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Neighborhood Factors, Depression, and Body Mass Index Among Patients with Lupus in Georgia

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Walden University
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Abstract

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by

Aisha Hill

MS, Fort Valley State University, 2014

BS, Mercer University, 2011

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health- Epidemiology

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Abstract

Elevated BMI (overweight and obesity) is a common health-related issue and affects more than half of the lupus population. Weight issues lead to additional health-related issues, such as heart disease and disabilities in the lupus population. To address the shortage of research focusing on this specific issue in the lupus population, one approach is a novel outlook on how neighborhood factors have the capability of determining or altering behaviors, such as physical activity, healthy eating, and healthy social relationships. Another variable to consider is depression and its capability of altering interactions, relationships, self-esteem, or even the inflammatory state of the body. These variables have potential to be driving forces of elevated BMI. The objectives of this study were to determine whether associations exist between (a) neighborhood factors and elevated BMI and (b) depression and elevated BMI. Bronfenbrenner's bioecological model was the theoretical framework for this study, and ordinal logistic regression was employed on secondary data from the Georgians Organized Against Lupus cohort study. The findings revealed that neighborhood factors did not predict BMI and depression did significantly predict BMI among individuals with lupus in Georgia ($p < .05$). The significance remained when adding covariates for age, gender, and race to the model ($p < .05$); however, the statistical significance ceased when adding education level and ethnicity to the model ($p > .05$). The findings of the current study contribute to social change through the promotion of new or altered policies and interventions geared toward improving psychological health and eliminating depression among individuals with lupus to improve health outcomes, specifically BMI.

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Dedication

This dissertation is dedicated to my beloved grandmother, Glady's Flagg Hill. You have inspired me in more ways than I could explain and was my backbone throughout most of my accomplishments. Grandma, you are now my angel and I can still feel your energy. I am FINALLY finished, I know you are proud of all that I will and have accomplished. Also, my treasured grandmother, Alice Mae Sanders, I love you dearly and you have been my rock, constantly illustrating strength, style, and the value of family. To my grandfathers, George Hill and Willie Sanders, thanks for supporting my grandmothers and being that figure. To my dear Granddaddy George, I love you so dearly, you have given me the gift of unconditional love for as long as I can remember.

Grandparents are profoundly special. They have so many stories and experiences to share and they provide a link to cultural heritage and family history. I feel so grateful to have them.

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Chapter 1: Introduction to the Study

Introduction

Obesity is a global public health problem that affects individuals worldwide and is an endemic in many countries. Metabolic syndrome, which includes obesity, has an increased prevalence in patients with system lupus erythematosus (SLE; Kazazian et al., 2019). SLE is a complex autoimmune disorder with multiple organ involvement that is more common than realized, especially among specific racial and ethnic groups (Gordon & Lim, 2016). Hallmarks of the course of SLE include premature cardiovascular disease, as well as dermatologic, musculoskeletal, and internal organ involvement (Falasinnu et al., 2019). SLE places the body in a vulnerable position in which other diseases have the opportunity to manifest and develop while the body is in this inflammatory state. SLE is most common in African Americans and Asians, and the disease is more aggressive and has an increased mortality rate in these groups as well. Racial minorities often share similar beliefs and traditions, and along with biophysical variations (variations in disease phenotypes), these may be partially to blame for the disparities among specific groups of SLE patients (Falasinnu et al., 2019). Obesity was ranked number four in the top five comorbidities that contribute to an increased risk of premature death in SLE patients (Gordon & Lim, 2016).

The physical environment where one resides could influence a vast majority of behaviors because the neighborhood includes the physical environment where the resident spends the majority of their time and carry out most of their activities. The safety of the area, its aesthetic quality, availability of healthy foods, social cohesion, and other

characteristics are determining factors in the habits and behaviors of residents. While it is hard to determine whether the majority of individuals with SLE live in poor or low-income neighborhoods, it has been suggested that living in or around a high proportion of poverty is associated with poorer health outcomes and increased levels of disease damage in SLE patients (Yelin et al., 2019). A decreased body mass index (BMI) and an improved diet were linked to healthy lifestyle-promoting neighborhood factors, and there is strong evidence that having access to healthier food and physical activity opportunities is associated with decreased obesity and increased physical activity and healthy eating behaviors (Pitts et al., 2015).

Depression is common in patients with inflammatory illnesses, and there is an increased prevalence and incidence of depression in patients with autoimmune diseases, including SLE and rheumatoid arthritis (Gregory, Mak, & McIntyre, 2018). Furthermore, there is an association between an increased prevalence and incidence of depression and metabolic disorders associated with inflammation, such as, obesity arthritis (Gregory et al., 2018). It is not fully understood whether depression leads to obesity or whether obesity leads to depression in the SLE group. Women have higher rates of autoimmunity as well as depression compared to men (Derry et al., 2015). The literature suggests that inflammation, a common characteristic in autoimmunity, may contribute to depression in some individuals (Derry et al., 2015). The body undergoes a great deal of inflammation when SLE is present, and proinflammatory cytokines are known to induce depressive symptoms (Derry et al., 2015). SLE and its inflammatory characteristics may be of

concern as a cause of depression; however, one could argue that depression is caused by the inflammatory state of the body in obesity.

It was necessary to investigate whether there is an association between neighborhood factors and BMI as well as between depression and BMI in the SLE population. Determining whether one or both of these relationships exist and understanding them will help policy makers and public health practitioners gain a better understanding of how to target obesity among SLE patients. Neighborhood factors have a lot to do with the lifestyles and behaviors of individuals residing there, such as eating habits, physical activity, social cohesion, and other behaviors that may lead to weight gain or contribute to increased BMI. Understanding the mental state or whether an individual is depressed could help to determine whether mental health is of concern and needs to be targeted in approaches against obesity in the SLE population. Associations have been discovered between neighborhood or physical environmental factors and weight issues, as well as between depression and weight issues in the general population and in those with diabetes, heart disease, and other diseases. Individual behaviors are often influenced or affected by the environment where individuals live and work (Pitts et al., 2015). However, few researchers have investigated these same types of relationships in the SLE population. There have been no studies in which researchers examined this relationship using a large population of SLE individuals from rural Georgia, specifically investigating whether there is an association between BMI and neighborhood factors (aesthetic quality, walkability, social cohesion, availability of healthy food, safety, and violence) and BMI and depression. This study will provide more detailed information

pertaining to the SLE population and allow for a more tailored approach at targeting and combatting obesity within this community. In this chapter, I discuss the background of this research topic and the problem statement, purpose of the study, and research questions and hypotheses.

Background

The following are selected articles relating to the incidence of obesity or weight issues in patients with lupus. The keywords searched were *obesity, BMI, BMI, overweight, lupus, SLE, systemic lupus erythematosus, neighborhood, environment,* and *walkability* in the databases Google Scholar, PubMed, Embase, ProQuest, and EBSCO.

Obesity has been researched among the SLE population in several studies. Teh, Zakhary, and Sandhu (2018) confirmed that the disease activity of SLE patients is associated with obesity and that obesity is independently linked with increased SLE disease activity. In a sample of SLE patients, Phildrich, Bishoy, and Vaneet (2019) found that obesity was associated with worse disease activity and suggested the importance of targeting obesity for improvement in health outcomes of SLE patients. There are high rates of obesity in the SLE population, reported at a 39% incidence rate among a group of women with SLE (Patterson et al., 2019). Oeser et al. (2005) examined SLE patients to determine the relationship between BMI and functional capacity and found that obese SLE patients are at an increased risk of impaired functional capacity (difficulty in performing activities of daily living) and inflammation. Sacre et al. (2015) confirmed that being overweight is a major contributor to atherosclerosis in the SLE population. Patterson et al. (2019) confirmed that obesity is independently associated with worse

patient-reported outcomes (disease activity, depressive symptoms, pain, and fatigue in women with SLE. Obesity is common, problematic, and a modifiable target for improving health outcomes among individuals with SLE.

Safety in neighborhoods is a vital part of an individuals' lifestyle and their involvement in activities. Yelin, Trupin, Bundle, & Yazdany (2018) investigated the perspectives of individuals with SLE regarding the role of neighborhood and poverty in health outcomes of SLE patients. The researchers found that persons in poverty were forced to deal with food insecurity and thereby relegate their management of SLE to occurrences of flares (Yelin et al., 2018). Also, the SLE patients reported that crime in their neighborhoods contributed to stress, worsening their disease activity (Yelin et al., 2018). Depression affects up to 50% of the SLE population (Palagini et al., 2013). In one study, the relationship between obesity and cognitive impairment was examined in a group of women with SLE; 20% of the participants were cognitively impaired, 28% were physically inactive, and 50% were obese, and there was a significant association found between both obesity and inactivity and cognitive impairment (Katz et al., 2012). Obesity and physical inactivity are elevated in SLE and these factors need examination in relation to depression and neighborhood factors. The objective of this investigation was to determine the relationship of both depression and neighborhood factors to elevated BMI (overweight or obesity) in individuals with SLE.

Problem Statement

A healthy weight status is often challenging to maintain and is sometimes accompanied by other health issues. Being overweight affects two out of every three

adults in the United States (Langellier et al., 2014). Numerous health risks are associated with obesity, and obese patients with lupus have a greater risk of developing diseases or conditions, such as Type 2 diabetes, high cholesterol, hypertension, heart disease, respiratory issues, and experiencing miscarriages as well as disability (Katz et al., 2011).

SLE is a complex autoimmune disease in which normal immune responses are directed against healthy organs and tissues (Akanase, Shum, & Mitnick, 2012). Lupus has multiorgan involvement, and patients are impacted at a lower BMI than is problematic for the general population (Katz et al., 2011). One report revealed a 39% prevalence of obesity among a group of women with lupus (Petri, 2000). While lupus is already accompanied by disabling symptoms, such as swelling and pain, obesity further exacerbates the symptoms.

Using the federal poverty threshold to describe neighborhood socioeconomic status (SES), Trupin et al. (2008) found that individuals with SLE in lower SES neighborhoods had more disease activity and physical inactivity than individuals in neighborhoods with higher SES. According to Lopez (2012), an individual's residential location and the presence of a supermarket may affect their obesity status. Lower prevalence of obesity was associated with greater walkability and the availability of healthy foods, determined by the presence of supermarkets in neighborhoods (Boehmer et al., 2007; Mujahid et al., 2008). Obesity is a common metabolic disorder in SLE, and depression is one of the more common psychiatric disorders in SLE, with prevalence rates between 10.8% and 39.6% (Jorge et al., 2017). This relationship may be bidirectional in the lupus population, meaning that depression may contribute to

increased disease activity in patients with SLE, and SLE activity may contribute to depression (Nery et al., 2007). Depression is prevalent in the SLE population and is known to contribute to an increase in inflammatory markers (Greco et al., 2009). In one study, researchers found that BMI mediated the relationship between depression and coronary artery calcification in patients with lupus (Greco et al., 2009). Depression induces weight gain, specifically abdominal obesity (Björntorp et al., 2001). The production of cortisol in the presence of insulin causes an inhibition of lipid-mobilizing enzymes, which is mediated by glucocorticoid receptors found in fat deposits, especially in abdominal visceral fat (Björntorp et al., 1999). Depression has been linked to inflammation and obesity (Byrne et al., 2015). SLE is associated with a high prevalence of psychiatric disorders and significant psychological suffering in all age groups (Nery et al., 2007). The concept that beauty is reflected in thinness in the United States and Europe may lead to depression by causing an increase in body dissatisfaction and a decrease in self-esteem (Luppino et al., 2010). There is moderate research dedicated to investigating if there is a significant relationship between depression and BMI in the SLE population, but little to none has been focused on the SLE population in Georgia.

High disease activity in patients with lupus leads to treatment with corticosteroids like prednisone, which have been linked to organ damage, which is more common in those who develop SLE at an older age compared to younger patients (Maddison et al., 2002; Thamer et al., 2009). In addition, long-term use of corticosteroids has a common side effect of weight gain, occurring in 70% of long-term users (Schiro & Stein, 2015). One study revealed that short- and long-term use of corticosteroids is associated with

weight gain, and adults who used steroids for more than 15 days experienced an increase in weight of 5% to 13.5% (Conklin & Hong, 2019). Additionally, individuals who spend a large amount of time working lack free time and may experience health problems and poor behaviors, including obesity, fatigue, stress, and poor work-life balance (Prasad & Thakur, 2019). Complex health issues, such as lupus, that involve both individual and neighborhood factors as potential etiology contributors are difficult to study (Lopez, 2007).

Little is known about the effects of obesity in patients with lupus or other chronic inflammatory diseases (Oeser et al., 2005). Few researchers have explored neighborhood or physical environmental factors, such as accessibility to healthy foods, safety, social cohesion, and physical activity options and their association with health outcomes in the lupus population (Trupin et al., 2008). Trupin et al. (2008) suggested that future research should investigate the underlying mechanisms of the differences in weight between different neighborhood SES individuals. *Upstream determinants* are usually described as those beyond the control of the individual and have influence over behaviors, often in the form of tangible characteristics in the built environment or surrounding natural environment (Lakerveld & Mackenbach, 2017). It is important to seek approaches to eliminate or lessen poor health outcomes in the lupus population by identifying factors that contribute to the relationship between neighborhood or physical environment, depression, health habits, and elevated BMI. Because inflammation accompanies both obesity and depression, it could perhaps mediate the relationship between obesity and

depression (Luppino et al., 2010). It is vital to study this relationship within the lupus population to determine whether it contributes to the high rate of obesity.

Purpose of the Study

The SLE population is faced with the phenomenon of obesity, and this problem impacts functional capacity and health-related quality of life among individuals trying to combat SLE (Ayán & Martín, 2007). In national estimates from 2015–2016, the prevalence of obesity in adults was 39.8%: 46.8% in non-Hispanic African American adults and 37.9% in non-Hispanic Caucasian adults (Hales et al., 2017). While few studies have addressed the body composition in the SLE population, one study reported 30–50% of SLE patients as obese, depending on the obesity measure being used (Katz et al., 2011). The purpose of this quantitative study was to determine the weight differences between African Americans and other race groups, age groups, ethnicities, genders, and education levels in patients with lupus living in physical environments that differ regarding safety, aesthetic quality, violence, social cohesion, walking environment, and healthy food, as well as those with and without depression.

The cohort of patients with lupus were studied to determine whether there is an association between depression and weight issues. Secondary data that included scores for each of the variables, neighborhood factors, depression, and BMI and those which described the participants' immediate physical environment, depression status, and weight status were examined to determine differences within the cohort of patients with lupus. Investigating these differences within the SLE population was unique because, unlike the general population, individuals with SLE are faced with prolonged,

accelerated, and abnormally elevated levels of inflammation, which heightens the likelihood for other diseases or disorders to arise. Also, exploring individuals' physical environment and depression and how these factors impact the weight status of patients with lupus is underresearched. In overweight individuals, it is vital to monitor moods and detect early signs of depression (Luppino et al., 2010). There may be a heightened need to monitor and cross-examine moods and weight, not only in the general population, but in populations with elevated inflammation in order to target the depression and improve health outcomes impacted by weight issues and depression.

Research Questions and Hypotheses

This study explored the relationship between neighborhood factors and elevated BMI and depression and elevated BMI among patients with lupus.

RQ1: Is there an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$1: There is no association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a1: There is an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and

elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

RQ2: Is there an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$2: There is no association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a2: There is an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

Table 1

Variables Included in the Analysis

Independent	Mediating	Confounding	Dependent
Neighborhood factors	None	Gender	BMI
Depression		Age Ethnicity Education level	

Note. All participants have been diagnosed with lupus.

Theoretical Framework for the Study

A bioecological theoretical framework was used to structure this study. This framework was provided by Bronfenbrenner's bioecological model, which postulates that behavior is influenced by immediate environment, such as a neighborhood (McDaniel et al., 2015). Bronfenbrenner's bioecological model and its ability to study human development over time has been used extensively to investigate health issues, such as

overweight and obesity and their occurrence. This model provided structure in studying the BMI of patients with lupus and the occurrence of obesity within the lupus population as it relates to neighborhood factors and depression. Considering both the physical and social environments as vital contributors to health, the bioecological approach is ideal in investigating whether neighborhood factors contribute to specific health concerns, such as obesity, in the lupus population (Bone, 2015). Obesity is a growing public health issue associated with various health problems, the rates of which appear to be higher in the lupus population compared to the general population (Bernantsky, 2002; Kipen et al., 1998). Kipen et al. (1998) found that patients with lupus are at a disadvantage in that the disease itself, as well as corticosteroids, have significant effects on their body composition. Chronic inflammation, as seen in lupus, has been known to affect body composition and metabolism (Katz et al., 2011). The health issue explored was elevated BMI in the SLE population, together with how factors such as lack of neighborhood safety, variability in social cohesion neighborhood, inaccessibility to physical activity (walkability), and little access to healthy food contribute to the challenge of maintaining a healthy weight in poorly structured neighborhoods. Also, this study explored depression and its association with BMI. Furthermore, application of the conceptual model offered guidance on ways to target obesity and develop policies affecting the contribution of neighborhood factors to obesity in patients with lupus.

