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Poverty, Food Insecurity, and Obesity Among Urban and Rural Populations

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Walden University
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Abstract

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MS, Mississippi Valley State University, 2002

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Dissertation Submitted in Partial Fulfillment

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Abstract

Over 17 million food-insecure households are associated with increasing obesity rates across the United States. Although food insecurity and obesity are distinct social concerns, the two are linked and may be influenced by poverty and geographic location. Public health authorities and state leaders responsible for the health and nutrition of rural populations in particular would benefit from this information. The purpose of this quantitative cross-sectional study was to examine whether poverty mediated the relationship between food insecurity and obesity among urban and rural adults. The study was guided by the poverty, food insecurity, and obesity conceptual framework. The study addressed the association between poverty and food insecurity, poverty and obesity, and food insecurity and obesity. Records from 9068 participants in the 2012 Behavioral Risk Factor Surveillance System (BRFSS) were weighted to represent the population of Louisiana. Logistic regression models indicated that individuals living in poverty were 6 times more likely to experience food insecurity and that living in poverty and being food insecure doubled the odds of being obese. Poverty mediates the relationship between food insecurity and obesity in a dynamic and complex manner. Findings also indicated gender and age differences in rates of obesity, poverty, and food insecurity, as well as higher rates of obesity in rural populations. Social change implications include providing additional evidence of how poverty affects food insecurity and obesity, which may encourage states with high poverty rates to initiate food insecurity surveillance using BRFSS to reduce obesity.

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Dedication

"I know what I'm doing. I have it all planned out—plans to take care of you, not abandon you, plans to give you the future you hope for." Jeremiah 29:11

I dedicate this dissertation to God, who has been with me in every step of this journey and has given me the strength to continue until the end. I would not have finished this course without the favor, grace, love, and wisdom of God. I also dedicate the dissertation to my loving husband, Travis Walls, and my children, Travis Jr., Treasure, and Trevor, who have endured this journey with me. They have supported me, even when it meant sacrificing time together. They were by my side, day by day, inspiring me to continue and finish it. I also want to dedicate it to my parents, Joseph and Dorothy, who always believed in me and in my dreams, kept the children without any reservations, and taught me that I can do all things through Christ who strengthens me.

Acknowledgments

"And though your beginning was small, your latter days will be very great." Job 8:7

Many people helped me during this process. I would like to thank all of them sincerely. First, I want to thank God for all the blessings in my life. Second, I would like to thank my husband, Travis, for his unconditional support, and my children, Travis Jr., Treasure, and Trevor, for their patience and continued encouragement during these years. I also want to thank my parents (Joseph and Dorothy Ivory), sisters (Turila, D'Otra, and Dorothy Vanessa), and my parents by love (John and Ora Walls) for understanding and supporting me during this process. God blessed me with great friends and family who were always there to provide prayer, wise counsel, and reassurance.

My heartfelt thanks go to my committee members, Dr. Lorreta Cain and Dr. Diana Naser, for their insight into this study. Special thanks to my chair on this project, Dr. Mary Lou Gutiérrez. Her guidance, assertive recommendations, and continued support were crucial in accomplishing my goals.

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Chapter 1: Introduction to the Study

The attention public health officials have paid to the obesity epidemic is far from cosmetic because of the threat to public health. The complex consequences of obesity affect the health of individuals including their physical, social, and mental well-being. The health outcomes and inequalities of obesity are documented and impose a monetary challenge on health care finances in the United States (CDC, 2015). Historically and in some cultures, high fatty food consumption is a well-established and accepted dietary and traditional practice; however, research evidence supports further insight regarding this behavior (Boyington et al., 2008).

Research shifted from addressing the outcomes to providing attention to prevention measures. To understand obesity, attention to its risk factors is vital. Obesity is a chronic disease caused by the imbalance between food intake and energy output (Drewnowski & Specter, 2004). Adequate food is often scarce in segments of the United States (Beaulac, Kristjansson, & Cummins, 2009). Socioeconomic status, geographic location, age, education, and ethnicity are other factors that may increase the risk for obesity (Pampel, Krueger, & Denney, 2014; Piontak & Schulman, 2014; Wang, McPherson, March, Gortmaker, & Brown, 2011). Many people living in impoverished areas are at risk for food insecurity (Piontak & Schulman, 2014); however, the assumption that they are all food insecure is not true. There is no direct path from poverty to obesity because there are other factors to consider.

