth

measures the accumulation of these resources. The use of wealth as an indicator is based on the assumption that income in combination with total assets is a better measure of socioeconomic circumstance.

## Strengths and Limitations of Income and Wealth

When using income or wealth as SEP measures, a number of issues have to be taken into consideration. First, people are wary of providing information pertaining to their personal income (Turrell 2000). Hauser (1994) found that in the United States, non-response to questions about income is high and that income tends to be poorly reported, particularly by individuals with high incomes. Further, the response rate to questions about income varies country, birth cohort and gender. Because of issues of non-response rates income has been described as more sensitive than education and occupation as measures of socioeconomic position (Galobardes et al. 2004). Secondly, Kreiger et al. (1997) argue that although disposable income reflects what individuals/households can actually spend, this information does not necessarily reflect all the components of income (i.e. dividends, child support, alimony, transfer payments, pensions, "in kind" transfers, and food stamps).

Income is a SEP indicator that can be unstable and fluctuates significantly over the short term (Kreiger 1997). Between 26% and 39% of individuals in the United States aged 45 to 65 years, experience income reductions of 50% more than once in an 11-year period (Duncan 1996). Fluctuations in income are more pronounced for those at the bottom of the income distribution because they are less likely to have stable employment (McDonough et al. 1997). Galobardes et al. (2004) argued that current income for different age groups may vary and be most sensitive during the prime earning years and that income for young and older adults may be a less reliable indicator of their true SEP as income typically follows a curvilinear trajectory with age. Many

health studies measure income at only one point in adulthood, and consequently fail to capture the health effects of prolonged exposure to low income, or to account for movement into and out of low-income groups (Kaplan and Lynch 2000). Measuring income at only one point in time may also make it difficult to recognize the effect of reverse causality, where people with poor health suffer a loss of income (Galobardes et al. 2007).

In general, wealth is more strongly linked to social class than income because assets are an indication of the ability to meet emergencies or to buffer the effects of temporarily low income due to unemployment (Shavers 2007). Though measuring wealth has a strong conceptual and empirical basis, few studies in affluent countries have measured wealth (Braverman, et al. 2005). Wealth similar to income shares a significant degree of sensitivity among respondents leading to high error rates or low response rates. Further, methods of calculating wealth can be difficult, because of the multiple factors that contribute to it (Shavers 2007). Income, wealth, occupation status and education have all been used in health research to determine how SEP affects health. The choice of which SEP measure to use is fraught with a number of considerations.

#### SEP and Health

Winkleby et al. (1992) argued that it is conceptually and methodologically unconstructive to claim that one measure of SEP is universally better than another. Each indicator reflects a particular dimension of social stratification, which may be more or less relevant to health outcomes and at different stages in the life course (Naess, Claussen and Davey Smith 2004). Although in many cases an inverse relationship between SEP and health is observed, there is a
lack of a consistent association between the various socioeconomic indicators and different health outcomes.

The varied association between SEP and health may be explained by two potential mechanisms. First, some measures may represent specific aspects of social position that influence a particular health outcome better than other measures. Studies have found that characteristics of a mother's occupation, such as physical or mental stress, may be associated with premature birth, but not with decreased fetal growth (Kreiger 1991); and that a woman's reproductive history was more strongly associated with her household's class than with her individual class (Krieger 1991). Gortmaker (1979) found that household poverty, not low parental education was associated to social position are more accurately depicted by some socioeconomic measures than by others. A woman's education for example may be a better predictor of the health habits she practices during pregnancy than her household income. The second mechanism is especially evident when applying measures of SEP across subpopulations such as racial groups.

#### SEP, Health, and Race

The health problems of U.S. blacks are considerable and are observable over the life course (Ferraro and Farmer 1996). Blacks generally report higher levels of morbidity, and manifest the highest mortality rate for heart disease, stroke and many types of cancer (Centers for Disease Control 2002; Otten, Teutsch, Williamson, and Marks 1990; Reed Darity, and Robertson 1993). Another study found 13.7 percent of non-Hispanic black infants were low birth weight, compared with 7.2 percent of non-Hispanic whites (Martin et al. 2010). A major explanation for

the racial health inequality focuses on socioeconomic position (Farmer and Ferraro, 2005). Blacks traditionally have a lower education level than whites (Newburger and Curry 2000), have higher unemployment rates than white adults (Thomas and Hughes 1986) and are more likely to experience poverty at all ages. Research also showed that SEP influences patterns of morbidity and mortality (Berkman Gurland 1998). This has led some scholars to assume that racial health differences would shrink appreciably, or disappear If SEP differences were abolished (Markides and Mindel 1987). There is no consensus surrounding this argument, particularly given that there is evidence that within each level of SEP, blacks generally have worse health status than whites. In addition studies observe a higher infant mortality rate among black women than white women despite having equal levels of education (Schoendorf et al 1992). Infant mortality among white American women with a college degree or higher is 3.7 deaths per 1,000 births. In contrast, African American women with the same education have 10.2 deaths per 1,000 births - almost three times higher than their white counterparts (Vital Statistics of the United States 2002).

Statistically adjusting for SEP substantially reduces, but does not eliminate, racial disparities in health (Ferraro and Farmer 1996; Kreiger and Fee 1994). Moreover, some studies find that the black-white mortality ratio actually increases with rising SES (SEP). With regards to infant mortality the black-white gap is narrowest among women who have not completed high school, and highest among those women with a college education (Krieger et al 1993). It has also been found that African America mothers with a college degree have worst birth outcomes than white mothers without a high school education. (Vital Statistics of the United States 2002). Further, there is growing recognition that the issue is not race *or* class, but how race *and* class operate (Collins 2000). Evidence points to race and class not being identical or interchangeable (Farmer and Ferraro 2005). There is some heterogeneity within racial categories. Although the

rate of poverty among black Americans is higher than white Americans, two thirds of black people in the country are not poor, and 2/3 of all poor are white (Williams 1997). Though race and socioeconomic position are closely related, they clearly represent distinct dimensions of inequality. It is for this reason that the role of race in the association between SEP and health is conceptualized as being based on discrimination rather than biological differences.

One study comparing birth weight among infants of U.S. born blacks, African – born blacks, and U.S. born whites investigated whether observed racial disparities in preterm birth were due to biological differences (David and Collins 1997). Given the well-established finding that preterm birth can run in families, the study assumed that if blacks were genetically predisposed toward premature birth regardless of education, prenatal care or lifestyle, Africans as a group would have a greater genetic predisposition than African Americans who are racially mixed comparatively. David and Collins (1997) found that the health status of Africans and whites were about the same. African Americans however tended to have worst outcomes that the other two groups. Further, it was found that when African women migrate to the U.S. it takes just one generation before their daughters are at risk of having premature babies at a significantly higher rate and with poorer birth outcomes. This clearly suggests that the social environment surrounding racial discrimination affects health. Persistent racial/ethnic discrimination in U.S. society modifies the usual influence of SEP such that racial/ethnic variations still exist within the same occupation, income and education.

There are two alternative hypotheses that explain how race and SEP interact in shaping health – the minority poverty hypothesis and the diminishing returns hypothesis. The minority poverty hypothesis states that blacks living in poverty have a unique disadvantage (Farmer and Ferraro 2005). Throughout the life course, poor minority persons face enormous threats to health

and well-being as a result of combined disadvantage due to poverty and race (Willie 1989). The health gap between blacks and whites is greatest for those living in poverty and least for those in the upper social strata (Farmer and Ferraro 2005). The diminishing returns hypothesis in contrast maintains that the differences between black and white people are greatest at the highest levels of SEP. In other words, minority persons do not experience the same returns as whites for higher SES (SEP) achievement. There has been research that substantiates this perspective, particularly in regard to educational attainment. Blacks experience diminishing returns on the resources they attain (Bowles and Gintis 1976). For example, Braveman (2003) found consistently lower mean family incomes for African Americans compared to whites for five different levels of educational attainment. In addition to the theoretical perspectives to understanding the SEP/Health association, it is important to consider methodological approaches.

#### Methodological Approaches to Understanding the SEP/Health Association

An important issue related to measurement of the SEP/health association concerns how the relationship between a particular SEP indicator and a health outcome is expressed. The most common approach in health studies has been to express socioeconomic health differences as rate ratios of extreme socioeconomic groups (Lynch and Kaplan 2000). Results of studies are usually expressed in the following manner "compared to those with a university degree, people with less than a primary education had threefold increased risk of some health outcome" (Lynch and Kaplan 2000). This approach is useful in expressing the relative health disadvantage on one particular socioeconomic group compared to another. A disadvantage of this approach is that it ignores the relationship in the rest of the population. In addition rate ratios do not necessarily elucidate the public health importance of socioeconomic health inequality in terms of the size of the exposed population or the absolute level of risk (Pamuk 1985).

In addition to comparing relative risk of adverse health outcomes, other methodological approaches are used to evaluate the SEP/ health association across different racial subpopulation which are based on the assumption that SEP measures may not necessarily have the same meaning across race/ethnic or other demographic groups. Shavers (2007) advocated multivariate analyses stratified by race/ethnicity, age or other demographic categories. This approach enables examining the effect of specific SEP measures across and within groups by examining the magnitude of the odds ratios produced from stratified multivariate analyses; thus allowing for the assessment of interactive effects between SEP and the stratification variable.

#### Early Life Health/Low Birth Weight as a Measure of Health

In addition, to understand the overall population health of a society, it is critical to consider early life health. Studies have found that poor childhood health may have both direct and indirect negative impacts on adult health (Palloni 2006), and that people who experience poorer health outcomes such as low birth weight (LBW) have relatively worse health as adults (Case, Fertig, and Paxson 2005). The 'Developmental and Life Course perspective'' shows how early life influences onset of disease in middle and late life based on two hypotheses (Berkman and Kawachi, 2000). The first hypothesis states that some exposure in early childhood could influence developmental processes. By molding patterns of response during these "critical stages", early life experiences then would make the individual vulnerable or less resistant to various diseases in adulthood (Barker 1992). The second hypothesis claims that detrimental early life health creates cumulative disadvantage (Ross and Wu 1995), and sets in motion a series of

subsequent experiences that accumulate to produce disease after 30, 40, 50 or 60 years of disadvantage (Berkman and Kawachi, 2000).

Infant mortality is usually examined as an important measure of society or community health because early life health contributes to overall population health. However, understanding low birth weight (LBW) within a broader health context is crucial because LBW has direct implications for infant mortality, as well as long-term impacts on health outcomes in adult life (Kramer, Goulet and Lydon 2000; World Health Organization 2011). Low birth weight infants are at higher risk for various developmental and health outcomes including cognitive development, higher prevalence of respiratory distress and asthma (Boardman, Finch, and Hummer 2001). Low birth weight is an important measure/health outcome to investigate the larger question of why the United States spends so much on health care, but in relative terms has little to show for it. Lewitt et al. (1995) estimated that 35% of all healthcare spending on newborn children in the United States is related to LBW children even though they make up less than 8% of newborns. In 2005, each gram below 2,500 grams cost up to \$20 per month in additional healthcare (Almond et al. 2005). Altogether, using LBW as a measure of societal health is essential because the social patterns associated with LBW may contribute substantially to social inequalities in adult disease (Davey Smith et al. 2007) and poor overall population health.

In addition to links with overall population health, it has been found that increased risk of LBW is associated with social class (Kogan 1995). However, the precise way in which socioeconomic position actually causes an increased risk in LBW is not entirely clear. Still, Rosenwaike (1971) states that infants fare better if the socioeconomic level of the parents is higher. In addition, better-educated women are more likely to have early exposure to prenatal

care. Early exposure to prenatal care is an important component in the socioeconomically determined lifestyle that influences pregnancy outcomes (Rosenwaike 1971). Paneth (1995) was somewhat in agreement and suggested that poverty, which is associated with reduced access to healthcare, poor nutrition, lower education, and inadequate housing, may be responsible for some of the risk.

Commensurate with the conventional definition of low birth weight - a baby born at a weight less than 2,500 grams or 5 pounds 8 ounces - most health studies have dichotomized the measurement of LBW (Case et al. 2005). The dichotomization also reflects many studies finding a higher risk of adverse health outcomes in the short, medium and long term being associated with low birth weight (Gortmaker and Wise 1997). However, dichotomization of data may result in loss of information as important variations in LBW are ignored. In this regard dichotomization is especially problematic because of questions surrounding the definition of low birth weight. Paneth (1995) asked, should [LBW] be considered the same for babies of all types and from all populations? Are there different kinds of LBW babies? Populations vary considerably in the size of their babies at birth. Indian infants average weight is 2,900 grams (6 pounds, 6 ounces) while the average Swedish baby weighs 3,500 grams (7 pounds, 11 ounces) (Wang, Guyer and Page 1994). Although health researchers should not assume that population differences are only "natural", caution must be exercised when adopting a Eurocentric standard and applying it to every subpopulation. While considering LBW is critical to understanding population health, it is essential how it may be influenced by socioeconomic position.

## Utilizing Multiple and Contextual Measures of SEP

Some SEP measures may reflect specific aspects of social position that influence a particular health outcome better than other measures (Andersen and Mortensen 2006). Based on this some studies have used multiple measures to enable a better understanding of how different dimensions of inequality affect health. A study by Parker et al. (1994), used data from the 1988 National Maternal and Infant Health Survey to compare the associations between five socioeconomic indicators for SEP and reproductive outcomes. The five indicators of SEP were maternal education, paternal education, maternal occupation, paternal occupation and family income. It was found that all socioeconomic indices were inversely associated with low birth weight. However, the association between SEP and LBW differed depending on race, and the SEP indicator used. There was elevated risk of LBW among both black and white mothers of low socioeconomic status regardless of the measure used. However, the magnitude of association between a particular socioeconomic indicator and LBW often differed between white and black women. It was found that maternal education and occupation were the best predictors of low birth weight. However the magnitudes of association between racial groups suggest that a mother's education and occupation represent different aspects of social position in black and white women. Studies like the one by Parker et al. (1994) avoid the pitfalls of using just one measure of socioeconomic position. However, the reliance on traditional indicators such as education and occupation does not go far enough to accurately and fully understand the SEP association with health.