Nature of the Study

The study relied on hypothesis testing to answer each of the research questions. The first null hypothesis, after adjusting for all other variables, states that there would be

no association between neighborhood factors and elevated BMI among individuals with lupus in Georgia. The second null hypothesis postulates that there would be no association between depression and elevated BMI in individuals with lupus in Georgia after adjusting for all other variables. The first independent variable investigated was neighborhood factors, which were characterized within the data as walking environment, healthy food, safety, violence, and social cohesion. The second independent variable investigated was depression, which was identified through a series of questions concerning feelings of depression, hopelessness, emptiness, worthlessness, unhappiness, not cheerful, no reason to live, and no interests.

This quantitative study was conducted using secondary data from the 2012–2014 Georgians Organized Against Lupus (GOAL) study to assess the relationship between neighborhood factors and BMI and depression and BMI in patients with lupus from Georgia. The dependent variable was BMI, and the independent variables were neighborhood factors and depression. The study used a quantitative cross-sectional design along with secondary data obtained from the GOAL cohort of patients with lupus. Whether there was a relationship between neighborhood factors and BMI and a relationship between depression and BMI in patients with lupus was assessed for statistical significance using ordinal logistic regression. Statistical analyses were performed using SPSS software.

Definition of Terms

Dependent Variable

Body mass index (BMI): An individual's weight in kilograms divided by the square of height in meters as defined by the Centers for Disease Control and Prevention (CDC, 2015).

Independent Variables

Aesthetic quality: The quality of the neighborhood based on the presence of trash and litter, the maintenance of the homes and buildings, whether the buildings are attractive, and the attractiveness of the neighborhood.

Age: The number of years a participant with SLE has lived.

Depression: Mental health disorders characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration, as provided by the World Health Organization (WHO, 2017).

Education level: The highest grade or grade level completed.

Ethnicity: The state of belonging to a social group that has common national and cultural traditions.

Gender: Either of two sexes (male and female) considered with reference to social and cultural differences rather than biological ones.

Healthy food: The availability of a large selection of fruits and vegetables, if they are of high quality, and whether there is a large selection of low-fat products available and accessible in a neighborhood.

Neighborhood factors: The physical environment where an individual resides.

Race: An individual's physical characteristics, such as bone structure and skin, hair, or eye color.

Safety: Whether individuals feel safe walking in their neighborhood day or night, whether violence is a problem, and if the neighborhood is safe from crime.

Social cohesion: Whether residents of a neighborhood are willing to help their neighbors, generally get along with each other, can be trusted, and share the same values.

Violence: The occurrence of weapon fights, gang fights, sexual assault or rape, robbery, or mugging in a neighborhood.

Walking environment or walkability or built environment: Whether a neighborhood offers opportunities to be physically active, has local sports clubs and other facilities with opportunities to exercise, is pleasant to walk in, has trees that provide enough shade, whether there is an ease to walk in the neighborhood, and whether others are often seen walking or exercising in neighborhood.

Assumptions

It was assumed that all the participants were diagnosed with lupus. I also assumed that all individuals with lupus in the area participated in the GOAL study. Additionally, it was assumed that self-reported responses to the survey questions would be correct and truthful.

Scope and Delimitations

The specific aspects addressed in this study were neighborhood factors, better explained as the physical environment in which participants reside, and depression and

how they may or may not predict elevated BMI among a population of individuals with lupus. There have been no studies that specifically focused on the neighborhood factors of aesthetic quality, walking environment, healthy foods, social cohesion, violence, and safety and their association with weight or body composition issues in the lupus population. Also, depression had not been investigated as a potential factor contributing to elevated BMI in the lupus population, specifically one consisting of patients with lupus from Georgia.

The data were collected from a population of residents of Georgia (Lim et al., 2014). Protected health information was obtained by the Georgia Department of Public Health using its public health surveillance exemption to the HIPAA Privacy Rule (45 CFR, Parts 160 and 164) to obtain the information without patient consent (Lim et al., 2014). The Georgia Lupus Registry (GLR) is a registry used to improve the ability to estimate incidence and prevalence of SLE in a large population (Lim et al., 2014). The cases were identified by using by the American College of Rheumatology (ACR) criteria or by a combination of case definitions used to diagnose SLE (Lim et al., 2014), and all individuals without SLE were excluded. The outcome of this analysis is generalizable to the lupus population because all the participants have lupus.

Limitations

Potential barriers include the use of secondary data, which prevents obtaining information on variables not collected and limits the quality of the study to the quality of these data. Also, the use of secondary data eliminates the ability of having direct contact with participants if specific questions or concerns arise regarding the data. The cross-

sectional design eliminates the possibility of establishing causality. Self-reporting introduces the potential for dishonesty from the participants concerning their perceptions of safety, healthy food availability, and walkability. This may be due to lack of knowledge, mistrust, fear, or embarrassment. Also, some individuals with lupus may have been unaware that they had it or they did not participate in the survey for other reasons, possibly resulting in overlooked cases of SLE.

Significance

The physical environment has been shown to influence gender differences and SLE phenotype; however, few studies have focused on the connection between the physical environment and BMI within the lupus population (Gergianaki et al., 2019). The results of this study will provide information about the lupus population and findings on neighborhood factors and their contribution to BMI within the lupus population. As more public health practitioners and researchers are leaning toward the neighborhood as a potential target in developing interventions that are population-based, it is important to understand the influence that the neighborhood environment has on health outcomes and individual health behaviors (Abdul-Sattar & Abou El Magd, 2017). Findings from this study could aid policy makers and public health practitioners in helping the lupus population better manage their weight by providing evidence of factors contributing to or associated with BMI, thereby providing the opportunity for these factors to be targeted through population-based interventions. Neighborhood factors have a major impact on health habits, such as physical activity and nutrition and stress, and therefore have potential to be driving forces in BMI or weight issues seen in the lupus population (Salvy

et al., 2017). With 30% or more of the lupus population and up to 50% of women with lupus being obese or overweight, it is vital to engage the community and public health practitioners and develop interventions that will decrease this phenomenon (Rizk et al., 2012). Supporting patients with lupus and their maintenance of a healthy weight may allow for a decrease in many of the associated ailments, including depressive symptoms, pain, fatigue, and worse disease activity (Patterson et al., 2019). In the effort to overcome obesity, the focus should not be on the individual but on the population (Schwartz & Brownell, 2007). There is a shortage of interventions and programs focusing on the lupus population, let alone on weight issues within the population. A better understanding of underlying or associated factors contributing to weight issues within the lupus population may provide structure for policy, intervention, and program development. The specific variables in this study have the potential to provide more insight into the increased rate of obesity seen in the lupus population. Understanding neighborhood factors and depression and their contributions to obesity in the lupus population may allow for targeting the issue more specifically and appropriately. Investigating the lupus population will offer more insight into the role that inflammation plays in the development of depression. This investigation contributes to the awareness of how two common health problems—obesity and depression—relate and how psychosocial or sociocultural factors may relate with weight issues. This increased awareness could lead to better prevention and early detection of obesity and depression, thereby allowing for overall better outcomes in the SLE population. The lupus population is burdened with a lack of detailed information on factors, such as poor mental health or neighborhood challenges that lead to consequences,

such as poor health outcomes, that they face given their disease state. A more detailed look into each psychosocial and biophysical factor will enhance the ability to better diagnose and treat lupus and its counterparts by providing information on associated factors and identifying potential risks. This study has the potential to lead to social change by providing information on whether neighborhood factors and/or depression contribute to weight issues seen within the lupus population. The results of this research may provide insight into specific behaviors that should be targeted by policy makers and practitioners in an effort to alter the behaviors contributing to weight issues. This can assist in the elimination of obesity and could improve overall health outcomes of patients with lupus.

Summary

SLE is an underresearched, complex autoimmune disease with an estimated 1.5 million cases in the United States and 5 million cases worldwide. The GLR reported that lupus incidence and prevalence rates are among the highest in the United States and reported an age-adjusted incidence rate of 5.6 per 100,000 person-years and an age-adjusted prevalence rate of 73 per 100,000 person-years (Lim et al., 2014). Obesity is an independent risk factor in individuals with lupus, causing worse disease activity. Obesity is increasingly more common in individuals with lupus and may exacerbate inflammation (ACR, 2017). Categorized by BMI, obesity is often caused by behaviors or lifestyle, such as low physical activity or unhealthy eating habits, which can contribute to weight gain. Understanding why individuals may have poor health habits that contribute to weight issues will better assist in policy development. The physical environment and its features,

such as sidewalks, safety or violence issues, or even social cohesion, may lead to lack of physical activity or poor perception of eating healthy food, which can lead to weight issues. Depression can cause an individual to fall into isolation and lack drive to be active or can lead them to unhealthy binge eating. It is important to investigate the specific avenues that are vital in and will assist in combating obesity in the SLE population. This population already faces poor health outcomes, and obesity may exacerbate those. Chapter 1 focused on the description and rationale of the study topic by providing an introduction and background, problem statement, purpose of the study, overview of the theoretical framework, nature of the study, limitations, and significance of the study. Chapter 2 will provide a review of the literature, strategies used for searching the literature, variables of interest, and a more detailed discussion of the theoretical framework employed.

Chapter 2: Literature Review

Introduction

Obesity or elevated BMI is a major issue within the lupus population and is a comorbidity in about 30% or more of the lupus population (Katz et al., 2011; Patterson et al., 2019). Obesity has potential harmful effects in the general population, and these effects are even worse in the lupus population. Obesity can influence or promote inflammation, putting the body in a more vulnerable state. According to the (2017), physicians should expect higher perceived disease activity in obese patients with lupus and work toward mitigating obesity to improve outcomes in SLE patients.

The purpose of this study was to determine whether associations exist between BMI and depression and between BMI and neighborhood factors in patients with lupus in Georgia. Ethnicity, race, gender, age, and education level were analyzed for potential confounding. Other researchers have investigated obesity in the lupus population, as well as depression and different neighborhood factors in the lupus population, but no other study was conducted to specifically investigate depression and neighborhood factors in the lupus population and their potential association with elevated BMI.

This chapter includes a comprehensive review of relevant literature pertaining to the impact of neighborhood factors and depression on BMI. The employed theoretical foundation for this study, Bronfenbrenner's bioecological theory, is explained in this chapter. There is an in-depth review of neighborhood factors and obesity or elevated BMI in the general and SLE populations. This chapter is divided into the following sections:

introduction, literature search strategy, theoretical foundation, literature review of the key concepts and variables, summary, and conclusion.

The CDC provides mortality statistics used for health care policy planning and allocating resources, generating a ranked list of 113 leading causes of death; however, SLE is not included in this list (Yen & Singh, 2018). SLE has a mortality rate that remains higher than the general population, and the risk of death in SLE patients is 2 to 5 times as high as in the general population (Nieves & Izmirly, 2016). As Gergianaki, Bortoluzzi, and Bertsias (2018) mentioned, it is pivotal to obtain an updated view of the epidemiology, risk factors, and prognosis of SLE to gain a better understanding of the disease burden. Several studies have identified the complications that being overweight or obese add to an SLE patient. In one study, the overweight patients were found more likely to be faced with hyperglycemia and metabolic syndrome than normal weight patients (Zen et al., 2014). Katz et al. (2011) stated that obesity or body composition in SLE have not been addressed, except in a few studies used to determine that obesity is usually accompanied by disability and is associated with increased functional limitations. Shen et al. (2013) found that SLE patients were at increased risk of depression and anxiety compared to the general population and that SLE patients suffering from anxiety and depression were from lower SES, had worse disease activity, and experienced lower quality of life. As suggested by Shen et al. (2013), there is a sense of urgency for psychosocial interventions to assist the SLE population with mental health. These interventions will be most powerful and precise in targeting the mental state only if investigations are undertaken to look into the potential or related causes or risks relative

to mental health, specifically depression, in the SLE population. McCormick et al. (2018) determined that high financial strain in women with SLE was a significant predictor of the onset of depression. Financial strain is significantly associated with neighborhood factors, as it often is the determining factor as to where an individual resides.

The aim of this study was to close the gap in the literature concerning the lupus population by examining specific neighborhood factors, such as aesthetic quality, walkability, safety, violence, social cohesion, and healthy food, as well as depression in a cohort of patients with lupus to determine if they are related to the increased prevalence of obesity and overweight seen in patients with lupus.

Literature Search Strategy

To search the literature pertaining to the established topic, the following databases were used: ProQuest, PubMed, Embase, and Google Scholar. The terms used to complete the search included *obesity, overweight, BMI, lupus, systemic lupus erythematosus, SLE, neighborhood factors, physical environment, walkability, social cohesion, healthy food, nutrition, safety, violence, pain interference, depression, obesity epidemiology, incidence, risks*, and *lupus registries*. The search method described above generated several peer-reviewed studies. There is a gap to be addressed with respect to weight issues within the lupus population and the modifiable risk factors associated with the psychological status and physical environment in which the individuals reside. Non-peer-reviewed studies and studies older than 10 years were excluded, except in the case of groundbreaking research.

Theoretical Framework

The immediate environment were a person resides could have major effects on how they behave and perceive the world around them. Bronfenbrenner's ecological perspective has undergone successive changes and reformulations after its first introduction in the 1950s, in which Bronfenbrenner perceived development as a result of the interaction of an individual and context (Domingues & Gonclaves, 2014; Rosa & Tudge, 2013). Bronfenbrenner's bioecological theory of human development was used to assess the possible associations between neighborhood poverty, perceived crime, and environmental factors, and satisfaction with blood pressure in at-risk African American communities. The results indicated that there was an association between poverty and perceived neighborhood environmental factors and systolic and diastolic blood pressure (Coulon et al., 2015). This theory was initially known as the ecological model and was used to explain human development focusing on the impact of context (Rosa & Tudge, 2013). The Bronfenbrenner ecological approach has undergone three phases of development and emergence of the theory (Coulon et al., 2015). In the final version of the bioecological model, Bronfenbrenner was concerned with how individual characteristics, in conjunction with context and environment, both spatial and temporal, influenced proximal processes (Coulon et al., 2015). Proximal processes can be described as the development processes of systematic interaction between individual and environment, whereas spatial and temporal processes represent space and time, respectively.

Literature Review Related to Key Variables and Concepts

Obesity

Risk factors and incidence in the general population. A growing health concern, obesity is a major issue for many adults and is associated with serious health risks. There is a multidimensional etiology of obesity that includes environmental, genetic, and behavioral factors that lead to an increased caloric intake and a decreased energy outflow due to inadequate physical activity (WHO, 2013). *Adiposity* is a term used for severely obese or overweight individuals because the body abnormally accumulates adipose tissue in obesity (Versini et al., 2014). Soluble mediators, adipokines, are secreted by adipose tissue, and these adipokines are responsible for the proinflammatory state in obese people (Versini et al., 2014). As an indicator of functionality and physical proficiency, optimal body composition is often determined by BMI (Sofková et al., 2013). Some of the associated health risks include cardiovascular disease, disabilities, osteoarthritis, Type 2 diabetes, hypertension, high cholesterol, mobility-related disorders, and obstructive sleep apnea (Katz et al., 2010). It has been well established that besides being linked to the development of several diseases, obesity is associated with reduced life expectancy, cognitive dysfunction, and reduced quality of life (Jantaratnotai et al., 2017). Obese patients are faced with the social challenge of earlier unemployment or retirement, higher dependence on disability welfare, and loss of productivity (Shamseddeen et al., 2011). This significant threat and its potential to pose other health threats puts major pressure on individuals and health systems globally (Pineda et al., 2018).

Obesity is a major issue in the United States, impacting about 93.3 million U.S. adults 2015–2016 (CDC, 2018). Between 2007 and 2008, 35.5% of U.S. adult women were reported as obese (Santos et al., 2010). Overweight and obesity were ranked as the fifth leading global risk for mortality in 2010 (WHO, 2009). In 2010, the WHO reported that approximately 35% of the world was overweight (BMI 25–30 kg/m^2) or obese (BMI > 30 kg/m^2) and more recently, WHO estimates that there are over 600 million adults (13% of the adult population) worldwide that are obese and a 23% prevalence of obesity in the European region (Pineda et al., 2018). The WHO reports that approximately 2.8 million people die each year from obesity or being overweight. Finkelstein et al. (2009) reported that medical costs of the obese population exceed the medical costs of the normal weight population by roughly 42%.

Approximately 70 million U.S. citizens reside in rural areas, 23% of the population (Befort, Nazir, & Perri, 2012). The residents of rural areas, when compared to their urban counterparts, experience an increased incidence of chronic diseases and obesity, which is the case in both non-Hispanic White people and non-Hispanic Black people (Befort et al., 2012). The differences in obesity between rural and urban populations may be a major contributing factor to geographic health disparities (Befort et al., 2012). The CDC defines the *built environment* as all of the physical parts in which an individual lives, including homes, streets, open spaces, buildings, recreation, and infrastructures and suggests that individuals' built environment has influential power over their level of physical activity. The disparity seen in rural areas may be due to the built

environment and a lack of access to environmental characteristics that promote physical activity and eating healthier diets.