In this study, I examined the independent and combined impact of poverty on food insecurity and obesity among adults in Louisiana. It was important to study the relationship between food insecurity and obesity among the adult population because of the mixed results of previous studies and the steady increase of obesity in the United

States. According to the Behavioral Risk Factor Surveillance Survey (BRFSS), the prevalence of obesity remains high among adults in the United States (CDC, 2015). Obesity prevalence estimates from self-reported BRFSS data indicate that in 2011 through 2014 several states in the South had a prevalence of obesity above 30% (Figures 1, 2, 3, and 4). In 2014 Mississippi and West Virginia had the highest prevalence of obesity among adults (≥ 35.0%), and the remaining states had an obesity prevalence of 20% or higher (BRFSS). The research gap indicated the need to document the relationship between poverty, food insecurity, and obesity in a state with high prevalence of obesity. Study findings can promote social change by informing program intervention strategies that may reduce the burden of obesity in states with high rates of poverty and obesity.

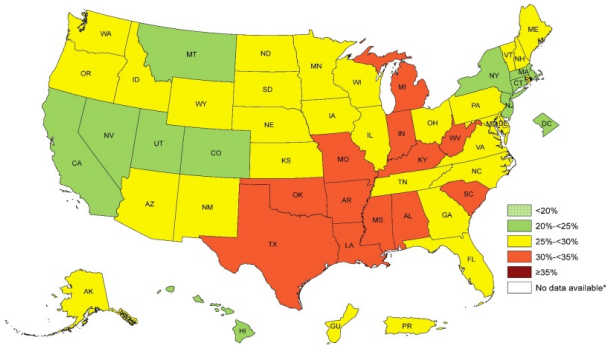

Figure 1. Self-reported obesity prevalence among U.S. adults by state and territory, BRFSS, 2011
Source: Behavioral Risk Factor Surveillance System
https://www.cdc.gov/obesity/data/prevalence-maps.html

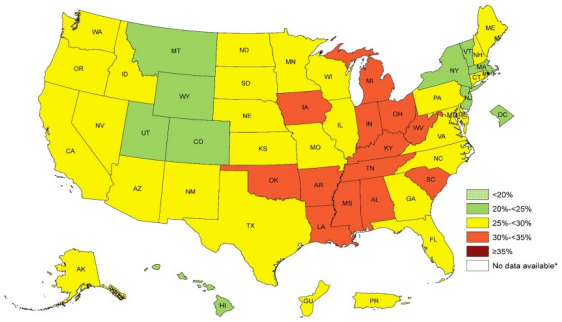

Figure 2. Self-reported obesity prevalence among U.S. adults by state and territory, BRFSS, 2012
Source: Behavioral Risk Factor Surveillance System
https://www.cdc.gov/obesity/data/prevalence-maps.html

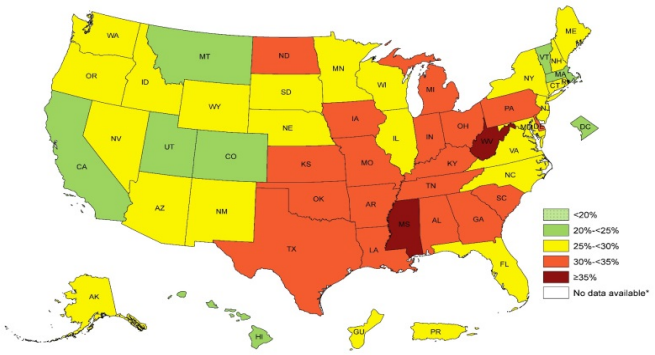

Figure 3. Self-reported obesity prevalence among U.S. adults by state and territory, BRFSS, 2012
Source: Behavioral Risk Factor Surveillance System
https://www.cdc.gov/obesity/data/prevalence-maps.html

