

EXPLORING THE RELATIONSHIP BETWEEN NEIGHBORHOOD EFFECTS AND
DIABETES, OBESITY AND LACK OF SLEEP OUTCOMES
IN METROPOLITAN DETROIT, MICHIGAN

By

Kyeesha M. Wilcox

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Geography—Master of Science

2020

ABSTRACT

EXPLORING THE RELATIONSHIP BETWEEN NEIGHBORHOOD EFFECTS AND DIABETES, OBESITY AND LACK OF SLEEP OUTCOMES IN METROPOLITAN DETROIT, MICHIGAN

By

Kyeesha M. Wilcox

The objective of this project was to examine the role of neighborhood effects on diabetes, obesity and lack of sleep in Metropolitan Detroit. This project asked if the health indicators varied by neighborhood socioeconomic position (SEP), if non-Hispanic (NH) Blacks and Hispanics resided more in lower neighborhood SEPs, if mean rates of the health indicators were different across SEP and if SEP and diabetes had a significant association. Using the Modified Darden Kamel Composite Socioeconomic Index for 2011-2015, neighborhood SEPs were identified for census tracts in Metropolitan Detroit. Average health prevalence rates for each health indicator were found for each of the neighborhood SEPs. Neighborhoods of lower SEPs had the greatest prevalence for all three health indicators and greatest proportion of NH Blacks and Hispanics. All health prevalence rates were significantly different across SEPs. However, SEP was not significantly associated with diabetes after adjusting for smoking and obesity.

ACKNOWLEDGMENTS

Thank you to my thesis committee—Dr. Joe Darden, Dr. Amber Pearson and Dr. Ashton Shortridge. Their encouragement, feedback and guidance helped greatly in completing this project. I also thank Dr. Teresa Mastin for their help in the brainstorming phase of the project. I am proud of the small victories that occurred along the way—whether they were about learning how to use a particular software program, finding articles that sparked new ideas or simply overcoming an issue to help move forward the project. This project was two years in the making and my thesis committee as well as others helped see this project to the end.

I thank MSU's Department of Geography, Environment and Spatial Sciences for their funding support to help me pursue my research and earn my master's degree. Six years ago, I started my undergraduate career at Middle Tennessee State University (MTSU). During my time at MTSU, I completed a thesis through the Honors College. Now having done another thesis through MSU, I can say that the process was extremely beneficial in becoming familiar with scholarly research and writing. Thank you again to my Honors College advisors, my department professors and advisor and my thesis advisors at MTSU for helping prepare me for this journey at MSU.

Last but not least, I would like to thank my parents, Bobby and Maxcine Wilcox. They continue to be two of my biggest supporters and have provided a great deal of upliftment not only while I have been at MSU but also throughout all my schooling. They act as beautiful role models. Also, my family and friends' support during this time have been great and aided in helping me find the strength to complete this project.

Thank you all very much.

TABLE OF CONTENTS

LIST OF TABLES	vi
LIST OF FIGURES	vii
CHAPTER ONE: INTRODUCTION.....	1
Background	1
Research Questions and Hypotheses.....	2
Study Area.....	4
Conceptual Framework	5
CHAPTER TWO: LITERATURE REVIEW	7
Past Research on Health and Neighborhood Effects.....	7
Diabetes.....	8
Obesity	8
Sleep.....	9
Racial and Socioeconomic Disparities Related to Health	10
Diabetes.....	10
Obesity	12
Sleep.....	13
Addressing the Gaps in Literature.....	13
Summary of Previous Literature	13
Filling in the Gap	15
CHAPTER THREE: DATA AND METHODOLOGY	18
Introduction	18
CDC 500 Cities: Local Data for Better Health Dataset, 2014-2015	18
Defining the Health Indicators.....	21
Diabetes.....	21
Obesity	22
Sleep.....	23
American Community Survey, 5-Year Estimates, 2011-2015.....	23
The Modified Darden-Kamel Composite Socioeconomic Index, 2011-2015.....	25
Limitations of the Data.....	30
CHAPTER FOUR: RESULTS	33
Introduction.....	33
Health Indicators by SEP	33
Research Question #1	33

Diabetes.....	35
Obesity	37
Sleep.....	39
Hypothesis #1.....	40
Proportion of Races by SEP.....	41
Research Question #2	41
Visualizations of SEPs and Proportions of Race	44
Hypothesis #2.....	49
ANOVA Testing of Mean Rates and SEP	49
Research Question #3	49
Hypothesis #3.....	50
Linear Regression of Diabetes and SEP	51
Research Question #4	51
Hypothesis #4.....	52
CHAPTER FIVE: DISCUSSION.....	53
In Reference of Previous Studies	53
Diabetes, Obesity and Lack of Sleep by SEP	55
Disproportionate Racial/Ethnic Populations and Health.....	55
CHAPTER SIX: CONCLUSION.....	57
Contributions	57
Further Research	58
Broader Impact.....	58
REFERENCES	59

LIST OF TABLES

Table 1. Spatial and Social Structure of Metropolitan Detroit in 2011-2015 based on the Modified Darden-Kamel Composite Socioeconomic Index.....	29
Table 2. Diabetes Crude Prevalence by SEP	35
Table 3. Obesity Crude Prevalence by SEP	37
Table 4. Lack of Sleep Crude Prevalence by SEP	39
Table 5. Proportion of Races by SEP.....	41
Table 6. Regression Output for Diabetes.....	51

LIST OF FIGURES

Figure 1. Locations of 23 census tracts that were excluded from the analysis due to having no socioeconomic position (SEP)	19
Figure 2. Locations of 502 census tracts that were used within this analysis.....	20
Figure 3. Very High Socioeconomic Position (SEP 5) Neighborhoods	44
Figure 4. High Socioeconomic Position (SEP 4) Neighborhoods	45
Figure 5. Middle Socioeconomic Position (SEP 3) Neighborhoods.....	46
Figure 6. Low Socioeconomic Position (SEP 2) Neighborhoods.....	47
Figure 7. Very Low Socioeconomic Position (SEP 1) Neighborhoods.....	48

CHAPTER ONE: INTRODUCTION

Background

In the United States, the rate of diabetes has been steadily increasing. In 2010, the CDC reported that diabetes affected 25.8 million people, or 8.3% of the U.S. population (CDC 2011). By 2012, U.S. diabetes outcomes reached to 29.1 million people, or 9.3% of the population (CDC 2014c). As of 2015, 30.3 million people living in the U.S., or 9.4% of the population, have diabetes (CDC 2017b). Two unhealthy outcomes associated with diabetes prevalence are obesity and lack of sleep. Researchers (Full-Rowell et al. 2016; Simonelli et al. 2016) have shown that race, neighborhood effects and socioeconomic status influence not only sleep duration but also has effects on diabetes and obesity (Gebreab et al. 2017; Piccolo et al. 2015; Signorello et al. 2007). Additionally, studies have shown that obesity prevalence was higher in urban areas rather than non-urban areas (Koh et al. 2015).

This study examined diabetes, obesity and lack of sleep to understand the geographic implications in addition to the influence of neighborhood effects on health outcomes in city-suburban and census tract-level analyses in Metropolitan Detroit, Michigan. Spatial stratification of neighborhood socioeconomic positions was the basis of this thesis project in order to help identify gaps in health outcomes in the metropolitan area. Geographic and socioeconomic stratification by neighborhood socioeconomic positions can help pinpoint specific neighborhoods that differ in outcome rates than its surrounding communities. This identification was key in aiding health officials and leaders in creating community-specific health intervention tools and education materials.

Research Questions and Hypotheses

This project aimed to answer the following four research questions:

1. Are the rates of diabetes, obesity and lack of sleep greater in neighborhoods of lower neighborhood socioeconomic positions?
2. Are the percentages of non-Hispanic Black and Hispanic residents greater in neighborhoods of lower neighborhood socioeconomic positions?
3. Are the mean rates of diabetes, obesity and lack of sleep significantly different between each socioeconomic position (SEP)?
4. After adjusting for the smoking rate and obesity rate, is there a significant association between SEP and diabetes?

Based on previous studies, this project hypothesized that:

- 1. H_A: As neighborhood socioeconomic position decreases, rates of diabetes, lack of sleep and obesity will be greater.**

Utilizing the same methodology as Barnes (2018) and Moody et al. (2016), who used the Modified Darden-Kamel Composite Socioeconomic Index in their studies on asthma and child blood lead levels, respectively, this project expects to find similar results. In both authors' research, neighborhoods of lower neighborhood socioeconomic positions had higher rates of asthma and child blood level. The Modified Darden-Kamel Composite Socioeconomic Index has not been used to evaluate the influence of neighborhood effects on diabetes, obesity and lack of sleep outcomes in Metropolitan Detroit.

- 2. H_A: Non-Hispanic (NH) Black and Hispanic residents live disproportionately in neighborhoods with lower neighborhood socioeconomic positions, and consequently experience greater rates of diabetes, obesity and lack of sleep than NH White residents.**

Darden et al. (2018) found that Hispanics living in Metropolitan Detroit often did not reside in neighborhood of a higher socioeconomic position. Darden et al. (2010) found that as socioeconomic position increased in Metropolitan Detroit, the portion of Black residents decreased while the portion of White residents increased; alternatively, as socioeconomic position decreased, the portion of Black residents increased while the amount of White residents decreased. As previously mentioned in Hypothesis 1, Barnes (2018) and Moody et al. (2016) identified that for asthma and child blood levels, respectively, higher rates of the conditions were found in neighborhoods of lower neighborhood socioeconomic positions. These studies suggest that, since Black and Hispanic residents are more likely to reside in neighborhoods of lower neighborhood socioeconomic positions and negative health conditions were shown to be higher in neighborhoods of lower neighborhood socioeconomic positions, the expected research outcome is that there will be a disparity in the rate of health outcome by racial composition of neighborhoods in Metropolitan Detroit.

- 3. H_A: The mean rates of diabetes, obesity and lack of sleep are significantly different between each socioeconomic position (SEP).**

The test has not been conducted for diabetes, obesity and lack of sleep before using the quintile-based approach of the Modified Darden-Kamel Composite

Socioeconomic Index. This study expected that the mean rates of diabetes, obesity and lack of sleep would be significantly different across the five SEPs.

4. H_A: SEP is significantly associated with diabetes, after adjusting for smoking and obesity.

The Centers for Disease Control and Protection (CDC) noted that risk factors of diabetes are smoking (CDC 2019a) and being overweight and having limited physical activity (CDC 2019b). Additionally, studies have pointed to socioeconomic factors (Gebreab et al. 2017; Myers et al. 2017; Piccolo et al. 2015) as having influence on diabetes prevalence. The 500 Cities: Local Data for Better Health dataset did not contain socioeconomic data, so the U.S. Census American Community Survey, 2011-2015 was supplemented. However, the dataset did have smoking rates and obesity rates which were used in the linear regression model. For this study, we expected that after adjusting for smoking and obesity rates, socioeconomic positions (SEP) would be significantly associated with diabetes prevalence in neighborhoods within Metropolitan Detroit, Michigan.

Study Area

Metropolitan Detroit, Michigan is comprised of three counties: Macomb, Oakland and Wayne. As of 2015, the population of each county was 854,689 in Macomb County, 1,229,503 in Oakland County and 1,778,969 in Wayne County (US Census Bureau 2016). These counties of Metropolitan Detroit make up 39% of Michigan's population.

The highest percentage of non-Hispanic Whites was found in Macomb County. The highest percentages of non-Hispanic Blacks and Hispanics were found in Wayne County.

Alternatively, the lowest percentage of non-Hispanic Whites was found in Wayne County, while the lowest percentage of non-Hispanic Blacks and Hispanics were found in Macomb County. In education, Oakland County led in having more residents aged 25 or over with a bachelor's degree or higher. Macomb and Wayne counties produced roughly the same percentage of high school graduates in 2015 (US Census Bureau 2016). In 2015, unemployment and poverty rates were highest in Wayne County and lowest in Oakland County (US Census Bureau 2016).

Darden et al. 2000 found in Metropolitan Detroit that the proportion of White and Black residents differed greatly in the City of Detroit versus the Detroit suburbs. As neighborhood socioeconomic positions increased, the portion of White residents increased while the portion of Black residents decreased; alternatively, as a neighborhood socioeconomic position decreased, the portion of Black residents increased while White residents' population decreased (Darden et al., 2000). More recently, Darden and Rubalcava (2018) found that the portion of Hispanic White residents in Metropolitan Detroit was 'modest' but still less in the affluent neighborhoods.

Conceptual Framework

William J. Wilson coined the term 'neighborhood effects' in 1987. The framework was described in Elliott et al. 1996 (with Wilson as an author) in reference to disadvantaged neighborhoods. A disadvantaged neighborhood was described as a neighborhood impacted by not only poverty but also high rates of unemployment, cultural heterogeneity, population turnover, changes in the job market and urban renewal and other housing policies (Elliott et al. 1996). The neighborhood effects theory asserts that one's neighborhood can positively or negatively affect their chances for success—where 'success' can range in meaning from education or job opportunities to mental or physical health.

Recent studies on Metropolitan Detroit, Michigan have used the neighborhood effects framework. Moody et al. (2016) used this framework to examine blood lead levels and found that neighborhoods with higher socioeconomic statuses experienced decreased blood lead levels. Studies such as Darden et al. (2010) and Darden et al. (2000) have shown that suburban communities comprise residents of higher socioeconomic statuses than the central city in metropolitan areas. Barnes (2018) found that asthma hospitalizations were much higher among the Black population compared to the White population, and overall hospitalization was higher in neighborhood characterized as having a lower socioeconomic position.