Risk factors and incidence in the lupus population. SLE is a chronic autoimmune disorder with multiorgan involvement and a large profile of autoantibodies (Versini et al., 2017). The epidemiology of lupus is under researched, causing a giant gap in understanding the mechanisms that contribute to the evolution and development of the disease (Gergianaki et al., 2018). The origin of SLE is unknown, yet it affects approximately 20 out of every 10,000 females (Somers et al., 2014). This complex disease has an estimated prevalence of 1 per every 144 Black females and 1 per every 492 White females 18 years of age or older (Chakravarty et al., 2007). SLE patients have a 2.4 standardized mortality ratio, meaning that they are 2.4 times as likely to die from any cause when demographically compared and matched to individuals without SLE (Askanase, Shum, & Mitnick, 2012). The mortality rate for people with SLE has decreased in the last five years, but it remains significantly higher than the mortality rate in the general population (Yen & Singh, 2018). Alarmingly, the ratio of the mortality rate of people with SLE to the mortality rate of people without SLE was 34.6% higher in 2013 than in 1968, and the mortality rates were likely even higher in both 1968 and 2013 than reported (Yen & Singh, 2018). Under reporting of SLE on the death certificates of SLE patients is more frequent in the older patients and patients lacking health insurance (Calvo-Alen et al., 2005). Black people in Africa have a lower incidence of SLE than Black people in the U.S. (Maidhof & Hilas, 2012)., implying that environmental factors are key in the pathogenesis of SLE (Bae, Fraser, & Liang, 1998). SLE has an increased

frequency and tends to be more severe among individuals that are not White (Gergianaki et al., 2018; Singh & Yen, 2018). The incidence of SLE is increased by five to nine fold in African Americans compared to Caucasians (Lewis & Jawad, 2017). This can be attributed to differences in genetic risks, socioeconomic status, and access or adherence to therapy or treatments (Gergianaki et al., 2018). Most common in females, SLE has been ranked in the top 20 leading causes of death in females aged 5-64, tenth among females aged 15-24, fourteenth among those aged 25-34, and fifteenth among those aged 10-14, over the last decade (Yen & Singh, 2018). Gergianaki et al., 2018, reports that there is a female-to-male ratio of 7-15:1 in adults for the incidence of SLE. Of patients diagnosed with lupus, 90% are women (Boodhoo, Liu, & Zuo, 2016). African American women have an increased prevalence rate of SLE versus Caucasian women (211 per 100,000 person-years compared to 64 per 100,000 person-years; Izmirly et al., 2017). Race and socioeconomic disparities are vital health determinants that contribute to the progression and frequency of chronic illnesses such as SLE (Gergianaki et al., 2018).

Obese SLE patients are at an increased risk for poor outcomes, such as lupus disease activity, depression, and fatigue (Patterson et al., 2019). One third of a representative sample of women with SLE were obese (Patterson et al., 2019). The secretion of adipokines seen in obese individuals has recently been proven to contribute to the progression of several autoimmune diseases, including rheumatoid arthritis, multiple sclerosis, and psoriasis (Versini et al., 2017). Metabolic syndrome (MetS) is a collection of atherosclerosis risk factors, which includes abdominal obesity, atherogenic dyslipidemia, hypertension, and insulin resistance (Mok et al., 2018). Obese patients with

lupus are at an increased risk for MetS compared to non-obese patients with lupus due to the increased gene and protein expression of pro-inflammatory molecules (La Cava, 2019). The increased accumulation of fat could lead to an increase in proinflammatory cytokines, and the increase in inflammation could lead to hypertension, diabetes mellitus, and coronary heart disease (Borges et al., 2012). While MetS is more prevalent in the SLE population, a multivariate analysis revealed an association between age, disease duration, corticosteroid use, and the presence of MetS in SLE patients (Parker et al., 2011). Obesity is associated with increased disease damage, increased steroid dosage, and increased disease duration in patients with lupus (Rizk et al., 2012). Obesity contributes to a strong proinflammatory environment, meaning it supports inflammation and in the presence of autoimmunity, such as SLE, the inflammation thrives and flourishes (Versini et al., 2014). An analysis of Brazilian patients with lupus found that excess weight is associated with older age, lower education levels, higher disease damage, higher frequency of hypertension and diabetes, and lower frequency of antimalarial use than in the general population (Santos et al., 2010). It was found that obesity is independently associated with SLE Disease Activity Index (SLEDAI) score (Teh, Zakhary, & Sandhu, 2019). Clinical studies have shown that obesity in SLE patients is linked to decreased physical activity, increased fatigue, increased burden of atherosclerosis, neurocognitive incapacities, and a lower overall quality of life (Katz et al., 2011; Katz et al., 2012; Rizk et al., 2012). Obesity puts a damper on physical functioning and promotes or adds to the body's state of inflammation, which promotes other diseases or illnesses. Versini et al.,

2014, suggested that obesity may aggravate the course of SLE and affect the treatment response of SLE patients.

Obesity is a growing health issue that has an even higher risk in the lupus population (Katz et al., 2011). Up to 50% of patients with lupus are obese (Rizk et al., 2012). The prevalence of MetS is steadily increasing in the SLE population (Lee et al., 2018). SLE patients have an increased need of intervention to avoid and eliminate the development of worse disease activity and the development of other diseases.

Neighborhood and Obesity

Where one resides and works, vastly impacts their level of physical activity and access to healthy or unhealthy foods (Barton et al., 2015). The development of SLE is a complex entity that cannot be explained by genetics alone. There are many other factors that play a role in the development of the disease, such as environmental triggers and diet (La Cava, 2019). Physical inactivity is a global pandemic and is the fourth leading cause of death worldwide (Kohl et al., 2012). Despite evidence of its protective effects, the role of physical activity remains undervalued (Kohl et al., 2012). There are four domains of life that describe how people spend their time that contribute to physical activity: leisure/ recreation/exercise, occupation, transportation and household (Sallis et al., 2012). For example, if there are various destinations close by the residential area, people are more likely to walk or bike as means of transportation. The household can contribute to physical activity depending upon the design (i.e., stairs) and equipment (i.e. treadmill, bike, stair stepper) inside of the home. Public health practitioners must be careful not to overlook safety and violence issues in the physical environment and how they can

contribute to an individual's behaviors and overall health outcome. Epidemiological studies have found that physical activity has substantial potential to prevent or help manage several diseases, including cardiovascular disease, cancer, and diabetes, while physical inactivity or sedentary lifestyle contribute to increased mortality worldwide. Physical inactivity has been linked to several poor health outcomes, especially obesity. In 2008, an estimated 9.4% of the 57 million deaths worldwide were attributed to physical inactivity, translating to 5 million deaths (Bouchard, Blair, & Katzmarzyk, 2015). The social and physical environment in which one lives play a major role in physical activity (Amram et al., 2019). Lower levels of physical fitness are related to higher BMI in the general population (Ortega et al., 2018). Physical inactivity is a primary, modifiable risk factor for obesity and diseases. Less than 40% of adults met the United States physical activity guidelines for the high level of the recommended aerobics (moderate intensity > 300 minutes/week, or vigorous-intensity for > 150 minutes/week, or an equivalent combination), and fewer than 55% of adults met the guidelines for the minimum level of the recommended aerobics (moderate-intensity for ≥ 150 minutes/week, or vigorous-intensity for ≥ 75 minutes/week, or an equivalent combination) in 2018, with the built environment being identified as a reason for lack of or limited physical activity (CDC, 2018). Physical fitness is associated with body weight and composition in SLE women, with lower levels of physical fitness leading to higher weight (Sola-Rodríguez, 2019). While environmental research on physical activity has increased since 2000 (Sallis et al., 2015), this is not the case for environmental research on physical activity in the SLE population.

Disparities in obesity between racial/ethnic groups and between people of varying socioeconomic status raise the need to take an in- depth look into factors that may be contributing to obesity (Sallis & Glanz, 2009). For example, what effect do activity-friendly environments have on the obesity disparities (Sallis & Glanz, 2009). Several studies have shown that there is substantially less access to parks and recreation facilities in low-income, low-education, and minority communities in the United States (Sallis & Glanz, 2009). In one study, Caucasian people lived in areas with healthier food choices, while Chinese and Hispanic individuals lived in areas with more walkability (Auchincloss et al., 2013). Older Black women are more likely to have poor neighborhood perceptions and less physical activity than their White counterparts (Li et al., 2017). Neighborhood perceptions are based on feelings of safety, community cohesion, accessibility, and aesthetics (Li et al., 2017). Poor neighborhood perceptions include feelings of unsafety, lack of social cohesion, and little to no accessibility to aesthetics or to a built environment that supports and promotes physical activity or healthy food intake.

Aesthetic quality. The aesthetic quality of a neighborhood is related to the attractiveness of the area in relation to various elements, including the architectural design and views and vistas that are available or accessible to the public. The aesthetic quality of the neighborhood has the potential to impact the well-being of its inhabitants, because the attractiveness of the neighborhood is associated with walking and cycling. The “Built” environment is one that contributes to the neighborhood’s aesthetics. One study examined the relationship between perceived neighborhood aesthetic environment

and overweight/obesity in South Africans, and the results revealed a positive association between aesthetics quality and physical activity (Malambo et al., 2017). Neighborhood aesthetics are associated with a lower prevalence of obesity/overweight in a cross-sectional study of older adults in Dutch Municipality (Putrik et al., 2015). The perception of whether the neighborhood is attractive or allows for safe physical activities has a lot to do with whether an individual will be motivated to get out into the neighborhood and be active. The aesthetic quality of the neighborhood is discussed further in the upcoming sections (walking environment, healthy food, safety and violence, and social cohesion).

Walking environment. Studies have shown that there are linkages between BMI and walkability (Hirsch et al., 2014). Sofková et al. (2013), explains walkability as available opportunities to be physically active in close proximity to an individual's home using the following parameters to define walkability: types of homes, shops, facilities, access to services, streets, safety, places for walking and biking, and surroundings. Contributing a great deal to walkability, hence physical activity, are places that can be designed to support and promote daily activities, including, parks, sidewalks, trails, schools, workplaces, playgrounds, childcare settings, and private recreation facilities (Sallis & Glanz, 2009). Walkability can be further described as a characteristic of the built environment in a neighborhood, and the characteristics of the physical environment of neighborhoods have been associated with physical activity levels and obesity/overweight (Hoehner et al., 2011). Furthermore, a relationship between neighborhood characteristics (i.e., walkability) that support more physical activity and lower levels of BMI was identified (Hoehner et al., 2011).

Sofková et al. (2013) found that more walkable environments are positively reflected in body composition of older women and fat mass in younger women. A walkable neighborhood has features that promote or encourage walking in the neighborhood, such as sidewalks, recreational sites, or trails. A walkable neighborhood is also characterized by an urban type setting that encourages pedestrian activity and minimizes environmental degradation; an association with social, economic and land use; equitable access to facilities, goods, and services; and protection of environmental and human health (Talen & Koschinsky, 2013). Walking is an easily maintained and inexpensive way to promote a physically active lifestyle, because it does not require special facilities or equipment and can be done for many reasons, including leisure and transportation (Hootman et al., 2019).

A study by Arvidsson et al. (2013) found that residents of high walkability neighborhoods had a higher mean of daily, moderate physical activity on both weekdays and weekends, and that those with high income had consistently more moderate physical activity than those with low income. Individuals that reside in neighborhoods with recreational facilities are more likely to be physically active and less likely to be obese or overweight (Sallis & Glanz, 2009). Living in an area with less walkability may cause individuals to favor and become dependent upon vehicular transportation and adopt sedentary lifestyles (Kozo et al., 2012). Many suggestions have been made by organizations such as the CDC, the World Health Organization, and the Institute of Medicine to make changes to the built environment to support and promote more physical activity, such as walking for recreation or transportation (Khan et al., 2009).

Neighborhoods with more walkability have greater levels of neighborhood cohesion and social interaction (Stewart et al., 2016). The more an individual is out in the neighborhood, the more likely they are to socialize and have interactions with neighbors which promote cohesive networks. Suburban communities are designed in a manner that encourage car dependency, discourage walking, and thereby contribute to the rise of obesity (Glazier et al., 2014). A study people living in Toronto, Canada found that residents of more walkable areas were more than twice as likely to walk, bicycle, or use public transit than residents of less walkable areas, and that those living in less walkable areas were one-third more likely to be overweight or obese (Glazier et al., 2014). Walkability is a major determinant of whether a population is physically active, and while it has been researched a great deal, little research on it has been done in the lupus population of Georgia.

Healthy food. The obesity epidemic has been attributed to several factors, but one primary cause is increased caloric intake, which increased by ≥500 kilocalories in adults and ≥150 in children between 1977 and 2006 (Cobb et al., 2015). In addition, the prevalence of obesity not being uniform across neighborhoods suggests that neighborhoods may play a role in obesity (Cobb et al., 2015; Powell & Han, 2011). For example, the availability of healthy foods in a given neighborhood affects the prevalence of obesity in that same neighborhood.

Diet plays an important role in the development of disease in the general population. It is also a factor that is associated with the development of obesity in the SLE population. In assessing the nutritional status and food intake of a population of SLE

patients, Borges et al. (2012), found that SLE patients eat large amounts of sugars, sweets, oils, and fats and low amounts of fruits and vegetables. In addition, 98.8% consumed less than four servings of vegetables per day, 85.6% consumed less than three servings of food, and there was a 32.3% decrease in the intakes of grains, 36% decrease in beans, 27% decrease in meat, and a 78% increase in oil intakes. Santos et al. (2010) suggested that the most common nutritional disorder in SLE patients is being overweight. Obesity triggers systemic inflammation, whereas, malnutrition causes immunosuppression, collectively altering an individual's response to a specific disease (Santos et al., 2010).

The presence of supermarkets near an individual's residence has been linked to a lower prevalence of obesity or elevated BMI (Auchincloss et al., 2013). Residents with more access to healthy food options are more likely to have more healthful diets (Sallis & Glanz, 2009). This can be impacted by the individuals' access to transportation or available money for purchasing these items. Healthy food that is readily available and conveniently located is more likely to be eaten. On the other hand, reduced income, which leads to budgetary constraints, may result in families purchasing and consuming more low-cost, nutrient-compromised, energy-dense foods instead of healthy foods (Kharmats et al., 2014; Mayer et al., 2014). One study found that caregivers in low-income families have negative perceptions concerning healthy foods and the convenience of obtaining them, and obesity and overweight were associated with their perceptions (Vedovato et al., 2016). Higher odds of being overweight or obese are associated with an increased availability or presence of fast food at the county level (Xu, Wen, & Wang,

2015). It has been shown that more deprived communities are faced with fruits and vegetables being more expensive and not readily available (Cummins et al., 2010). While this is not the case for all materially deprived communities, those that shop in smaller stores within deprived communities tend to pay the greatest price premium for healthy foods when compared to those that shop in larger stores (Cummins et al., 2010). Consumers in deprived or socioeconomically disadvantaged areas are content with traditional stores and less likely to visit newer stores (Cummins et al., 2010). Low-income families that live paycheck-to-paycheck are forced to buy small quantities of food at a time. There has been a rise in the prices of fruits and vegetables when compared to refined sugars and grains, which makes access to several types of processed foods much easier, affecting a range of income levels, but mainly low-income people (Gordon-Larsen, 2014). Processed foods are defined as food items that have been subjected to a series of mechanical or chemical processes to change or preserve them. Food items are ultra-processed to create durable, accessible, convenient, hyperpalatable, and highly profitable food items that are ready-to-eat or ready-to-drink, such as, sugary drinks, packaged snacks, buns, nuggets, cakes, hots dogs, industrially prepared pizzas, meals, pies, and other dishes (Monteiro et al., 2017). An analysis of nationwide data collected from 2000 to 2013 indicated that eighty of the included countries experienced an increase by 43.7% in the sales of ultra-processed foods (Monteiro et al., 2015; Moubarac, 2015). Ultra-processed foods are associated with obesity (Monteiro et al., 2015). With the low costs, hyperpalatable, and more satiating features of ultra-processed foods, low-income communities will buy and consume more of them. With the introduction of chemicals

into food products and intake of these food products, disease has an environment that promotes and supports proliferation and advancement of the disease. Whereas many studies have focused on healthy food availability and obesity or elevated BMI, there has been limited research in this area within the lupus population.