The choice of socioeconomic measurement should be based on theoretical assumptions of how socioeconomic position is linked to health damaging exposures and health protective resources and ultimately to health (Lynch and Kaplan 2000). The use of traditional measures

successfully reflected these assumptions. However, with the association between traditional measures and health being already established, there is little more to be gained by continuing to measure SEP with traditional measures. In order to investigate how levels of inequality and variation in social context affect health, Shavers (2007) advocates using measures that reflect specific factors that may have an impact on a particular outcome. For example, factors such as transportation to medical appointments, type of health insurance, support systems and knowledge of appropriate care are likely to be more useful than traditional measures in understanding the socioeconomic context of health. Oakes and Rossi (2003) concurred, adding that for public health purposes, there is a greater need for SEP measures to capture more of the social context than education, occupational position, and/or income.

In response to the need for more contextual measures of SEP that may have value for public health policy, Gazmararian, Adams and Pamuk (1996), evaluated multiple and contextual SEP measures, and investigated on associations between measures of socioeconomic status and maternal health behavior. The study used population-based data for Caucasian women from Alaska, Maine, Oklahoma, and West Virginia who delivered a live infant in 1990-1991, and participated in the Pregnancy Risk Assessment Monitoring System (PRAMS). Maternal education, Medicaid payment for delivery, and Women, Infants, and Children (WIC) during pregnancy, were among the measures used in the study.

#### Contextual Measures of Socioeconomic Position

## (1) Medicaid and WIC

Medicaid is one source from which a contextual measure may be derived. Medicaid is a joint federal – state program that provides health coverage to poor families, and individuals who

have no medical insurance, or families that have inadequate insurance. Federal guidelines extend Medicaid to low-income pregnant women if family income is at or below 133 percent of the federal poverty line. In Michigan, Medicaid also covers pregnant women with income up to 185 percent of the federal poverty line (FPL) through its 'Healthy Kids' Medicaid program (Michigan Department of Community Health 2010). Medicaid as a measure of social position captures material and social deprivation, as well as relatively low social status (derived from having low income). By virtue of its eligibility criteria, Medicaid status reflects specific factors that research has shown may affect health (i.e. lack of access to medical care, low income and poverty).

Another assistance program from which a contextual measure has been created was The Special Supplemental Food Program for Women, Infants and Children (WIC). The Special Supplemental Food Program for Women, Infants and Children provides supplemental food, health care referrals and nutrition education for poor, pregnant, breast-feeding, and postpartum women; infants; and children up to age five who are at nutritional risk. Pregnant women who are eligible for the program have an income at or below 185 percent of the poverty level, participate in other federally funded programs (e.g. Medicaid) and show evidence of health or 'nutritional risk' as verified by a health professional (Kowaleski-Jones and Duncan, 2000). The Gazamararian et al. (1996) study assumed that specific factors reflected in the eligibility criteria for WIC (i.e. poverty and associated low income and poor nutrition), was associated in poor maternal health behaviors.

Gazmararian et al. (1996) used WIC and Medicaid to reflect specific aspects of social position that influence maternal health behavior. By virtue of their eligibility criteria, Medicaid payment for delivery, as well as WIC during pregnancy were conceptualized as measures of

poverty. Using WIC participation and Medicaid receipt avoided recall problems that are problematic for SEP measures such as income. In addition WIC participation and Medicaid receipt captured factors known to affect health (i.e. poverty and material and social deprivation that accompany it). Using multiple contextual measures including 'Medicaid payment of delivery' and 'WIC during pregnancy', the study enabled a better understanding of how different dimensions of inequality during the critical period of pregnancy could affect health behaviors.

Despite advantages of using 'Medicaid payment of delivery' and 'WIC during pregnancy', Gazmararian et al. (1996) reported on a number of complications. One concern was that WIC status and Medicaid payment indicate only the number of women who actually use these programs rather than the number of women who are eligible to receive this assistance. When comparing WIC or Medicaid participants to non-participants, failure to adjust for differences in need may have caused underestimation of the effects of the programs. Nevertheless, Gazmararian et al. (1996) argued that results and distributions of the study were similar to state poverty status, which indicated that WIC and Medicaid participation measures were reasonably accurate measures of poverty. Gazmararian et al. (1996) also reported problems concerning potential comparisons across regions because eligibility requirements for both Medicaid and WIC vary by state. In addition, the study points out that because the SEP measures used were inherently dichotomous, there were potential limitations regarding the interpretation of data. For instance, information on how slight changes in a woman's SEP could impact LBW is lost. Gazmararian et al. (1996) also failed to use measures of social support as proxies of socioeconomic position. Proxies for social support are important because they are often strongly correlated with SEP, and may offer insight into the mechanisms that explain the fundamental association between of SEP and a particular health outcome. Characteristics such as maternal

marital status, having a single mother or being an orphan, illegitimacy, broken family and death of father or mother at an early age are circumstances that often result in low SEP (Galobardes et al. 2004). Indicators such as maternal marital status offer insight as to the social and economic context that affect health outcomes.

#### (2) Social Support and Marital Status

Economic well-being and social support are specific factors within marriage that confer advantages with respect to health (Ross, Morowsky and Goldsteen 1990). Married mothers may have wider social networks than single mothers. Also, individuals who have spousal support may have the benefit of greater stability, less stress, and may be supported in practicing healthpromoting behaviors that result in better health outcomes. Single individuals, in contrast, are more likely to engage in more risky health behaviors. The uncertainty of, or lack of economic support can also have an effect on health. This also may be associated with less material resources, poorer housing conditions and a less healthy diet (Wyke and Ford 1992). The findings of research on the relationship between maternal marital status and health further substantiate the material deprivation/culture and behavior theory. Manderbacka et al. (1992) argues that a social selection perspective, which maintains that healthier people are selected to marriage and conversely people with severe health problems have difficulty finding and keeping marriage partners, lacks validty. Further, longitudinal studies are needed to fully clarify the direction of the marital status health relationship (Wyke and Ford 1992).

Maternal marital status offers insight into social and economic conditions that traditional measures may not. There are however issues to consider. First, the predictive value of marital status may be diminished due to the fact that the status of marriage has changed in many countries. Having offspring does not necessarily entail marriage (Manderbacka et al 1992).

Second, married and unmarried mothers are heterogeneous groups. The characteristics of a mother's relationship with the father therefore may be more important for health outcomes than formal marital status.

# The Case for Studying SEP Associations with LBW among Black and Whites using Multiple and Contextual Measures

While some attention has been paid to SEP as the main variable of interest, there is further need to explore the relationship of multiple and contextual SEP measures with health in order to fully understand this well-established association, as well as how this association may differ across subpopulations. The Gazmararian et al. (1996) study attained a deeper understanding of the social context of health by using multiple contextual measures including WIC and Medicaid. However, the study did not include racial minorities, despite evidence showing that the association between SEP and health differs across racial subpopulations (Parker et al 1994). As contextual as WIC and Medicaid are, they may not represent identical socioeconomic disadvantage for blacks and whites. Do the specific factors found in WIC and Medicaid (i.e. poverty, nutritional risk, and lack of access to medical care) reflect the same inequality among blacks compared to whites?

The literature shows that the association between SEP and health can vary depending on the health outcome in question. The Gazmararian et al. (1996) study investigated maternal health behavior, but it would be beneficial to evaluate the relative risk of LBW using multiple and contextual measures. Previous studies have shown how maternal education as well as specific factors related to socioeconomic position (lack of insurance, low income, poverty, poor nutrition, lack of or inadequate medical care) can affect low birth weight. Medicaid and WIC by virtue of

their eligibility criteria contain information on these factors. A period of disadvantage at certain points in the life course can affect health outcomes at latter stages in life. A woman's experiences before and during pregnancy could have implications for her health, and ultimately for her newborn child. For these reasons a case can be made for using maternal education, Medicaid before pregnancy and WIC participation during pregnancy for studying the SEP/health association. Additionally, given the above addressed drawbacks of using marital status as a measure of SEP, paternal acknowledgement on the infant's birth certificate is used in this study in lieu of maternal marital status. This accounts for social and economic support where there is no marriage. Altogether, using contextual measures such as Medicaid, WIC, paternal acknowledgement and maternal education may be a first step in understanding potential mechanisms that could affect low birth weight.

Moreover, Oakes and Rossi (2003) maintained that for public health purposes, there is a greater need for SEP measures that capture more of the social context than education, occupational position or income. If public health policy is to address the complex multidimensional context of inequality behind poor population health, composite measures of SEP may be helpful. Composite variables that inform public health policy should be relevant, methodologically simple and transparent, and easy to interpret (OECD, European Commission, Joint Research Centre 2008). Composite measures in this context are constructed by combining information about several SEP measures (i.e., income, employment, education and other contextual indicators). Composite SEP measures have often been constructed using indexes, scales, or factor analysis techniques and can be divided into two basic categories: those that measure material and social deprivation such as the Townsend Index (Townsend 1987) (e.g. social class) and those that measure social standing or prestige such as the Hollingshead Index of

Social Prestige or Position (Hollingshead 1958). The Townsend Index measures multiple material deprivation in an area, by using variables that measure unemployment, car and home ownership as a percentage of all households, and household crowding. The Hollingshead Index of Social Prestige or Position is based on four factors: education, occupation, sex and marital status. Composite indicators can be used to summarize the complex or multi-dimensional nature of socioeconomic position. *The OECD Handbook on Constructing Composite Indicators: Methodology and User Guide* states that composite measures can be easier to interpret than attempting to find a trend in many separate indicators. Additionally they can reduce the size of a list of indicators may send misleading policy messages if they are misinterpreted (OECD, European Commission, Joint Research Centre 2008). There is the risk of politicians drawing simplistic policy conclusions if composite measures are not used in combination with the sub-indicators.

A clear case has been made for the use of multiple and contextual SEP measures, but if meaningful public health policy toward improving population health is to be more informed, a composite variable comprised of maternal education, WIC during pregnancy, Medicaid before pregnancy and paternal acknowledgement may prove beneficial.

Therefore, based on the presented review of the literature, the following research questions have been explored:

- What are the associations between selected measures of SEP (maternal education, WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement a composite variable) and low birth weight?
- 2) How does race interact with socioeconomic position in determining variations in low birth

weight?

3) What are the differences between associations of contextual measures of SEP (i.e. WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement) and traditional measures of SEP (i.e., education) with low birth weight? How do these differences reflect the socioeconomic context of the population under consideration?

## **RESEARCH DESIGN AND METHODOLOGY**

## Introduction

The association between socioeconomic position and heath outcomes has been well established in health research (Lynch and Kaplan 2000). Specifically, research investigating the relationship between socioeconomic position (SEP) indicators and health outcomes found that the magnitude of the relationship depends on the SEP measure selected, the health outcome of interest, and the subpopulation under consideration (Braveman et al. 2005; Shavers, 2007; Gazmararian et al, 1996). Although many studies have gained insights into the SEP/Health association using traditional measures (i.e. education, income and occupation) there is a public health need to conduct studies that reflect more of the socioeconomic inequality that can affect low birth weight. Furthermore, there is a need for associations of SEP and LBW to be investigated across racial subpopulations. Therefore, to understand the association between various dimensions of social and economic inequality across black and white subpopulations, this study utilizes four measures of socioeconomic position (education, WIC, Medicaid and paternal acknowledgement) as well as a composite measure to address the research questions below.

## Research Questions

 What are the associations between selected measures of SEP (maternal education, WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement, a composite measure of SEP) and low birth weight?

- 2. How does race interact with these measures of SEP to determine variations in low birth weight?
- 3 What are the differences between associations of contextual measures of SEP (i.e. WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement) and traditional measures of SEP (i.e., education) with low birth weight? How do these differences reflect the socioeconomic context of the population under consideration?

The following hypotheses arise from the above research questions.

# *Hypothesis:*

- (1) Mothers with low levels of education have higher odds of having LBW infants than mothers with higher levels of education.
- (2) Mothers who are enrolled in WIC during pregnancy have higher odds of having LBW infants than mothers who are not enrolled in WIC during pregnancy.
- (3) Mothers who are Medicaid recipients before pregnancy have higher odds of having LBW infants than mothers who are not Medicaid recipients during pregnancy.
- (4) Mothers who do not indicate paternal acknowledgement on infant birth certificates have higher odds of having LBW infants than mothers who indicate paternal acknowledgement on infant birth certificates.
- (5) The effects of race on the association between selected SEP measures (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, paternal acknowledgement on infant birth certificates and composite measure) and LBW are different for black and white mothers such that black mothers have higher odds of having LBW infants in all cases than white mothers.

(6) Contextual measures of SEP have a stronger association with LBW than traditional measures of SEP.

## Study Population and Sample:

This dissertation is the product of a secondary data analysis of seven annual data cohorts (2000-2006) collected by the Pregnancy Risk Assessment and Monitoring System (PRAMS) program in Michigan. Michigan PRAMS is part of an ongoing surveillance project of the Centers for Disease Control and Prevention (CDC) in which state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after pregnancy is collected. Michigan PRAMS is part of the CDC initiative to reduce infant mortality and low birth-weight births in the United States (CDC 2010).