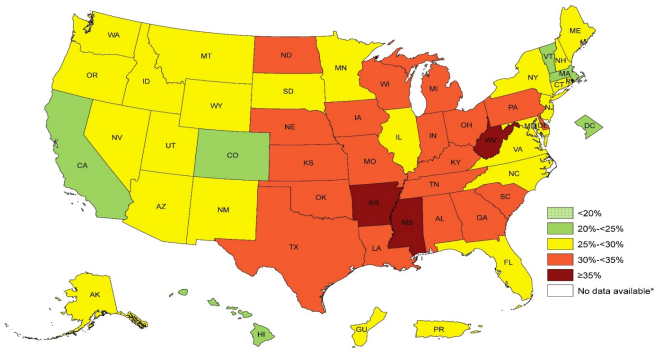

Figure 4. Self-reported obesity prevalence among U.S. adults by state and territory, BRFSS, 2014
Source: Behavioral Risk Factor Surveillance System
https://www.cdc.gov/obesity/data/prevalence-maps.html

Chapter 1 presents an introduction to the study, including a description of the problem and significance of the study, key terms, and conceptual framework. Key terms are defined to provide a clear understanding of the issue and operationalization of the variables. The conceptual framework is described to provide a basis for the research and hypotheses. Chapter 1 concludes with the identification of the limitations and delimitations of the study.

Background of the Study

Obesity poses a major public health concern in the United States due to the increased risk associated with multiple chronic diseases. The Centers for Disease Control and Prevention (CDC, 2015) reported that more than 52% of the population is overweight, and another 42% is obese. The Robert Wood Johnson Foundation (RWJF, 2013) projected that half of the adult population will be obese by 2040. Given the obesity epidemic in the United States, there is a growing concern for understanding factors related to availability, utilization, and access to adequate foods (Moore, Diez-Roux, Nettleton, & Jacobs, 2008). Obesity prevalence has progressively increased presenting a burden of disease and disability (Dixon, 2010).

Health outcomes are associated with the economic and quality of life burden in the United States. Obesity-related health care costs are estimated to be $210 billion per year, or 21% of the total national health care budget (RWJF, 2013). In 2008, the estimated annual medical cost of obesity in the United States was $147 billion. The medical costs for people who were of normal weight were $1,429 lower than for people who were obese (CDC, 2015). Wang et al. (2011) reported that the higher the percentage of the population that is obese or overweight, the greater the utilization of health care services, which yields higher treatment costs for many obesity-related illnesses. Obesity

trends vary by income and education level, race and ethnicity, and geographic location (Befort, Nazir, & Perri, 2012). Estimating costs from health consequences of obesity is multifaceted. Food systems, changing demography, and the economy are mediating factors in estimating the costs.

Food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Campbell, 1991, p. 409). Food insecurity is widespread and highly prevalent in the United States and worldwide (United States Department of Agriculture [USDA], 2011). Food insecurity can lead to hunger, undernutrition, and over nutrition, which in turn can lead to obesity (Fernandez, Caillet, Lhuisser, & Chauvin, 2014). In 2010, approximately one-third (78.6 million) of the U.S. population was obese (CDC, 2014).

Global food production has nearly tripled in the last half century, yet food insecurity persists. Global increases in food output consistently surpassed population increases. Factors such as socioeconomic status, food systems, food availability, and dietary intake may directly influence the relationship between food insecurity and obesity (Befort et al., 2012; Connell et al., 2007; Freedman & Bell, 2009). Food production does not seem to be the problem as much as poverty (Food and Agriculture Organization of the United Nations [FAO], 2014).

Poverty increased significantly in the U.S. population from 2008 to 2012. According to the U.S. Census Bureau, in 2012 more than 16% of the U.S. population lived in poverty, compared to 13.2% (39.8 million) in 2008. Poverty is a problem in rural populations, and food insecurity is a significant and growing concern in rural and urban

populations. Poverty may have a direct influence on food insecurity in rural and urban areas.

Food insecurity is a measure of food deprivation related to several factors including geography, behavior, sociodemographic factors, and the economy. The CDC (2014) noted a significant increase in the prevalence of obesity in rural areas and speculated the increase in obesity is associated with an increase in food insecurity. Gundersen (2013) agreed that ddemographic and socioeconomic factors such as income and unemployment are associated with food insecurity. Fernandez et al. (2014) examined whether food insecure individuals were obese due to the increased tendency for individuals to purchase inexpensive, calorie-dense foods, or whether scarcity increased the tendency of these individuals to overeat. Futhermore, Markwick, Ansari, Sullivan, and McNeil (2014) proposed an association between social indicators (lower income, less education, lack of employment) and food insecure households.