Safety and violence. Safety and the perception of being in a safe environment has a lot to do with whether an individual engages in physical activity. There is an association between crime and perceptions of unsafe neighborhoods and low levels of physical activity among adults and children (Abdul-Sattar & Abou El Magd, 2017; Suglia et al., 2016). This holds true even after adjusting for socioeconomic status. Neighborhood crime and safety may influence social cohesion. For example, in unsafe neighborhoods there may be less social interaction and distrust among residents, inhibiting social interaction and social cohesion (De Jesus et al., 2010). In one study, Black women viewed their neighborhood as less safe and less attractive compared to White women (Li et al., 2017). Kremers et al. (2012) found that increased cycling and use of active transportation were associated with less crime and lower BMI in elderly, male residents of the Netherlands. One study found that the BMI of Libyan adults was significantly associated with " an unsafe environment and low perceived crime safety at night" (Lemamsha, Papadopoulos, & Randhawa, 2018). A study of a community-based cohort of African American youth followed over a span of 18 years found that neighborhood violence was a contributing factor to an increased risk of obesity in the participants that lived in disadvantaged areas (Assari et al., 2016). While it is known that African Americans are most likely to live in disadvantaged areas, which increases their exposure to and fear of violence, it is also a

fact that lupus has an increased incidence rate in the African American community (Assari et al., 2016; Williams et al., 2018). Therefore, safety and violence in the neighborhood is a major issue for many people with lupus, impacting their participation in physical activity. Initiatives that enhance neighborhood safety and work against violence are vital strategies that could be used to overcome obesity in the lupus population.

Social cohesion. The social environment is one of the less extensively studied aspects of the neighborhood environment, yet it is equally important as the more extensively studied aspects, such as the built environment (Suglia et al., 2016). Social cohesion is a term used to reference the trust, respect, and participation within a community, and it can have an effect on health through community integration (Guilcher et al., 2017). Neighborhood social cohesion has been linked to disease activity in SLE patients, as less social cohesion leads to higher disease activity (Abdul-Sattar & Abou El Magd, 2017). Social interaction has the capacity to enhance the sense of "community," the feeling of belonging to a group, emotional attachment to the community, thereby promoting resident involvement in more neighborhood activities (Jun & Hur, 2015). Enhancement of the neighborhood social environment through physical environment features, such as the addition of sidewalks, parks or recreational center, and bike trails, can encourage residents to engage in pedestrian, on-the-street, activities, thereby increasing opportunities for informal contact cultivating social cohesion (Jun & Hur, 2015).

Depression and Obesity

Depression and obesity are both major public health concerns and often accompany one another. Along with obesity, psychosocial disorders were common from 2003 to 2013, with anxiety and depression accounting for most of the cases (Brumpton et al., 2013). Depression can affect people of all ages, under any circumstances; however, there is an increased risk of becoming depressed where there is increased poverty, unemployment, death or break-ups, physical illness, and alcohol and drug use (WHO, 2017). The high prevalence of obesity (30%) and depression (10%) in the United States make them leading public health concerns (Jantaratnotai et al., 2017). The association between obesity and depression is often bidirectional, meaning that obesity could lead to depression and depression could lead to obesity. It has been established that depression and obesity are both chronic inflammatory diseases (Jantaratnotai et al., 2017). Jantaratnotai et al. (2017) suggested that obesity and depression are comorbidities with a similar pathology and etiology and their co-occurrence in an individual is associated with adverse health outcomes. In the Nord-Trøndelag Health Study, Brumpton et al. (2013) investigated weight changes in men and women with symptoms of anxiety, depression or both and found that there was an increased incidence of obesity in both the men and women compared to those without symptoms of depression, anxiety or both. In a meta-analysis, Luppino et al. (2010) found that depression is predictive of obesity. The most unfavorable patient-reported health outcomes in patients with lupus have been pain, fatigue, and depressive symptoms, yet the rationales for these outcomes are not completely understood (Patterson et al., 2019). Worse MetS components (abdominal

obesity, high waist circumference, high blood pressure, high triglycerides, and low levels of high-density-lipoproteins) result in higher depression levels, leading to worse health-related quality of life in patients with lupus (Lee et al., 2018).

Mental changes are associated with SLE, and among neuropsychiatric SLE patients, depression is among the most common mental disorders, ranging from 17% to 75% in the SLE population (Palagin et al., 2013). Depression is thought to have central nervous system involvement and to be linked to an impaired immune system (Figueiredo-Braga et al., 2009). Depression and fatigue were associated in a group of SLE patients, and fatigue, accompanied by an increase in cytokine markers, may signify an alert signal of a flare-up of immune activation in SLE patients (Fonseca et al., 2014). Several studies have focused on depression and its association with BMI outside of the SLE population, but few have looked into depression and its association with elevated BMI in the SLE population.

Summary and Conclusions

Obesity and overweight are major public health concerns in the United States, with 35% of adults in the United States being obese. Obesity is associated with worse health outcomes in women with SLE who are burdened with the side effects of obesity at a lower BMI than the general population (Katz et al., 2011). Obesity can be detected through the use of a BMI calculator, which allows for categorizing individuals based on a score, according to their weight and height. BMI serves as an estimate of body fat and a gauge of the risk of developing diseases that occur with more body fatness (NIH, 2019). An elevated BMI or obese status is associated with daily activity limitations, disabilities,

and unemployment in obese individuals with lupus (NRCL, 2019). While there has been substantial research on understanding how obesity is impacted by neighborhood factors and depression in the general population, the research is limited in the SLE population and more limited in the SLE population in Georgia.

Based on this review, it is evident that various factors existing in an individual's physical environment/neighborhood impact their routine daily habits. Depression is another influential factor, impacting an individual's eating habits and physical activity involvement. For example, individuals with symptoms of depression, which include fatigue and energy loss, are more likely to engage in low levels of physical activity (Sander et al., 2018). The majority of this review suggests that an individual's behaviors and habits are very reliant on their immediate environment and surroundings, including perceptions regarding safety and social aspects, as well as their mental/emotional state. Identification of risk factors and behavioral modifications are both vital in healthy weight management and overall health and disease management in adults, as they allow for targeting those risk factors and changing the behaviors that can be altered. The majority of researchers have suggested and supported the development of neighborhoods that promote physical activity, healthy eating, and healthy minds to eliminate weight issues.

Interventions targeting elevated BMI in the SLE population should include the development of built and social environments and policies that promote behavioral changes which will lead to improved health outcomes. The policies should lead to the development of built and social environments that include, but are not limited to, an increase in healthy food availability, physical environments that promote and provide

feelings of safety for physical activity involvement, and mental health promotion. The next chapter will entail a detailed discussion on the research methodology that will be used in an attempt to answer the research questions that are the theme of this study. I will discuss the research design and rationale, the methodology, and threats to validity of this study.

Chapter 3: Research Method

Introduction

The purpose of this study was to determine the relationship between neighborhood factors and elevated BMI as well as depression and elevated BMI among individuals with lupus residing in Georgia. The BMI of the individuals was assessed in relation to neighborhood predictors of BMI and in relation to depression. The objective of this study was to close the gap in practice and in the literature regarding neighborhood factors and elevated BMI and depression and elevated BMI in the lupus population. Gaining a better understanding of whether there is an association between neighborhood factors, depression, and elevated BMI among individuals with lupus supports and expands ongoing research on obesity and weight issues in the lupus population, as well as the additional health threats that weight issues may pose. Provided in this chapter is a comprehensive description of the employed methodological approach using data from the GOAL cohort surveys. This chapter provides more details on the research design and rationale for the study, the methodology, which includes details about the population, the sampling strategy and procedures, and instrumentation, and threats to validity. Also, an in-depth description of the GOAL study is included in this chapter along with the sampling design and data collection methods used by the GOAL study.

Research Design and Rationale

Aims and objectives of a specific study should be the driving forces in determining the research design, and the research design should be chosen before selecting the statistical tests to be used (Bettany-Saltikov & Whittaker, 2014). The type of

research design provides structure to the research so that it fits together; for example, the subjects, instruments, and how the study will be conducted and analyzed should all align (Bettany-Saltikov & Whittaker, 2014). In quantitative studies, the design is either descriptive or experimental. A descriptive study includes subjects that are measured once, and the analysis provides information on associations between variables (Bettany-Saltikov & Whittaker, 2014).

This study was based on the bioecological model, a derivative of the ecological theory developed by Bronfenbrenner in 1979, which uses the concept that the surroundings of an individual determine that individual's development. The bioecological model has four major components: (a) process, (b) person, (c) context, and (d) time (process-person-time-context model; Hapunda, Abubakar, & van de Vijver, 2017). Human development is a transactional process (relating to exchange or interaction between people and the environment) influenced by an individual's interactions with various components of the environment (Hapunda et al., 2017). Based on the bioecological model, less access to physical activity and healthy food options leads to health issues, such as obesity.

A subset of the variables in the GOAL data set was used for this study, those variables necessary to answer the research questions. The dependent variable was the lupus patient's BMI, a variable calculated using the reported weight and height of the patient. The two independent variables consisted of the lupus patient's neighborhood factors and depression. Neighborhood factors included the aesthetic quality, walkability, healthy food availability, safety, violence, and social cohesion of the neighborhood.

Depression was measured as a total score determined by calculating the individual's feelings of being depressed, hopeless, sad, worthless, unhappy, disinterested, and no reason to live. Quantitative research was appropriate for this study because it allowed for examining the relationships between neighborhood factors and BMI and depression and BMI in patients diagnosed with lupus by measuring the variables using a numerical system, analyzing the measurements through use of statistical tests, and reporting the relationships and associations among the investigated variables (Lucas-Alfieri, 2015).

With their inexpensive and relatively fast nature, cross-sectional studies can be used to gain insight on the prevalence of outcomes or exposures and to estimate odds ratios (Setia, 2016). Therefore, a quantitative cross-sectional design was appropriate in the examination of the two independent variables and one dependent variable. This study used secondary data obtained from the GOAL database to explore neighborhood factors and depression as possible predictors of elevated BMI in adults with lupus in Georgia. One way to explain the meaning of using secondary data is the analysis of already existing data collected in primary research and registry settings (Cheng & Phillips, 2014). The use of already existing data provides a low-cost method and maximizes the use of the collected data, as long as it is made available by government, agencies, and researchers to qualified researchers (Cheng & Phillips, 2014). The data collected in a survey are typically geared toward a specific topic; therefore, secondary data may not specifically address the research questions of a particular study (Cheng & Phillips, 2014).

Two research questions and hypotheses will guide this study:

RQ1: Is there an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$1: There is no association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a1: There is an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

RQ2: Is there an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$2: There is no association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a2: There is an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

The Chi-square test of independence was the initial statistical test of choice for analyzing whether there was an association between the independent and dependent

variables in this study; however, not all requirements were met. Specifically, the assumptions of the Chi-square test are: (a) the two variables are measured at the nominal or ordinal level, (b) the two variables consist of two or more categorical, independent groups, (c) each subject contributes data to only one cell in the Chi-square (only one time point), (d) a particular subject only fits into only one level of each variable, and (e) there should be five or more expected subjects in at least 80% of the cells. Once obtaining the secondary data set and gaining a better understanding of the data, I determined that the independent variables, depression and neighborhood factors, were measured as scores on a continuous scale, rather than on a nominal or ordinal scale. Therefore, I used a more appropriate statistical test, ordinal logistic regression, for the hypotheses testing of this study.

The advantage of employing the ordinal logistic regression is the ease of categorization and collation of the variables. Ordinal logistic regression is used to predict an ordinal dependent variable given one or more categorical or continuous independent variables. The assumptions to be determined before selecting ordinal logistic regression are (a) if there is an ordinal dependent variable and (b) if there are one or more continuous or categorical (ordinal or nominal) independent variables. The other two assumptions are determined once the statistical analysis of the data begins. The third assumption is that there is no multicollinearity, meaning that the independent variables are not highly correlated with each other. The final assumption is that there is proportional odds, explained as each independent variable having an identical effect at each cumulative split of the ordinal dependent variable. The Hosmer–Lemeshow test, the

Lipsitz test, and the Pulkstenis–Robinson tests are all appropriate in testing the goodness of fit in ordinal logistic regression, although each may be better suited for specific types of covariates (continuous or categorical; Fagerland & Hosmer, 2016). It is not common for the collected data to fail one or two assumptions, and a researcher must decide whether a different statistical test is more appropriate, if there are other ways of looking into the assumption, and if they will proceed with the analysis even when certain violations occur (Long & Freese, 2006; Williams, 2016).

The dependent variable was BMI, calculated using the formula: weight (kg)/[height (m)]^2 (CDC, 2017). CDC (2017) BMI calculations were used to place the participants into nominal categories, consisting of underweight (BMI less than or equal to 18.5), normal weight (BMI = 18.5–24.9), overweight (BMI = 25.0–29.9), and obese (BMI = 30.0 or greater). The ordinal logistic regression is generally used when the dependent variable is ordinal. This test allowed for predicting the dependent variable given the independent variables. Specifically, I was able to determine if any of the independent variables were statistically significant predictors of the dependent variable and how well the independent variables may predict the dependent variable. There are four assumptions of an ordinal logistic regression: (a) the dependent variable is ordinal; (b) there are one or more independent variables that are continuous, ordinal, or nominal; (c) there is no multicollinearity; and (d) there are proportional odds. Multicollinearity is when two or more independent variables are highly correlated, which poses issues with understanding which variable contributes to the explanation of the dependent variable and issues with calculating an ordinal logistic regression. The tolerance and variance

inflation factor (VIF) values were consulted to determine if multicollinearity was present in the model. Tolerance should be less than .01, and VIF, the reciprocal of tolerance, should be 10 or greater. The assumption of proportional odds can be explained as each independent variable having an identical effect at each cumulative split of the ordinal dependent variable. The full likelihood ratio in SPSS Statistics was used to test for this assumption, which compared the fit of the proportional odds model to a model with varying location parameters. As this specific test may flag violations that do not exist, proportional odds was further tested using separate binomial logistic regressions on cumulative dichotomous dependent variables (using dummy variables). The full likelihood value in the test of parallel lines had a Chi-square value that was small and not significant ($p > .05$), rejecting the null hypotheses, satisfying the proportional odds assumption. Considering the ordinal categories that were used to describe the study participants' BMI and the categorical and continuous nature of the independent and control variables, depression, neighborhood factors, age, gender, ethnicity, race, and education level, the ordinal logistic regression statistical significance test was appropriate (determined using SPSS statistics) for analyzing the research questions in this study.

Methodology

Study Population

The population of interest for this study was adults with lupus in Georgia. The rationale for studying patients diagnosed with lupus was their increased incidence of obesity, affecting more than half of them. Obesity increases the risk of mortality in patients diagnosed with lupus compared to the general population through mechanisms

that are pro-inflammatory (Meza-Meza et al., 2019). The GOAL cohort consists of longitudinal data from consenting adults with a validated diagnosis of SLE (Drenkard et al., 2013). The GLR, which was implemented between 2003 and 2010, was the primary source of the SLE patients. The purpose of the GLR was to advance epidemiologic understandings of SLE through more complete case finding in a targeted population, avoiding bias of referral in a particular institution, defining the incidence and prevalence optimally using available case definitions, and characterizing the SLE patients from a population perspective (Lim et al., 2014). The CDC funded the registry, and its implementation took place through a partnership between the Georgia Department of Health and Emory University (Drenkard et al., 2013). The members of the GOAL cohort were comprised of 70% participants from the GLR and 30% from the Grady Memorial Hospital (lupus clinics), Emory University, and community rheumatologists in metropolitan Atlanta (Drenkard et al., 2013).

Sampling and Sampling Procedures

The GLR, the primary source of the GOAL cohort, is a population-based registry designed for estimating the incidence and prevalence of SLE (Lim et al., 2014). The Georgia Department of Public Health utilized its "public health authority" to claim exemption from the HIPAA Privacy Rule (45 CFR parts 160 and 164) in an effort to obtain protected health information without written patient consent (Lim et al., 2014). The capture-recapture method helped to avoid underreporting and biased ascertainment by determining whether the diagnosed cases met the various case definition criteria and

to avoid duplicate counting of patients that were encountered at multiple facilities (Lim et al., 2014).

The sites used for recruitment made it possible for the GOAL cohort to be representative of the full spectrum of socioeconomic and racial groups. The GOAL cohort study was community-based, therefore the selection bias that usually accompanies hospital-based cohorts of patients diagnosed with lupus was prevented, and there was more participation from the less represented populations. The recruitment process to participate in the GOAL study included the mailing of research flyers and general information, prepaid postage interest cards, and follow-up calls to attain potential participants for the study. The diagnosis by an expert clinician is typically the standard; however, this is impractical when considering large population-based studies (Lim et al., 2014). The GOAL cohort survey included a variety of questions, including socio-demographics, access to health care, lifestyle factors, lupus outcomes, health status and utilization of primary care services (Drenkard et al., 2013). The survey questions pertaining to lifestyle factors, health care access, primary care services, and health status were worded in the same manner as those in the ongoing CDC Behavioral Risk Factors Surveillance System (BRFSS) survey (Drenkard et al., 2013).