The overall PRAMS project was initiated in 1987 in response to slowly declining infant mortality rates and little change in the incidence of low birth weight in the previous 20 years. The PRAMS project, in light of research indicating that maternal behaviors during pregnancy may influence infant birth weight and mortality rates, aimed to improve the health of mothers and infants by reducing adverse pregnancy outcomes.

PRAMS provides state-specific data for planning and assessing health programs and for describing maternal experiences during and shortly after birth that may contribute to maternal and infant health (CDC 2010). These data can be used to identify groups of women and infants at high risk for health problems, to monitor changes in health status, and to measure progress towards goals in improving the health of mothers and infants. Hence PRAMS data are utilized by public health researchers in the investigation of emerging issues in the field of maternal and child health. PRAMS data are also used by state and local governments in the planning and review of

intervention programs and policies aimed at reducing health problems among mothers and babies. Further, PRAMS data are used by state agencies to identify other agencies that have important contributions to make in planning maternal and infant health programs and to develop partnerships with those agencies (CDC 2010). PRAMS data are available to the public through submission and approval of a proposal to the IRB at CDC. With regard to Michigan PRAMS, the Michigan Department of Community Health (MDCH), under the auspices of the CDC, conducts the data collection (Michigan PRAMS Annual Report 2006).

Michigan PRAMS surveys mothers who have delivered a live-born infant within a calendar year. Natality information, collected by Michigan's Office of Vita Records and Health Statistics, serves as the sampling frame from which Michigan PRAMS selects survey respondents. Mothers who had delivered a live-born infant who subsequently died are included in the sampling frame. Only one infant of a multiple gestation is included in the sampling frame unless the gestation includes four or more siblings. In that instance, all of the infants are excluded from the sampling frame. Multiple gestations of more than three live infants are considered a special population and are removed from the sampling frame. Because of the inherent characteristics of this population, these infants tend to have higher mortality rates. Other exclusion criteria in Michigan PRAMS are out-of-state births to residents, in-state births to nonresidents, missing information, delayed or early processing of birth certificates, adopted infants and surrogate births. Oversampling is utilized to gather sufficient number of responses among small sub-populations within the state.

Michigan PRAMS data is a stratified random sample. Stratification allows separate estimates of subgroups of interest as well as comparisons across these subgroups. Each calendar month a sample is drawn from the births recorded in the prior month. Once the sample has been

identified, the information is forwarded to the Michigan State University (MSU) Office of Survey Research, which is subcontracted by the MDCH to conduct the survey (Michigan PRAMS Annual Report 2006).

Michigan PRAMS uses a mixed-mode methodology to gather information from women selected to participate in the survey. The combination of mail and telephone survey methodology is used to maximize response rates. Mailing is the primary form of data collection in the Michigan PRAMS survey because of the ready access to mailing addresses and the cost effectiveness of using mail surveillance. Women are first notified of the Michigan PRAMS survey and then sent the questionnaire by mail. If the mother does not respond after three attempts by mail, she is then contacted by telephone and has the opportunity to participate in the Michigan PRAMS survey via telephone. Telephone follow-up for women who did not respond to mail generally increases the overall response rate. Mailing is usually initiated within two to three months after delivery. Data collection usually takes place within 95 days of being contacted, which means that the infants are about six months old then. To reduce recall bias, no questionnaires completed after nine months of delivery are accepted. Data collection procedures and instruments are standardized to allow comparisons between states. Because the Michigan PRAMS survey employs a mixed-mode methodology, two types of questionnaires are available; the self-administered and interviewer-administered questionnaires (CDC 2006).

## Data Sources and Access to Data

Access to the Michigan PRAMS dataset for years 2000 to 2006 was obtained from the Michigan Department of Community Health after a proposal was submitted and approved. This proposal was also submitted to the Institutional Review Board (IRB) for Michigan State

University (MSU) and approval was given to conduct the analysis. All requirements for human subjects' protection and the necessary certification administered by the MSU Biomedical and Health Institutional Review Board (BIRB) were maintained throughout this study. This study is a product of a secondary data analysis and does not involve any direct contact with human subjects. There are also no personal identifiers in the Michigan PRAMS data set (CDC, 2006).

#### Survey Instrument

The Michigan PRAMS questionnaire consists of two parts. First, there are core questions, developed by CDC, that appear on all states' surveys. Second, there are state-added questions that address the needs of different states. Topics addressed in the PRAMS core questionnaire include barriers to and content of prenatal care, obstetric history, maternal use of alcohol and tobacco, physical abuse. Other questions address different topics, including social support and services, mental health, and injury prevention. Topics addressed by the new state-added questions also include feelings of discrimination, racism, mental/emotional abuse, and prepregnancy contraception. A copy of the Michigan PRAMS full questionnaire is included in Appendix C.

The total sample used in this study consisted of 13,827 individuals; 4,389 black mothers and 9,438 white mothers after cleaning the data set for missing values. Only white and black mothers were included in the current study due to inadequate sample sizes of other racial/ethnic groups.

## Weighting

After Michigan PRAMS data collection is concluded, mothers' responses are linked to their corresponding birth certificate data. The linked Michigan PRAMS response/birth certificate data set is then sent to the CDC for weighting (Michigan PRAMS Annual Report 2006). Weighting of the data set allows researchers to estimate the statistics for the entire state's population of women who delivered a live-born infant from data gathered from a sample of mothers in that population. In Michigan PRAMS there are three weighting components that adjusted for sample design, non-response, and omissions in the sampling frame. Non-response adjustments used in Michigan PRAMS attempt to compensate for the tendency of women having certain characteristics (such as being unmarried or of lower education) to respond at lower rates than women without those characteristics. The rationale for applying non-response weights is the assumption that non-respondents would have provided similar answers to respondents' answers for the stratum and adjustment category (Michigan PRAMS Annual Report 2006).

Evaluating reliability of the Michigan PRAMS questionnaire is difficult due to two reasons. First, most measures in the PRAMS survey rely on single indicators for a single construct. Thus, internal consistency of multiple indicators cannot be examined. Second, it is not possible to assess the temporal stability (test-retest reliability) of the PRAMS questionnaire because the cross-sectional surveys are based on different samples of respondents each year (Ayoola 2007).

The validity of the PRAMS questionnaire varies by item, since the items measure different constructs. There is no report of criterion-related validity. This is possibly due to lack of a gold standard with which to compare many measures. As part of the efforts to address the validity of PRAMS, several revisions or phases of the questionnaire have been designed. Prior to

the revision of the questionnaire, questions are evaluated for item non-response, write-in responses, and whether respondents correctly followed the skip patterns in the survey. Using these criteria, questions that perform poorly are revised accordingly and pretested before being included in the questionnaire again.

The PRAMS data are based on women's self-reports and this increases the possibility of biases. Although the bulk of the responses are self-administered questionnaires mailed to respondents, a potential source of bias is interviewer bias in telephone interviews, where the respondents provide the response he or she believes would be appropriate. Recall bias is another potential source of bias that may influence the PRAMS result. But in order to address the problem of recall bias in the PRAMS, newly delivered women within 2 to 6 months of delivery are interviewed instead of longer periods of gaps (5 years) used in other national survey such as the National Survey of Family Growth (NSFG) (Ayoola 2007).

# Variables

This study utilizes four individual-level SEP measures available in Michigan PRAMS (maternal education, 'WIC during pregnancy', 'Medicaid receipt before pregnancy', and paternal acknowledgement on the infant's birth certificate). These measures reflect different aspects of SEP (i.e. actual resources and status) that have links with low birth weight. This study also constructs a composite SEP measure that combines three selected individual-level SEP measures. Maternal education is a commonly used traditional SEP index while 'WIC during pregnancy', 'Medicaid receipt before pregnancy', and 'paternal acknowledgement on the infant's birth certificate' are less common measures of SEP that reflect specific material and social factors that may have direct implications for low birth weight.

## Dependent variable:

# Low Birth-weight

Infant birth weight was used as the main dependent variable because of its implications for overall population health (Palloni 2006; Case, Fertig, and Paxson 2005). Infant birth weight information regarding births of Michigan mothers is derived from information on birth certificates. Although infant birth weight information was obtained as a continuous variable, it has been dichotomized for the purposes of this study. Mothers who gave birth to infants that weigh less than 2500 grams (5 lbs 8 oz) at birth were classified as "low birth weight" (LBW) and mothers who had infants weighing 2500 grams or more at birth was classified as "not low birth weight". The designation of LBW as infants born below 2500 grams (5 lbs 8 oz) is based on convention (Case et al. 2005; Paneth 1995) as well as higher risk for various developmental and health outcomes (Boardman, Finch, and Hummer 2001). Based on this categorization a dummy variable was created for infant birth weight (1=low birth weight and 0=not low birth weight).

# Independent Variables:

### Maternal Education

Michigan PRAMS information regarding maternal demographic characteristics such as maternal age, race/ethnicity and maternal education are obtained through the birth file of Michigan mothers. Maternal education was used as a SEP measure to reflect knowledge related assets as well as socioeconomic circumstances over a period of time which may cumulatively affect health throughout the life course. As a SEP measure, maternal education is advantageous because it includes persons not counted in the labor force. The socioeconomic position of mothers who may not have an occupation may therefore be captured. Maternal education is coded into four categories, <12 years, 12 years (high school graduate), some college, and college

graduates in PRAMS. For the current study maternal education was coded as 0 = >12 years, 1 = 12 years (high school graduate), or 2 = <12 years of education (Table 1, Appendix A). This categorization assumes that time spent in education reflects the material and social resources available to attend school over a period of time, which may cumulatively effect low birth weight. This categorization of maternal education also assumes that high school graduation as a specific educational achievement has implications (i.e. material and social) for SEP and ultimately health.

## Medicaid Receipt Before Pregnancy

Medicaid eligibility requirement for pregnant women and women with infants is income at or below 185% of the federal poverty income guidelines in Michigan and having no or inadequate health insurance (Georgetown University Health Policy Institute 2009). On the questionnaire, the respondent was asked if she received Medicaid before pregnancy. *PRAMS Question #2: Just before you got pregnant, were you on Medicaid?* 

No

## Yes

Mothers who are on Medicaid before pregnancy encounter specific conditions that may affect health such as lack of access to medical care, low income, and various statuses of poverty. Medicaid status of mothers was used to generate a dummy variable (1=on Medicaid before pregnancy, 0=not on Medicaid before pregnancy) (Table 1 Appendix A).

#### WIC Participation During Pregnancy

Respondents were also asked if they received WIC benefits during pregnancy.

PRAMS Question #22: During your pregnancy, were you on WIC (The Special Supplemental Nutrition Program for Women, Infants, and Children)?

No

Yes

Although state WIC eligibility criteria vary somewhat, in general women qualify if they meet a state residency requirement, are at a nutritional risk and have income at or below 185% of the federal poverty income guidelines, or participate in other federally funded programs such as food stamps (Gazmararian et.al. 1996). WIC was used as a SEP measure of poverty that reflects material deprivation that affects health directly, or indirectly (i.e. poor nutrition). Women were classified as either 'yes, WIC participant'; or 'no, not on WIC'. Mothers classified as being on WIC during pregnancy were materially deprived. Hence, a dummy variable was created for WIC benefits during pregnancy (1=on WIC during pregnancy and 0=not on WIC during pregnancy) (Table 1 Appendix A).

#### Paternal Acknowledgement

Research has shown that spousal support is associated with social and economic well being which ultimately has an impact on health (Ross, Morowsky and Goldsteen 1990). Given the shortcomings of marital status as an indicator of spousal support (addressed in chapter 2), paternal acknowledgement was instead used in the analysis. After Michigan PRAMS data collection is complete, individual mothers' responses are linked to the birth certificate data. Respondents were then classified based on the presence or absence of paternal acknowledgement on birth certificates and coded into a separate dummy variable (0=yes paternal acknowledgement present, 1= no paternal acknowledgment) (Table 1 Appendix A). Mothers who gave birth to

infants who did not have paternal acknowledgment are more likely to lack social and economic spousal support, which may affect health.

## Low Birth Weight Risk Assessment Composite Measure

Composite measures of SEP are constructed by combining information about several SEP measures. For instance, the Townsend Index captures factors related to multiple material deprivation (i.e. unemployment, car and home ownership as a percentage of all households, and household crowding). Similarly there are composite measures such as the Hollingshead Index of Social Prestige or Position that combines information of several factors (i.e. education, occupation, sex and marital status) that captures different dimensions of social prestige. For this study three SEP measures (Medicaid before pregnancy, WIC during pregnancy, and maternal education) were combined using Factor Analysis methods to develop a composite SEP measure. This composite measure aims at capturing cumulative effects of various material and social dimensions of socioeconomic inequality (i.e. knowledge related assets, socioeconomic circumstances over a period of time, lack of access to medical care, low income/poverty, and poor nutrition). Factor analysis is a method for data reduction that works well with regression. This helps to combine variables and lead to more parsimonious models that are easy to interpret for public health purposes.

## Age

Michigan PRAMS information regarding maternal age is obtained through the birth file of Michigan mothers. Age is recorded as a continuous variable. For the study sample maternal

age ranged from 13 to 48. The variable was used as a continuous variable. Age was controlled during analysis in order to focus on the social conditions that affect health.

## Moderator:

## Race

Michigan PRAMS obtains maternal race/ethnicity information from the birth file of Michigan mothers. Mothers were categorized as 0=white, 1=black, and 2=other (American Indian, Chinese, Japanese, Filipino, Hawaiian, Alaska Native, other non-white and other) (Table 1 Appendix A). This study is limited to black and white mothers due to the small sample size of the other racial/ethnic sub-groups which prohibits appropriate statistical analysis procedures to be applied to such sub-groups.