The neighborhood effects framework suggests that residents in suburban areas should have less prevalence of diabetes, while urban areas in or near the central city of a metropolitan statistical area should have greater rates of diabetes prevalence. The project had two objectives which were: 1. To determine the extent to which diabetes outcomes are associated with neighborhood characteristics (e.g., poverty, unemployment, vehicle ownership, income, occupation, education, home value, rent, home ownership) in Metropolitan Detroit; and 2. To determine the extent to which diabetes, obesity and lack of sleep outcomes vary by racial composition of neighborhoods in Metropolitan Detroit. This framework was useful in gaining insight into possible factors associated with these health indicators.

CHAPTER TWO: LITERATURE REVIEW

Past Research on Health and Neighborhood Effects

Past research on health disparities in Metropolitan Detroit has revealed that neighborhoods matter in health outcomes. The Modified Darden-Kamel Composite Socioeconomic Index is a method that has been used analyze data on neighborhood effects. Using this method, researchers (Moody et al. 2016; Barnes 2018) have found significant results on the influence of neighborhood effects on blood lead levels and asthma in Metropolitan Detroit, Michigan.

Moody et al. (2016) sought to understand how blood lead levels in children were influenced by neighborhood socioeconomic positions defined by the Modified Darden-Kamel Composite Socioeconomic Index. The Michigan Department of Community Health supplied the individual pediatric blood lead levels data. For all races included in this study, blood lead level averages increased as neighborhood socioeconomic status decreased. Black children living in neighborhoods of higher socioeconomic status had a lower mean of blood lead levels than White children living in neighborhoods of lower socioeconomic status. Moody et al. (2016) found that children living in neighborhoods of higher socioeconomic statuses experienced decreased blood lead levels in Metropolitan Detroit.

Barnes (2018) studied asthma using the same methodology as Moody et al. (2016). Barnes found that neighborhood positions influenced asthma outcomes, noting that the highest rate of asthma hospitalization in White children was still lower than the lowest rate of asthma hospitalization among Black children. For all socioeconomic positions identified by the Modified Darden-Kamel Composite Socioeconomic Index, Black adults and children's rates of asthma

hospitalization were two to five times higher than their White counterparts. Barnes (2018) noted that most of the asthma hospitalizations occurred near the central city of Detroit and the southeastern region of Oakland County and the south region of Macomb County. In other words, higher rates of asthma hospitalization were concentrated around the City of Detroit and its nearby neighborhoods. Other researchers have used different methods to examine neighborhood effects on health.

Diabetes

Black, Hispanic and White residents in Boston, Massachusetts were studied by Piccolo et al. (2015) to determine the possible influence that neighborhood positions on type 2 diabetes outcomes. The built environment theory used in this study resembles that of the neighborhood effects framework since both emphasize the power of the neighborhood on the residents' social and economic positions. Diabetes was found to be significant associated with lower income, less education and non-professional occupations. The authors noted that, when compared to White participants, Black participants were 2.89 times more likely to have type 2 diabetes, while Hispanic participants were 1.48 times more likely.

Obesity

Yang and South (2018) investigated obesity using data from the National Longitudinal Survey of Youth, 1979. Participants were aged 14 to 22 years old. Data from the U.S. Census for years 1980-2000 identified census tract level neighborhood socioeconomic positions. Body mass index was highest among non-Hispanic Blacks and Hispanics. Non-Hispanic Whites had higher socioeconomic statuses than their non-Hispanic Black and Hispanic counterparts. Residential segregation was also highlighted by Yang and South in this article. Non-Hispanic Blacks and

Hispanics were found to live in neighborhoods primarily with residents of their same ethnicity and race. The authors noted that among non-Hispanic Blacks, body mass index was not associated with poverty rate nor the amount of the same race in their neighborhoods, however higher body mass index had significant relationships with working long hours, being married, having completed college and receiving public assistance. For Hispanics, poverty rate and neighborhood racial composition were not associated with higher readings of body mass index. Among Non-Hispanic Whites, body mass index increased after marrying or receiving public assistance, while it decreased with the improvement of family income.

Sleep

Johnson et al. (2017) found several significant relationships related to sleep duration. In a longitudinal, multi-ethnic study, the authors investigated areas in Maryland, Illinois, North Carolina, California, New York and Minnesota between 2000-2012. Non-Hispanic Whites, along with Asians, reported having more favorable neighborhood conditions. Reports of better neighborhood conditions were significantly associated with receiving more sleep. Out of Non-Hispanic Whites, Asians and Hispanics, African Americans received the least amount of sleep. Shorter sleep duration was associated with higher proportions of African Americans, lower income, higher percentage of having a Bachelor's degree or greater, higher body mass index and expressing higher levels of mood and mental health issues.

Earlier, Fuller-Rowell et al. (2016) examined how racial disparities in the context of neighborhood disadvantage affected differences in sleep patterns. Using census tract-level data of five economic positions from the 2000 US Census, the authors created a similar index used by Barnes (2018) and Moody et al. (2016) to be paired with the participants' addresses. After linking the neighborhood disadvantage to sleep, the authors found that racial disparities in

waking after sleep onset (WASO) persisted. Sleep duration was found not be significantly related to neighborhood disadvantage. Similarly to Johnson et al. (2017), African American received less sleep time than their White counterparts.

Racial and Socioeconomic Disparities Related to Health

Diabetes

Orr et al. (2019) investigated diet quality among diabetics. Using National Health and Nutrition Examination Survey data from 1999-2014, Healthy Eating Index 2010 (HEI) scores were given to participants and stratified across education levels, socioeconomic status and levels of food security. The authors found that across time, all races/ethnicities experienced positive change in their diet qualities. Despite this finding, disparities existed between the level of diet quality among diabetics of higher and lower socioeconomic status. A more significant finding of the study was that, “the mean HEI score for individuals with low income observed near the end of the study period was still lower than the mean HEI score for those with higher income at the beginning of the study” (Orr et al. 2019, p.6).

Myers et al. (2017) conducted a study that found in the Diabetes Belt of the United States, higher diabetes prevalence was more pervasive among African American populations and associated with obesity, physical inactivity and natural amenities such as water access. However, outside of the Diabetes Belt, higher prevalence was more associated with socioeconomic conditions and education levels in addition to obesity, physical inactive, outpatient visits and single mother-headed households. At the county-level, the Diabetes Belt comprised the majority of high diabetes counties, while non-Diabetes Belt counties in the West and Midwest were among the lowest prevalence percentages. In counties in the Diabetes Belt, lower diabetes

prevalence was significantly associated with exercise and health facility density. Counties in the non-Diabetes Belt had significant associations between physician density, elder populations and Hispanic populations. Myers et al. (2017) points out that socioeconomic factors influence diabetes prevalence more so in non-Diabetes Belt counties while natural amenities such as “temperate climate, mild humidity, varied topography and water access” influence prevalence in Diabetes Belt counties.

In a longitudinal study, Gebreab et al. (2017) investigated African Americans in Metropolitan Jackson, Mississippi. The Jackson Heart Study data was used in this study. African American participants who developed type 2 diabetes during the study exhibited higher rates of BMI, less physical activity, tended to be older and already had a family history of diabetes. Significant associations were found in older participants that resided in neighborhoods with lower social cohesion and higher violence. Additionally, participants with lower incomes and less education were likely to live in neighborhoods with more unfavorable food stores, lower social cohesion and higher violence. Type 2 diabetes was lower in neighborhoods with more social cohesion, while more violence increased the prevalence of type 2 diabetes. Type 2 diabetes was found to be significantly associated with neighborhood social cohesion and unhealthy food systems.

Signorello et al. (2007) used the Southern Community Cohort Study to determine if any associations existed between race and diabetes. The participants resided in urban and non-urban areas in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia. The authors found that income influenced the percentage of diabetes outcomes among White and Black participants. For participants whose income was below \$15k, diabetes prevalence was higher among White men

and African American women. For participants whose income was above \$50k, diabetes prevalence was higher among African American men and women. Despite experiencing similar levels of income, education and body mass index, diabetes outcomes differed among White and Black men and women.

Obesity

Koh et al. (2015) examined spatial relationships among obesity prevalence in Metropolitan Detroit. Using the 2010 Behavioral Risk Factor Surveillance System, the authors accessed census tract-level data. Results showed that obesity prevalence was higher in neighborhoods closer to the central city of Detroit rather than in the suburbs of Oakland and Macomb counties. Most high obesity prevalence neighborhoods (88%) were in Wayne County. In Oakland county, approximately thirty neighborhoods were characterized as having high obesity, and in Macomb County, there were a total of four high obesity tracts. Neighborhoods that were characterized as both low income and high obesity were primarily located in Wayne County and, more specifically, in the City of Detroit.

Budzynska et al. (2013) highlighted the role of the built environment in health behavior. Participants living outside of the City of Detroit frequented supermarkets and fresh markets more, had better self-reported health and less chronic illness. Body mass index was higher in participants living in the City of Detroit. Inside of Detroit, over fifty percent of participants were considered obese, while the percentage outside of Detroit was approximately forty. The study's geographic stratification identified city and suburban differences in health behaviors associated with food deserts in Detroit.

Sleep

Singh et al. (2005) investigated total sleep time and obesity in Metropolitan Detroit. Over three thousand participants were involved in a telephone survey that took place over the course of two weeks. The authors found that body mass index had a significant and negative association. Additionally, higher diabetes outcomes were negatively associated with total sleep time. Racial differences also existed in total sleep time. African Americans were 2.5 times more likely to sleep five hours or less than their White counterparts. Moreover, African Americans were 1.5 times more obese than Whites.

Addressing the Gaps in Literature

Although several studies have examined diabetes, obesity and sleep, very few, if any, have examined the relationship between these health indicators together and neighborhood effects employing the Modified Darden-Kamel Composite Socioeconomic Index based on census tracts to characterize neighborhoods. Among the few studies that have used the composite index include Darden et al. (2018), Barnes (2018), Moody et al. (2016), Darden et al. (2000) and Darden et al. (2000). Using the composite index in this study to examine diabetes, obesity and sleep expands our knowledge on neighborhood effects on health disparities. A spatial perspective of these health indicators in Metropolitan Detroit will inform health researchers of areas in need of health intervention.

Summary of Previous Literature

Previous literature on neighborhood effects, diabetes, obesity and sleep have made several contributions to scholarly knowledge. This section will highlight the main points known

about the influence of neighborhoods effects on health outcomes and health disparities related to race and socioeconomic status. In short, past research have found that:

Neighborhood Effects

1. Neighborhood effects have been shown to affect sleep (Johnson et al. 2017), obesity (Yang and South 2018) and diabetes (Gebreab et al. 2017; Piccolo et al. 2015) in areas across the United States.

Diabetes

2. Diabetes is higher among non-Hispanic Blacks and Hispanics than Non-Hispanic Whites (Piccolo et al. 2015; Signorello 2007).
3. Diet quality among diabetics has improved for all races/ethnicities; however socioeconomic disparities exist in the level of quality (Orr et al. 2019).
4. Diabetes in the Midwest may be more influenced by issues such as poverty and unemployment rates (Myers et al. 2017).

Obesity

5. In Metropolitan Detroit, obesity and lower income are concentrated around the central city (Koh et al. 2015).
6. Higher body mass index, obesity and fewer visits to supermarkets and fresh markets were found among residents living in the City of Detroit (Budzynska et al. 2013).

Sleep

7. Experiences of less sleep are higher among non-Hispanic Blacks (Johnson et al. 2017; Fuller-Rowell et al. 2016; Singh et al. 2005).
8. Non-Hispanic Whites and Asians reported better favorable neighborhood conditions and receiving more sleep (Johnson et al. 2017).
9. Neighborhood disadvantage was not associated with sleep duration, but racial disparities existed between sleep duration (Fuller-Rowell et al. 2016). The authors used five socioeconomic characteristics, which included poverty, public assistance rate, education of less than high school, median income, education of bachelor's degree or higher. These variables were found to be correlated with each other, however with the inclusion of more socioeconomic characteristics, different results were expected to be found.

Filling in the Gap

As noted above, past research has found key associations related to neighborhood effects and health disparities, however, questions still remain prior to the present study. These gaps are filled by the use of new data made available by the CDC by census tracts; the use of the Modified Darden-Kamel Composite Socioeconomic Index to examine the three health indicators of diabetes, obesity and sleep in Metropolitan Detroit, a Metropolitan area where residential segregation is among the highest level in the United States. Here is how this study addressed the gaps.

1. **Health Indicators:** This study researched diabetes, obesity and sleep, together by census tracts, for the first time, in Metropolitan Detroit Michigan.

2. **Location:** There has not been a study focusing on Metropolitan Detroit that has examined diabetes, obesity and sleep outcomes in relation to neighborhood effects. Studies using other data and methods (Johnson et al. 2017; Yang and South 2018; Gebreab et al. 2017; Piccolo et al. 2015) have focused on these health indicators and neighborhood effects and found significant associations.
3. **Methodology:** Two studies (Barnes 2018; Moody et al. 2016) have used the Modified Darden-Kamel Composite Socioeconomic Index to investigate asthma and blood lead levels, respectfully. However, this methodology has not been used to investigate neither diabetes, obesity nor sleep in the United States or more specifically in Metropolitan Detroit, Michigan. Additionally, the inclusion of nine socioeconomic characteristics, we expected to find that stronger associations between neighborhood effects and diabetes, obesity and lack of sleep.
4. **Scale:** Census tracts have been used primarily to evaluate neighborhood effects, but this geographical scale had not been used to evaluate the influence of neighborhood effects on diabetes, obesity and sleep in Metropolitan Detroit. More recently, Koh et al. (2015) investigated obesity using census tracts in the Metropolitan Detroit Area, however the study did not use the Modified Darden-Kamel Composite Socioeconomic Index to find a relationship between neighborhood socioeconomic positions and this study's three health indicators.