The GOAL inclusion criteria were as follows: must have a validated diagnosis of SLE (documentation of ≥ 4 ACR criteria per the patient's physician) or CLE (documentation by a skin biopsy or clinical diagnosis by a dermatologist or rheumatologist of discoid lupus, lupus panniculitis, chilblain lupus, lupus tumidus, or other types of skin lupus); must be ≥18 years of age; must have the ability to provide

informed consent; and must be a Georgia resident. Participants were excluded if they were unable or unwilling to provide informed consent and/or unable or unwilling to complete periodic questionnaires.

Power Analysis

The sample size calculation is essential for a research study, as it is required to assure that there is adequate power to detect statistical significance (Suresh & Chandrashekara, 2015). A power analysis can be either retrospective (post-hoc) in which the statistical power of a test given the sample size and effect size is computed, or prospective (a priori) in which a statistical power target is selected (Park, 2015). If a study is underpowered, it risks being statistically inconclusive, while a study with larger than the required sample size results will be more expensive and will expose excess subjects to the study procedures (Suresh & Chandrashekara, 2015). Power is the probability that the null hypothesis will be correctly rejected, and a minimum power of 80% is desirable (Suresh & Chandrashekara, 2015). Sample size and the quality of the data are factors that contribute greatly to the reliability, validity, and generalizability of the results (Suresh & Chandrashekara, 2015). To determine the statistical power, the XLSTAT data analysis and statistical solution extension from excel was used. The null hypothesis (H_0) is that the difference between the proportions is equal to 0, and the alternative hypothesis (H_a) is that the difference between the proportions is different from 0. In this case, the risk of not rejecting the null hypothesis H_0 when it is false is 0.121. Providing parameters, such as, alpha of 0.05 and 0.80 power, a sample size of 102 is necessary for this study.

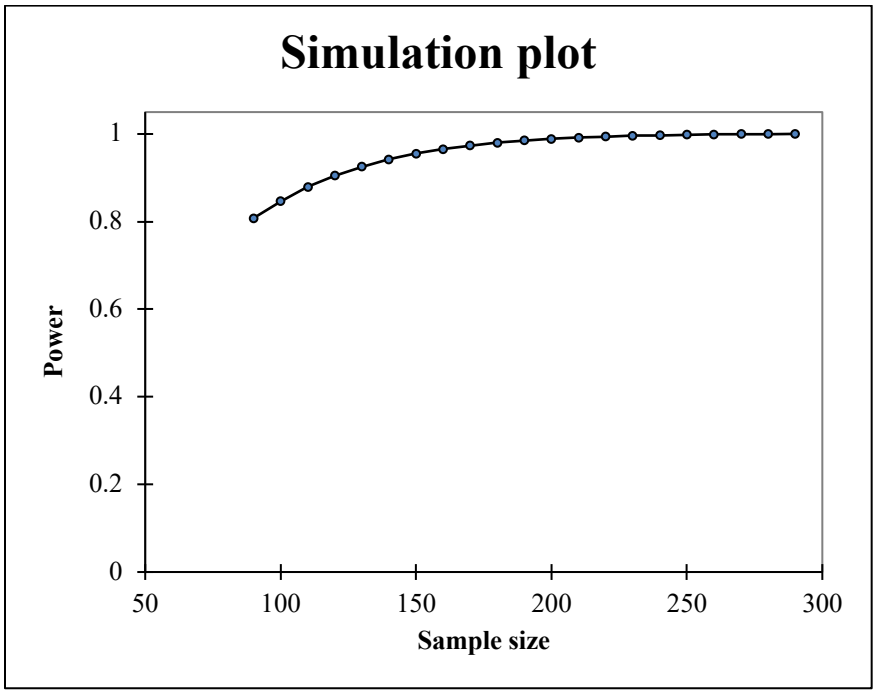

Figure 1. Stimulation plot of power analysis for necessary sample size.

Procedures for Recruitment, Participation, and Data Collection

The recruitment of the SLE patients into the GOAL cohort was done by mail, phone, and in person (Drenkard et al., 2013). The SLE patients were asked to complete annual self-administered surveys (Drenkard et al., 2013). Professional abstractors were given the duty of abstracting clinical data from the medical records of the participants, for which they used the GLR case definition to validate the diagnosis of SLE (Drenkard et al., 2013).

The participants in the GOAL cohort were selected through the use of various case definitions (different definitions used to diagnose SLE; Lim et al., 2014). The survey was designed to gain more insight into the lifestyle, behaviors, background, and environment of the SLE patients residing in Georgia. The GLR, which was the primary source of the SLE patients in Georgia used to develop the GOAL data set, was a 7-year

implementation through a partnership between the Georgia Department of Public Health and Emory University (Drenkard et al., 2013). Data were collected from a combination of patient-completed research surveys, follow-up telephone or in-person discussions, patient medical records, and public databases. IRB approved surveys were given on an annual basis and were the primary source of data. The accuracy of the data was enhanced through the utilization and annual screening of public databases, including the Georgia Hospital Discharge Database, Georgia Office of Vital Records, Georgia Comprehensive Cancer Registry, and census level information. The types of data collected were categorized as follows: demographics, access to health care and utilization of services, medical care quality indicators, employment and disability, lupus phenotype, lupus and non-lupus treatment, health status, disease activity, non-specific symptoms, lupus disease damage, comorbidities, health-related behaviors, psychosocial factors and coping, optional biological markers, and cutaneous lupus severity. Data collected at follow-up years were collected using the participants' preferred methods (mail, telephone, face-to-face, and web).

Procedures and permissions for gaining access to data sets. Analysis of secondary data is a systematic method that requires procedural and evaluative steps (Johnston, 2017). The procedure for gaining access to these data was a semi-difficult process, because these data were not readily available to the public. The data had already been stored by the research group, and there were some restrictions and procedures that were necessary in gaining access for this study because the data include patient sensitive

information. GOAL data are the property of Dr. Sam Lim and Dr. Cristina Drenkard; therefore, permission for use of the data was provided by them.

The data from the GOAL study was first provided in the form of a data dictionary. The data dictionary included all of the variables that were in the study along with the responses. From the data dictionary, the GOAL research team requested a list of the required variables that were necessary for this study. I was added to the GOAL study's Institutional Review Board (IRB), in which the Collaborative Institutional Training Initiative trainings for Emory University were required. The training is a compilation of institutional courses, including trainings titled "clinical research coordinator," "biomedical focus," "social/behavioral," "good clinical practice and ICH," and "human subject research track." Upon IRB approval (04-27-20-0676347), the team's biostatistician assembled a data set package specific to the requested variables.

Instrumentation

The GOAL cohort survey was initially designed to investigate how socio-demographics and healthcare factors may affect SLE patients and their health outcomes (Drenkard et al., 2013). The BRFFS survey was used as a guide for wording the questions in the GOAL cohort survey. The GOAL cohort survey was appropriate for this study because it included questions and answers from SLE patients that provided data for answering the research questions of this study. To validate the diagnoses of lupus and different lupus outcomes, validated questionnaires and medical record reviews were used for which patients were requested to sign a medical release form in lieu of validation procedures. All research that has used the test/retest (capture-recapture) method using

BRFSS questions has high levels of reliability (Pierannunzi, Hu, & Balluz, 2013). The reliability of the BFRSS is also supported by a study that compared the prevalence estimates of selected health indicators and chronic diseases among three national health surveys in the United States (BRFSS, National Health and Nutrition Examination Survey (NHANES), and National Health Interview Survey (NHIS), in which the estimates were similar among the three surveys (Li et al., 2012).

Operational Definitions

Systemic lupus erythematosus. The population of interest for this study comprised individuals that were diagnosed with SLE. SLE, according to the CDC, is the most common type of lupus (CDC, 2018a). SLE and its autoimmunity features cause widespread inflammation and tissue damage in affected organs resulting from the immune system attacking its own tissues (CDC, 2018a). SLE is known to affect the skin, lungs, kidneys, blood vessels, and joints (CDC, 2018a). The disease is not curable; however, treatments for managing the disease are available. While the disease can range from mild to life-threatening, with proper medical care, preventive care, and education, the quality of life can be improved significantly (CDC, 2018a).

Body mass index. BMI is a person's weight in kilograms divided by the square of their height in meters (CDC, 2019). A high BMI could be an indicator of high body fatness and used to screen for health indicators that could lead to health problems (CDC, 2019). Using an ordinal scale, BMI was categorized as underweight, normal or healthy weight, overweight, or obese employing the scale provided by the CDC (CDC, 2019).

Neighborhood factors (physical environment). Neighborhoods can be described demographically or according to structural characteristics. The population characteristics, such as home ownership, education attainment, employment, income, etc., are often defining entities of a neighborhood. The data set included the following factors to describe the neighborhood: aesthetic quality, walking environment, healthy food, safety, violence, and social cohesion. The score was an average across all factors and measured on a continuous scale.

Aesthetic quality. This is defined as the quality of the neighborhood based on the presence of trash and litter, the presence of noise, the maintenance of the homes and buildings, whether the buildings are stimulating or motivating, and the attractiveness of the neighborhood. The aesthetic quality will be measured by averaging the five factors used to define the quality of the neighborhood. Measured on an ordinal/Likert scale, each of the components of the aesthetic quality used the following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Walking environment. This was an average score based on whether the participants' neighborhood offers many opportunities to be physically active, has local sports clubs and other facilities with opportunities to exercise, is pleasant to walk in, has trees that provide enough shade, is easy to walk in, and whether people can be seen walking or exercising in their neighborhood. For example, participants were asked whether their neighborhood offers many opportunities to be physically active. Measured on an ordinal/Likert scale, each of the components of the walking environment uses the

following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Healthy food. This was based on the availability of a large selection of fruits and vegetables, whether they were of high quality and whether there was a large selection of low-fat products in the participants' neighborhood. Each of the components of healthy food used the following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Safety. This was defined as whether the participants felt safe walking in their neighborhood day or night, whether violence was a problem and if the neighborhood was safe from crime. Each of the components of safety used the following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Violence. This was defined as the occurrence of fights using weapons, gang fights, sexual assault or rape, robbery or mugging in the participants' neighborhood. Each of the components of violence used the following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Social cohesion. This was defined as whether the participants were willing to help their neighbors, generally get along with each other, could be trusted, and shared the same values. Each of the components of social cohesion used the following response coding: 1 for strongly agree; 2 for agree; 3 for neither agree nor disagree; 4 for disagree; and 5 for strongly disagree.

Depression. This involved disorders characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration as defined by the World Health Organization (2017). Depression was measured on a continuous scale. This was a score produced from a calculation of the components listed above.

Gender. This was defined as either of the two sexes (male and female) and categorized as *male* or *female*.

Education level. This was defined as the highest grade or grade level completed by the participant. This was categorized as elementary/middle school, junior high/high school, college/university, and graduate/professional school.

Age. This was the number of years an individual with SLE had lived.

Ethnicity. This was defined as belonging to a social group that had common national and cultural tradition. This was categorized as either *Hispanic or Latino* or *not Hispanic or Latino*.

Race. This was defined as an individual's physical characteristics. This demographic was categorized as *American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, White,* or *Other.*

Data Analysis Plan

The presented research questions were answered by using the GOAL cohort survey data set and ordinal logistic regression. The independent variables, neighborhood factors and depression, were entered as scale data into SPSS. The other independent variables were gender (male, female); education level (elementary/middle school, junior

high/high school, college/university, graduate/professional school); age (date of birth); ethnicity (*Hispanic or Latino* or *not Hispanic or Latino*); and race (*Black or African American or not Black or African American*). Gender, ethnicity, and race were entered as nominal data, age was entered as continuous scale data, and education level was entered as ordinal data into SPSS. The dependent variable, BMI, was entered as ordinal data into SPSS.

The Chi-square test is a non-parametric test that is generally used when the dependent variable has categories that are nominal or ordinal; in this case, BMI would be the dependent variable with nominal categories (i.e., underweight, normal weight, overweight, obese) that can also be ordered (ordinal). This test was not used because all assumptions were not met, specifically there were too many cells in the crosstabs with expected frequencies less than 5. Therefore, ordinal logistic regression, which is a parametric test used when there is an ordinal or ordered dependent variable, was employed. Data from the GOAL study survey was entered into SPSS, and descriptive statistics were calculated to provide information on the study population's demographics. Once all assumptions were met, SPSS software was used to analyze the data. The statistically significant effects of the independent variables on the dependent variables were determined.

Two research questions and hypotheses were used to guide the study.

RQ1: Is there an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI

among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$1: There is no association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a1: There is an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

RQ2: Is there an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$2: There is no association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a2: There is an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

Threats to Validity

External Validity

External validity refers to the generalizability of the conclusions of a study to other individuals in other places at other times (Yu, 2018). The research should be

applicable in various settings, so that the research contributes in a meaningful manner. External validity can be used to describe whether the research can be applied to the "real world." External validity is considered low if the research is not generalizable to a different research study and high if it is generalizable to a different study (Steckler & McLeroy, (2008) This suggests that external validity is how research results translate to public health practice and what is the responsibility of researchers, funding agencies, and journals in facilitating the use of research results in public health programs or policies. In other words, generalizability, applicability, and transferability all describe external validity.

There is a disconnect between the massive quantity of available research data and its relevance to practitioners and the field (Huebschmann, Leavitt, & Glasgow, 2019). Threats to external validity include selection biases, constructs, methods, and confounding, "real world" versus "experimental world," and history effects and maturation (LAERD, 2012). Selection bias has to do with sampling of the population being investigated and occurs when the studied sample does not represent the population from which it was selected (LAERD, 2012). To avoid this bias, the researcher should use random assignment in the research design in which participants are randomly assigned to the different groups being compared (LAERD, 2012). In terms of the "real world" versus the "experimental world," individuals that are aware that they are a part of a research study potential for research findings to be influenced by the experimental world rather than the independent variables. Therefore, there is always doubt that we can make generalizations from people that have experienced treatments to people in the real world

that have not experienced the same treatments (LAERD, 2012) The experimenter effect is when the experimenter's personal bias (i.e. expectations of a particular result, incentives, and measurement of subjective variables), may be a threat to either or both, external and internal validity. Historical events may threaten internal and external validity. History effects refer to events that happen in the environment that have potential to change the conditions of a study, hence change the outcomes. For example, if an exposure occurs before the start of an experiment, it may influence or alter the outcome. This threat to internal validity will affect the generalizability of the study, hence external validity. Maturation and time can mean change over time. In the case that a study is ongoing over the course of some months or years, things may change, such age, education level, and other characteristics, which may lead to a different outcome. Validity is threatened once the difficulties of determining whether changes in the dependent variable are actually due to the independent variable(s).

Internal Validity

Internal validity refers to whether the research was done right and was sound. It deals with whether the observed results are true in the population being studied and not due to methodological errors (Patino & Ferreira, 2018). It allows for gauging how strong the research methods were. History, maturation, testing, instrumentation, statistical regression, subject selection, experimental mortality, selection-maturation interaction, John Henry effect and Hawthorne effect, and Rosenthal's effect are all factors that pose threats to internal validity (Yu, 2018).

Internal validity of a study has to do with how well the results of the study apply to similar individuals outside of the study and applies to all types of studies, including those about prevalence, associations, interventions, and diagnosis (Patino & Ferreira, 2018). Instrumentation is vital in maintaining the validity of a study, and changing the instrument, observers, or scorers can all impact the outcome of the analysis (Yu, 2018). Random assignment can aid in alleviating bias due to selection of subjects by selecting the participants through randomization or by chance (Yu, 2018). The John Henry effect and Hawthorne effect are similar in that participants may change their behavior if they are aware of their role as research subjects or that they are being compared to something or someone else (Yu, 2018). Lastly, the Rosenthal effect occurs when the participants are treated with extra care or are given high expectations (Yu, 2018). According to the Boston University School of Public Health (2015), the following tips should help in minimizing threats to validity: maintain consistency of the instrumentation, administrators, and method of administration at each observation point; avoid using extreme performance or scores to select participants; reduce the amount of time between the pretest and posttest and be careful when children are the participants; be mindful of the selection threat to validity when working with nonequivalent comparison groups; and identify any events or changes that could cause changes to the program outcomes or results.

Construct Validity

Construct validity refers to whether operational variables adequately represent theoretical constructs (Steckler & McLeroy, 2008). Constructs serve as mental

abstractions used to express the ideas, people, organizations, events and/or other entities of interest (LAERD, 2012). Constructs help explain different components and measure or observe the behavior of theories (LAERD, 2012). Construct validity can be simplified as the degree to which a test measures what it claims to be measuring. Quantitative research requires that broad concepts are narrowed down into constructs that are measurable (LAERD, 2012). For example, a study may be interested in the phenomenon of weight, which can be viewed from a wide spectrum of perspectives. Instead, BMI is a more measurable, organized and precise way of explaining weight. The use of a single-method (mono-method) to measure constructs can pose threats to the external and construct validity of a study, which can be avoided by using multiple methods to measure constructs. The use of multiple methods is often a great method for eliminating or reducing the risk for method bias, which is caused when a different method may have provided more insight into the construct than just the single method (LAERD, 2012).