## Data Analyses:

For the purposes of this study, Michigan PRAMS data from 2000 to 2006 were aggregated to maximize sample size and to allow for stratification of the sample based on mothers' race (black and white). The data was analyzed using STATA 10 s.e. (Data Analyses and Statistical Software). All analyses takes into account the complex survey design to obtain correct point estimates and variance estimates. The PRAMS data set contains information on the sampling weights associated with each case/respondent. These weights are the inverse of the probability of a case being sampled. Using the 'svy' commands of the STATA statistical software (release 10 s.e.) the information on sampling weights, stratification, and clusters, can be incorporated to provide correct population estimates. Several levels of statistical analysis are employed in this study. Preliminary analyses to determine the distribution of variables are carried out. These include assessment of the distributions of the responses to key variables in the analysis, as well as assessments of missing data patterns. The data analysis begins with calculating item response rates for each SEP measure and cleaning up missing data. Next, univariate analyses of the key variables is conducted which includes frequency distributions and summary statistics such as sample percentages, means, medians, and modes. These univariate analyses focus on identifying the basic characteristics of all of the variables examined in the study. T-tests and tests of proportions are used where applicable to compare population estimates for black and white sub-populations.

Pearson's correlation coefficients are used for comparisons of different SEP measures to determine the agreement and multicollinearity between SEP measures. Matrices of correlations between variables provide a fast check for multicollinearity (Hamilton 1992). Pearson's correlation coefficients greater than 0.50 were used to indicate whether measures were comparable enough to indicate similar dimensions of SEP are being measured. A correlation coefficient below .50 suggests that the selected SEP measures capture different dimensions of socioeconomic stratification (Gazmararian et al. 1996).

Linear regression model works poorly for dichotomous Y variables such as the one used in this study (LBW). The OLS models assumptions are grossly violated when applied for such dichotomous variables. However, using a logistic model overcomes limitations of linear regression by modeling predicted probabilities in terms of log odds, odds, odds ratios, and probabilities (Hamilton 1992). Hence, rate ratios such as the once used in this study are often determined in health research to express health inequality across extreme socioeconomic groups (Lynch and Kaplan 2000). Binary logistic regression is used to determine the relationships between individual SEP measures and the health outcome (LBW). In these binary logistic regression models some predictors such as maternal demographic characteristics (age and race) are controlled. Next, interactions between selected SEP measures and race is modeled in two ways. Firstly, an interaction model for the total population is developed that includes the interaction terms for race with maternal education, WIC, Medicaid, and paternal acknowledgment. This model helps assess whether significant interactions between race and the SEP measures exist in the total population. Secondly, the total population is stratified by race (black and white) and binary logistic regression is used to model interactions between race and the individual-level SEP measures to test for the effect of race as a moderator (as suggested by the conceptual framework in figure 1). This second approach enables investigating the effect of specific SEP measures across and within groups by examining the magnitude of the odds ratios produced from stratified multivariate analyses; thus allowing for the assessment of interactive effects between SEP and the stratification variable (race).

One disadvantage of the binary logistic regression model is the lack of a direct and unique format for R-squared. However a number of pseudo R-squared have been developed to help assess the model fit in STATA. The pseudo R-squared in STATA compares the chi-square value of the current model with that of the unconditional model (a model with no predictors) (Hamilton 1992). The larger the pseudo R-squared, the better the model fit. Hence, pseudo Rsquared values will be used for model comparisons and to determine model fit. For all hypothesis tests the appropriate regression models will be displayed in Chapter 4. The regression models will vary in terms of the independent variables selected (as specified by the hypotheses). For all

regression models regression diagnostics to examine the logistic model assumptions will be carried out.

Finally, Factor analysis is used to combine information of the four selected SEP measures and develop a composite measure of SEP. Generally, factor analysis is used to create indexes with variables that measure similar things (Hamilton 1992). It is a method of data reduction that helps combine variables and lead to more parsimonious models. By using factor analysis, variations in several variables can be narrowed down to few unobserved variables (latent variables). In this study such latent variables are investigated as potential composite measures of SEP. Once factors are identified, their associations with LBW is determined for the total population as well as black and white sub-populations.

## ANALYSIS AND INTERPRETATION OF DATA

# Introduction

The main purpose of this study is to describe the associations between socioeconomic position (SEP) and low birth weight (LBW). In particular the study focuses on how this association differs for contextual measures of socioeconomic position (i.e. WIC participation during pregnancy, Medicaid before pregnancy, and paternal acknowledgement on birth certificate) as opposed to a traditional measure (maternal education). This study also compares these SEP – LBW associations across black and white subpopulations in Michigan. The study uses data from Michigan Pregnancy Risk Assessment Monitoring System (MI PRAMS) from 2000 to 2006. This chapter presents the data analysis. This data analysis consists of several levels. First, data cleaning and handling of missing data is carried out. Recoding of key variables and issues of multicollinearity are also taken into consideration at this stage. Second, preliminary univariate analyses is conducted to determine the distribution of variables in the total population and black and white subpopulations separately. Mean and proportion comparisons of black and white subpopulations through t-tests/ tests of proportions are carried out for relevant variables. Third, binary logistic regression modeling and factor analysis of data are carried out to study hypotheses1 through 6 followed by a summary of the findings. The chapter concludes with a summary and interpretation of the findings.

#### Data Cleaning and Handling of Missing Data

The response rates obtained for the variables selected for this study are summarized in Table 2 (Refer to Appendix A). In the overall sample, item response rates are high for all four SEP measures (maternal education, being on WIC during pregnancy, Medicaid before pregnancy, and paternal acknowledgment on birth certificates) with values ranging from 98.56% to 100.0%. The high response rates may be due to the Michigan PRAMS combination mail/telephone survey that uses three attempts to contact selected participants by mail, failing which they are contacted by telephone. When the sample was stratified by race the response rates did not vary considerably between black and white women. The lowest response rates (100.0%) were obtained for maternal education for black women (98.81%). The highest response rates (100.0%) were obtained for paternal acknowledgment, race, and birth weights obtained through birth records for both black and white mothers. The percentage of respondents with missing values for age was quite low at 0.01%. In the raw data set the number of missing values for age, WIC, Medicaid, and education were 1, 25, 18, and 219 respectively (Table 3, Appendix A).

Missing data was cleaned before inferential data analysis, through removal of the missing cases. This was not problematic as the overall response rates were high and there were no specific patterns to the missing data in black and white subpopulations. In addition, during regression using STATA, observations with missing values are also deleted by default in the statistical program unless otherwise specified.

## Recoding of Key Variables

Most of the key variables under consideration were recoded to fit the logistic regression models to be developed. MI PRAMS information regarding maternal demographic characteristics such as maternal age, race/ethnicity and maternal education, are obtained through the birth file of Michigan mothers. Maternal education is gathered in four categories, <12 years, 12 years (high school graduate), some college, and college graduates. For this study maternal

education was recoded as 0 = >12 years, 1 = 12 years (high school graduate), or 2 = <12 years of education. In MI PRAMS women were classified as either 'yes, Medicaid recipient'; or 'no, not on Medicaid'. For the purposes of the study this classification was used to generate a dummy variable (1=on Medicaid before pregnancy, 0=not on Medicaid before pregnancy). Women were also classified as either 'yes, WIC participant'; or 'no, not on WIC'. A dummy variable was created for WIC benefits during pregnancy (1=on WIC during pregnancy and 0=not on WIC during pregnancy). After MI PRAMS data collection is complete, individual mothers' responses are linked with the birth certificate data. Respondents were then classified based on the presence or absence of paternal acknowledgement on birth certificates and coded into a separate dummy variable (0=yes paternal acknowledgement present, 1= no paternal acknowledgment). Mothers were categorized as 0=white, 1=black, and 2=other (American Indian, Chinese, Japanese, Filipino, Hawaiian, Alaska Native, other non-white and other). Maternal age is kept as a continuous variable and is controlled in the analysis. For a detailed description of recoding of variables, see table 1 (Appendix A).

Infant birth weight was used as the main dependent variable (i.e. health outcome). Infant birth weight information regarding births of Michigan mothers is derived from information on birth certificates. For the purposes of this study, mothers who gave birth to infants that weigh less than 2500 grams (5 lbs 8 oz) at birth are classified as "low birth weight" (LBW) and mothers who have infants that weigh 2500 grams or more at birth are classified as "not low birth weight". Based on this categorization a dummy variable was created for infant birth weight (1=low birth weight and 0=not low birth weight). The sample consisted of birth-weight data for a total of 13,652 infants (of black and white mothers) where 30.93% was recorded as LBW (n=4,222) and 69.07% was not LBW (n=9,430).

# **Population Description**

In the study sample the majority of women (54%) had less than 12 years of education. White women accounted for approximately 61% of the total population while blacks (28.4%) were the most prevalent minority group in the study population. In this sample the largest proportion of births was to women aged 20-29 years of age. Approximately 42% reported being on WIC during pregnancy while prior to pregnancy, approximately 18% of women reported being on Medicaid. The majority of women (80%) gave birth to infants whose birth certificates had paternal acknowledgement on them. Table 3 (Appendix A) summarizes these maternal demographic characteristics of the study sample. The table also presents hypothesis tests for raw data of the two continuous variables maternal education and maternal age. The hypothesis test for maternal education indicate that mean education is significantly different from 0 in the population (p<.05). The total n is different for the selected variables due to how the PRAMS data were collected during 2000 to 2006 where some questions were not included in the survey in certain years.

The selected measures of SEP (maternal education, WIC participation during pregnancy, Medicaid before pregnancy and paternal acknowledgement on the infant's birth certificate) are unevenly distributed among white and black groups within the study sample. The majority of blacks (67.37%) had less than 12 years of education while almost half of whites in the sample (49.85%) had 12 years or fewer of schooling. Almost 4 in every 10 white women (26.52%) had more than 12 years of education while less than 10% of black women had attained similar years of schooling. The majority of black women in the study sample (63.4%) reported being on WIC during pregnancy, while most white women (63.3%) did not participate in that program. While
most women reported not being on Medicaid before pregnancy, a greater proportion of black women (37.7%) were recipients of Medicaid compared to white women (12.1%). The majority of both black and white women did report paternal acknowledgment on the infants birth certificate, however a considerably greater proportion of black women (44.53%) did not give birth to infants who had a signature of paternal acknowledgement on their birth certificates as compared to white women (11.15%). The distribution of selected SEP measures across black and white sub-populations is summarized in Table 4 (Appendix A).

A t-test for mean comparison for maternal education of black and white mothers indicate that there is a significant difference in mean education between the black and white populations (p<.001). Three sample tests of proportions were also carried out for the dichotomous variables WIC during pregnancy, Medicaid before pregnancy, and paternal acknowledgement. Hypothesis tests indicate that the proportions of women on WIC during pregnancy, Medicaid before pregnancy, and having paternal acknowledgement is significantly different for black and white populations with p-values <.001 in all three cases (See table 4 for details).

#### Distribution Characteristics of Low Birth-weight

As discussed above, the health outcome under consideration for this study is low birth weight. Among the 13,652 live births of black and white infants in the study sample, approximately 31% weighed less than 2,500 grams. The prevalence of low birth weight (LBW) infants varies by selected maternal characteristics. Specifically, the rate of LBW was higher among black women (35.96%) than among white women. Women with less than 12 years of education reported the highest prevalence of LBW infants (nearly 30%); the rate of LBW births decreased with increasing years of schooling. The highest rate of LBW was seen in women who were either under 18 years of age (39.33%) or over 40 years old (42.77%). Medicaid recipients and those women who participated in WIC reported a somewhat higher prevalence of LBW infants compared with women who did not participate in these programs. Women who had given birth to infants, who did not have paternal acknowledgement on their birth certificates, reported a substantially high prevalence of LBW.

# Research Questions and Associated Hypotheses

To examine multiple SEP measures as exposures of interest, and to construct a composite measure that reflects different dimensions of socioeconomic inequality and to investigate how the different SEP measures impact LBW across black and white subpopulations, the following research questions and associated hypotheses are examined in this study.

#### Research Question 1

What are the associations between selected measures of SEP (maternal education, WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement, a composite measure of SEP) and LBW?

**H1**: Mothers with low levels of education have higher odds of having LBW infants than mothers with higher levels of education.

**H2**: Mothers who are enrolled in WIC during pregnancy have higher odds of having LBW infants than mothers who are not enrolled in WIC during pregnancy.

**H3**: Mothers who are Medicaid recipients before pregnancy have higher odds of having LBW infants than mothers who are not Medicaid recipients before pregnancy.

**H4**: Mothers who do not indicate paternal acknowledgement on infant birth certificates have higher odds of having LBW infants than mothers who indicate paternal acknowledgement on infant birth certificates.

## Research Question 2

How does race interact with these measures of SEP to determine variations in LBW?

**H5**: The effects of race on the association between selected SEP measures (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, paternal acknowledgement on infant birth certificates and composite measure) and LBW are different for black and white mothers such that black mothers have higher odds of having LBW infants in all cases than white mothers. Research Question 3

What are the differences between associations of contextual measures of SEP (i.e., WIC during pregnancy, Medicaid participation before pregnancy, paternal acknowledgement) and traditional measures of SEP (i.e., education) with LBW? How do these differences reflect the socioeconomic context of the population under consideration?