5. **Race/Ethnicity:** This study did not identify racial differences in prevalence/outcomes; however, it did identify the racial compositions of neighborhoods in Metropolitan Detroit. By identifying the neighborhood racial compositions, this study determined if non-Hispanic Blacks and Hispanics are living in neighborhoods with higher rates of diabetes, obesity and sleep, as compared to non-Hispanic Whites. No study exists that has investigated Metropolitan Detroit by evaluating health outcomes in relation to racial composition of neighborhoods.

CHAPTER THREE: DATA AND METHODOLOGY

Introduction

Data were obtained from two sources: 1) from the CDC, which published census tract level data for diabetes collected between 2014 and 2015 and 2) from the U.S. Bureau of the Census, American Community Survey 5 year estimates, 2011-2015, in neighborhoods in Metropolitan Detroit, which is made up of Macomb, Oakland and Wayne counties (U.S. Census Bureau 2016; CDC 2017a). Using the modified Darden-Kamel Composite Socioeconomic Index, this project identified the socioeconomic positions of neighborhoods which were divided into five quintiles. Next, the distribution of tracts by diabetes, obesity and lack of sleep outcomes percentages were analyzed. Once the socioeconomic and spatial distributions were found, the percent of the population in each quintile were presented for the ethnicities and races of non-Hispanic Black, non-Hispanic White and Latino/Hispanic.

CDC 500 Cities: Local Data for Better Health Dataset, 2014-2015

The 500 Cities: Local Data for Better Health dataset created by the CDC provides census tract level data for cities all around the United States. In Michigan, a total of 525 census tracts are included for the available health data on cities comprising Metropolitan Detroit for the years 2014-2015. This project only used census tracts in the 500 Cities dataset that were located in Metropolitan Detroit and had socioeconomic positions (SEPs) to aid in the project's objective of conducting a quintile-based analysis.

After identifying the socioeconomic positions (SEPs) of each of the Metropolitan Detroit census tracts in the 500 Cities: Local Data for Better Health dataset, 23 census tracts were identified not to have an SEP within the Darden-Kamel Composite Socioeconomic Index (Figure 1). The spatial information for the 23 excluded census tracts is as followed: Dearborn (1), Detroit (13), Farmington Hills (1), Livonia (2), Rochester Hills (2), Southfield (1), Sterling Heights (1), Troy (1) and Warren (1).

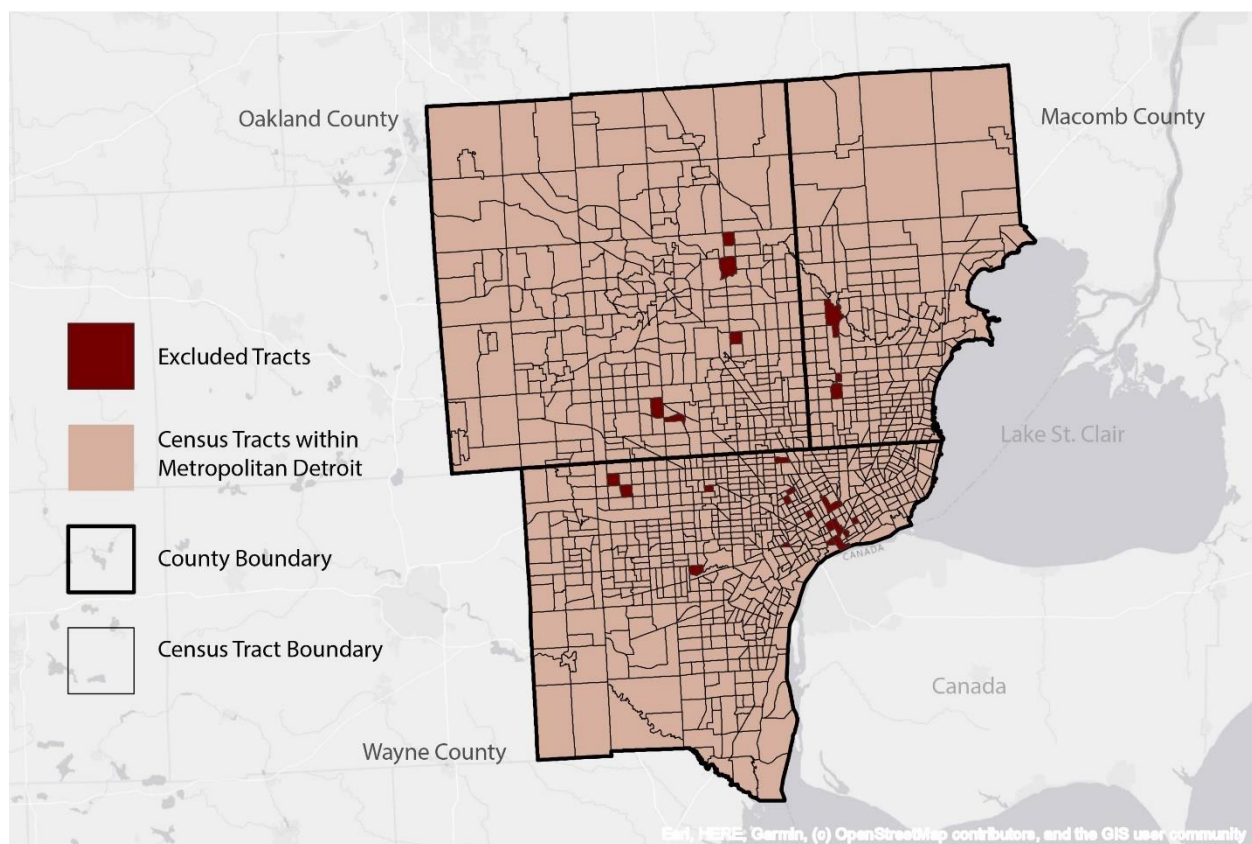


Figure 1. Locations of 23 census tracts that were excluded from the analysis due to having no socioeconomic position (SEP)

A total of 502 census tracts within 10 Metropolitan Detroit cities were analyzed for this project, after excluding census tracts that did not have SEPs (Figure 2). The following information includes the individual cities and their corresponding amount of census tracts included in the 500 Cities: Local Data for Better Health dataset: 23 census tracts were included for Dearborn; 279 census tracts were included for Detroit; 21 census tracts were included for Farmington Hills; 29 census tracts were included for Livonia; 18 census tracts were included for Rochester Hills; 22 census tracts were included for Southfield; 25 census tracts were included for Sterling Heights; 21 census tracts were included for Troy; 41 census tracts were included for Warren; and 23 census tracts were included for Westland.

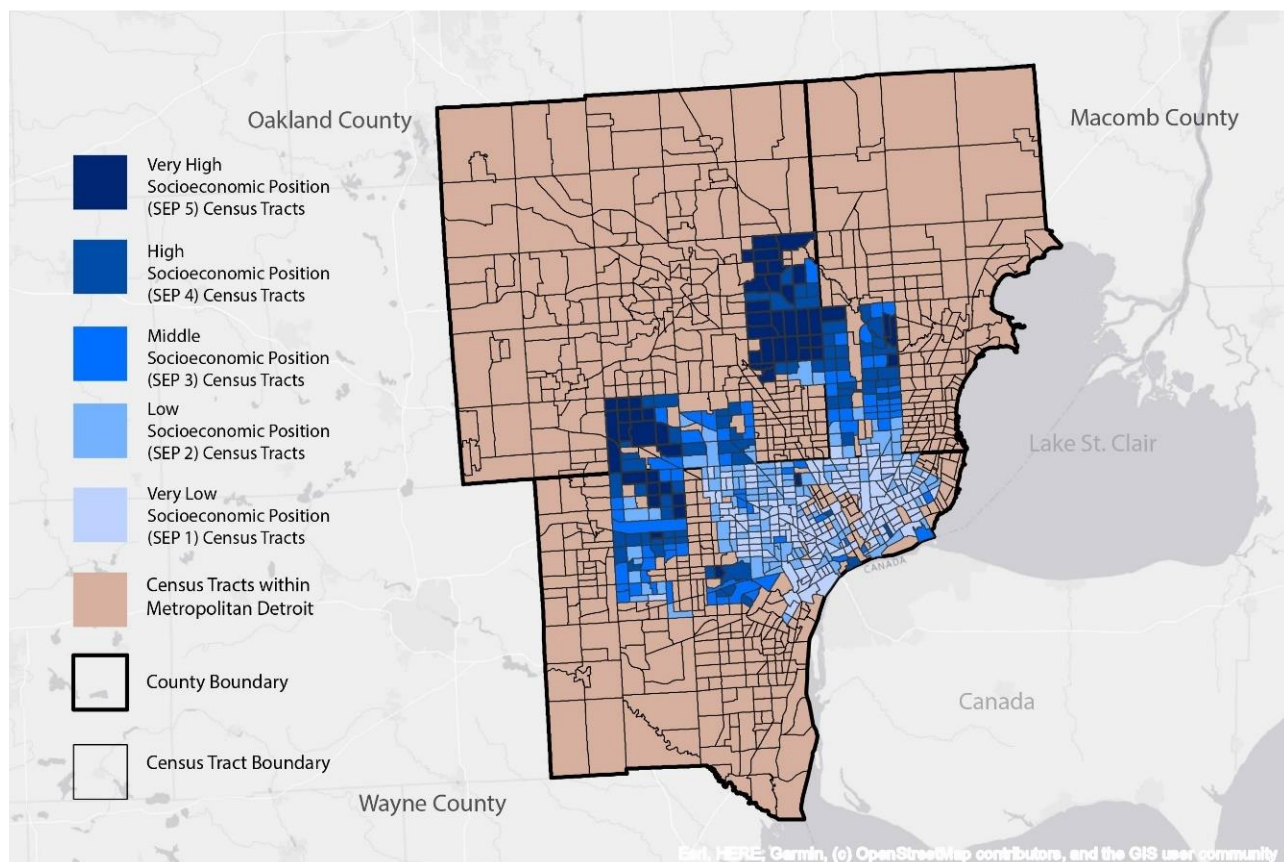


Figure 2. Locations of 502 census tracts that were used within this analysis

Defining the Health Indicators

The 500 Cities Project: Local Data for Better Health dataset contains the crude prevalence of 28 health variables for health outcomes, health behaviors and preventive services. For the purposes of this project, we used averaged diabetes, obesity and lack of sleep data available between the years 2014 and 2015. All data from the 500 Cities Project is obtained from the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a phone survey that asks residents about health-related behaviors, conditions and services. Only adults 18 years or older are able to participate in the survey, and there is no compensation for survey participation. The survey asks a fixed set of questions every year and rotates alternative sets of questions that are dependent on a state's specific need. This project used BRFSS data from 2014-2015 for diabetes, obesity and lack of sleep. The following sections describe the methodology of finding each variable's values and the questions asked during the survey.

Diabetes

In the 2014 and 2015 BRFSS questionnaires, diabetes-related questions included: "(Ever told) you have diabetes"; "How old were you when you were told you have diabetes"; "Have you had a test for high blood sugar or diabetes within the past three years"; "Have you ever been told by a doctor or other health professional that you have pre-diabetes or borderline diabetes"; "Are you now taking insulin"; "About how many times in the past 12 months have you seen a doctor, nurse or other health professional for your diabetes"; "Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy"; "...About how many times in the past 12 months has a doctor, nurse or other health professional checked you for 'A one C'"; "Have you ever taken a course or class in how to manage your diabetes yourself" (CDC, 2013; CDC, 2014a).

The full statement for the diabetes variable is: Diagnosed diabetes among adults aged ≥ 18 years. This variable is found by taking the “respondents aged ≥ 18 years who report ever been told by a doctor, nurse or other health professional that they have diabetes other than diabetes during pregnancy” and dividing by “respondents aged ≥ 18 years who report or do not report ever been told by a doctor, nurse or other health professional that they have diabetes (excluding those who refused to answer, had a missing answer, or answered “don’t know/not sure”)” (CDC, 2016a). The percentage used reports annual crude and age-adjusted prevalence, and time period of the case definition is “lifetime (ever diagnosed)” (CDC, 2016a).

Obesity

In the 2014 and 2015 BRFSS questionnaires, the body mass index was found by asking the following questions: “About how much do you weigh without shoes”; “About how tall are you without shoes” (CDC, 2013; CDC, 2014a). Body mass index was self-reported and calculated to reveal if the respondent was obese.

The full statement for the obesity variable is: Obesity among adults aged ≥ 18 years. The variable is found by taking “respondents aged ≥ 18 years who have a body mass index (BMI) $\geq 30.0 \text{ kg/m}^2$ calculated from self-reported weight and height. [Excluding: 1. Data from respondents measuring $<3\text{ft}$ or $\geq 8\text{ft}$; 2. Data from respondents weighing $<50 \text{ lbs}$ or $\geq 650 \text{ lbs.}$; 3. Data from respondents with BMI $<12 \text{ kg/m}^2$ or $\geq 100 \text{ kg/m}^2$; or 4. Pregnant women]” and dividing by “respondents aged ≥ 18 years for whom BMI can be calculated from their self-reported weight and height (excluding unknowns, refusals to provide weight or height and [the exclusions are as followed]): 1. Data from respondents measuring $<3\text{ft}$ or $\geq 8\text{ft}$; 2. Data from respondents weighing $<50 \text{ lbs}$ or $\geq 650 \text{ lbs.}$; 3. Data from respondents with BMI $<12 \text{ kg/m}^2$ or $\geq$

100 kg/m²; or 4. Pregnant women” (CDC, 2016b). The percentage used reports annual crude and age-adjusted prevalences, and the time period of the case definition is “current” (CDC, 2016b).