Ethical Procedures

The IRB of Walden University was sought for approval before beginning this study. The IRB ensures that all research conducted at Walden University conforms to ethical standards and U.S. federal regulations. The IRB maintains responsibility for protecting human research subjects from any unreasonable, unethical risks. However, archival data were utilized in this research study, so informed consent was not necessary. I met with the GOAL study research group and asked for approval to use their data set to assess whether associations between neighborhood factors and BMI and depression and BMI existed. The data set collected by the group was protected and stored using a

secured platform to protect the participants' confidentiality. I was approved to use the data set from the GOAL study, and its statistician provided me with a personalized data set, including the necessary variables to answer this study's research questions. Once the necessary approvals were in place and the data provided, the data set was downloaded in SPSS format and stored to proceed with statistical analysis.

Summary

This chapter illuminates the employed research design, providing justification for choosing this approach and an overview of research methods, threats to validity, and ethical procedures. The procedures for collecting and analyzing the data were proposed in this chapter. The purpose of this study was to determine whether there are associations between neighborhood factors and BMI and between depression and BMI in patients diagnosed with lupus residing in Georgia. For hypotheses testing, ordinal logistic regression has been selected, with all assumptions met. Secondary data from the GOAL study cohort survey was used for statistical analyses after appropriate procedures were completed in an effort to obtain all necessary approvals (committee, URR, and IRB). The BMI of the patients diagnosed with lupus was used as the dependent variable, while the neighborhood factors (aesthetic quality, walking environment, healthy food, social cohesion, safety, violence) and depression were used as the independent variables, and other variables were included in the model.

The IBM SPSS Statistics Version 25 software was employed for the statistical analysis. Descriptive and inferential analyses were completed and used to determine and define the demographics of the sample. Two hypotheses were tested at the 0.05 level of

significance. The next chapter, Chapter 4, provides the detailed results of the statistical analyses. Chapter 5 provides a discussion and interpretation of the findings, as well as limitations of the study and implications for positive social change.

Chapter 4: Results

Introduction

The purpose of this study was to perform a quantitative examination to determine whether there is an association between neighborhood factors and BMI and whether there is an association between depression and BMI among individuals with lupus. I examined whether age, education level, ethnicity, and gender were confounders in the association. The first independent variable, neighborhood factors, included the aesthetic quality, walkability, health food availability, safety, violence, and social cohesion reported by the participants. The second dependent variable, depression, was examined based on a group of questions pertaining to the participants' feelings of depression, hopelessness, emptiness, and worthlessness. The outcome, or dependent variable, BMI, was calculated by dividing the participants' weight in kilograms by their height in meters squared. The GOAL study survey, a survey used to track the behaviors and lifestyle of individuals with lupus in Georgia, was the source of the data. The quantitative data used in this study were retrieved specifically from the GOAL survey Waves 1 and 5. In this chapter, the data collection, descriptive statistics, inferential statistics, findings, and a summary will be presented. The research questions and associated hypotheses that guided this research study were as follows:

RQ1: Is there an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$1: There is no association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a1: There is an association between neighborhood factors (aesthetic quality, walking environment, healthy food, safety, violence, social cohesion) and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

RQ2: Is there an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level?

$H_0$2: There is no association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

H_a2: There is an association between depression and elevated BMI among patients with lupus in Georgia, controlling for gender, age, ethnicity, and education level.

The relationships between neighborhood factors and BMI and depression and BMI were examined with the use of ordinal logistic regression at the $\alpha = 0.05$ level of significance. The study results are presented using descriptive statistics, tables, figures, and inferential statistics. This chapter is comprised of three sections, including data collection, results, and summary.

Data Collection

Instrumentation

The GOAL Cohort Study is a longitudinal study of consented adults with a validated diagnosis of SLE (Drenkard et al., 2013). The primary source of the patients included in the study was the GLR, a population-based registry geared toward estimating the incidence and prevalence of SLE in Georgia area, funded by the CDC (Drenkard et al., 2013). As a partnership between Emory University and the Georgia Department of Public Health, the GLR was implemented between 2003 and 2010 (Drenkard et al., 2013). Of the 910 patients recruited into the GOAL cohort, 70% were ascertained from the GLR, while the remainder were recruited from Emory University, Grady Memorial Hospital, and community rheumatologists from the metropolitan Atlanta area (Drenkard et al., 2013; Lim et al., 2014). The survey that was delivered between August 2011 and June 2012 included 840 validated GOAL participants and 751 respondents to the survey (Drenkard et al., 2013).

The patients recruited into the GOAL study cohort were asked to complete annual self-administered surveys by mail, phone, or in person (Drenkard et al. 2013). The diagnosis of SLE was validated by trained abstractors who were responsible for collecting clinical data from the patients' medical records. The medical records were accessed for extraction of clinical data without the patients' consent, which was allowed under the Health Insurance Portability and Accountability Act Privacy Rule, 45 CFR Parts 160 and 164 (Drenkard et al., 2013). The CDC considered the GOAL project to be a surveillance project, rather than a research study, and it thus did not require IRB review.

However, it was reviewed and approved by the IRBs at Emory University and the Georgia Department of Public Health (Lim et al., 2014).

The GOAL study survey was designed to find out information on sociodemographics, healthcare access, lifestyle factors, lupus outcomes, health status, and use of primary preventive care among lupus patients in Georgia (Drenkard et al., 2013). This survey was designed to mimic and was similarly worded to the BRFSS. The BRFSS is a CDC-administered ongoing random-digit landline telephone survey used to collect data on health conditions and behaviors associated with morbidity and mortality among noninstitutionalized U.S. populations (Drenkard et al., 2013). The BRFSS survey uses a stratified, multistage probability sampling design. It is administered nationally to a representative sample of U.S. adults from all 50 states and the District of Columbia, Puerto Rico, and the U.S. Virgin Islands (Drenkard et al., 2013). Reliability and validity of this survey have been illustrated in multiple ethnic groups.

The participants were required to have validated SLE, be at least 18 years of age, and willing and able to participate in annual surveys/questionnaires. The diagnosis of SLE was validated by either the participants meeting at least four of the ACR criteria, having a diagnosis from a board-certified rheumatologist, or meeting less than four ACR criteria but additionally having lupus-related kidney disease (Lim et al., 2014). The ACR criteria are the most widely accepted standard of reference for SLE diagnosis; at least four of the 11 revised classification criteria must be met (defined by the ACR in 1982 and updated in 1997; Lim et al., 2014).

Study Results

Demographics and Descriptive Statistics

To maintain 80% statistical power with an alpha of 0.05, a sample size of at least 102 was necessary as provided by XLSTAT. For both research questions, the sample size exceeded this cutoff. To be included in the current study, a participant needed to respond to all the questions. Participants who did not respond to all the questions were excluded using the listwise feature in the SPSS software. This feature automatically excludes cases that do not have all the necessary information across the variables.

Research Question 1. The first wave of the GOAL study was mainly comprised of women (n = 728), totaling 93.3 % of the survey participants (n = 780). The mean age for the participants was 48 years (SD =13.73, N = 780). African Americans comprised 80.4 % of the survey participants, followed by Caucasians at 17.8%. Over 95% of the participants were from non-Latino or non-Hispanic ethnic backgrounds. Regarding BMI, 3% were underweight, 30.5 % were normal weight, 23.9% were overweight, and 42.6% were obese (see Figure 2). Education levels were almost evenly divided among junior high/high school (32.6%), college/university (32.8 %), and graduate/professional (34.6%). Out of 780 consented participants in Wave 1, 775, 776, 775, 775, 707, and 774 of the participants responded to the survey questions pertaining to aesthetic quality, walking environment, healthy food, safety, violence, and social cohesion, respectively.

Research Question 2. The GOAL cohort survey (Wave 5) was comprised of 909 participants. The mean age for the participants was 47.5 years (SD =13.94, N = 909), while 93.4 % were women. The vast majority of the participants identified as African

American (81.5 %), followed by Caucasian (16.5%). In total, 18.5% identified themselves as not African American. More than 95% of the participants identified as non-Hispanic or Latino. Of the participants, 31.0% reported their highest completed level of education as junior high/high school, 48.2% reported college/university, and 20.9% reported graduate/professional school. Regarding BMI, 3.3% of the sample was underweight, 31.0% were normal weight, 23.2% were overweight, and 42.4% were obese (see Figure 3). Regarding physical activity or exercise, 34.0% reported that they had not engaged in any other than their job within the past month, while 66.0% reported that they had.

Normality. The data were explored for normality. The standard normal distribution has skewness and kurtosis equal to zero. With BMI as the dependent variable, the skewness = -.334 and the kurtosis = -1.263 indicated that the data were normally distributed but slightly skewed to the left with a slightly heavier tail than in normal distribution (see Figures 4 and 5. Normality of the data was confirmed with Q-Q plots and the Kolmogorov-Smirnov test ($p > .05$).

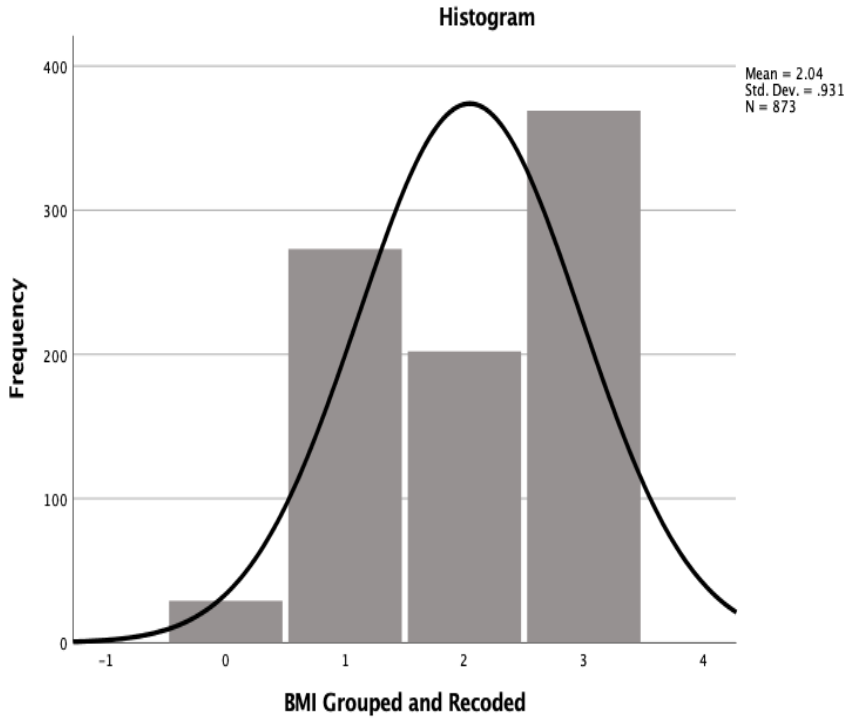

Figure 2. Normality of BMI among the GOAL cohort.

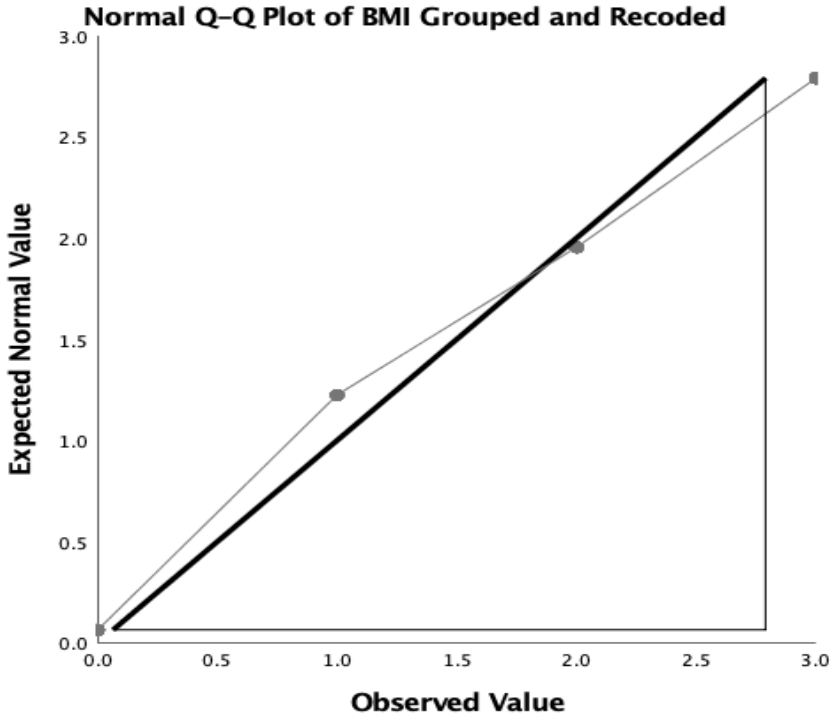

Figure 3. Normality of the distribution of the data.

As a part of the GOAL study Wave 1 survey, the participants were asked questions pertaining to their perceptions of the neighborhood in which they resided (Table 4). For each of the subfactors of the neighborhood factor, the average of the responses to the questions pertaining to that specific subfactor was calculated to describe the participants' perceptions of their neighborhoods.

Table 2

Neighborhood Survey Questions for Each Subfactor in the Analysis

Aesthetic quality	There is a lot of trash and litter on the street in my neighborhood. There is a lot of noise in my neighborhood. In my neighborhood the buildings and homes are well-maintained. The buildings and houses in my neighborhood are interesting. My neighborhood is attractive.
Walking environment	My neighborhood offers many opportunities to be physically active. Local sports clubs and other facilities in my neighborhood offer many opportunities to exercise. It is pleasant to walk in my neighborhood. The trees in my neighborhood provide enough shade. In my neighborhood it is easy to walk places. I often see other people walking in my neighborhood. I often see other people exercising (for example, jogging, bicycling, playing sports) in my neighborhood.
Healthy food	A large selection of fresh fruits and vegetables is available in my neighborhood. The fresh fruits and vegetables in my neighborhood are of high quality. A large selection of low-fat products is available in my neighborhood.
Safety	I feel safe walking in my neighborhood, day or night. Violence is not a problem in my neighborhood. My neighborhood is safe from crime.
During the past 6 months, how often:	
Violence	Was there a fight in your neighborhood in which a weapon was used? Were there gang fights in your neighborhood? Was there a sexual assault or rape in your neighborhood? Was there a robbery or mugging in your neighborhood?
People in my neighborhood:	
Social cohesion	Are willing to help their neighbors. Generally get along with each other. Can be trusted. Share the same values.

The participants in the GOAL cohort study survey Wave 5 were asked several questions in an effort to measure the presence of depression or depressive symptoms (Table 4). A score was calculated based on the answers to each of the questions, and this score was the depression score used in the analysis for RQ2. This depression score ranged from 8 to 40 (lower to higher indication of depression), with a mode of 8 (not depressed). The test for normality of the distribution of depression scores was normal but slightly skewed to the left (skewness=1.113).

Table 3

Frequencies of BMI Categories

	Frequency	%
BMI		
Underweight	29	3.3
Normal weight	270	31.0
Overweight	202	23.2
Obese	369	42.4

Table 4

Survey Questions (Feeling During the Past 7 Days) in Percentages

	Never	Rarely	Sometimes	Often	Always
Depressed	30.1	19.9	33.3	11.2	5.4
Hopeless	51.4	17.8	19.0	8.5	3.3
Not cheerful	52.4	18.3	20.0	6.7	2.6
Empty	56.4	15.2	18.2	6.7	3.5
Worthless	60.0	16.4	13.9	6.1	3.6
Unhappy	33.3	18.9	33.4	9.7	4.7
No reason to live	75.4	12.3	7.0	3.6	1.7
Uninterested	53.4	17.2	20.2	6.5	2.7

Statistical Assumptions

Ordinal logistic regression. BMI, the dependent variable, was measured at the ordinal level (underweight, normal weight, overweight, and obese), which assures that the first assumption that the dependent variable is measured at the ordinal level is met. Also, the independent variables, depression, neighborhood factors, age, gender, ethnicity, race, and educational level were a combination of continuous and categorical variables, satisfying the second assumption that one or more of the independent variables are categorical, continuous, or ordinal. The predictor variables were tested a priori to verify there was no violation of the assumptions of normality, homoscedasticity, and multicollinearity. The appendix includes tables showing assumption testing for the GOAL data set used in this analysis.

Multicollinearity. Dummy variables were created for the variables with more than two categories, so that each of the categories was treated as an individual variable (i.e., the one education level variable was transformed into three variables representing each level: (junior high/high school, graduate/professional and college university). The same was done for the race, gender, and ethnicity variables. To satisfy the assumption that there was no multicollinearity in the model, the tolerance and the VIF were accessed, and all of the variables in the model resulted in a Tolerance greater than .1 (.451 as the lowest) and a VIF of less than 10 (2.216 as the highest). These values indicated the absence of multicollinearity.