**H6**: Contextual measures of SEP reflect larger associations with LBW than traditional measures of SEP.

The inferential data analysis for this study begins with an exploration of the associations between selected measures of SEP (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, and paternal acknowledgement on infant's certificate) and LBW through Pearson correlations. Missing data were cleaned for all variables of interest (age, race, maternal education, WIC, Medicaid, and paternal acknowledgement) before beginning the data analysis. This left the data set with a total sample size of 15,316 observations. Once other races were removed, the black and white total sample size was 13,513 (See table 4 for details).

As shown in Table 5 (Appendix A), there were low overall correlations between the four selected measures of SEP with values ranging from .054 to .346. The lowest correlation was obtained between paternal acknowledgment and WIC participation (0.054) whereas the highest correlation was obtained between education and WIC participation (-0.346). The low correlations between SEP measures such as paternal acknowledgment and WIC indicate that these measures are capturing different dimensions of SEP. The relatively high correlation between Medicaid and WIC was expected since low income is one of the eligibility requirements for both Medicaid and WIC participation. Such high correlations between poverty, Medicaid, and WIC participation have also been reported in other studies conducted by Gazmararian et.el. (1996). Gazmararian et.el. (1996) suggest that correlation coefficients that are less than 0.5 indicate that these measures reflect different dimensions of SEP and are not indicative of high levels of multicollinearity.

# **Hypothesis 1:** *Mothers with low levels of education have higher odds of having LBW infants than mothers with high levels of education.*

In order to test the first hypothesis, a binary logistic regression model was developed for the total population with education as the main independent variable and LBW as the dependent variable. Mother's age and race were controlled in the analysis. As shown in table 6 below, the odds of having a LBW child increase with decreasing levels of education. The odds of having a LBW child increases by 1.083 times for women with 12 years of education compared to those with more than 12 years of education (95% CI = 0.98, 1.08) when maternal age and race are held constant. This difference is not statistically significant. The odds of having a LBW child increases by 1.519 times for women with less than 12 years of education compared to those with more than 12 years of education (95% CI = 1.50, 1.54) when maternal age and race are held constant. This difference is significant at p<.001 level.

One disadvantage of the logistic regression model is the lack of a direct and unique format for R-squared to determine the amount of variance in the dependent variable explained by the independent variables. However a number of pseudo R-squared have been developed to help assess the model fit in STATA. The reported pseudo R-squared in STATA compares the chi-square value of the current model with that of the unconditional model (a model with no predictors) (Hamilton 1992). The larger the pseudo R-squared, the better the model fit. The pseudo R-squared for this model was recorded as 0.08 (8%).

Since logistic regression models use maximum likelihood methods (MLE) for model estimation, STATA also reports Likelihood Ratio Chi-squared (hypothesis test) and Log likelihood (LL<0) values. MLE involves finding the coefficients that make the log of the likelihood function (LL<0) as large as possible, or -2 times the log of the likelihood function as small as possible. Therefore in STATA Log likelihood (LL<0) acts as another model fit index. For the current model with maternal education as the main independent variable, the reported Log likelihood is -8241.99.

According to the logistic regression model in table 6 it can be seen that with increasing maternal education, the odds of having low birth-weight infants decrease for the total population. These results agree with hypothesis 1 (See table 6 and 18, Appendix A).

**Hypothesis 2:** *Mothers who are enrolled in WIC during pregnancy have higher odds of having LBW infants than mothers who are not enrolled in WIC during pregnancy.*  In order to test the second hypothesis, a binary logistic regression model was developed for the total population with maternal WIC participation during pregnancy as the main independent variable and LBW as the dependent variable. Once again, mother's age and race were controlled in the analysis. As shown in table 7 the odds of having a LBW child increases for those who were WIC recipients during pregnancy. The odds of having a LBW child is 1.15 times higher for those who are on WIC during pregnancy as compared to those who are not on WIC during pregnancy, when maternal age and race are held constant (95% CI = 1.046-1.272). This difference is significant at p<.01 level.

The pseudo R-squared for this model was recorded as 0.065 (6.5%). For this logit model with WIC during pregnancy as the main independent variable, the reported Log likelihood is - 5765.19. According to the results it can be seen that Mothers who are enrolled in WIC during pregnancy have higher odds of having LBW infants than mothers who are not enrolled in WIC during pregnancy. These result agree with hypothesis 2 (See table 7 and 18, Appendix A).

**Hypothesis 3:** *Mothers who are Medicaid recipients before pregnancy have higher odds of having LBW infants than mothers who are not Medicaid recipients before pregnancy.* 

To test the third hypothesis a binary logistic regression model was developed for the total population with Medicaid receipt before pregnancy as the main independent variable and LBW as the dependent variable. Once again, mother's age and race were controlled in the analysis. As shown in table 8 below the odds of having a LBW child increases for those who were Medicaid recipients before pregnancy. The odds of having a LBW child is 1.27 times higher for those who were on Medicaid before pregnancy than those who were not on Medicaid before pregnancy,

when maternal age and race are held constant (95% CI = 1.129-1.425). This difference is significant at p<.001 level.

The pseudo R-squared for this model was recorded as 0.071 (7.1%). For this logit model with Medicaid before pregnancy as the main independent variable, the reported Log likelihood is -5769.87. According to the results it can be seen that Mothers who were enrolled in Medicaid before pregnancy have higher odds of having LBW infants than mothers who were not enrolled in Medicaid before pregnancy. These results agree with hypothesis 2 (See table 8 and 18, Appendix A).

**Hypothesis 4:** *Mothers who do not indicate paternal acknowledgement on infant birth certificates have higher odds of having LBW infants than mothers who indicate paternal acknowledgement on infant birth certificates.* 

To test the forth hypothesis a binary logistic regression model was developed for the total population with paternal acknowledgment on infant birth certificates as the main independent variable and LBW as the dependent variable. Once again, mother's age and race were controlled in the analysis. As shown in table 9 below, the odds of having a LBW child increases for those who did not have paternal acknowledgment on infant birth certificates. The odds of having a LBW child is 1.525 times higher for those who did not have paternal acknowledgment on infant birth certificates than those who had paternal acknowledgment on infant birth certificates, when maternal age and race are held constant (95% CI = 1.387-1.677). This difference is significant at p<.001 level.

The pseudo R-squared for this model was recorded as 0.0089 (0.89%). For this logit model the Log likelihood is -8343.31. According to the results it can be seen that Mothers who

did not have paternal acknowledgment on infant birth certificates have higher odds of having LBW infants than mothers who had paternal acknowledgment on infant birth certificates. These results agree with above hypothesis 4 (See table 9 and 18, Appendix A).

**Hypothesis 5:** The effects of race on the association between selected SEP measures (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, paternal acknowledgement on infant birth certificates and composite measure) and LBW are different for black and white mothers such that black mothers have higher odds of having LBW infants in all cases than white mothers.

Interactions between the SEP measures and race were modeled in two ways. Firstly, an interaction model for the total population was developed that included the interaction terms for race with maternal education, WIC, Medicaid, and paternal acknowledgment. As displayed in table 10 below, this model shows that race and education has a significant interaction effect on LBW in the total population. The effect of race on the association between education and LBW is different for different racial sub-groups (p<.001). Similarly paternal acknowledgement also has a significant interaction effect on LBW. The effect of race on the association between paternal acknowledgement and LBW is different for different racial sub-groups (p<.001). However the interaction terms for 'WIC and race' and 'Medicaid and race' are not statistically significant (Table 10, Appendix A).

To further investigate the interaction effects of race, two separate regression models were developed for black and white subpopulations. These models help determine variations in odds ratio measures for each SEP measure. In stratified analysis (stratified by the maternal demographic characteristic race) these variations indicate the interactive effects of the variables

selected for stratification. All models in this data analysis have been controlled for the effects of age.

Binary logistic regression analysis for white mothers show that, overall, each SEP measure except WIC during pregnancy is significantly associated with low birth weight (Table 11). However, the strengths of association differ considerably for each measure with values ranging from an odds ratio of 0.937 (for those who have 12 years of education compared to those who have greater than 12 years of education) to 1.939 (for those who have no paternal acknowledgment on birth certificates compared to those who have paternal acknowledgment). The odds of having a LBW child increase with decreasing levels of education. The odds of having a LBW child decreases by 0.937 times for women with 12 years of education compared to those with more than 12 years of education (95% CI = 0.836, 1.102) when controlled for age, WIC, Medicaid, and paternal acknowledgement. This result is not significant. The odds of having a LBW child increases by 1.209 times for women with less than 12 years of education compared to those with more than 12 years of education (95% CI = 0.998, 1.213) when controlled for age, WIC, Medicaid, and paternal acknowledgement. This result is significant at p < .01 level. The odds of having a LBW child increases by 1.107 times (10.7%) for white women on WIC during pregnancy compared to those women who are not on WIC during pregnancy (95% CI = 0.969, 1.265) when controlled for maternal education, age, Medicaid, and paternal acknowledgment. This result is not statistically significant. The odds of having a LBW child increases by 1.261 times (26.1%) for white women who were on Medicaid before pregnancy compared to those women who were not on Medicaid before pregnancy (95% CI = 1.063, 1.496)when controlled for maternal education, age, WIC, and paternal acknowledgement. This result is significant at p<.01 level. Finally, the regression estimates also show that white women who do

not indicate paternal acknowledgment on birth certificates are 1.939 times more likely to have a LBW child compared to those who indicate paternal acknowledgment (95% CI = 1.614, 2.328) when controlled for the effects of maternal education, age, WIC, and Medicaid. This result is significant at p<.001 level.

Through the results it is apparent that being on Medicaid, having low levels of education, and lacking paternal acknowledgment increases the risk of white women delivering low birth weight children. These regression estimates are also consistent with above hypothesis 1 through 4. Pseudo R-squared for the model is 0.145 (14.5%) and the estimated Log likelihood is -3978.51 (Table 11, Appendix A).

Binary logistic regression analysis for black mothers show that, maternal education and WIC during pregnancy are significantly associated with low birth weight (Table 12). The strengths of association differ considerably for each measure with values ranging from an odds ratio of 0.759a (for those who are on WIC during pregnancy compared to those who are not on WIC) to 1.348 (for those who have less than 12 years of education compared to those who have more than 12 years of education). The odds of having a LBW child increase with decreasing levels of education compared to those with more than 12 years of education (95% CI = 1.123, 1.252) when controlled for age, WIC, Medicaid, and paternal acknowledgement. This result is not statistically significant. The odds of having a LBW child increases by 1.348 times for women with less than 12 years of education compared to those with more than 12 years of education (95% CI = 1.025, 1.436) when controlled for age, WIC, Medicaid, and paternal acknowledgement. This result is significant at p<.05 level. The odds of having a LBW child decreases by 0.241 times (24.1%) for black women on WIC during pregnancy compared to those

women who are not on WIC (95% CI = 0.635, 0.907) when controlled for the effects of maternal education, age, Medicaid, and paternal acknowledgment. This result is significant at p<.01 level. The odds of having a LBW child increases by 1.004 times (0.4%) for black women who were on Medicaid before pregnancy compared to those women who were not on Medicaid before pregnancy (95% CI = 0.838, 1.207) when controlled for maternal education, age, WIC, and paternal acknowledgement. This result is not statistically significant. Finally, the regression estimates also show that black women who do not indicate paternal acknowledgment on birth certificates are 1.005 times (0.5%) more likely to have a LBW child compared to those who indicate paternal acknowledgment (95% CI = 0.842, 1.199) when controlled for maternal education, age, WIC, and Medicaid. This result is not significant.

Through the results it is apparent that having low levels of education, not being on WIC during pregnancy, and lacking paternal acknowledgment somewhat increases the risk of black women delivering low birth weight children. Overall, it seems that the strengths of associations between individual SEP measures and LBW are lower for black mothers than white mothers and are generally not statistically significant. Pseudo R-squared for the black subpopulation model is 0.045 (4.5%) and the estimated Log likelihood is -1674.27. According to the results the hypothesis 5 is somewhat disapproved. Although the effects of race on the association between selected SEP measures (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, paternal acknowledgement on infant birth certificates and composite measure) and LBW are different for black and white mothers blacks mothers do not have higher odds of having LBW infants in all cases (Table 12, Appendix A).

# **Hypothesis 6:** Contextual measures of SEP show stronger associations with LBW than traditional measures of SEP.

A comparison of logit models for hypothesis 1 through 4 reveals that the strengths of associations between the selected SEP measures and LBW are different for traditional SEP measures (maternal education) and more contextual measures (Medicaid before pregnancy, WIC during pregnancy, and paternal acknowledgment) with regard to the total population. Paternal acknowledgment shows the highest association with LBW and WIC during pregnancy shows the lower association as demonstrated by percent change in odds ratios (see table 13), with maternal education (traditional SEP measure) being in between. These results raise the possibility that traditional measures and more contextual measures of SEP may be affecting LBW differently as suggested by hypothesis 6, although not always in the direction suggested by this hypothesis. Some contextual measures show stronger associations with LBW than education (Table 13, Appendix A).

#### Creating A Composite Measure for Socioeconomic Position

Next section of the data analysis consists of creating a composite measure of SEP by combining traditional and contextual measures. Factor analysis is used to create this composite variable by combining maternal education, Medicaid before pregnancy, WIC during pregnancy, and paternal acknowledgment as measures of SEP. Factor analysis identified two factors with Eigen values that are greater than 1 (Table 14). The relative weight of factor 1 in the total variance is 44.18%, whereas the relative weight of factor 2 is 25.87%. Factors 1 and 2 in combination account for 70.05% of the total variance. Kaiser criterion suggests retaining factors

with Eigen values equal to or higher than 1. For this reason factor analysis limits further analysis to 2 factors (factor 1 and factor 2) (Hamilton 1992).