Sleep

In the 2014 BRFSS questionnaire, the lack of sleep-related question asked was: “On average, how many hours of sleep do you get in a 24-hour period” (CDC, 2013). The 2015 BRFSS questionnaire removed the section on ‘inadequate sleep’ and added the following questions to the anxiety and depression section: “Over the last 2 weeks, how many days have you had trouble falling asleep or staying asleep or sleeping too much”; “Over the last 2 weeks, how many days have you felt tired or had little energy” (CDC, 2014a).

The full statement for the sleep variable is: Sleeping less than 7 hours among adults aged ≥ 18 years. The variable is found by taking “respondents aged ≥ 18 years who report usually getting insufficient sleep (<7 hours for those aged ≥ 18 years, on average, during a 24-hour period)” and dividing by “respondents aged ≥ 18 years who report 0-24 hours of sleep (excluding those who refused to answer, had a missing answer or answer “don’t know/not sure)” (CDC, 2016b). The percentage used reports annual crude and age-adjusted prevalences, and the time period of the case definition is “current” (CDC, 2016b).

American Community Survey, 5-Year Estimates, 2011-2015

The U.S. Census Bureau supplies data on American households annually. Through the internet, mail, telephone and interviews, the Bureau gathers responses for the American Community Survey (ACS). Responses are required of households whose address are randomly selected to participate.

The ACS survey includes four categories of characteristics: social, economic, housing and demographics. Social characteristics of the participants reference topics such as their education, marital status, relationships fertility (married, unmarried and by age groups), grandparents as guardians, veteran status, disability, residence in the state/city/county, place of birth, ancestry, primary language spoken at home and computer and internet use. Economic characteristics represent the employment status, methods of commuting to work, occupation, industry, type of worker, income and health insurance coverage of the participants. Housing characteristics discuss housing occupancy, units in structure, year the structure was built, rooms and bedrooms of the housing units, ownership of unit, years in residence at unit, car ownership, value of unit and gross rent. Demographic characteristics cover the participants' sex, age, race and citizenship by sex.

The American Community Survey collects information at the national, regional, state, county, city and census tract level. Also, information is available for zip code tabulation areas, Metropolitan/ Micropolitan Statistical Areas and American Indian Area/Alaska Native Area/Hawaiian Homelands.

The ACS website noted that limitations exist in the survey's methodology related to nonsampling errors and confidence intervals. The nonsampling error values were to be cautioned due to standard errors not reflecting "the effect of correlated errors introduced by interviewers, coders or other field or processing personnel or the effect of imputed values due to missing responses" (US Census Bureau, 2019, p. 12). The confidence intervals may not be fully representative of the true values because the researchers used large sample theory "which may cause negative values of zero or smaller estimates" (US Census Bureau, 2019, p. 12).

The Modified Darden-Kamel Composite Socioeconomic Index, 2011-2015

The Modified Darden-Kamel Composite Socioeconomic Index identifies socioeconomic positions (SEP) for census tracts. This methodology can determine spatial inequality in relation to residents' ability to find employment, earn a higher living wage and work in non-laborious jobs. The nine socioeconomic characteristics included in the index are: poverty, unemployment rate, median household income, percentage of vehicle ownership, percentage of professional & managerial workers, percentage of people holding a bachelor's degree or other higher education, median house value, median monthly rent and percentage of home ownership. The index uses data from the U.S. Census Bureau American Community Survey.

This methodology has been used in various articles including Moody et al. (2016), Darden & Rubalcava (2018) and Barnes (2018). The articles all focus on Metropolitan Detroit but differ in the topics being discussed. One article discusses blood lead levels and the others examine residential segregation among Hispanic and Non-Hispanic White populations and asthma hospitalizations. The first article using this methodology, Darden et al. (2010), focused on residential segregation among Black and White populations.

In Moody et al.'s article, the index was broken down to z-score variations. A formula identifying the composite socioeconomic z-score index was used which included components of the "three counties [of] Wayne, Oakland, and Macomb", "the number of variables in the index", "the...z-score for a given census tract", the mean of the variable in the three counties and the standard deviation of the variable in the three counties (Moody et al. 826). After the scores were found, the census tracts were divided into quintiles. These quintiles revealed census tracts that fell into the five socioeconomic positions: very high (5), high (4), middle (3), low (2) and very low (1). Not all census tracts are assigned socioeconomic positions using this methodology and

usually are excluded from the datasets. In this article's case, 116 census tracts were removed from the original total of census tracts. The Composite Socioeconomic Index helped reveal that "Black children were overrepresented in the very low and low SEP neighborhoods and white children overrepresented in the middle, high and very high SEP neighborhoods" (831). Also, Black children living in higher socioeconomic positions had lower levels of blood lead concentration. The major finding of the article was that blood lead levels were shown to be connected to the socioeconomic composition of the neighborhoods in Metropolitan Detroit.

In Darden et al. (2010) the composite socioeconomic index revealed that most neighborhoods with higher socioeconomic positions were in Oakland County and less than 5% of Black residents resided in that county. White-Black neighborhood composition shifts negatively and positively, respectively, as socioeconomic position changes from very high to very low. By using the modified Darden-Kamel Composite Socioeconomic Index, Darden and Rubalcava (2018) found that the Hispanic population living in Metropolitan Detroit were predominately in lower socioeconomic positions and non-Hispanic Whites were "located disproportionally in neighborhoods of high socioeconomic characteristics" (327).

This methodology is helpful in revealing variations in opportunities available for residents in urban areas, more specifically in Metropolitan Detroit. Although this index is formulated for Metro Detroit, the composite socioeconomic index z-score formula can be used for any city or metropolitan area that has census data available through the American Community Survey. As found in the other articles, not all census tracts have assigned socioeconomic positions; however, the methodology does identify socioeconomic positions for a majority of census tracts in the metropolitan and city areas.

The nine variables of the modified Darden-Kamel Composite Socioeconomic Index have been defined by Darden et al. 2010 and Moody et al. 2016 as:

1. *Percent below poverty*—the percent of all occupied households whose income in the past 12 months is below the US poverty level.
2. *Unemployment rate*—the percent of civilians 16 years and older who were neither at work nor with a job but not at work during the reference week and who were actively seeking work during the last 4 weeks and available to start a job.
3. *Median housing income*—the median income of all family members 16 years and older including those without income.
4. *Percent of households with vehicle*—percent of occupied housing units with at least one vehicle available.
5. *Percent of residents with management, business, science and arts occupations*—percent of workers 16 years and older that hold positions in management, business and financial operations occupations or professional and related occupations as codified by the US Bureau of the Census for the 2011-2015 5-year estimates.
6. *Percent of residents with bachelor's degrees or higher*—percent of the total population 25 years and older that holds at least a bachelor's degree.
7. *Median value of dwelling in dollars*—the median value of owner-occupied housing which is the respondent's estimate of how much the property would sell for if it were for sale.

8. *Median gross rent of dwelling in dollars*—the contract rent value plus the estimated average monthly cost of utilities
9. *Percent homeownership*—percent of owner-occupied housing units with a mortgage.

The formula is as follows:

$$CSI_i = \sum_{j=1}^k \frac{V_{ij} - V_{jDMA}}{S(V_{jDMA})}$$

Where CSI_i is the composite socioeconomic z-score index for census tract i , the sum of z-scores for the socioeconomic status (SES) variables j , relative to the two-three county/metropolitan area; k is the number of variables in the index; V_{ij} is the j th socioeconomic position (SEP) variable for a given census tract i ; V_{jDMA} is mean of the j th variable in the two-three country/metropolitan area; and $S(V_{jDMA})$ is standard deviation of the j th variable in the two-three county/metropolitan area (Darden et al. 2010).

Table 1. Spatial and Social Structure of Metropolitan Detroit in 2011-2015 based on the Modified Darden-Kamel Composite Socioeconomic Index

Mean characteristics of census tracts

Neighborhood index of SEP (quintiles)	Poverty (%)	Unemployment (%)	Median income (US\$)	Vehicle ownership (%)	Professional and managerial workers (%)	Bachelor's or higher education (%)	Median house value (US\$)	Median monthly rent (US\$)	Home ownership (%)
Very high SEP	3.3	5.5	95,035	97.2	55.9	54.3	202,710	1,226	84.4
High SEP	6.2	7.4	63,041	95.2	40.4	32.7	154,441	1,016	74.7
Middle SEP	10.9	9.8	49,598	93.0	31.1	21.7	107,314	901	69.1
Low SEP	24.2	16.5	34,898	86.0	23.0	14.8	78,198	882	55.9
Very low SEP	42.0	28.2	21,888	71.0	16.4	8.3	58,757	784	45.8
<i>All tracts</i>	<i>17.4</i>	<i>13.5</i>	<i>52,815</i>	<i>88.4</i>	<i>33.3</i>	<i>26.3</i>	<i>119,837</i>	<i>960</i>	<i>66.0</i>

Source: Calculated by Darden and Rubalcava (2018) from the data in the U.S. Bureau of the Census (2011-2015) American Community Survey 5-year Estimates.

Notes: SEP = socioeconomic position; The census data for the three-county (Wayne, Oakland and Macomb) Detroit Metropolitan area for this study was based on a total of 1,098 census tracts.

The Darden-Kamel Composite Socioeconomic Index for 2011-2015, shown in Table 1, organized census tracts into quintiles for nine socioeconomic variables. Darden and Rubalcava (2018) uncovered that in SEP 5, or Very high SEP, poverty (3.3%) and unemployment (5.5%) held the lowest percentage while median income (\$95,035), vehicle ownership (97.2%), the percentage of professional and managerial workers (55.9%) and residents holding a bachelor's degree or higher education (54.3%), median house value (\$202,710), median monthly rent (\$1,226) and rate of home ownership (84.4%) was highest in SEP 5. Alternatively, in SEP 1 or Very Low SEP, the poverty rate was 42%; the unemployment rate was 28.2%; the median income was \$21,888; the rate of vehicle ownership was 71%; the percentage of professional and managerial workers was 16.4%; the percentage of residents holding a bachelor's degree or higher education was 8.3%; the median house value was \$58,757; the median monthly rent was \$784; and the rate of home ownership was 45.8%.

Using the quintile-based approach of Darden et al. (2010; 2016; 2018) will be beneficial in identifying 1. How health is affected by neighborhood socioeconomic positions and 2. Which racial populations are residing in greater numbers in lower socioeconomic positions (SEPs). The census tracts (or neighborhoods) within Metropolitan Detroit have already been grouped into quintiles, or SEPs. The 500 Cities: Local Data for Better Health dataset does not use all the census tracts within Macomb, Oakland and Wayne counties. The census tracts within the 500 Cities dataset were matched with their corresponding SEPs for a quintile-based analysis. A total of 502 census tracts were used for this analysis.

Limitations of the Data

Limitation 1: The 500 Cities: Local Data for Better Health Dataset does not include health prevalence by race or by age, which would be help provide a more specific determination

of which racial populations and age groups in need health intervention. Instead, the American Community Survey, 2011-2015 provided information on the racial composition of each SEP. The racial compositions of each SEP were found and used to determine which racial groups were overpopulated in each SEP in relation to the health prevalence in each SEP. Although the 500 Cities data did not offer information for the racial groups or age, the American Community Survey provided information for the racial composition of the census tracts within the 500 Cities dataset. Using the racial composition of the American Community Survey, this project was able to determine if one or more proportions of a race were uneven in different socioeconomic positions (SEPs).

Limitation 2: The American Community Survey does not offer data for an analysis of the percentage of the racial population over 45 years old within a census tract. The current variable within the American Community Survey stated as ‘Sex by Age (*Racial Group*)’ only contains percentages of age group within the context of the male or female (Black, Non-Hispanic White or Hispanic) population. If this information was available, each census tract with the age information could be matched with their corresponding SEP and analysis of the percentage of the racial group in each SEP could be accomplished. Determining the percentage of Black, Non-Hispanic White and Hispanic populations over the age of 45 years old within each SEP was not possible for this project.

Limitation 3: The 500 Cities: Local Data for Better Health dataset uses the Behavioral Risk Factor Surveillance Survey (BRFSS) data, which is self-reported. The CDC’s 500 Cities project points out a few limitations of working with this data. For the diabetes variable, the CDC acknowledged that a limitation of the data was that about 25% of diabetes cases are not diagnosed. For the obesity variable, the main limitation is that “self-reports of height and weight

lead to lower BMI estimates compared with the estimated obtained when height and weight are measured”, (CDC 2016b; Merrill and Richardson 2009; Kuczmarski et al. 2001). For lack of sleep, the CDC noted that sleep duration or quality of sleep was not measured, and there was no identification of specific sleep problems which could have better explained sleep patterns or average hours of sleep.

CHAPTER FOUR: RESULTS

Introduction

This thesis project aimed to answer four research questions regarding diabetes, obesity and lack of sleep. This chapter contains results for 1. the health indicators' percentages by socioeconomic position (SEP), 2. the proportion of Black and Hispanic residents by SEP, 3. an ANOVA analysis testing for the significance of the difference of means of each health indicator by SEP and 4. a linear regression of diabetes and SEP, after adjusting for smoking and obesity rates. NOTE: All calculations were conducted using STATA 16 statistical software.