Dummy variables were created for each of the variables with more than two categories, each treated as an individual variable (i.e., the one education level variable

was transformed into three variables representing each level: (junior high/high, college/professional and college university). The same was done for the race variable. To satisfy the assumption that there was no multicollinearity in the model, the Tolerance and the VIF were consulted, and all of the variables from the model resulted in a Tolerance greater than .1 (.724 as the lowest) and a VIF of less than 10 (1.381 as the highest). These values indicated the absence of multicollinearity.

Proportional odds. The assumption of proportional odds was assessed by a full likelihood ratio test comparing the fitted model to a model with varying location parameters, $\chi 2(24) = 36.611$, $p = .048$. The difference in the model fit "Chi-square ($\chi 2$)" was small and barely statistically significant; however, the null hypothesis stating that the slope coefficients were the same across all coefficients could not be rejected.

The test statistics in the goodness-of-fit test is a measurement of the variation in the model that cannot be explained. The deviance goodness-of-fit statistic represents the difference in fit between the current and full models, therefore a non-statistically significant value for deviance is desirable. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data: $\chi 2(2,040) = 1,558.351$, $p = 1.000$, but most cells were sparse with zero frequencies in 75 % of cells, so these values were not reliable and therefore further examination was required.

Alternatively, the likelihood-ratio test served as a better method for assessing the model fit. It assesses the change in the model fit when comparing the full model to the intercept-only model. The final model statistically significantly predicted the dependent variable over and above the intercept-only model, $\chi 2(12) = 57.178$, $p < .001$. In other

words, at least one of the independent variables added statistically significantly to the model. All of the assumptions were satisfied in one way or another(consult tables in the appendix).

To test the assumption of proportional odds as assessed by a full likelihood ratio test comparing the fitted model to a model with varying location parameters, $\chi2(14) = 17.952$, $p = .209$. The difference in the model fit "Chi-square ($\chi2$)" was small and not statistically significant, so the null hypothesis that the slope coefficients were the same across all coefficients was rejected. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data: $\chi2(2,516) = 1,926.154$, $p = 1.000$, but most cells were sparse, with zero frequencies in 74.7% of cells. These values were not reliable, and therefore further examination was required. The final model statistically significantly predicted the dependent variable over and above the intercept-only model, $\chi2(7) = 63.061$, $p < .001$. In other words, at least one of the independent variables added statistically significantly to the model. All of the assumptions for ordinal logistic regression were met (relevant tables are included in Appendix A).

Logistic Regression Results

Research Question 1. By default, SPSS completed a listwise deletion of cases with missing values, resulting in ($n = 685$) valid cases included in this analysis. An ordinal logistic regression analysis to investigate whether there was an association between neighborhood factors, age, gender, education level, ethnicity, race, and elevated BMI in lupus patients was conducted. To run the analysis, the PLUM procedure was run followed by the GENLIN procedure. Using this method outputs the estimation of the

parameters of the model in the form of a table, parameter estimates, shown in Table 7. Parameter is an alternate name for the coefficients in the model. The model entails parameters that include thresholds (BMI levels) and slope coefficients (the independent variables). As there were four categories of the BMI variable, there were three cumulative logits and three equations. The GENLIN procedure automatically makes the second category the reference category in dichotomous categorical variables. The reference variables in this model were Hispanic or Latino coded "1" for the ethnicity variable; female coded "1" for the gender variable; and Not African American or Black coded "1" for the race variable. Because the Education level variable was polytomous, the reference group was Graduate Professional coded "3", which only gave two comparisons. Therefore, the Education level variable was recoded, and the reference category was Junior High/High School coded "3."

The predictor variable, neighborhood factors (five subfactors measured on a scale of 1 to 5), in the ordinal logistic regression analysis was found to make no significant contribution to the model. For the neighborhood variables; aesthetic quality ordered log-odds (Estimate) = .171, *SE* = .158, *Wald* = 3.008, *p* = .278; walking environment ordered log-odds (Estimate) = .080, *SE* = .1262, *Wald* = .400, *p* = .527; healthy food ordered log-odds (Estimate) = .-.060, *SE* = ..078, *Wald* = .592, *p* = .442; safety ordered log-odds (Estimate) = .-.025, *SE* = ..1053, *Wald* = .058, *p* = .810; violence ordered log-odds (Estimate) = -.107, *SE* = .1441, *Wald* = .554, *p* = .457; and social cohesion ordered log-odds (Estimate) = .106, *SE* = .1044, *Wald* = 1.038, *p* = .308, each for an increased level of BMI. The estimated odds ratio favored a positive relationship of approximately one-

fold increased odds of having an elevated BMI for every one unit increase of each neighborhood factor (scale); however the relationship was not significant for any of the neighborhood factors ($p > .05$). The predictor variable age (scale) in the ordinal logistic regression analysis was found to contribute to the model. The age ordered log-odds was (Estimate) = .019, *SE* = .0055, *Wald* = 12.255, $p < .001$ for an increased level of BMI. The estimated odds ratio favored a positive relationship of nearly one- fold *Exp (Estimate)* = 1.020, 95% CI (1.009, 1.031) increased odds of having an elevated BMI for every one year increase of age (scale). The predictor variable gender (nominal) in the ordinal logistic regression analysis was found to contribute to the model. The male participants (Estimate) = -0.775, *SE* = 0.2874, *Wald* = 7.271, $p < .01$. The estimated odds ratio favored an inverse relationship in which males were less likely to have an elevated BMI [*Exp (Estimate)* = 0.461, 95% CI (0.262, 0.809)] compared to the reference variable females (nominal). The predictor variable race (nominal) in the ordinal logistic regression analysis was found to contribute to the model. The African American/Black participants (Estimate) = 0.912, *SE* = 0.2011, *Wald* = 20.543, $p < .001$. The estimated odds ratio having an elevated BMI favored a positive relationship of over two- fold *Exp (Estimate)* = 2.488, 95% CI (1.678, 3.691) compared to the reference variable Not-African American/Black (nominal). The predictor variable ethnicity (nominal) in the ordinal logistic regression analysis was found not to contribute to the model. The non-Hispanic participants (Estimate) = -.024, *SE* = 0.3669, *Wald* = 0.004, $p > .05$ and did not have a significant predictive nature of BMI in this population. The predictor variable education level (nominal) in the ordinal logistic regression analysis was found not to contribute to

the model. The college/university education level had an ordered-log ratio of (Estimate) = 0.247, *SE* = 0.1758, *Wald* = 1.974, $p > .05$, and the junior high/high school level had an (Estimate) = 0.006, *SE* = 0.1832, *Wald* = 0.001, $p > .05$ compared to graduate/professional level.

A cumulative odds ordinal logistic regression with proportional odds was run to determine the effect of neighborhood factors, gender, education level, race, ethnicity, and age, on BMI. The parameter estimates (Table 5) should be referenced for the results, including the Exp(B) representing the odds, the 95% Wald Confidence Interval, and the significance of the hypothesis test for each variable.

Table 5

Parameter Estimates From the Ordinal Logistic Regression Analysis (RQ1)

Parameter		B	SE	Hypothesis test			Exp(B)	95% Wald confidence interval for Exp(B)	
				Wald Chi-square	df	Sig.		Lower	Upper
Threshold	[BMI=0]	-1.559	3.088	3.088	1	.079	.210	.037	1.197
	[BMI=1]	1.319	2.294	2.294	1	.130	3.741	.679	20.624
	[BMI=2]	2.366	7.324	7.324	1	.007	10.656	1.920	59.133
Junior high/high school		.006	.1832	.001	1	.975	1.006	.702	1.440
College/university		.247	.1758	1.974	1	.160	1.280	.907	1.807
Graduate/professional		0[a]	.	.	.	.	1	.	.
Non-Hispanic Latino		-.024	.3669	.004	1	.949	.977	.476	2.005
Hispanic Latino		0[a]	.	.	.	.	1	.	.
Black		.912	.2011	20.543	1	.000	2.488	1.678	3.691
Not Black		0[a]	.	.	.	.	1	.	.
Male		-.775	.2874	7.271	1	.007	.461	.262	.809
Female		0[a]	.	.	.	.	1	.	.
Age (years)		.019	.0055	12.255	1	.000	1.020	1.009	1.031
Aesthetic quality		.171	.1580	1.178	1	.278	1.187	.871	1.618
Walking environment		.080	.1262	.400	1	.527	1.083	.846	1.387
Healthy food		-.060	.0775	.592	1	.442	.942	.809	1.097
Safety		-.025	.1053	.058	1	.810	.975	.793	1.198
Violence		-.107	.1441	.554	1	.457	.898	.677	1.192
Social cohesion		.106	.1044	1.038	1	.308	1.112	.906	1.365

Research Question 2. By default, SPSS completed a listwise deletion of cases with missing values, resulting in (n = 856) valid cases included in this analysis. An ordinal logistic regression analysis to investigate whether there was an association between depression, age, gender, education level, ethnicity, race and elevated BMI in lupus patients was conducted. To run the analysis, the PLUM procedure was run

followed by the GENLIN procedure. Using this method outputs the estimation of the parameters of the model in the form of a table, Parameter Estimates, shown below (Table 8). Parameter is an alternate name for the coefficients in the model. The model entails parameters that include thresholds (BMI levels) and slope coefficients (the independent variables). As there are four categories of the BMI variable, there are three cumulative logits and three equations. The GENLIN procedure automatically makes the second category the reference category in dichotomous categorical variables. The reference variables in this model were Hispanic or Latino coded "1" for the ethnicity variable; female coded "1" for the gender variable; and Not African American or Black coded "1" for the race variable. As the Education level variable was polytomous, the reference group was graduate/professional coded "3." which only gave two comparisons. Therefore, the Education level variable was recoded, and the reference category was junior high/high school coded "3."

The predictor variable, depression (scale), in the ordinal logistic regression analysis was found to contribute to the model. The depression variable ordered log-odds (Estimate) = .018, SE = .009, $Wald$ = 4.506, $p < .05$ for an increased level of BMI. The estimated odds ratio favored a positive relationship of nearly one- fold *Exp (Estimate)* = 1.018, 95% CI (1.001, 1.036) increased odds of having an elevated BMI for every one unit increase of depression (scale). The predictor variable age (scale) in the ordinal logistic regression analysis was found to contribute to the model. The ordered log-odds (Estimate) = .0024, SE = .005, $Wald$ = 24.736, $p < .001$ for age. The estimated odds ratio favored a positive relationship of nearly one- fold *Exp (Estimate)* = 1.024, 95% CI

(1.015, 1.034) increased odds of having an elevated BMI for every one year increase of age (scale). The predictor variable gender (nominal) in the ordinal logistic regression analysis was found to contribute to the model. The male participants (Estimate) = -0.528, *SE* = 0.2641, *Wald* = 3.998, $p < .05$. The estimated odds ratio favored an inverse relationship in which males were less likely to have an elevated BMI *Exp (Estimate)* = 0.590, 95 % CI (0.351, 0.990) compared to the reference variable females (nominal). The predictor variable ethnicity (nominal), in the ordinal logistic regression analysis was found not to contribute to the model. The predictor variable race (nominal) in the ordinal logistic regression analysis was found to contribute to the model. The African American/Black participants (Estimate) = 0.783, *SE* = 0.1796, *Wald* = 18.987, $p < .001$. The estimated odds ratio of African Americans/Black people having an elevated BMI favored a positive relationship of over two fold *Exp (Estimate)* = 2.187, 95 % CI (1.538, 3.110) compared to the reference variable not African American (nominal). The predictor variable ethnicity (nominal) in the ordinal logistic regression analysis was found not to contribute to the model. The non-Hispanic participants (Estimate) = 0.300, *SE* = 0.330, *Wald* = 0.827, $p > .05$. The predictor variable education level (nominal) in the ordinal logistic regression analysis was found not to contribute to the model. The college/university education level had an ordered-log ratio of (Estimate) = 0..256, *SE* = 0.1674, *Wald* = 2.335, $p > .05$ and the junior high/high school level had an (Estimate) = .167), *SE* = 0.1830, *Wald* = 0.828, $p > .05$ compared to graduate/professional level. After recoding the education variable to deselect the graduate/professional level from being the reference category, creating a comparison between graduate/professional and junior

high/high school level Estimate (Estimate) = -0.167, *SE* = 0.1830, *Wald* = .828, $p > .05$, the variable was still found not to have any statistically significant contribution to the model.

A cumulative odds ordinal logistic regression with proportional odds was run to determine the effects of depression, gender, education level, race, ethnicity, and age, on BMI. The odds of lupus patients having an elevated BMI as it pertains to each variable are presented in Table 6.

Table 6

Parameter Estimates From the Ordinal Logistic Regression Analysis (RQ2)

Parameter		B	SE	Hypothesis test			Exp(B)	95% Wald confidence interval for Exp(B)	
				Wald Chi-square	df	Sig.		Lower	Upper
Threshold	[BMI=0]	-1.22	0.4404	7.673	1	0.006	0.295	0.125	0.7
	[BMI=1]	1.659	0.4184	15.731	1	0	5.256	2.315	11.934
	[BMI=2]	2.67	0.4244	39.58	1	0	14.44	6.285	33.174
Non-Hispanic Latino		0.3	0.3303	0.827	1	0.363	1.35	0.707	2.58
Hispanic Latino		0[a]	.	.	.	.	1	.	.
Black		0.783	0.1796	18.987	1	0	2.187	1.538	3.11
Not Black		0[a]	.	.	.	.	1	.	.
Junior high/high school		.167	0.183	0.828	1	0.363	1.181	0.825	1.691
College/university		0.256	0.1674	2.335	1	0.126	1.291	0.930	1.793
Graduate/professional		0[a]	.	.	.	.	1	.	.
Male		-0.53	0.2641	3.998	1	0.046	0.59	0.351	0.99
Female		0[a]	.	.	.	.	1	.	.
Depression		0.018	0.0085	4.506	1	0.034	1.018	1.001	1.036
Age in years		0.024	0.0048	24.736	1	0	1.024	1.015	1.034

To address the research questions of this study, ordinal logistic regression was employed. Depression, neighborhood factors, gender, age, race, ethnicity, and education level were the predictor variables from the research questions. Tables 7 and 8 summarize the results from the ordinal logistic regression analysis.

Research Question 1: Neighborhood factors. The ordinal logistic regression results showed that neighborhood factors were not statistically significant predictors of BMI ($p > .05$). Therefore, the null hypothesis was not rejected.

Research Question 2: Depression. The ordinal logistic regression results showed that depression was a statistically significant predictor of BMI, so they were associated ($p < .05$). Therefore, the null hypothesis was rejected.

Covariate 1: **Age**. The ordinal logistic regression results showed that age was a statistically significant predictor of BMI, so they were associated ($p < .05$). Therefore, the null hypothesis was rejected.

Covariate 2: Gender. The ordinal logistic regression results showed that gender was a statistically significant predictor of BMI, so they were associated ($p < .05$). Therefore, the null hypothesis was rejected.

Covariate 3: Education level. The ordinal logistic regression results showed that education level was not a statistically significant predictor of BMI ($p > .05$). Therefore, the null hypothesis was not rejected.

Covariate 4: Race. The ordinal logistic regression results showed that race was a statistically significant predictor of BMI, so they were associated ($p < .05$). Therefore, the null hypothesis was rejected.

Covariate 5: Ethnicity. The ordinal logistic regression results showed that ethnicity level was not a statistically significant predictor of BMI ($p > .05$). Therefore, the null hypothesis was not rejected.

Summary

Independent variables (predictors) neighborhood factors and depression along with control variables (covariates) age, gender, race, ethnicity, and education level were assessed using cumulative odds ordinal logistic regression with proportional odds to predict elevated BMI in patients with lupus. Depression, age, gender, and race were statistically significant predictors of elevated BMI, while neighborhood factors, ethnicity, and education level were not statistically significant predictors. In Chapter 5, the findings will be presented in the form of interpretations. In addition limitations of the study and recommendations for future research will be discussed.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to determine whether there is an association between neighborhood factors and BMI and an association between depression and BMI in patients with lupus. The differences examined were between African Americans and other race groups, Hispanic/Latinos and non-Hispanic/Latinos, men and women, different education levels, and different ages. Confirming that there is an issue with elevated BMI in the lupus population, prior studies reported that 30–50% of SLE patients are obese (Katz et al., 2011). Several researchers have examined the relationship between neighborhood factors and BMI, as well as depression and BMI. However, there are limited studies that have defined neighborhood factors and depression in the manner that this investigation has, specifically in the lupus population.

The nature of this study entailed hypotheses testing using a cross-sectional quantitative approach. The first null hypothesis was that there is no association between neighborhood factors, elevated BMI, age, gender, race, ethnicity, and education level in patients with lupus. The second null hypothesis was that there is no association between depression, elevated BMI, age, gender, race, ethnicity, and education level in patients with lupus. Secondary data from the GOAL cohort study were used to assess these relationships. The dependent variable used was BMI, and the independent variables were neighborhood factors, depression, age, gender, race, ethnicity, and education level. I used SPSS Version 25 software to run an ordinal logistic regression to determine the statistical significance of the relationship between these variables. The results from the analysis

were that depression, race, age, and gender are significant predictors of elevated BMI. However, neighborhood factors, education levels, and ethnicities in this study did not have a statistically significant association with BMI. This chapter will include a detailed discussion of the findings from this research. The limitations and recommendations for future research will also be discussed, as well as implications for social change.