The study utilizes Varimax rotation in order to produce orthogonal factors that are not correlated to each other. This setting in STATA was used during data analysis to ensure that the identified factors are not correlated to each other and that they can be used to create new composite variables/indexes without inter-correlated components. The factor rotation matrix in table 14 shows that the correlation between factor 1 and factor 2 is very low (0.0158).

Factor loadings in factor analysis are the weights and correlations between each variable and the factor. The higher the load, the more relevant it is in defining the factors dimensionality. Here, two factors are retained due to Eigen values that are greater than 1. According to factor loadings presented in Table 14, it seems that 'maternal education', 'WIC during pregnancy' and 'Medicaid before pregnancy' defines factor 1 and 'paternal acknowledgment' defines factor 2. The factor loadings for maternal education, WIC during pregnancy and Medicaid before pregnancy are 0.7869, 0.8001 and 0.7122 respectively. The factor loading for paternal acknowledgement is 0.9704.

"Uniqueness" in factor analysis is a STATA estimate that refers to the variance that is not shared with other variables in the overall factor model. Hence, 37.5% of the variance in maternal education is not shared with the other variables. Similarly, 34.3% of the variance in WIC during pregnancy and 42.1% of the variance in Medicaid before pregnancy are not shared with the other variables in the overall factor model. Because of the high factor loadings of maternal education, WIC during pregnancy and Medicaid before pregnancy on factor 1, this factor (FACTOR 1) is used as a composite measure for SEP. Table 14 gives a complete summary of factor analysis for the selected SEP measures and also summarizes the scoring coefficients (regression coefficients)

used to estimate the individual scores per case in the total sample, using factor 1 (Table 14, Appendix A).

Once factor 1 was defined as the new composite variable, binary logistic regression was used to determine the associations between factor 1 (composite measure consisting of maternal education, WIC, and Medicaid) and low birth weight for the total sample (Table 15, Appendix A). Odds ratio from this binary logistic regression indicates that in the total sample, mothers who have less than 12 years of education, are on WIC during pregnancy, and are on Medicaid before pregnancy are 1.167 times (16.7%) more likely to have a low birth weight child than mothers who have 12 or more years of education, are not on WIC during pregnancy, and are not on Medicaid before pregnancy. This result is significant at the p=.001 level (Table 15, Appendix A). The pseudo R-squared for this model is .039 (3.9%) and the reported Log likelihood is -6541.33.

The study also used binary logistic regression analysis for the newly constructed composite measure of SEP and LBW for black and white mothers separately. Odds ratio from the binary logistic regression for white mothers indicate that mothers who have less than 12 years of education, are on WIC during pregnancy, and are on Medicaid before pregnancy are 1.225 times (22.5%) more likely to have a low birth weight child than mothers who have 12 or more years of education, are not on WIC during pregnancy, and are not on Medicaid before pregnancy. This result is significant at the p=.001 level (Table 16, Appendix A). The pseudo R-squared for this model is .071 (7.1%) and the reported Log likelihood is -4004.55.

Interestingly a statistically significant association between composite measure of SEP and LBW for black mothers was not observed in the sample (Table 17, Appendix A). Odds ratio from the binary logistic regression for black mothers indicate that mothers who have less than 12 years of education, are on WIC during pregnancy, and are on Medicaid before pregnancy are

0.04 times less likely to have a low birth weight child than mothers who have 12 or more years of education, are not on WIC during pregnancy and are not on Medicaid before pregnancy. However this result is not statistically significant. Essentially, it is indicating that there is no statistically significant difference between mothers who score high on the composite measure and the mothers who score low on the composite measure, among the black sub-population. The pseudo R-squared for this model is .003 (0.3%) and the reported Log likelihood is -1674.60.

# Summary of Findings

Maternal education, WIC, Medicaid and paternal acknowledgement as measures of SEP among women in Michigan have all shown associations with low birth weight when age and race are held constant. The odds of having a LBW child increases by 51 percent for women with less than12 years of education compared to women with more than 12 years of education. The odds of having a LBW child are 15 percent higher for women participating in WIC during pregnancy compared to women who were not on WIC during pregnancy. Women on Medicaid just before pregnancy have 27 percent higher odds of have a LBW infant while generally speaking women whose infants did not have paternal acknowledgement on their birth certificates were more likely to be born at a LBW. These findings are consistent with a number of other studies that have examined the relationship between SEP and health. The socioeconomically disadvantaged are more likely to have adverse health outcomes such as low birth weight.

The results of this study also show a lack of uniformity with respect to selected SEP indicators and low birth weight in the total sample. Maternal education, Medicaid, WIC and paternal acknowledgement all provide information about women's access to social and economic resources. These indicators however reflect different dimensions of inequality even though there

may be some overlap between them. It is likely for instance that maternal education which is often completed by early adulthood affects the chances of a woman participating in Medicaid. However, variations in the associations between selected indicators and LBW suggest that they are not interchangeable. In the total population, maternal education and paternal acknowledgement have the strongest association with LBW. Meanwhile Medicaid and WIC during pregnancy had relatively moderate associations with LBW.

Variations in associations between the various SEP indicators and LBW were also observed across racial groups. Among whites, women who have attained less than 12 years of education are 20 percent more likely to have a LBW infant compared to those who have had more than 12 years of education. Meanwhile, among black women, those who have had less than 12 years of education have 35 percent greater odds of having a LBW infant compared to women who have more than 12 years of schooling. The observed association between WIC and LBW was not statistically significant among white women. Among blacks, it was evident that those women who were on WIC during pregnancy were 25 percent less likely to have had a LBW infant compared to those women who were not. The study also observed a moderate association between Medicaid before pregnancy and LBW among white women. However no statistically significant association was observable between Medicaid and LBW among black women. A very strong association between paternal acknowledgement and LBW was evident among white women, however no significant association was found among black women. The composite variable created from selected SEP indicators (i.e. maternal education, Medicaid before pregnancy and WIC during pregnancy) has a relatively moderate association with LBW at the total sample level and among whites (Table 18, Appendix A).

# Interpretation of Findings

Overall findings show that the observed relationship between socioeconomic position and LBW varies depending on the SEP measure used and across racial subpopulations. By utilizing previously discussed perspectives, it is possible to establish a framework which relates these findings to the original purpose of the study – to understand the context of inequality related to health and how race moderates this association. The Marxian-Weberian hybrid theoretical framework alongside the material deprivation/ culture and behavior theory and the minority poverty hypothesis facilitate an understanding of how SEP is associated with LBW and how this association varies across racial groups. The hybrid Marxian Weberian framework that informs many health studies posits that locations in the social structure determine life chances and lifestyles which have implications for health. Lifestyles and health behaviors that cause increased odds of health are likely to be determined by positions of socioeconomic disadvantage. It is for this reason why social patterning of LBW is observable in the sample.

The material deprivation/ culture and behavior theory further articulates the assumptions of the Marxian-Weberian framework and maintains that material deprivation has direct and indirect effects on health. Material deprivation indirectly affects health through health behavior, lack of medical services, or a poor diet. Consequentially people at the bottom of the social scale suffer material deprivation and partake in a culture in which forms of health behavior are harmful (Kogan 1995). The minority poverty hypothesis states that racial minorities experience poverty more profoundly as a result of the combined effects of race and poverty. The use of contextual SEP indicators (WIC during pregnancy, Medicaid before pregnancy and paternal acknowledgement) and maternal education are therefore based on these assumptions of how socioeconomic position affects health.

Maternal education as measured in 'number of years of education' as an indicator reflects in part a material dimension of socioeconomic position. It can be assumed that higher levels of education confer advantages. Being able to attend school for longer periods of time reflects a better overall socio-economic environment over a period of time. Additionally more years of education reflect greater opportunities to learn or acquire health protective behaviors. The material assets associated with having more years of education facilitate the acquisition of cognitive resources and the learning of behaviors that protect or improve health. Years of education, which is typically completed in early adulthood, reflect material circumstances that according to the lifecourse and development perspective could have a cumulative or delayed effect on health in adulthood. Greater odds of LBW found among women with less than 12 years of education are likely a result of a period of material disadvantage throughout childhood. This period of material disadvantage may have created fewer opportunities to acquire health protecting behaviors and assets. Findings suggest that attaining exactly 12 years of education (equivalent to a high school diploma) does not confer any health advantages over those who had less than 12 years of education. This result is reflective of the manner in which maternal education was artificially categorized and the effect of high school drop out rates on the distribution of the sample. Although a high school diploma may not have the same currency as it may have decades ago, as a credential it is likely to confer advantages with respect to employment, working conditions and income.

It is clear in the findings that low levels of education affect racial subpopulations differently. Low levels of education are associated with LBW among both black and white women. The odds of LBW for poorly educated black women however are far higher compared to their white counterparts. Black women experience the effects of low levels of education more

profoundly. Further, compared to their white counterparts, black women have comparatively less to show for improvements in socioeconomic position. More years of education do not benefit black women to the same degree as white women. Although there are arguments pointing to natural biological differences in birth weight between the so called races, it is likely that racial discrimination combined with socioeconomic position is responsible for LBW disparities between black and white women.

Participation in the Women Infants and Children program during pregnancy also reflect material disadvantage. In the total sample, women who participated in WIC during pregnancy had greater odds of giving birth to a LBW infant. This seems at the outset counterintuitive given the fact that the WIC program is geared toward reducing adverse pregnancy outcomes including low birth weight. A cursory glance at this finding suggests that WIC is ineffectual or even harmful with respect to pregnancy outcomes. Understanding this finding demands understanding why WIC is used as an indicator of SEP in the first place. WIC participation during pregnancy by virtue of the program's eligibility criteria is an indicator of material circumstances during the critical pregnancy period that may indirectly affect the chances of low birth weight. The eligibility criteria for WIC includes having a household income below 185 percent of the federal poverty guideline and that the applicant be at "nutritional risk". Nutritional risk is determined at an initial medical screening and includes risk factors such as inadequate/inappropriate diet, anemia, inadequate weight gain, obesity, smoking while pregnant and alcohol consumption. Participating in WIC during pregnancy then reflects material disadvantage and associated behaviors and lifestyles that ultimately place women at greater odds of having a LBW infant.

There is no significant association between WIC during pregnancy and LBW among white women. Meanwhile for black women, being on WIC during pregnancy is associated with

lower odds of low birth weight. These findings suggest that WIC during pregnancy may not be a good indicator of material disadvantage when race in taken into consideration. These findings are likely due to the efficacy of the WIC program as well as characteristics within racial subpopulations. It is plausible that WIC is beneficial for blacks but not for whites. White women may be relatively healthier at the onset and thus less likely to benefit from the program. There may also be racial differences with regard to the precise risk factors behind eligibility to the WIC program. This ultimately may mean that the program masks the effect specific aspects of material deprivation among black mothers.

Medicaid as a SEP indicator reflects the material circumstances of women right before pregnancy based on the eligibility criteria of the program. Inadequate access to healthcare and relatively low household income are material factors that may indirectly cause LBW. While being on Medicaid before pregnancy is associated with greater odds of low birth weight in the total sample and among white women, there is no significant association among black women. This finding is striking given that Medicaid is geared to assisting the most vulnerable access healthcare. These results are congruent with relatively recent studies on the effect of Medicaid on LBW. However studies that have investigated the impact of Medicaid on LBW before substantial changes were made to the program in the 1980s, show results that counter the findings of this dissertation (Hughes and Simpson 1995). To understand the counterintuitive results of this study, it is helpful to consider how changes made to the Medicaid's eligibility criteria may affect its association to low birth weight.

Expansions to Medicaid during the 1980s increasing targeted women without health insurance but with greater resources. More precisely, women covered by later expansions was more likely to be white, married, older, employed and less likely to receive public assistance.

Guyer (1990) suggests that this expanded eligibility has not translated in to actual coverage and/ or access to care. Women covered by later expansions are more likely to be white and better off are less likely to fully benefit from the program. One plausible explanation may be due to the relative recency with which this group has interacted with the program. Newly eligible white women may not be familiar with the intricacies of the program in a manner that fully benefits them. Further, stigma may be a barrier, preventing many white women from taking advantage of the benefits of the program. Consequentially, only the most materially destitute of the newly eligible white women take part. White women who have no other choice participate in Medicaid. Due to historical discrimination blacks out of necessity are more familiar with entitlement programs like Medicaid. Because black women are more likely to qualify for and participate in other entitlement programs, the effect of Medicaid on LBW may be difficult to establish. In sum the precise factors of eligibility found in Medicaid are of different consequence for black and white women.

It is assumed that characteristics of a mother's relationship with the father may convey benefits for health outcomes. It is for this reason that paternal acknowledgement is used as an SEP indicator to reflect economic well-being and social support. Studies have shown that single motherhood is associated with less material resources, poorer housing conditions a less healthy diet and social support (Wyke and Ford 1992); factors that have direct and indirect impacts on low birth weight. This study has found that paternal acknowledgement is a strong predictor of low birth weight. Generally speaking, women who did not have paternal acknowledgement on their child's birth certificate had over 50 percent greater odds of low birth weight. Paternal acknowledgement signified a greater likelihood that the women in the total sample who had no spousal support were more likely to be materially deprived and more likely to engage in

behaviors detrimental to health. Among whites, women were twice as likely to have a LBW infant if there was no paternal acknowledgment. Findings suggest that paternal acknowledgement has no effect on the odds of LBW among black women. One plausible explanation revolves around differences in the predominant family forms among blacks and whites. It is likely that black women access economic and social support from sources other than that of a paternal figure. Socio-historical realities facing blacks have arguably made other family forms (i.e. extended family) an alternative source of social and economic resources that may affect the risk of low birth weight. There is no similar adaptation among whites, and as a result, the absence of a paternal figure is devastating to white women's pregnancy outcomes like low birth weight.