As mentioned in Chapter Three: Data and Methodology, SEP 1 represented neighborhoods with a very low socioeconomic position, while SEP 5 represented neighborhoods with a very high socioeconomic position. A total of 502 census tracts were matched with SEPs from the Modified Darden-Kamel Composite Socioeconomic Index. The distribution of census tracts within each SEP is as followed: SEP 1 (189), SEP 2 (118), SEP 3 (72), SEP 4 (70) and SEP 5 (53). The results for research questions 1-4 are based on the quintiles, or socioeconomic positions (SEPs), for each of the health variables within the 500 Cities: Local Data for Better Health dataset.

Health Indicators by SEP

Research Question #1

Research question #1 asked: Are rates of diabetes, obesity and lack of sleep greater in lower SEPs? Descriptive statistics were found for all three health indicators. Using the Modified Darden-Kamel Composite Socioeconomic Index, socioeconomic positions (SEPs) were used to represent specific neighborhood socioeconomic characteristics. The results for this research

question reveal clear distinctions between the health indicators' prevalence rates and SEPs within Metropolitan Detroit, Michigan.

SEP 1, or neighborhoods with a very low neighborhood socioeconomic position, contained the highest prevalence for diabetes crude prevalence. As neighborhood socioeconomic position (SEP) increased, illness prevalence decreased. This finding supports previous literature (Barnes 2018; Moody et al. 2016; Darden et al. 2010) that discovered, in Metropolitan Detroit, neighborhood effects have a clear influence on health outcomes.

Diabetes

Table 2. Diabetes Crude Prevalence by SEP

	Mean	SD	Min	Max	P25	P50	P75	ANOVA (p-value)
SEP 5*	7.9	1.1	5.0	12.8	7.2	7.9	8.4	
SEP 4	9.6	2.1	5.1	15.7	8.1	9.7	10.6	
SEP 3	10.9	2.4	6.6	17.4	9.1	10.5	11.5	<0.001
SEP 2	14.6	3.6	4.7	21.7	11.5	14.9	17.7	
SEP 1	18.3	3.2	10.1	26.6	15.9	18.8	20.6	

Note: Values are based on 502 census tracts from the 500 Cities: Local Data for Better Health Dataset. A total of 10 cities from this dataset were located within Metropolitan Detroit and used for this analysis. SEP stands for socioeconomic position and is based on the Darden-Kamel Composite Socioeconomic Index.

SD= Standard deviation; Min= minimum value; Max= maximum value; P(25/50/75)= percentile range

****SEP 5 = very high, SEP 4 = high, SEP 3 = middle, SEP 2 = low and SEP 1 = very low***

Sources:

Centers for Disease Control and Prevention. (2017a). 500 Cities: Local Data for Better Health, 2017 Release, 2014-2015. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, 2017.

Darden, J.T., M. Rahbar, L. Jezierski, M. Li and E. Velie. (2010). The Measurement of Neighborhood Socioeconomic Characteristics and Black and White Residential Segregation in Metropolitan Detroit: Implications for the Study of Social Disparities in Health. Annals of the Association of American Geographers, 100(1): 137-158.

Table 2 describes diabetes crude prevalence by SEP. In Table 2, the mean diabetes crude prevalence of SEP 1 was 18.3%. Prevalence continued to grow smaller as socioeconomic

position (SEP) increased, where prevalence was 14.6% in SEP 2, 10.9% in SEP 3, 9.6% in SEP 4 and 7.9% in SEP 5. Diabetes crude prevalence ranged from 5.0% to 12.8% in SEP 5. This health variable's range increased to 5.1-15.7% in SEP 4, 6.6-17.4% in SEP 3, 4.7-21.7% in SEP 2 and 10.1-26.6% in SEP 1. The maximum value of diabetes crude prevalence in SEP 5 (12.8%) was 2.7% higher than the minimum value of diabetes crude prevalence in SEP 1 (10.1%). In summary, neighborhoods with a very high socioeconomic position, also known as neighborhoods in SEP 5, saw the smallest diabetes crude prevalence; alternatively, diabetes crude prevalence was, on average, greatest in neighborhoods with a very low socioeconomic position (SEP 1).

Table 3. Obesity Crude Prevalence by SEP

	Mean	SD	Min	Max	P25	P50	P75	ANOVA (p-value)
SEP 5*	24.8	2.6	20.1	34.9	23.4	24.2	26.1	
SEP 4	29.6	3.7	22.4	37.7	26.6	29.2	32.5	
SEP 3	33.1	4.0	25.1	43.9	30.2	32.7	35.2	<0.001
SEP 2	40.6	5.4	24.9	47.6	37.5	42.0	44.8	
SEP 1	46.3	3.0	33.8	53.3	44.8	46.9	48.4	

Note: Values are based on 502 census tracts from the 500 Cities: Local Data for Better Health Dataset. A total of 10 cities from this dataset were located within Metropolitan Detroit and used for this analysis. SEP stands for socioeconomic position and is based on the Darden-Kamel Composite Socioeconomic Index.

SD= Standard deviation; Min= minimum value; Max= maximum value; P(25/50/75)= percentile range

****SEP 5 = very high, SEP 4 = high, SEP 3 = middle, SEP 2 = low and SEP 1 = very low***

Sources:

Centers for Disease Control and Prevention. (2017a). 500 Cities: Local Data for Better Health, 2017 Release, 2014-2015. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, 2017.

Darden, J.T., M. Rahbar, L. Jezierski, M. Li and E. Velie. (2010). The Measurement of Neighborhood Socioeconomic Characteristics and Black and White Residential Segregation in Metropolitan Detroit: Implications for the Study of Social Disparities in Health. Annals of the Association of American Geographers, 100(1): 137-158.

Table 3 describes obesity crude prevalence by SEP. For SEP 1, obesity prevalence was 46.3%. Prevalence became smaller as socioeconomic position increased. The average mean of obesity prevalence was 40.6% in SEP 2, 33.1% in SEP 3, 29.6% in SEP 4 and 24.8% in SEP 5.

Obesity prevalence was 21.5 percentage points greater in SEP 1 than in SEP 5. The range differences in SEP 1 (33.8-53.3%), SEP 2 (24.9-47.6%), SEP 3 (25.1-43.9%), SEP 4 (22.4-37.7%) and SEP 5 (20.1-34.9%) show the differences in prevalence by neighborhood socioeconomic positions. The maximum value of obesity prevalence in SEP 5 was 34.9%, while in SEP 1, the minimum value of obesity prevalence was 33.8%. The maximum value of obesity prevalence in SEP 1 was 53.3%, which is 18.4 percentage points more than SEP 5. The mean average of obesity prevalence was greatest in SEP 1 (46.3%) and lowest in SEP 5 (24.8%).

Sleep

Table 4. Lack of Sleep Crude Prevalence by SEP

	Mean	SD	Min	Max	P25	P50	P75	ANOVA (p-value)
SEP 5*	33.6	1.8	30.0	42.1	32.7	33.2	34.3	
SEP 4	36.5	2.9	31.7	44.4	34.8	35.6	37.0	
SEP 3	39.2	4.1	32.5	49.7	36.3	38.1	41.1	<0.001
SEP 2	46.7	5.0	32.6	52.9	43.1	48.7	50.7	
SEP 1	51.6	2.7	42.3	56.0	51.0	52.4	53.3	

Note: Values are based on 502 census tracts from the 500 Cities: Local Data for Better Health Dataset. A total of 10 cities from this dataset were located within Metropolitan Detroit and used for this analysis. SEP stands for socioeconomic position and is based on the Darden-Kamel Composite Socioeconomic Index.

SD= Standard deviation; Min= minimum value; Max= maximum value; P(25/50/75)= percentile range

***SEP 5 = very high, SEP 4 = high, SEP 3 = middle, SEP 2 = low and SEP 1 = very low**

Sources:

Centers for Disease Control and Prevention. (2017a). 500 Cities: Local Data for Better Health, 2017 Release, 2014-2015. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, 2017.

Darden, J.T., M. Rahbar, L. Jezierski, M. Li and E. Velie. (2010). The Measurement of Neighborhood Socioeconomic Characteristics and Black and White Residential Segregation in Metropolitan Detroit: Implications for the Study of Social Disparities in Health. Annals of the Association of American Geographers, 100(1): 137-158.

Table 4 describes lack of sleep prevalence by SEP. Similarly, to diabetes (Table 2) and obesity (Table 3) prevalence, rates of lack of sleep were influenced by neighborhood

socioeconomic positions. The greatest prevalence rate was in SEP 1 (51.6%). Prevalence continued to grow smaller across SEP 2 (46.7%), SEP 3 (39.2%), SEP 4 (36.5%) and SEP 5 (33.6%). Lack of sleep prevalence was 18.0 percentage points greater in SEP 1 than in SEP 5. The following represents the range differences by SEP: SEP 1 (42.3-56.0%), SEP 2 (32.6-52.9%), SEP 3 (32.5-49.7%), SEP 4 (31.7-44.4%) and SEP 5 (30.0-42.1%). The maximum value of lack of sleep prevalence in SEP 5 was 42.1%, while in SEP 1, the minimum value of lack of sleep prevalence was 42.3%. The maximum value of lack of sleep prevalence in SEP 1 was 56.0% which was 15.9 percentage points more than SEP 5. The mean average of lack of sleep prevalence was greatest in SEP 1 (51.6%) and lowest in SEP 1 (33.6%).

Hypothesis #1

This project hypothesized that: **As neighborhood socioeconomic position decreases, rates of diabetes, lack of sleep and obesity will be greater.**

Tables 2-4 show that diabetes, obesity and lack of sleep prevalence became smaller as SEP increased from 1 to 5. The diabetes prevalence for each SEP was as followed: SEP 5 (7.9%), SEP 4 (9.6%), SEP 3 (10.9%), SEP 2 (14.6%) and SEP 1 (18.3%). The obesity prevalence for each SEP was as followed: SEP 5 (24.8%), SEP 4 (29.6%), SEP 3 (33.1%), SEP 2 (40.6%) and SEP 1 (46.3%). The lack of sleep prevalence for each SEP was as followed: SEP 5 (33.6%), SEP 4 (36.5%), SEP 3 (39.2%), SEP 2 (46.7%) and SEP 1 (51.6%).

This project rejects the null hypothesis that neighborhood socioeconomic positions and the health indicators' rates would be the same across all socioeconomic positions. In the case of all three health indicators, the rates of diabetes, obesity and lack of sleep were greater as the neighborhood socioeconomic positions decreased.

Proportion of Races by SEP

Research Question #2

Research question #2 asked: Are the percentages of non-Hispanic Black and Hispanic residents greater in neighborhoods of lower neighborhood socioeconomic positions?

Table 5. Proportion of Races by SEP			
	NH White	NH Black	Hispanic
SEP 5*	23.1	2.3	7.1
SEP 4	27.8	5.8	8.4
SEP 3	23.9	10.2	9.1
SEP 2	17.3	33.2	22.2
SEP 1	7.9	48.5	53.3

Note: Values are based on 502 census tracts from the 500 Cities: Local Data for Better Health Dataset. A total of 10 cities from this dataset were located within Metropolitan Detroit and used for this analysis. SEP stands for socioeconomic position and is based on the Darden-Kamel Composite Socioeconomic Index.

*SEP 5 = very high, SEP 4 = high, SEP 3 = middle, SEP 2 = low and SEP 1 = very low

Sources:

Centers for Disease Control and Prevention. (2017a). 500 Cities: Local Data for Better Health, 2017 Release, 2014-2015. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, 2017.

Darden, J.T., M. Rahbar, L. Jezierski, M. Li and E. Velie. (2010). The Measurement of Neighborhood Socioeconomic Characteristics and Black and White Residential Segregation in Metropolitan Detroit: Implications for the Study of Social Disparities in Health. Annals of the Association of American Geographers, 100(1): 137-158.

Note: Values were found by dividing the amount of NH Blacks (or Hispanics/NH Whites) in a census tract by the amount of NH Blacks (or Hispanics/NH Whites) in all census

tracts within the 500 Cities: Local Data for Better Health Dataset; then, the values were added together for each SEP to determine the percentage of each race within each SEP. These specific racial/ethnic populations were chosen for analysis due to previous literature discussing how diabetes, obesity and lack of sleep are influenced by neighborhood effects among NH Black, NH White and Hispanic populations throughout the United States.

Table 5 shows the percentages of NH White, NH Black and Hispanic populations that are in each of the socioeconomic positions (SEPs). The purpose of this table was to determine which racial/ethnic populations are disproportionately living in census tracts with greater rates of diabetes, obesity and lack of sleep than their racial/ethnic counterparts. This table identified that the percentage of the proportion of each racial/ethnic population differed by SEP.

The proportion of NH Blacks in SEP 1 averaged to 48.5% and became smaller as socioeconomic position moved to SEP 2 (33.2%), SEP 3 (10.2%), SEP 4 (5.8%) and SEP 5 (2.3%). The NH Black proportion was 6.2 times higher in SEP 1 and 1.9 times higher in SEP 2 than the NH White proportion in the respective SEPs. The NH Black proportion was lowest in SEP 5 (2.3%) and highest in SEP 1 (48.5%).

Alternatively, with the proportion of NH Whites, percentages were fairly even across all SEPs. SEP 1 contained 7.9% of the NH White proportion, and the percentages began to even out when moving up to SEP 2 (17.3%), SEP 3 (23.9%), SEP 4 (27.8%) and SEP 5 (23.1%). The NH White proportion was 10.0 times higher than NH Black proportions and 3.3 times higher than Hispanic proportions in SEP 5.

The proportion of Hispanics experienced the same pattern as NH Blacks—prevalence of Hispanic proportions in each SEP decreased as SEP increased. SEP 1 contained 53.3% of the Hispanic proportion of the neighborhoods within the 500 Cities: Local Data for Better Health

dataset. As SEP increased to SEP 2 (22.2%), SEP 3 (9.1%), SEP 4 (8.4%) and SEP 5 (7.1%), the average proportion of Hispanic populations decreased from 53.3% to 7.1%. The ratio of the Hispanic proportion in SEP 1 as compared to the proportion of NH Whites was 6.7. The Hispanic proportion was lowest in SEP 5 (7.1%) and highest in SEP 1 (53.3%).