Interpretation of the Findings

Hypotheses Testing Findings

According to this research, neighborhood factors are not predictive of elevated BMI in lupus patients. Putrik et al. (2015) reported that a lower prevalence of obesity and overweight was associated with more favorable neighborhood qualities and aesthetics in older adults in a Dutch municipality. The data and results from this study did not suggest the same association among adults with lupus in Georgia. Walkability has been described as a characteristic of the built environment, and the physical environment has been found to contribute to physical activity and overweight/obesity (Hoehner et al., 2011). Unexpectedly, the prevalence of obesity was higher in individuals in the most walkable environments compared to those in less walkable environments (Frank et al., 2007). This supports the findings of this study, in which neighborhood walkability was not a significant predictor of BMI in lupus patients. Diet often plays a role in an individual's weight. Decreased obesity and healthier diets have been linked to the presence of supermarkets and the availability of healthier food options in the neighborhood (Auchincloss et al., 2013; Sallis & Glanz, 2009). Access to healthier food options versus unhealthier food options was inconsistently related to obesity (Black & Macinko, 2008).

Aligning with this inconsistency, in the current study, I did not find a statistically significant association between BMI of lupus patients and the availability of healthy food. In addition, while neighborhood safety and violence tend to constrain participation in physical activity in a neighborhood among groups known to exhibit greater anxiety about crime, there is inconsistency in the evidence, as researchers have reported no association between physical activity and safety or crime (Foster & Giles-Corti, 2008), Supporting this inconsistency, BMI was not predicted by safety or violence in the current study. Neighborhood factors have been linked to higher disease activity in lupus patients, and social interaction can encourage involvement in neighborhood activities (Abdul-Sattar & Abou El Magd, 2017; Jun & Hur, 2015). BMI was not associated with social cohesion or built environment in participants from Perth, Western Australia (Christian et al., 2011). Similarly, social cohesion did not predict elevated BMI in lupus patients in Georgia in the current study. The null hypothesis was not rejected in the test of an association between neighborhood factors and elevated BMI in the lupus population in this study.

I found that the association between depression and elevated BMI is statistically significant in patients with lupus in Georgia. These findings support previous researchers who found high levels of depressive symptoms in obese women with lupus (Katz et al., 2011; Patterson et al., 2019). My findings are aligned with the findings that decreases in cognitive function, quality of life, and functional capacity are associated with increased BMI or obesity, as well as physical inactivity (Katz et al., 2012; Rizk et al., 2012) and the

finding that the implementation of physical activity leads to a significant reduction of depressive symptoms in SLE patients (Bogdanovic et al., 2015).

Depression is a generally overlooked subject, especially when studying the lupus population. A few studies have studied depression in the lupus population, but not in the context of elevated BMI. In the few studies focusing on depression and obesity in the general population, findings were that depression is predictive of obesity (Luppino et al., 2010). This was also the case in the current study in which the population of interest was the lupus population. Depressive symptoms are among the most unfavorable health outcomes in patients with lupus; however, the reasons for these outcomes are unclear (Patterson et al., 2019). Depression is the most common mental disorder in SLE patients and has been linked to impaired immune function and fatigue (Figueiredo-Braga et al., 2009; Fonseca et al., 2014; Palagin et al., 2013). Extending the discussions about depression in the SLE population, my results provide some insight into how important depression is in the lupus population in terms of contributing to elevated BMI. The results of this study extend the knowledge about depression and elevated BMI in the lupus population, clarifying that there is an association between the two. Also, depression remains predictive of elevated BMI, even when age, gender, and race are controlled for in the model.

I found that the association between depression elevated BMI is statistically significant in lupus patients from Georgia. As depressive symptoms increased, the likelihood of an elevated BMI increased. Age is a statistically significant predictor of BMI in patients with lupus from Georgia. As age increased, the odds of having an

elevated BMI increased. In line with past research findings that the ratio of SLE incidence in female to male adults is 7-15:1 (Gergianaki et al., 2018), the population of the current study was comprised of 93% women. Women with lupus are more likely to experience issues with their BMI when compared to men with lupus. African Americans are well represented in the lupus population included in this study. This aligns with research that reported the incidence of SLE to be five to nine fold higher in African Americans than in other racial groups (Lewis & Jawad, 2017). African Americans are at an increased odds of having an elevated BMI in the lupus population (Costenbader et al.,), and that was verified in the current study.

Depression can cause individuals to feel drained or fatigued and not have any energy or drive to participate in activities of normal everyday living. This alone could possibly pose a key risk for elevated BMI, being that most activities require physical output and energy expenditure, without which weight gain is likely to occur. Depression and its debilitating nature causes individuals to withdraw from others and become isolated and in many cases increases appetite or the desire to eat. The combination of the side effects of depression lead to weight gain and elevated BMI. Individuals with lupus experience extreme pain and fatigue. Being limited in completing everyday tasks and having to depend upon others could result in depression or depressive symptoms. Thus, the effects of both lupus and depression can lead to increased BMI.

It has been shown that elevated BMI or obesity is faced by 30% or more of the lupus population (NRCL, 2019). In the current study, 23.3 % and 42 % of the sample population were overweight and obese, respectively. Race is a vital health determinant

that contributes to the frequency and progression of chronic disease, and African Americans have a five- to- nine- fold increased incidence of SLE when compared to Caucasians (Lewis & Jawad, 2017; Gergianaki et al., 2018). Expectedly, 81.5% of the SLE population included in the current study was African American.

Theoretical Framework and Research Findings

My findings aligned with the employed framework, the bioecological model. The model suggests that an individual's behavior is influenced by their immediate environment. According to the hypotheses, an individual's BMI is influenced by their neighborhood features as well as by their psychological standing. The bioecological model considers both physical and social environments as determining factors or contributors to health. In the current study, the neighborhood or residential physical environment were not contributors to weight in the lupus population. However, the presence or lack of depression could be used to predict the weight status of lupus patients. As mentioned by Katz et al., (2011), chronic inflammation, a key feature of lupus, affects body composition and metabolism. As mentioned in the review of literature, depression also encourages inflammation. Therefore, when lupus patients are experiencing depression, the body is undergoing a double threat of inflammation, explaining their increased weight.

Limitations of the Study

The data set used in this analysis was limited to adults with lupus in Georgia. This may affect the generalizability of this study to other areas. The data were collected prior to the current study for other purposes; therefore, this limitation was not controllable in

the current study. The original study used a self-reporting approach, which makes it possible that the participants were not completely honest, either intentionally or non-intentionally, throughout the survey. It is notable that the questions were explained or written in layman's terms, so the participants were likely to have had a clear understanding of what was being asked. Also, the data were collected longitudinally heightening the risk of dropouts.

In the statistical analyses of the hypotheses, there were several cells with zero frequencies, requiring that the goodness-of-fit measures be considered with suspicion. Also, for the neighborhood subfactors, the patients were asked very specific questions that were measured on a Likert scale from 1 to 5 and then averaged. The questions may or may not have been worded or scored in a way to gain a true value because the questions were quite generic and did not ask any personal feelings about their perceptions. For example, one of the questions asked "was there a sexual assault or rape in your neighborhood?", but the answer may have been different if the question asked was "was there a sexual assault or rape in your neighborhood that has made you fearful to go outside or engage in activities?". Another limitation is that the cohort of participants were all from the same city in GA, increasing the likelihood that they had similar neighborhood features and perceptions.

Recommendations

The results from this study should be used in the effort towards improving the health outcome and quality of life of individuals that are diagnosed with lupus. There is a need for innovative knowledge regarding the lupus populations from other geographical

locations, because the subjects in the current study were all from the same city in Georgia. Therefore, extending this study to other areas is appropriate. Also, other factors should be taken into consideration as possible predictors of elevated BMI that over half of the lupus population is faced with. This study should also be applied to children to determine if the same relationship among the variables exists. Future researchers could use this study as a guide to identify other neighborhood factors or other psychological disorders that may be predictors of elevated BMI. Other physical environments to which individuals with lupus are exposed, such as work or school environments, should be investigated to determine whether they are predictors of BMI. Also, depression and lupus may have a bidirectional relationship; therefore, future research should consider whether lupus causes depression. There is a need for more research studies in the lupus population to determine which specific factors contribute most to the poor health outcomes experienced by the group. As African Americans are the most affected by lupus, and race is a predictor of BMI, it is vital that future research investigate the genetic and environmental factors that may be contributing to this disparity. Lupus is complex and very taxing on the body, yet the subject is under researched.

Implications for Social Change

The findings from this research study provide substantial evidence-based information concerning the lupus population in Georgia. Several educational/informative programs are underway in the state of Georgia to promote healthy and improved behavior among this population. The targeted behaviors are those that are modifiable and that support or promote a healthy weight/body mass composition. These will and should

include increased physical activity, meditating, practicing yoga, seeking counseling, eating healthier diets, and having positive relationships. Furthermore, public health practitioners and other professionals should encourage and develop new policies that will enforce routine mental check-ups in the lupus population to aid in providing better disease coping strategies for the lupus patients. These strategies could include, but are not limited to, meditation groups, yoga sessions, or periodic counseling for lupus patients. From the findings provided by the current study, policy makers should have rationale to develop more opportunities for the lupus population to have access to mental health professionals to aid in their fight against the development of depression. Health campaigns and research that already exist can benefit from the current study, because the findings highlight that depression, age, gender, and race are associated with elevated BMI. Already existing lupus focused entities should use this research as a rationale or justification for zoning in on the mental or psychological state of lupus patients.

Conclusion

Elevated BMI reflects overweight or obesity and is a common disease among the lupus population. Poor diet, physical inactivity, genetics, or poor health habits are likely at the center of the development of elevated BMI. This quantitative research focused on how neighborhood factors and depression, along with, age, gender, race, ethnicity, and education level, are associated with BMI in individuals with lupus in Georgia. This study was prompted by the gap in the literature that failed to make a connection or attempt to connect the aesthetic quality, walking environment, availability of healthy food, safety, violence, and social cohesion of neighborhoods, and the presence of depression to the

weight issue often seen in the lupus population. Prior studies have been inconsistent in findings about whether neighborhood factors are linked to obesity. While some studies found an association between neighborhood factors and obesity, they were investigating populations outside of the lupus population and using different ways of wording the questions. Depression had not been investigated in a population of individuals with lupus to determine if there was an association with obesity.

The findings of the current study supports Luppino et. al (2010) and their argument about the importance of monitoring moods and detecting early signs of depression. It is vital to detect mood changes and signs or symptoms of depression in lupus patients early on. This could aid in eliminating depression before it fully develops, offering a better hold on weight and other issues that may be related to depression. Physical activity is known to have an obvious, significant impact on weight issues. It has been proven to prevent long-term consequences of SLE, including obesity, yet 70% of SLE patients report sedentary lifestyles (Bogdanovic et al., 2015). Psychological differences, as seen in the form of depression in the current study, could contribute to the physical differences among populations.

Depression was a significant predictor of BMI among the lupus patients in the current study. This depression could be the cause of withdrawal and declines in physical activity, positive relationships, social interactions, and other activities, which may lead to weight issues. Depression affects up to 50% of the lupus population and has been linked to obesity and inflammation (Palagini et al., 2013; Byrne et al., 2015). The inflammatory feature of depression may also lead to weight issues among lupus patients. Although

neighborhood factors were not a significant predictor of BMI in the current study, they may be associated when considering other subfactors besides the ones included in the current study. Also, it is plausible that emotional responses, such as being fearful about crime in their neighborhood, might reveal more consistent associations with physical activity or BMI (Gosti and Giles-Corti, 2008). If their perception is that there is high crime in their neighborhood, but they are not fearful about the crime, they may still engage in physical activity, thus explaining the lack of association to BMI in this study. As stated by Lopez (2007), it is difficult to study complex health issues that involve individual and neighborhood factors. Trupin et al. (2008) suggested that future research examine the differences in weight between individuals with different neighborhood socioeconomic statuses (SES). The lupus population participants in the current study likely had the same or similar SES, because they were all from the same city.

Some of the recommendations stemming from the findings of the current study are that policy makers advocate and develop protocols for an increase in psychological counseling, especially among those with chronic or long-term illnesses. Healthcare providers could intervene and consult their patients more often and earlier in an effort to determine whether the patient has or is developing depressive symptoms. This will allow for referrals to counseling or other means of controlling depression. Also, healthcare providers could recommend physical activity and healthier diets to their patients, especially when depression or weight becomes an issue. Interventions should be developed targeting individuals with lupus to provide support and education for all aspects relative to the disease and its health outcomes. The social change implications

from the current study would result in a decrease in the prevalence of depression and obesity in the lupus population. This would lead to a decrease in the associated healthcare costs and an improvement in the health-related quality of life among lupus patients and their families.

The bioecological model posits that an individual's health is a result of their environment and interactions. As mentioned, depression represents the individual's immediate environment, the microsystem, which leads to a change in the psychological and biophysical state of the body. The findings of the current study are novel in illustrating that depression is a key factor in predicting BMI among individuals with lupus in Georgia.

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Appendix A: Tables

Research Question 1 (Wave 1)

Table 7

Coefficients of the Model (Multicollinearity) From Wave 1

Model		Collinearity Statistics	
		Tolerance	VIF
1	Age (years)	.896	1.116
	Aesthetic Quality	.845	1.184
	Walking Environment	.503	1.988
	Healthy Food	.650	1.538
	Safety	.451	2.216
	Violence	.590	1.694
	Social Cohesion	.543	1.843
	Activity	.600	1.665
	Gender	.977	1.023
	Race	.785	1.274
	Junior High / High School	.708	1.413
	College / University	.756	1.323
	Ethnicity	.832	1.203

Table 8

Test of Parallel Lines (Proportional Odds)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	1,558.351			
General	1,521.740	36.611	24	.048

Table 9

Goodness-of-Fit (Proportional Odds)

	Chi-Square	df	Sig.
Pearson	2,259.920	2,040	.000
Deviance	1,558.351	2,040	1.000

Table 10

Model-Fitting (Full Model Versus Intercept-Only Model)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1,614.530			
Final	1,558.351	56.178	12	.000

Hypothesis 2 (Wave 5)

Table 11

Coefficients of the Model (Multicollinearity) From Wave 5

Model		Collinearity Statistics	
		Tolerance	VIF
1	Race	.848	1.179
	College University	.744	1.344
	Graduate/Professional	.724	1.381
	Gender	.983	1.017
	Age (years)	.958	1.044
	Depression	.964	1.038
	Ethnicity	.871	1.148

Table 12

Test of Parallel Lines (Proportional Odds)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	1,940.252			
General	1,922.300	17.952	14	.209

Table 13

Goodness-of-Fit (Proportional Odds)

	Chi-Square	df	Sig.
Pearson	2,654.836	2,516	.027
Deviance	1,926.154	2,516	1.000

Table 14

Model-Fitting (Full Model Versus Intercept-Only Model)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2,003.313			
Final	1,940.252	63.061	7	.000

Appendix B: Data Use Agreement

DATA USE AGREEMENT

This Data Use Agreement ("Agreement"), effective as of April 1, 2020 ("Effective Date"), is entered into by and between Aisha Hill ("Data Recipient") and GEORGIANS ORGANIZED AGAINST LUPUS (GOAL) COHORT STUDY IRB#3656. ("Data Provider"). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research in accord with the HIPAA and FERPA Regulations.

1. Definitions. Unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the "HIPAA Regulations" codified at Title 45 parts 160 through 164 of the United States Code of Federal Regulations, as amended from time to time.

2. Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable HIPAA or FERPA Regulations.

3. Data to be included in the LDS. **No direct identifiers such as names may be included in the Limited Data Set (LDS).** The researcher will not name the Data Provider in the doctoral study that is published in Proquest unless the Data Provider makes a written request for the researcher to do so. In preparing the LDS, Data Provider or designee shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research, Wave 1 (neighborhood factors variables / survey questions, Wave 5 (depression factor variables / questions) including gender, age, weight, height, BMI, education level, race, and ethnicity.

4. Responsibilities of Data Recipient. Data Recipient agrees to:

a. Use or disclose the LDS only as permitted by this Agreement or as required by law;

b. Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

c. Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

d. Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

e. Not use the information in the LDS to identify or contact the individuals who are data subjects.

5. Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS for its research activities only.

6. Term and Termination.

a. Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

b. Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

c. Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

d. For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

e. Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

7. Miscellaneous.

a. Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

b. Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

c. No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

d. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

e. Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER **DATA RECIPIENT**

Signed: S. Sam Lim

Print Name: S. Sam Lim

Print Title: Professor of Medicine
Emory University

Signed: Aisha Hill

Print Name: Aisha Hill

Print Title: Research Specialist, PhD Student