When the strengths of associations between the traditional SEP measure (maternal education) and more contextual measures (Medicaid, WIC and paternal acknowledgement) are observed in the total sample as well across racial subpopulations it is clear that the meaningfulness of an indicator depends on the characteristics of the population under consideration. The differences in strength of association depend on the meaningfulness of the precise factors within the selected SEP measures that may be more relevant for some groups than for others.

The composite variable constructed for this study was comprised of WIC, Medicaid and maternal education, which reflect distinct but related aspects of material deprivation. As a SEP measure the composite variable reflected low income, inadequate access to medical care, inadequate nutrition, and low levels of education. Using factor analysis, precise material factors were isolated to investigate the association between SEP and low birth weight. Paternal acknowledgement does have a material component as it is associated with economic well-being

(better housing, economic certainty, better nutrition etc.) however it is clear that there is a substantial social dimension to the measure. Consequently it reflects a very different aspect of social position and thus was not included in the composite measure.

Findings show a moderate association between the composite variable at the population level and for white women. Being in a situation where there is inadequate access to medical care, poor nutrition, education and low income has consequences for the health of general population and for white women. A culmination of poor material conditions may result in unhealthy modes of behavior that affect low birth weight. One explanation behind the moderate association observed among whites and the general population is that there are likely to be many other factors not captured in the composite indicator that affect the odds of low birth weight. Generally speaking however, the composite indicator can be used to predict odds of LBW among whites and the general population. It is notable that the composite measure has no significant association with LBW among blacks. This is not surprising given that two of the three indicators used to construct the composite measure had either no significant association or an unexpected direction of association among blacks. The findings are not suggesting that certain material indicators of SEP do not affect the health of black women. It is likely that the higher odds of black women having a LBW infant are attributable to either specific material factors not captured in the composite measure or to factors independent of SEP.

In sum the findings have come about because (i) race and socioeconomic position both affect health (ii) the characteristics of the population under study affect the observed association between selected SEP measures and low birth weight (iii) socioeconomic position is not the sole explanation of racial differences in low birth weight.

## **IMPLICATIONS, RECOMMENDATIONS & CONCLUSIONS**

This chapter is organized into five sections. The first section focuses on how the results relate to the original problem and purpose of the studying this section, the implications and relevance of the findings. The next section focuses on the strengths and limitations of the study, which facilitates an understanding of the overall meaning and application of the study. Recommendations for further research and policy will be provided followed by an overall conclusion.

# Implications of Findings

By conducting secondary data analysis of Michigan PRAMS (2000-2006) this study investigated the association between multiple and contextual measures of socioeconomic position (i.e. maternal education, WIC participation during pregnancy, Medicaid participation before pregnancy and paternal acknowledgment) and low birth weight (LBW) across black and white subpopulations in Michigan. In addition, a composite variable was constructed to gain a deeper understanding of how the socioeconomic context of inequality is associated with low birth weight. This study adds to the growing body of knowledge pertaining to the SEP – health association. Findings point to a definite relationship between socioeconomic position and health, where the worst off in society have higher odds of having a low birth weight infant; a result consistent with countless previous health research investigating the fundamental social causes of poor health. However, observed varying associations using multiple and contextual measures (WIC, Medicaid, and Paternal Acknowledgement) in this study suggests that the SEP-LBW connection is more complicated than previous studies using singular traditional indicators may have suggested.

The association between socioeconomic position and LBW varies depending on what SEP measure is being used. For instance, in the total population, there are varying associations observable between selected SEP indicators (WIC, Medicaid, maternal education and paternal acknowledgement, composite measure) and low birth weight. Each SEP measure employed summarize distinct social and economic components of overall risk of poor health. More precisely the daily effects of poverty that have a dynamic effect on low birth weight are reflected. Findings suggest that certain measures reflect specific aspects of socio-economic position that influence LBW more accurately than others. For the total population, maternal education and paternal acknowledgement clearly have a much stronger association with LBW than WIC or Medicaid. Therefore a case may be made that the type of resources used to attain more years of schooling as well as social and material resources indicated by paternal acknowledgement are of most importance in predicting low birth weight.

The results of this study show that some factors related to social position are more accurately depicted by some SEP measures than by others. This is particularly true when considering the impact of race on the SEP – LBW association. Although factors associated with social and economic circumstances may appear identical irrespective of racial background, the implications for health differ substantially between blacks and whites. Socioeconomic position has a different meaning for black and white women regardless of how it is measured. Some SEP measures may be more useful in assessing risk for LBW among white women, whereas others may more accurately reflect the circumstances of black women. For instance, paternal acknowledgement was strongly associated with LBW among whites, yet no significant

association was observed among blacks; no significant association was observed with WIC among whites, while a positive association was observed among blacks; and a moderate association was observed among whites with respect to Medicaid, but no association was observable among blacks. Maternal education was the only SEP indicator that had a statistically significant association across both black and white subpopulations.

The variations in associations across race reveal some important lessons in the use and interpretation of SEP indicators in health research. The unique characteristics of women being studied cannot be overlooked. For instance, unique socio-historical realities, as well as current patterns of racial discrimination in its various forms, may compound LBW among black women. Material deprivation and poverty do have negative impacts on health but simply being a black woman may mean restricted access to the quantity and quality of health related desirable services such as public education and health care. Racial discrimination may cause psychological distress that may negatively affect mental and physical health as well as the likelihood to engage in health damaging behaviors. The observation of the strong association between paternal acknowledgement and SEP among white women further supports the point that a colorblind approach should not be employed when evaluating SEP measures in health research. Another important lesson is that there is no simple prescription for the measurement of socioeconomic position. This health study represents an initial step in evaluating less well-known contextual measures of SEP, which addresses a need in public health research for measures that more accurately reflect the lives of the population of interest. However the results show that it is not a simple matter of comparing traditional measures to more 'contextual' measures. There is no universally contextual measure that should be used. All the selected measures in the study reveal something unique depending on the characteristics of the population being considered.

As was previously discussed in this study, composite SEP measures summarize the complex nature of socioeconomic position, in a relevant, straightforward manner. This is valuable particularly for any public health policy that seeks to address the context of inequality behind poor population health. However, misleading policy messages are likely if the characteristics of the population are not taken into consideration. The lessons learned from evaluating selected measures across race have implications for the utility of the composite variable. The value of the composite variable is tied to the utility of its components, therefore care should be taken when using it at the population level and across racial categories. Findings in this study suggest that the composite variable is useful in assessing how the cumulative aspects of material deprivation are associated with LBW at the population level and among whites. However, it is evident that the factors contained within the composite variable do not accurately reflect the experiences of black women.

Evaluating the SEP-LBW association with multiple measures across race is a step toward understanding how the state of Michigan, and by extension the U.S., drastically underperforms with regard to overall population health. The data clearly indicated that low standards of living are bad for population health when WIC, Medicaid and maternal education are taken into consideration. Women in these material circumstances encounter physical conditions detrimental to their pregnancy outcomes such as poor nutrition, limited access to healthcare, and health limiting behaviors. Additionally it should be noted that any attempt to ameliorate the effect of inequality must be nuanced, as socioeconomic position itself is complex. Improving population health necessitates closing the LBW racial gap. Ultimately observed racial differences in the SEP – LBW association suggests that a one-size-fits-all policy may be ineffective particularly if policy is based on a simplistic, colorblind interpretation of socioeconomic position.

#### Strengths and Limitations

In a number of ways, this study is a departure from the conventional approaches to understanding the association between socioeconomic position and health. The use of multiple SEP measures in this study reflects the multifaceted nature of SEP as mentioned in the related literature. Since more than one measure was employed, the findings did not show only a singular strength of association. In contrast many prior health studies that used a single SEP measure ultimately leading to a potentially incorrect assessment of the importance of socioeconomic factors. On the other hand, measures facilitate results that more accurately reflect diverse realities of women in the population. The inclusion of contextual measures in this study has enabled alternative and more precise socioeconomic factors related to low birth weight. In addition, the composite measure has incorporated the use of cumulative indicators in investigating SEP-LBW association.

There are several notable limitations regarding the use of the contextual measures in the study. First, there are differences in the eligibility requirements for both Medicaid and WIC across states. Consequentially, regional or state comparisons on the basis of socioeconomic position may be more complicated when the contextual indicators in the study are used in favor of more traditional indicators such as education. Secondly, WIC, Medicaid and paternal acknowledgment are inherently dichotomous measures that enable striking comparisons between the most socio-economically deprived and other specific groups in society. However, this makes it difficult to decipher whether the moderate associations observed with LBW is a result of these measures not affecting LBW greatly or whether valuable information has been obscured because of the dichotomization of variables. Dichotomous data precludes exploring a graded relationship between SEP and low birth weight. For instance, not being on Medicaid does not necessarily

mean having access to best health insurance during pregnancy. There is a range of socioeconomic circumstances that fall between those extremes. Similarly, not being on WIC does not necessarily mean access to having a balanced, low-fat diet, rich in fresh fruit, grains and vegetables. Ultimately, incremental improvements in socioeconomic position may correspond to improvements in pregnancy outcomes such as low birth weight.

This study's findings suggest that maternal education is a meaningful indicator in the total population, as well as for black and white women who may not be actively participating in the labor market. Maternal education data tends to have high reliability and typically easy to collect in surveys. Unlike the contextual measures in this study, there are no difficulties with comparing education across states. However, there are issues that arise from having used education as a SEP measure. First, maternal education is usually completed in early adulthood, therefore excluding substantial changes in socioeconomic position during adulthood. Although there is evidence that a large proportion of adult health may be due to socioeconomic conditions experienced in childhood, on the job training, or abrupt changes in SEP during adulthood, could affect the odds of low birth weight. Secondly the way in which education was categorized in the study (<12 years, 12 years and >12 years), limits the interpretation of the data. There are likely additional health benefits that accrue to several educational milestones beyond what would equate to a high school education. Third, clearer evidence of diminishing returns would be have been observed if continuous or ordinal scale data on education was available in this study. An argument for more equitable redistribution of socio-economic resources could be more strongly made if maternal education was further stratified. Finally it should also be noted that quantity of schooling as measured in years does not necessarily equate to quality of schooling. Observed

disparities in LBW in the total population as well as across racial groups may be amplified if quality of education received was taken into consideration.

Any issues pertaining to the aforementioned SEP measures also impact the meaningfulness of the composite measure. This is not surprising given that the composite measure is comprised of a number of measures used in the study (i.e. WIC, Medicaid and maternal education). Like all the other measures in the study, its' meaningfulness is partly based on the characteristics of the population being considered. It is for this reason that the composite measure has meaning for the total sample and white women but not black women. Further, because the composite measure includes dichotomous data, potentially important information is obscured. As a result, the manner in which incremental changes in socioeconomic position impacts low birth weight cannot be accounted for.

# Recommendations

This study addressed the need for more differentiated models of the relationship between socioeconomic position and health. Ultimately, some additional issues have become apparent and therefore should be addressed in future research. It is likely that future research using this study's model will show similar patterns; however, in order to gain a more in-depth understanding studies should consider employing the following strategies. First, more individual SEP measures should be utilized. This may provide an even deeper understanding about how inequality affects low birth weight. Ideally, these measures would reflect (i) incremental changes in socioeconomic position and (ii) ecological data (i.e. zip code, census tract, block numbering) to capture area level effects. Additionally, given the ever-increasing diversity in the state of

Michigan, and across the United States in general, future research needs to include more racial/ethnic categories in the study sample.

The findings of the study add to the already mounting evidence that social and economic conditions are clearly related to health. Although the precise mechanism by which these socioeconomic conditions influence pregnancy outcomes is not fully understood, much of the evidence compels health policy to address growing disparities. Yet in order to do so, certain changes in the field of health research and in health policy will need to occur. Both policy makers and health researchers must adopt a broader understanding of health that incorporates socioeconomic dimensions. If health outcomes such as LBW are seen within a broader context, inevitably, there will be a wider range of remedies that combine both the biomedical and socioeconomic factors surrounding health. In order to facilitate this, health and medical research should routinely collect socioeconomic data related to individuals, families and communities. For instance, MI PRAMS could be even more useful as a tool for determining risk of poor pregnancy outcomes if more socioeconomic data is included. Finally, future research should attempt to identify the specific mechanism by which socioeconomic position influences LBW in order to develop and use more refined contextual measures of socioeconomic position.

## Conclusion

This study has helped to broaden the understanding of health to include social and economic inequality. The observed social patterning of health outcome is evidence that poor health cannot be perceived as only a biomedical condition. Many health researchers subscribe to this view, but because of how SEP is conventionally treated, social inequality is typically over simplified. Despite certain limitations of contextual measures, they can be useful for public

health research and provide a number of avenues of intervention for society's most vulnerable populations.

Relatively poor health at the state and national level may be addressed by ensuring that individuals, families and communities have adequate support such as sufficient income and access to health care. The data discussed provides some justification for the argument that resources used to prolong schooling could be reallocated from the more affluent whose health is not much affected, to the poor whose health is more responsive to added resources, ultimately resulting in average health improvement. Michigan and by extension the United States will have better population health with a more equal distribution of income. This may not be a politically popular goal. However, it is one worth considering given the ever-increasing financial and human costs of medical and service interventions in the state of Michigan and the United States.