Visualizations of SEPs and Proportions of Race

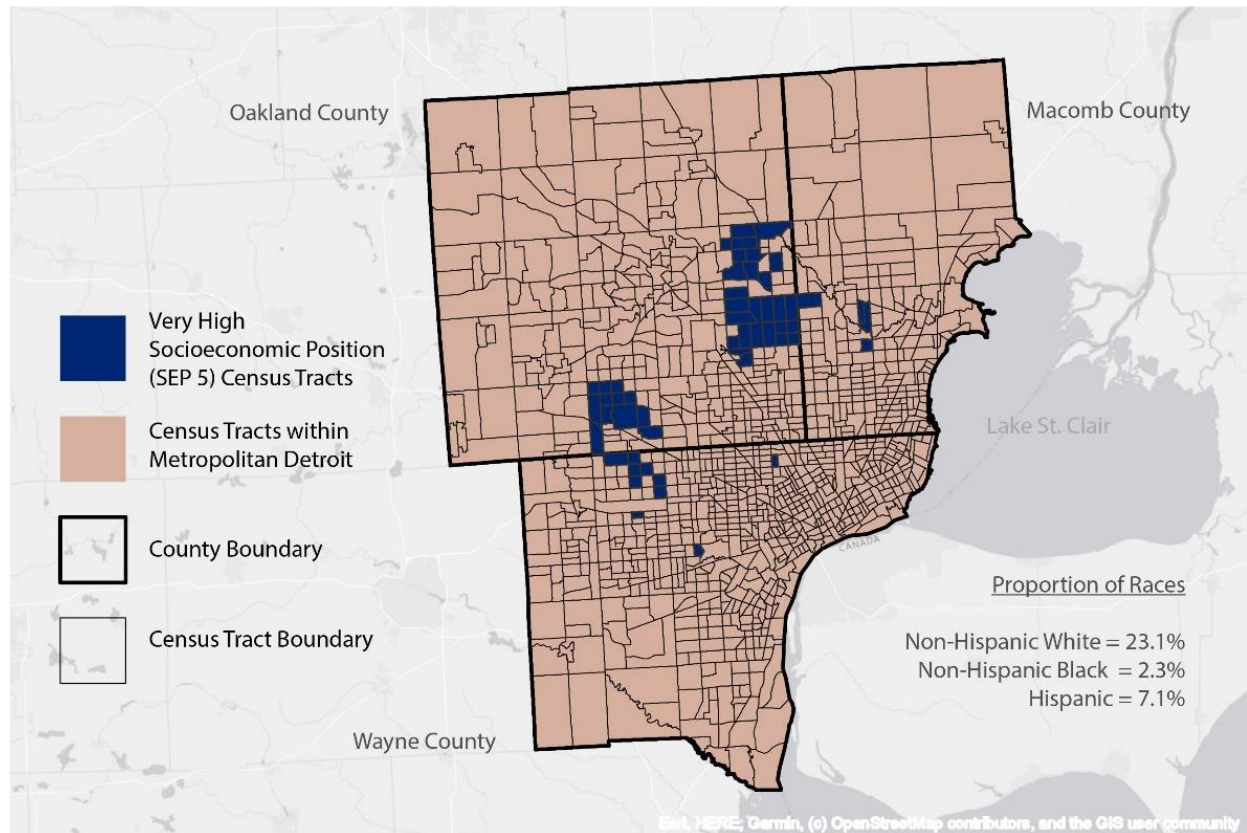


Figure 3. Very High Socioeconomic Position (SEP 5) Neighborhoods

Figure 3 visualizes the analyzed census tracts, or neighborhoods, with a very high socioeconomic position (SEP 5). There was a total of 53 analyzed census tracts/neighborhoods in SEP 5. These neighborhoods were primarily concentrated in Oakland County. Many of the neighborhoods in Oakland County were clustered near the eastern and south-central regions. These other neighborhoods were located near the center of Macomb County and on the outskirts of The City of Detroit in Wayne County. As noted in Table 5, the portion of Non-Hispanic Whites (23.1%), Non-Hispanic Blacks (2.3%) and Hispanics (7.1%) were uneven across the other socioeconomic positions (SEPs).

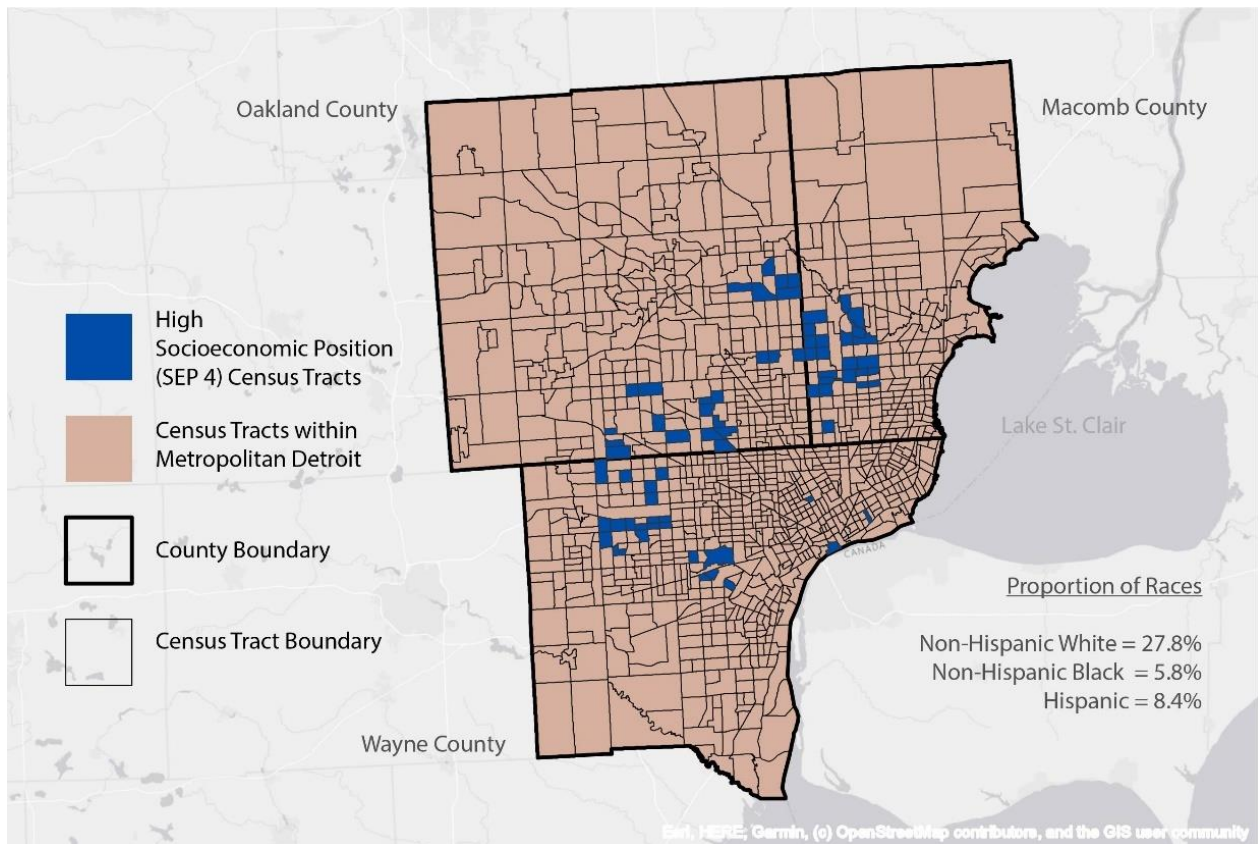


Figure 4. High Socioeconomic Position (SEP 4) Neighborhoods

Figure 4 depicts the analyzed census tracts, or neighborhoods, with a high socioeconomic position (SEP 4). There was a total of 70 analyzed census tracts/neighborhoods in SEP 4. These neighborhoods were located towards the west of The City of Detroit in Wayne County and the southwest region of Macomb County. In Oakland County, these SEP 4 neighborhoods were scattered across the southeast region. As noted in Table 5, the proportion of Non-Hispanic Whites was 27.8%, Non-Hispanic Blacks was 5.8% and Hispanics was 8.4% in SEP 4.

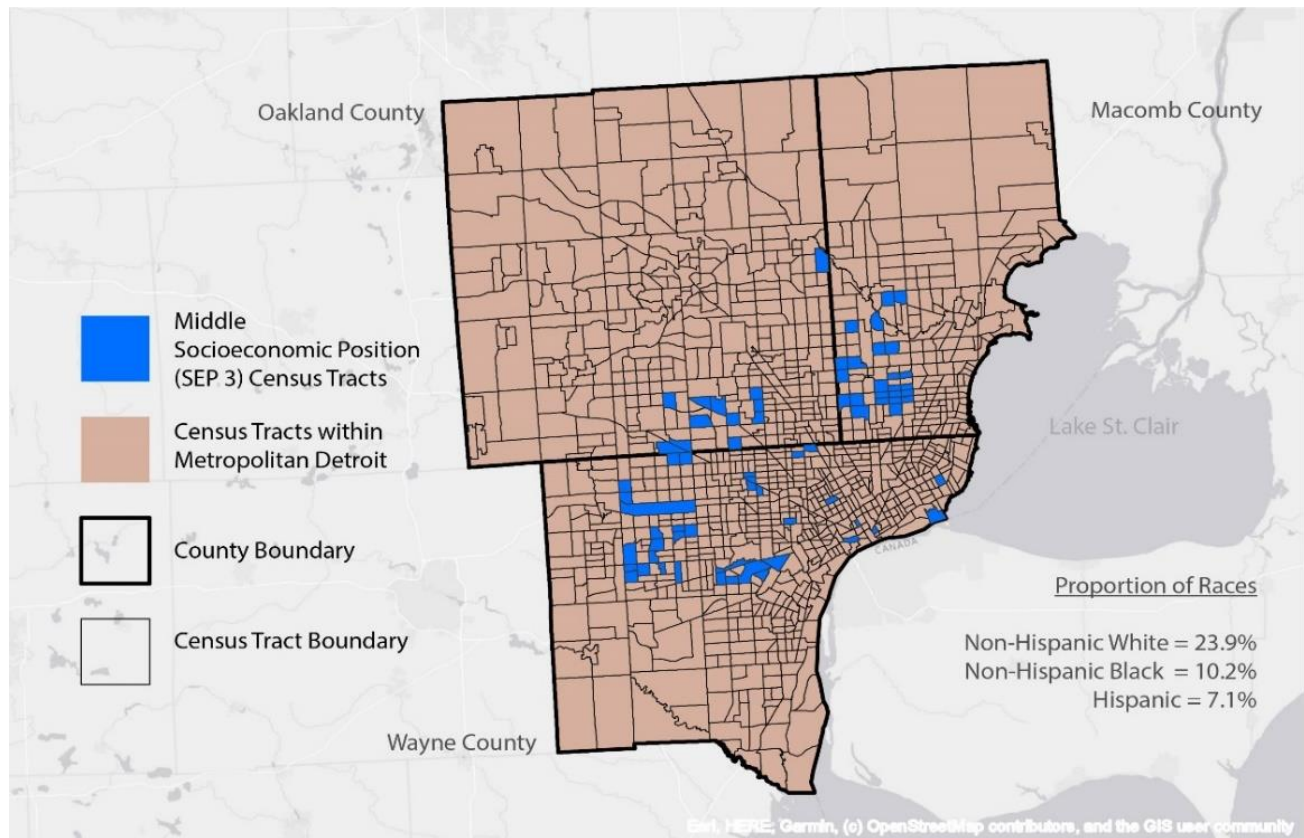


Figure 5. Middle Socioeconomic Position (SEP 3) Neighborhoods

Figure 5 shows the analyzed census tracts, or neighborhoods, with a middle socioeconomic position (SEP 3). There was a total of 72 analyzed census tracts/neighborhoods in SEP 3.

Analyzed neighborhoods in SEP 3 were found in all counties comprising Metropolitan Detroit.

These neighborhoods tended to be near the close outskirts of The City of Detroit. In Oakland and Macomb County, these neighborhoods were located towards the southeastern and southeastern regions, respectively. In Wayne County, the neighborhoods were found to the west of and within The City of Detroit. As noted in Table 5, the proportion of Non-Hispanic Whites was 23.9%, Non-Hispanic Blacks was 10.2% and Hispanics was 7.1% in SEP 3.

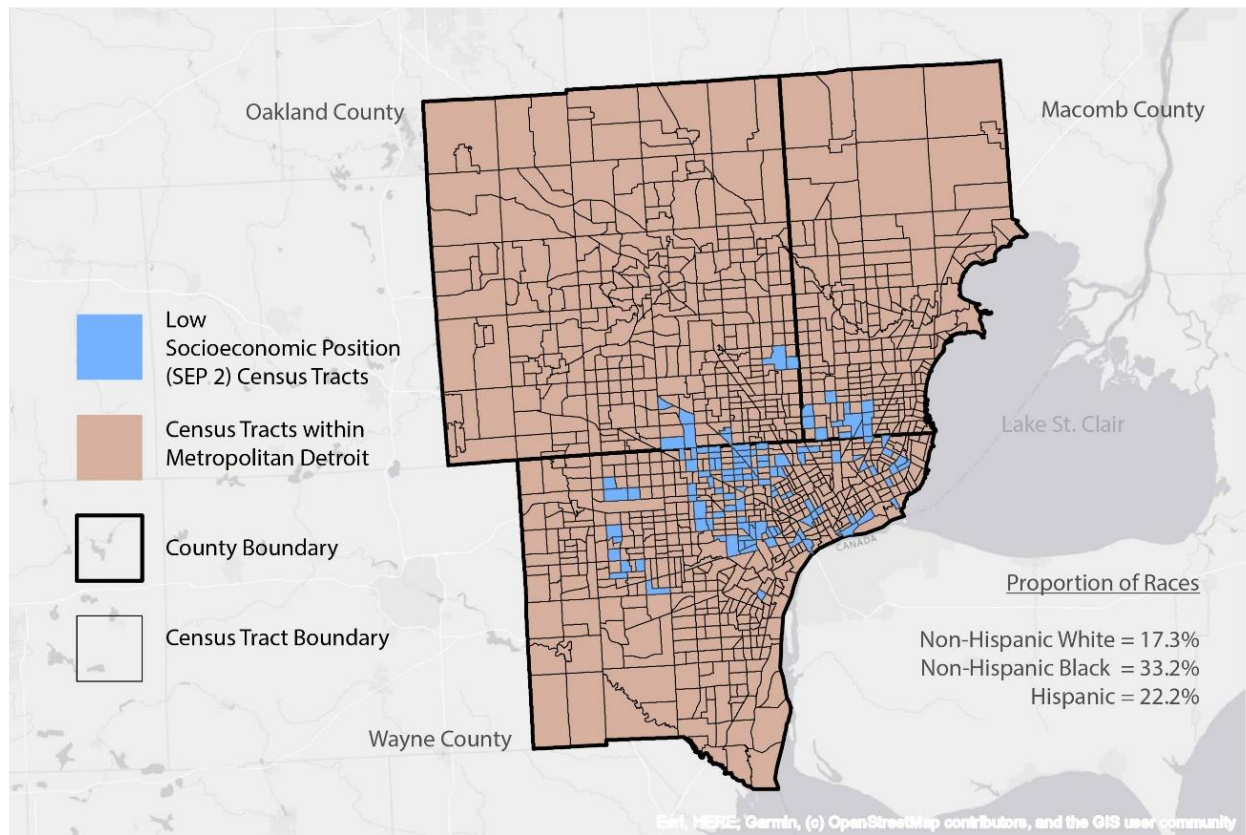


Figure 6. Low Socioeconomic Position (SEP 2) Neighborhoods

Figure 6 presents the analyzed census tracts, or neighborhoods, with a low middle socioeconomic position (SEP 2). There was a total of 118 analyzed census tracts/neighborhoods in SEP 2. Analyzed neighborhoods in SEP 2 were primarily concentrated in Wayne County and, more specifically, near The City of Detroit. These neighborhoods were clustered near the southeastern region of Oakland County. Additionally, other neighborhoods were located in the southwestern region of Macomb County. As noted in Table 5, the proportion of Non-Hispanic Whites was 17.3%, Non-Hispanic Blacks was 33.2% and Hispanics was 22.2% in SEP 2.

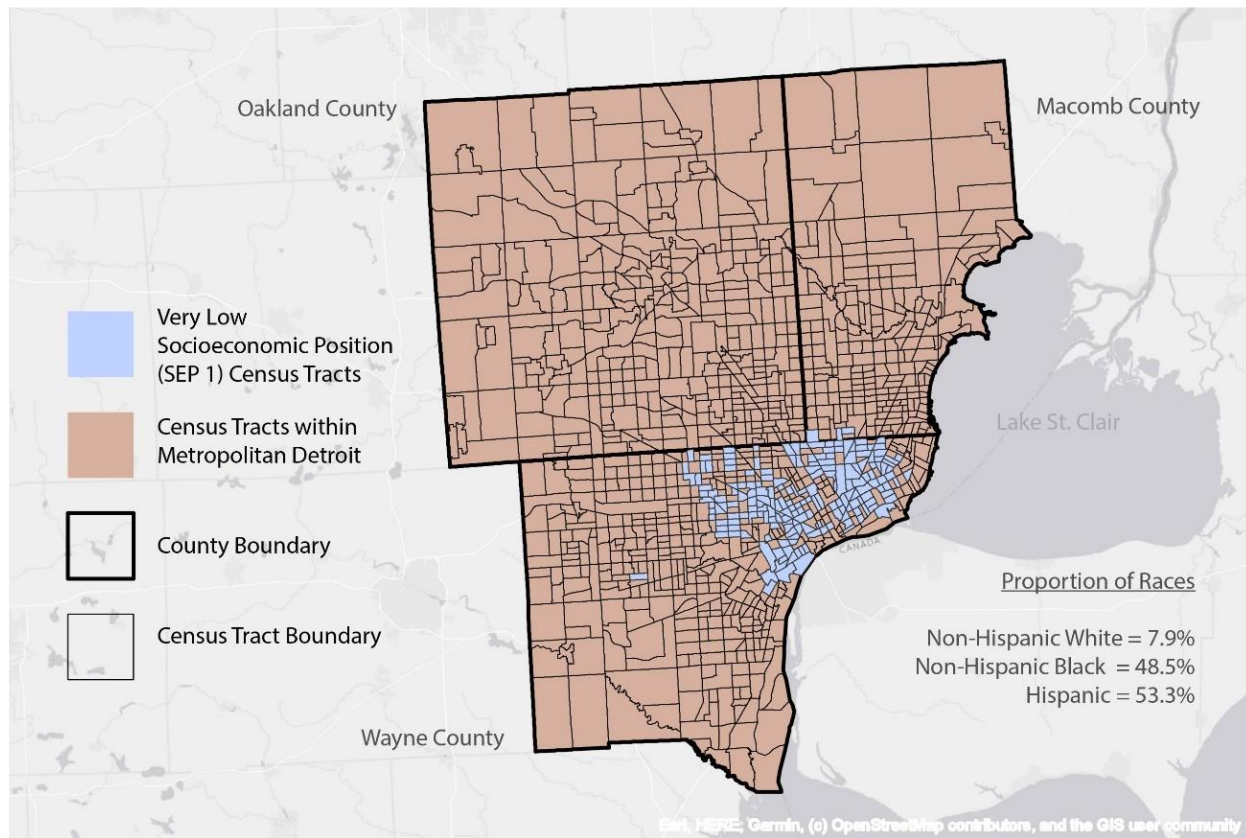


Figure 7. Very Low Socioeconomic Position (SEP 1) Neighborhoods

Figure 7 illustrates the analyzed census tracts, or neighborhoods, with a very low socioeconomic position (SEP 1). There was a total of 189 analyzed census tracts/neighborhoods in SEP 1.

Majority of these neighborhoods were clustered in The City of Detroit in Wayne County. A few census tracts were located at the southern border of Macomb County. No neighborhoods in SEP 1 were located in Oakland County. As noted in Table 5, the proportion of Non-Hispanic Whites was 7.9%, Non-Hispanic Blacks was 48.5% and Hispanics were 53.3% in SEP 1.

Hypothesis #2

This project hypothesized that: **Non-Hispanic (NH) Black and Hispanic residents live disproportionately in neighborhoods with lower neighborhood socioeconomic positions, and consequently experience greater rates of diabetes, obesity and lack of sleep than NH White residents.**

Table 5 showed the difference in racial composition across SEPs. Table 5 revealed the proportion of NH Blacks and Hispanics were greatest in SEP 1 and lowest in SEP 5. The inverse pattern was present among NH Whites, where their proportion was greatest in SEP 5 and lowest in SEP 1. The proportion of NH Blacks and Hispanics decreased as SEP increased. Diabetes, obesity and lack of sleep rates also decreased as SEP increased.

This project rejects the null hypothesis that the proportion of NH Blacks, NH Whites and Hispanics would be equally residing in each SEP. Looking at the racial composition of each SEP in relation to the health indicator rates of each SEP revealed that NH Blacks and Hispanics are in fact disproportionately residing in neighborhoods of lower socioeconomic positions, and because diabetes, obesity and lack of sleep rates were greater in lower SEPs, the proportion of NH Black and Hispanic populations are also more exposed to greater prevalence of these health indicators.

ANOVA Testing of Mean Rates and SEP

Research Question #3

Research question #3 asked: Are the mean rates of diabetes, obesity and lack of sleep significantly different between each SEP?

For diabetes, Table 2 showed that diabetes prevalence decreased as SEP increased. Diabetes prevalence was 18.3% in SEP 1, 14.6% in SEP 2, 10.9% in SEP 3, 9.6% in SEP 4 and

7.9% in SEP 5. Conducting a one-way ANOVA test revealed that mean diabetes prevalence was significantly different across SEPs.

Table 3 showed that obesity prevalence also decreased as SEP increased. Obesity prevalence was 46.3% in SEP 1, 40.6% in SEP 2, 33.1% in SEP 3, 29.6% in SEP 4 and 24.8% in SEP 5. The one-way ANOVA test between obesity and SEP found that mean obesity prevalence was significantly different across SEPs.

Table 4 showed that lack of sleep prevalence, similarly to diabetes and obesity, decreased as SEP increased. Lack of sleep prevalence was 51.6% in SEP 1, 46.7% in SEP 2, 39.2% in SEP 3, 36.5% in SEP 4 and 33.6% in SEP 5. Mean lack of sleep prevalence was found to be significantly different across SEPs after running a one-way ANOVA test.

Hypothesis #3

This project hypothesized that: **The mean rates of diabetes, obesity and lack of sleep are significantly different between each socioeconomic position (SEP).**

The far right-hand column of Tables 2-4 showed the ANOVA results of testing for the difference of mean rates between each SEP. The between variance for all health indicators proved to be significant. In other words, the mean rates for diabetes, obesity and lack of sleep, significantly differed across SEPs 1-5. This project rejects the null hypothesis that the mean rates of diabetes, obesity and lack of sleep would be the same across each SEP.

Linear Regression of Diabetes and SEP

Research Question #4

Research question #4 asked: After adjusting for the smoking rate and obesity rate, is there a significant association between SEP and diabetes?

Table 6. Regression Output for Diabetes					
	Coefficient	Standard Error	P-Value	95% Conf. Interval	
SEP	-0.25	0.14	0.09	-0.53	0.03
Smoking	-0.25	0.03	<0.001	-0.30	-0.20
Obesity	0.69	0.02	<0.001	0.64	0.73
Constant	-5.19	1.13	<0.001	-7.42	-2.97
<i>R-Squared 0.8696</i>					
<i>Adjusted R-Squared 0.8689</i>					
<i>No. observations 502</i>					

A linear regression was used to test if there was a significant association between SEP and diabetes after adjusting for smoking and obesity rates. The linear regression was conducted through STATA 16. Table 6, above, reveals the coefficients, standard errors, p-value and 95% confidence intervals of each variable and adjustment as well as the r-squared value.

This linear regression model produced an r-squared of 0.8696. 86.9% of the variance in diabetes prevalence can be attributed to SEP and the rates of smoking and obesity. After adjusting for smoking and obesity, SEP was found to have a negative, insignificant association between diabetes. For every one unit of change in SEP, diabetes prevalence would be expected to change by -0.25%. The smoking rate was negatively and significantly associated with diabetes. For every one unit of change in smoking, diabetes prevalence would be expected to

change by -0.25%. The obesity rate had a positive, significant association with diabetes. For every one unit of change in obesity, diabetes prevalence would be expected to change by 0.69%.

Hypothesis #4

This project hypothesized that: **SEP is significantly associated with diabetes, after adjusting for smoking and obesity.**

Table 6 showed the linear regression model used to answer if SEP was significantly associated with diabetes. Adjusting for smoking and obesity, SEP was found to have a negative, insignificant association with diabetes prevalence. This project fails to reject the null hypothesis that SEP would not be significantly associated with diabetes. SEP had an insignificant p-value of 0.09 while smoking and obesity had significant p-values (<0.001).

CHAPTER FIVE: DISCUSSION

In Reference of Previous Studies

This project presents the influences of neighborhood effects on diabetes, obesity and lack of sleep outcomes. In the reviewed literature, racial disparities were associated with diabetes (Piccolo et al. 2015; Signorello 2007) and sleep duration (Johnson et al. 2017; Fuller-Rowell et al. 2016; Singh et al. 2007). Non-Hispanic (NH) Blacks and Hispanics had higher rates of diabetes, and specifically for lack of sleep, NH Blacks experienced shorter sleep durations than NH Whites, Asians and Hispanics. Socioeconomic factors and proximity to The City of Detroit were associated with obesity in the reviewed literature (Koh et al. 2015; Budzynska et al. 2013).

Although analyzing racial disparities of these three health indicators was not possible for this project, this project was able to determine that a greater proportion of NH Blacks and Hispanics lived in neighborhoods of lower socioeconomic positions. Because this study is ecological in design versus at the individual level, further research is needed to test for racial disparities between the outcomes of diabetes, obesity and lack of sleep. Figures 3-7 and Table 5 visualize the placements of higher and lower socioeconomic positions with racial compositions.

Because this is an ecological study, a statement cannot be made to which racial population had higher rates of diabetes, obesity or lack of sleep. However, because this study evaluated the racial compositions of neighborhoods, a statement could be made that the proportions of NH Blacks and Hispanics were greater in neighborhoods of a lower socioeconomic position (SEP) and that diabetes, obesity and lack of sleep outcomes were also greater in neighborhoods of a lower SEP. These findings suggest that Non-Hispanic Blacks and Hispanics are at a greater risk of developing diabetes, obesity and lack of sleep due to living

disproportionately in neighborhoods with greater health prevalence and lower socioeconomic positions.