APPENDIX

# APPENDIX A

Tables

Variable	Source	Type of Data	PRAMS Question	PRAMS Coding	Operational Definition	Coding for the Analysis
Maternal Education	BC	Categorical	-	1= <12 years 2= 12 years 3= some college 4= college	Mother's level of education at her most recent pregnancy	0 = >12  years 1= 12 years 2= <12 years
Maternal age	BC	Continuous	-	Continuous	Mother's Age as indicated in infant birth certificate	Continuous
WIC during pregnancy	PQ	Categorical	During your pregnancy, were you on WIC (The Special Supplemental Nutrition Program for Women, Infants, and Children)?	1=No 2=Yes	If mothers was on WIC during the most recent pregnancy	Dichotomous 0=No 1=Yes
Medicaid before pregnancy	PQ	Categorical	Just before you got pregnant, were you on Medicaid?	1=No 2=Yes	If mothers was on Medicaid during the most recent pregnancy	Dichotomous 0=No 1=Yes
Paternal Acknowledgment	BC	Categorical	-	1=No 2=Yes	If paternal signature was present in infant birth certificate	Dichotomous 1=No 0=Yes
Birth weight	BC	Continuous	-	Continuous	Infant birth weight	Dichotomous 0 >2,500 g, 1= <2,500g

Table 1: Summary of Michigan PRAMS Response Categories and Operational Definitions of the Variables

Table 1 (cont'd)									
Race	BC	Categorical -	U= Unknown 1= Asian 2= White 3= Black	Mother's race as indicated in infant birth certificate	0= White 1= Black 2= Other				
			4= American Indian 5= Chinese 6= Japanese 7= Filipino 8= Hawaiian 9= Other non- white 10= Alaska native						

Note: PQ= PRAMS Questions; BC= Birth Certificate
Variable	<b>Total Population %</b>	Black %	White %	
Maternal Education	98.56	98.81	98.94	
Maternal age	99.99	100.00	100.00	
On WIC during pregnancy	99.77	99.78	99.87	
Medicaid before pregnancy	99.83	99.78	99.87	
Paternal acknowledgement	100.00	100.00	100.00	
Maternal Race	100.00	100.00	100.00	
Birth-weight	100.00	100.00	100.00	

Table 2: Response Rates of Socioeconomic Status Variables by Race

## Table 3: Maternal Demographic Characteristics

Demographic Characteristic	Sample	Percentage
	Frequency	
Maternal Education (n=15,552)		
<12 years	8,175	53.59
12 years	3,472	22.76
>12 years	3,389	22.22
Missing	2,19	1.44
Mean (99% CI)	3.52 (3.50-3.54)	p<.001
Mode	3	
Median	3	
Maternal Race (n=15,432)		
Black	4,389	28.44
White	9,438	61.16
Other	1,605	10.40
Missing	-	-
Maternal Age (n=15,468)		
<18	697	4.51
18-19	1,241	8.02
20-24	4,052	26.20
25-29	4,192	27.10
30-34	3,378	21.84
35-39	1,551	10.03
40+	356	2.30
Missing	1	0.01
Mean (95% CI)	26.86 (26.76-	p<.05
	26.96)	
Mode	27	
Median	27	

Table 3 (cont'd)

On WIC during pregnancy (n=10,832)		
Yes	4,597	42.44
No	6,210	57.33
Missing	25	0.23
Medicaid before pregnancy (n=10,855)		
Yes	1,951	17.97
No	8,866	81.86
Missing	18	0.17
Paternal acknowledgement (n=15,471)		
Yes	12,261	79.46
No	3,170	20.54
Missing	-	-

Table 4: Distribution of Socioeconomic Status Variables by Race

SEP Indicator	% Total	% Black	% White	Test of	Mean
	Population	(n=4,260)	(n=9,253)	Proportion	Comparison
	(n=13,513)				
Maternal Education					t=17.82
					df=13,641
					p<.001
<12 years	54.37	67.37	49.85		
12 years	23.09	22.68	23.62		
>12 years	22.54	9.95	26.52		
On WIC during				z=28.98	
pregnancy				p<.001	
Yes	42.7	63.4	36.7		
No	57.3	36.6	63.3		
Medicaid before				z=34.46	
pregnancy				p<.001	
Yes	18.0	37.7	12.1		
No	82.0	62.3	87.9		
Paternal				z=-43.75	
acknowledgment				p<.001	
Yes	79.47	55.47	88.85		
No	20.53	44.53	11.15		

Variables	Correlation Coefficient (r)
Medicaid/WIC	0.308
Paternal acknowledgement/WIC	0.054
Education/WIC	-0.346
Medicaid/Paternal acknowledgment	-0.077
Medicaid/Education	-0.269

Table 5: Correlation Coefficients for Socioeconomic Status Variables

Table 6: Odds Ratios for Maternal Education and Birth-weight for Total Population (black and white)

Variable	Total Population LBW (1=Yes, 0=No)	95% Confidence Interval
Maternal Education		
< 12 years	1.519***	0.981 - 1.088
12 years	1.083	1.509 – 1.542
>12 years	1.0	
Age	1.007*	1.000-1.014
Race (black=1)	1.343***	1.240-1.454
n	13432	
LR chi2(4)	133.24	
Prob > chi2	0.00	
Log likelihood	-8241.99	
Pseudo R2	0.08	

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

Variable	Total Population LBW (1=Yes, 0=No)	95% Confidence Interval
On WIC during pregnancy	1.15**	1.046 - 1.272
Age	1.00	0.995-1.010
Race (black=1)	1.45***	1.314-1.603
n	9502	
LR chi2(4)	75.76	
Prob > chi2	0.00	
Log likelihood	-5765.19	
Pseudo R2	0.065	

Table 7: Odds Ratios for WIC and Birth-weight for Total Population (black and white)

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

\*=significance at 0.05 level

Table 8. Odds	Ratios for M	edicaid and F	Rirth-weight for	Total Por	nulation (	black and	white)
Table 0. Odds	Ratios for M		Jin the weight for	1000110	Julation	Ulack and	winter

Variable	Total Population LBW (1=Yes, 0=No)	95% Confidence Interval
Medicaid before pregnancy	1.27***	1.129 – 1.425
Age	1.002	0.995-1.010
Race (black=1)	1.41***	1.277-1.562
n	9518	
LR chi2(4)	82.90	
Prob > chi2	0.00	
Log likelihood	-5769.87	
Pseudo R2	0.071	

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

Variable	Total Population LBW (1=Yes, 0=No)	95% Confidence Interval
Paternal Acknowledgment	(1=No, 0=Yes)	1.387-1.677
	1.525***	
Age	1.003	0.997-1.009
Race (black=1)	1.222***	1.123-1.328
n	13616	
LR chi2(4)	150.33	
Prob > chi2	0.00	
Log likelihood	-8343.31	
Pseudo R2	0.0089	

Table 9: Odds Ratios for Paternal Acknowledgment and Birth-weight for Total Population (black and white)

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

\*=significance at 0.05 level

Variable	LBW (1=Yes, 0=No)	95% Confidence Interval
Maternal Education		
12 years	1.013*	0.931 - 1.124
<12 years	1.258**	1.108 - 1.360
>12 years	1.0	
WIC	0.987	0.872 - 1.118
Medicaid	1.216*	1.026 - 1.441
Paternal Acknowledgment	1.826***	1.523 – 2.188
Maternal Education x Race	1.302***	1.211 - 1.401
WIC x Race	0.896	0.741 - 1.082
Medicaid x Race	0.890	0.699 – 1.133

Table	10.	Odds	Ratios	for	SEP	Measures	and	<b>Birth</b> -	weight
1 auto	10.	Ouus	Matios	101	DLI	wicasures	anu	DILIT	worgin

## Table 10 (cont'd)

Paternal Acknowledgment x Race	0.597***	0.468 - 0.762
Age	1.006**	1.003-1.027
n	9388	
LR chi2(4)	168.32	
Prob > chi2	0.00	
Log likelihood	-5656.21	
Pseudo R2	0.147	

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

\*=significance at 0.05 level

	White		
Variable	LBW (1=Yes, 0=No)	95% Confidence Interval	
Maternal Education			
12 years	0.937	0.836 - 1.102	
<12 years	1.209**	0.998 - 1.213	
>12 years	1.0		
On WIC during pregnancy	1.107	0.969 - 1.265	
Medicaid before pregnancy	1.261**	1.063–1.496	
Paternal Acknowledgment	(1=No, 0=Yes)	1.614-2.328	
	1.939***		
Age	1.016**	1.006-1.027	
n	6848		
LR chi2(4)	117.46		
Prob > chi2	0.00		
Log likelihood	-3978.51		
Pseudo R2	0.145		

	Table	11:	Odds	Ratios	for	SEP	Measures	and	Birth	weight	for	White
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\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

	Black				
Variable	LBW (1=Yes, 0=No)	95% Confidence Interval			
Maternal Education					
12 years	1.231	1.123 – 1.252			
<12 years	1.348**	1.025 - 1.436			
>12 years	1.0				
On WIC during pregnancy	0.759**	0.635 - 0.907			
Medicaid before pregnancy	1.004	0.838-1.207			
Paternal Acknowledgment	(1=No, 0=Yes)	0.842 - 1.199			
	1.005				
Age	1.012	0.998-1.027			
n	2562				
LR chi2(4)	15.00				
Prob > chi2	0.0203				
Log likelihood	-1674.27				
Pseudo R2	0.045				

Table 12: Odds Ratios for SEP Measures and Birth-weight for Black

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

Hypothesis		<b>Total Population</b>	% Change in Odds
	Variable	LBW (1=Yes, 0=No)	Ratio
1	Maternal Education		
	12 years	1.083	8.3%
	<12 years	1.519***	51.9%
	>12 years	1.0	-
2	On WIC during pregnancy	1.15**	15%
3	Medicaid before pregnancy	1.27***	27%
4	Paternal Acknowledgment	(1=No, 0=Yes)	52.5%
		1.525***	

Table 14: Factor Analysis for Maternal Education, WIC, Medicaid, and Paternal Acknowledgment n = 10523, Retained factors = 2 Number of parameters = 6 Rotation (unrotated)

Factor	Eigenvalue	Difference	Proportion	Cumulative proportion
Factor1	1.76720	0.73229	0.4418	0.4418
Factor2	1.03491	0.38024	0.2587	0.7005
Factor3	0.65467	0.11146	0.1637	0.8642
Factor4	0.54321		0.1358	1.0000

## Factor rotation matrix

	Factor1	Factor2
Factor1	0.9999	0.0158
Factor2	0.0158	0.9999

Rotated Factor Loadings (Pattern Matrix) and Unique Variances

9,1	,	1	
Variable	Factor 1	Factor 2	Uniqueness
Maternal Education	0.7869	0.0732	0.3754
WIC during pregnancy	0.8001	0.1277	0.3436
Medicaid before pregnancy	0.7122	-0.2678	0.4211
Paternal acknowledgment	0.0199	0.9704	0.0579

*Scoring Coefficients (method = regression; based on Varimax rotated factors)* 

Variable	Factor1	Factor2
Maternal Education	0.44585	0.07576
WIC during pregnancy	0.45362	0.12844
Medicaid before pregnancy	0.40139	-0.25418
Paternal acknowledgment	0.01741	0.93772

	LBW (1=Yes, 0=No)	95% Confidence Interval
Factor1	1.167***	1.120 - 1.216
n	10523	
LR chi2(1)	45.87	
Prob > chi2	0.00	
Log likelihood	-6541.33	
Pseudo R2	.039	

Table 15: Odds Ratios of LBW from Logistic Regression of Factor1 for the Total Sample

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

\*=significance at 0.05 level

Table 16: Odds Ratios of LBW from Logistic Regression of Factor1 for White

	LBW (1=Yes, 0=No)	95% Confidence Interval		
Factor1	1.225***	1.159 – 1.294		
n	6837			
LR chi2(1)	33.96			
Prob > chi2	0.00			
Log likelihood	-4004.55			
Pseudo R2	.071			
***= significance at 0.001 level				

\*\*= significance at 0.01 level

\*=significance at 0.05 level

	LBW (1=Yes, 0=No)	95% Confidence Interval	
Factor1	0.959	0.885 - 1.039	
n	6837		
LR chi2(1)	1.22		
Prob > chi2	0.2692		
Log likelihood	-1674.60		
Pseudo R2	.003		

\*\*\*= significance at 0.001 level

\*\*= significance at 0.01 level

Hypothesis	Hypothesis Statement	Predictive Effect
1	Mothers with low levels of education have higher odds of having LBW infants than mothers with higher levels of education.	Confirmed
2	Mothers who are enrolled in WIC during pregnancy have higher odds of having LBW infants than mothers who are not enrolled in WIC during pregnancy.	Partially confirmed (for total sample)
3	Mothers who are Medicaid recipients before pregnancy have higher odds of having LBW infants than mothers who are not Medicaid recipients before pregnancy.	Partially confirmed (for total sample and white sub-population)
4	Mothers who do not indicate paternal acknowledgement on infant birth certificates have higher odds of having LBW infants than mothers who indicate paternal acknowledgement on infant birth certificates.	Partially confirmed (for total sample and white sub-population)
5	The effects of race on the association between selected SEP measures (maternal education, WIC during pregnancy, Medicaid receipt before pregnancy, paternal acknowledgement on infant birth certificates and composite measure) and LBW are different for black and white mothers such that black mothers have higher odds of having LBW infants in all cases than white mothers.	Partially confirmed
6	Contextual measures of SEP reflect larger associations with LBW than traditional measures of SEP.	Not confirmed

 Table 18: Predictive Effects of Hypothesis for Associations of SEP Measures and Low Birth Weight

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