In support of previous literature using the Modified Darden-Kamel Composite Socioeconomic Index, this study determined that neighborhood effects were influential to health outcomes in Metropolitan Detroit. The review literature (Barnes 2018; Moody et al. 2016) looked at completely different health outcomes in Metropolitan Detroit and similarly found that poorer health outcomes were greater in neighborhoods of lower socioeconomic positions and that these lower socioeconomic positions were concentrated in or near The City of Detroit. Further research would be needed to determine if other health outcomes follow a similar pattern of greater prevalence in neighborhoods of lower socioeconomic positions.

In contrast to Fuller-Rowell et al. (2016)'s finding, neighborhood effects were in fact found to be influential to the outcomes of not only lack of sleep but also diabetes and obesity. Fuller-Rowell et al. 2016's study investigated sleep duration and used neighborhood disadvantage index which included five socioeconomic characteristics: poverty, public assistance rate, education of less than high school, median income and education of bachelor's degree or higher. These variables were correlated with each other but were not found to be influential to sleep duration. With the inclusion of the nine socioeconomic positions of the Modified Darden-Kamel Composite Socioeconomic Index, this study found different results. This study found that diabetes (Table 2), obesity (Table 3) and lack of sleep (Table 4) outcomes were greater in neighborhoods of lower socioeconomic positions (SEP). This study also found that the mean rates (Tables 2-4, far right-hand columns) were significantly different across each of the five SEPs.

Diabetes, Obesity and Lack of Sleep by SEP

SEP 1, or neighborhoods with very low socioeconomic positions, contained the highest prevalence for all three health indicators. Diabetes prevalence was 18.3% in SEP 1, 14.8% in SEP 2, 11.0% in SEP 3, 9.6% in SEP 4 and 7.9% in SEP 5. For obesity, prevalence increased as SEP increased from SEP 1 (46.3%), SEP 2 (40.6%), SEP 3 (33.1%), SEP 4 (29.6%) and SEP 5 (24.8%). Lack of sleep prevalence had a similar pattern where in SEP 1 prevalence was 51.6%, 46.7% in SEP 2, 39.2% in SEP 3, 36.5% in SEP 4 and 33.6% in SEP 5.

Diabetes (7.9%), obesity (24.9%) and lack of sleep (33.6%) prevalence was lowest in SEP 5. Diabetes (18.3%), obesity (46.3%) and lack of sleep (51.6%) prevalence was greatest in SEP 1. As neighborhood socioeconomic position (SEP) increased, health indicator prevalence decreased. This finding supports previous literature (Barnes 2018; Moody et al. 2016; Darden et al. 2010) that discovered, in Metropolitan Detroit, neighborhood effects have a clear influence on health outcomes.

Disproportionate Racial/Ethnic Populations and Health

As hypothesized, the proportion of Non-Hispanic (NH) Blacks and Hispanics were primarily concentrated in neighborhoods with lower neighborhood positions. The proportion of NH Blacks and Hispanics became smaller as SEP increased. Alternatively, the proportion of NH Whites increased as SEP increased but remained fairly evenly distributed across each of the five SEPs.

In relation to health, this finding suggests that NH Blacks and Hispanics living in neighborhoods of lower socioeconomic positions are at greater risk of developing diabetes, obesity and lack of sleep. Diabetes, obesity and lack of sleep rates experienced the same pattern

of decrease as SEP increased. These health indicators were lowest in SEP 5 and highest in SEP 1. The proportions of NH Blacks and Hispanics were greatest in SEP 1 and lowest in SEP 5. This study has shown, using a quintile-based approach, that greater levels of diabetes, obesity and lack of sleep are concentrated in neighborhoods of lower neighborhood socioeconomic positions. This project has found that a large proportion of NH Blacks and Hispanics are residing not only in neighborhoods of lower neighborhood socioeconomic positions, but also in neighborhoods with greater rates of diabetes, obesity and lack of sleep.

CHAPTER SIX: CONCLUSION

Contributions

In summary, this project makes original contributions to research by studying three related health outcomes together in Metropolitan Detroit using a neighborhood effects framed methodology which offered insight into differences of health outcomes by SEP and racial composition of the neighborhoods. A study such as this one has not been conducted before that aimed to: 1. research diabetes, obesity and lack of sleep, 2. investigate Metropolitan Detroit, 3. use the Modified Darden-Kamel Composite Socioeconomic Index, 4. use a census tract-level analysis and 5. determine how racial composition differs in relation to neighborhood socioeconomic position (SEP) and health indicator prevalence.

My research made three core contributions. This study:

1. Provided new findings based on new data from the CDC about diabetes, obesity and lack of sleep outcomes in Metropolitan Detroit, Michigan.
2. Examined, for the first time using the Modified Darden-Kamel Composite Socioeconomic Index, these health outcomes in relation to neighborhood effects in Metropolitan Detroit.
3. Determined how racial composition of neighborhoods vary with the variation in neighborhood percentages of diabetes, obesity and/or lack of sleep.

The project's results can inform local health professionals, health educators and academic researchers of specific neighborhoods needing more investigation into other factors that may be contributing to its higher or lower rates of diabetes outcomes.

Further Research

Further research is needed to investigate whether the built environment (i.e. supermarket/fast food restaurant availability, neighborhood walkability, healthcare access) also varies significantly by neighborhood socioeconomic position (SEP). A census tract analysis of characteristics of the built environment can aid in identifying possible areas that may need health intervention for each of the health indicators. Also, an analysis of diabetes, obesity and lack of sleep and neighborhood SEPs for 2016-2020 will help determine if any improvements to health outcomes by SEP occurred in the five-year period.

Broader Impact

Living in neighborhoods of differing socioeconomic positions affords residents to differing opportunities and resources. Non-Hispanic (NH) Black, Hispanic and NH White residents living in a lower socioeconomic neighborhood have vastly different experiences than their counterparts in neighborhoods of a higher socioeconomic position. This project aimed to determine how residents in neighborhoods in cities and suburbs in Metropolitan Detroit differ in the distributions of neighborhood socioeconomic positions and diabetes, obesity and lack of sleep outcomes. This project investigated health outcomes through the lens of neighborhood effects to understand the impact that neighborhood effects can have on health because, as Wilson's neighborhood effects conceptual framework has shown, where you live can influence greatly how you live.

REFERENCES

REFERENCES

- Barnes, L. (2018). Investigation of Racial and Socioeconomic Disparities in Asthma Hospitalizations in Metropolitan Detroit, Michigan (Order No. 10928123). Available from ProQuest Dissertations & Theses Global. (2100700590). Retrieved from <http://ezproxy.msu.edu/login?url=https://search-proquest-com.proxy1.cl.msu.edu/docview/2100700590?accountid=12598>
- Budzynska, K., P. West, R.T. Savoy-Moore, D. Lindsey, M. Winter and P.K. Newby. (2013). A Food Desert in Detroit: Associations with Food Shopping and Eating Behaviors, Dietary Intakes and Obesity. *Public Health Nutrition*, 16(12): 2114-2123.
- Centers for Disease Control and Prevention. (2019a). Smoking and Diabetes. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services, 2019.
- Centers for Disease Control and Prevention. (2019b). Who's at Risk? Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services, 2019.
- Centers for Disease Control and Prevention. (2017a). 500 Cities: Local Data for Better Health, 2017 Release, 2014-2015. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, 2017.
- Centers for Disease Control and Prevention. (2017b) National Diabetes Statistics Report. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services, 2017.
- Centers for Disease Control and Prevention. (2016a). Measure Definition: Health Outcomes. Retrieved from <https://www.cdc.gov/500cities/definitions/health-outcomes.htm>.
- Centers for Disease Control and Prevention. (2016b). Measure Definition: Unhealthy Behaviors. Retrieved from <https://www.cdc.gov/500cities/definitions/unhealthy-behaviors.htm>.
- Centers for Disease Control and Prevention. (2014a). 2015: Behavioral Risk Factor Surveillance System Questionnaire [PDF File]. Retrieved from <https://www.cdc.gov/brfss/questionnaires/pdf-ques/2015-brfss-questionnaire-12-29-14.pdf>.
- Centers for Disease Control and Prevention. (2014b). About the Behavioral Risk Factor Surveillance System (BRFSS). Retrieved from https://www.cdc.gov/brfss/about/about_brfss.htm.

- Centers for Disease Control and Prevention. (2014c). National Diabetes Statistics Report. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2014.
- Centers for Disease Control and Prevention. (2013). 2014: Behavioral Risk Factor Surveillance System Questionnaire [PDF File]. Retrieved from https://www.cdc.gov/brfss/questionnaires/pdf-ques/2014_BRFSS.pdf.
- Darden, J.T. and L. Rubalcava. (2018). The Measurement of Neighborhood Socioeconomic Characteristics and Hispanic and Non-Hispanic White Residential Segregation in Metropolitan Detroit. *Hispanic Journal of Behavioral Sciences*, 40(3): 312-329.
- Darden, J.T. and S.M. Kamel. (2000). Black Residential Segregation in the City and the Suburbs of Detroit: Does Socioeconomic Status Matter? *Journal of Urban Affairs*, 22(1): 1-13.
- Darden, J.T., M. Rahbar, L. Jezierski, M. Li and E. Velie. (2010). The Measurement of Neighborhood Socioeconomic Characteristics and Black and White Residential Segregation in Metropolitan Detroit: Implications for the Study of Social Disparities in Health. *Annals of the Association of American Geographers*, 100(1): 137-158.
- Elliott, D.S., W.J. Wilson, D. Huizinga, R.J. Sampson, A. Elliott and B. Rankin. (1996). The Effects of Neighborhood Disadvantage on Adolescent Development. *Journal of Research in Crime and Delinquency*, 33(4): 389-426.
- Fuller-Rowell, T.E., D.S. Curtis, M. El-Sheikh, D.H. Chae, J.M. Boylan and C.D. Ryff. (2016). Racial Disparities in Sleep: The Role of Neighborhood Disadvantage. *Sleep Medicine*, 27-28: 1-8.
- Gebreab, S.Y., D.A. Hickson, M. Sims, S.B. Wyatt, S.K. Davis, A. Correa and A.V. Diez-Roux. (2017). Neighborhood Social and Physical Environments and Type 2 Diabetes Mellitus in African Americans: The Jackson Heart Study. *Health & Place*, 43: 128-137.
- Johnson, D. A., G. Simonelli, K. Moore, M. Billings, M.S. Mujahid, M. Rueschman, I. Kawachi, S. Redline, A.V. Diez Roux and S.R. Patel. (2017). The Neighborhood Social Environment and Objective Measures of Sleep in the Multi-Ethnic Study of Atherosclerosis. *Sleep*, 40(1), <https://doi.org/10.1093/sleep/zsw016>.
- Koh, K., S.C. Grady and I. Vojnovic. (2015). Using Simulated Data to Investigate the Spatial Patterns of Obesity Prevalence at the Census Tract Level in Metropolitan Detroit. *Applied Geography*, 62: 19-28.
- Kuczmarski, M.F., R.J. Kuczmarski and M. Najjar. (2001). Effects of Age on Validity of Self-Reported Height, Weight and Body Mass Index: Findings From the Third National

- Health and Nutrition Examination Survey, 1988-1994. *J Am Diet Association*, 101: 28-34.
- Merrill, R.M. and J.S. Richardson. (2009). Validity of Self-Reported Height, Weight and Body Mass Index: Findings from the National Health and Nutrition Examination Survey, 2001-2006. *Prev Chronic Dis*, 6: A121.
- Moody, H.A., J.T. Darden, and B.Wm. Pigozzi. (2016). The Relationship of Neighborhood Socioeconomic Differences and Racial Residential Segregation to Childhood Blood Lead Levels in Metropolitan Detroit. *Journal of Urban Health*, 93(5): 820-839.
- Myers, C.A., T. Slack, S.T. Broyles, S.B. Heymsfield, T.S. Church and C.K. Martin. (2017). Diabetes Prevalence is Associated with Different Community Factors in the Diabetes Belt Versus the Rest of the United States. *Obesity*, 25: 452-459.
- Orr, C.J., T.C. Keyserling, A.S. Ammerman and S.A. Berkowitz. (2019). Diet Quality Trends among Adults with Diabetes by Socioeconomic Status in the US: 1999-2014. *BMC Endocrine Disorders*, 19(54): 1-9.
- Piccolo, R.S., D.T. Duncan, N. Pearce and J.B. McKinlay. (2015). The Role of Neighborhood Characteristics in Racial/Ethnic Disparities in Type 2 Diabetes: Results from the Boston Area Community Health (BACH) Survey. *Social Science & Medicine*, 130: 79-90.
- Signorello, L.B., D.G. Schlundt, S.S. Cohen, M.D. Steinwandel, M.S. Buchowski, J.K. McLaughlin, M.K. Hargreaves and W.J. Blot. (2007). Comparing Diabetes Prevalence Between African Americans and Whites of Similar Socioeconomic Status. *American Journal of Public Health*, 97(12): 2260-2271.
- Singh, M., C.L. Drake, T. Roehrs, D.W. Hudgel and T. Roth. (2005). The Association between Obesity and Short Sleep Duration: A Population-Based Study. *Journal of Clinical Sleep Medicine*, 1(4): 357-363.
- U.S. Census Bureau. (2019). American Community Survey Multiyear Accuracy of the Data. *Census.gov*. PDF.
- U.S. Census Bureau. (2016). American Community Survey, 5-Year Estimates, 2011-2015. *U.S. Census Bureau's American Community Survey Office*, 2016.
- Yang, T-C. and S.J. South. (2018). Neighborhood effects on Body Mass: Temporal and Spatial Dimensions. *Social Science & Medicine*, 217: 45-54.