Although obesity is a national challenge, obesity occurs at higher rates in rural areas. Befort et al. (2012) indicated that rural populations are disproportionately impacted by obesity and poverty. The Rural Assistance Center (RAC, 2014) identified specific challenges that are common among rural populations: limited transportation and availability of healthy foods, lack of public health funding and infrastructure, barriers to access, and environmental physiognomies, meaning characteristics.

Impoverished, food insecure and low-income households are vulnerable to obesity (Food Research and Action Center [FRAC], 2011). Food insecure households involuntarily shift to coping strategies depending on the time of the month or availability and access to healthy foods (Gundersen & Ziliak, 2014). In many studies, food insecurity and obesity were positively associated in women (Martin & Ferris, 2007; Wilde &

Peterman, 2006). Gundersen and Ziliak (2014) also found a positive association between food insecurity and overweight and obese children.

Household type, size, and complexity as well as income and race/ethnicity are associated with food insecurity. Single parent homes, the number of children, unpredictable household income, and complexity of household composition have been identified as factors that increase the likelihood of food insecure children and health problems (Gundersen & Ziliak, 2014; Olson, 1999; USDA-ERS, 2014). Mothers in households where food security is very low are more likely to be depressed compared to mothers in low-food-secure or food-secure households (Gundersen & Ziliak, 2014). Food insecurity has a disproportionate impact on rural households and lower income households (Food Research and Action Center, 2010). Low-income and minority populations are disproportionately affected by obesity and food insecurity (Freedman & Bell, 2009). Because obesity is a risk factor for many chronic conditions and is prevalent in rural populations (Befort et al., 2012), the association between food insecurity and obesity should be investigated, especially in underserved, at-risk populations (Befort et al., 2012; Drewnowski & Specter, 2004).

Problem Statement

Food insecurity is multifaceted, encompassing levels of food availability, access and choice, dietary habits, and diet quality (Rutten et al., 2010). Food insecurity is also associated with adverse adult health outcomes and linked to poverty (Leung, Epel, Ritchie, Crawford, & Laraia, 2014; USDA-ERS, 2014). Food insecurity is a growing public health concern that may lead to hunger, undernutrition, and over nutrition, which in turn can lead to obesity (Fernandez et al., 2014). Sarlio-Lahteenkorva and Lahelma (2001) examined the relationship between economic disadvantage, obesity, and food

insecurity. They noted that food insecurity is a complex issue associated with fear and experiences of food restriction affecting the quality of diet and eating behavior. Regular food restrictions may cause households to revert to coping strategies eating high-fat foods (Sarlio-Lahteenkorva & Lahelma, 2001).

Although researchers have shared some insight on the determinants of obesity, Gundersen and Ziliak (2014) called for further investigation of factors involving food access and sociobehavioral factors to improve public policies and interventions. Ross and Hill (2013) argued that without evidence-based results, a conclusion may be reached that food insufficiency and body weight are negatively associated; however, Ross and Hill concluded the opposite: Chronic stress such as economic hardship may be associated with increased body weight. On the other hand, Rutten et al. (2010) concluded that there appear to be mixed and contradictory results regarding the relationship between food insecurity and obesity and factors associated with the suggested relationship. Rutten et al. identified the need for further investigation of the complex relationships between poverty, food insecurity, and obesity across urban and rural contexts and ethnic groups. The relationship between poverty and food insecurity, and food insecurity and obesity, has been studied; however, limited data exist on the relationship between food insecurity and obesity with a direct and indirect influence of poverty (Rutten et al., 2010). The influence of poverty on the food insecurity and obesity association remains to be studied.

Purpose of the Study

The purpose of this study was to investigate the mediating role of poverty on the associations between food insecurity and obesity among adults who were surveyed in the 2012 Louisiana BRFSS (LA-BRFSS). An increase in obesity and the number of food

insecure households, coupled with the projected increase in adults with poor health outcomes, constitute a complex, poorly investigated area of study (Rutten et al., 2010). In this study, the independent variables were poverty and food insecurity, and the dependent variables were food insecurity and obesity.

Research Questions and Hypotheses

Research Question 1. Is poverty associated with food insecurity among adults?

Ho1: There is no association between household poverty and food insecurity among adults.

Ha1: There is an association between household poverty and food insecurity among adults.

Research Question 2. Is poverty associated with obesity among adults?

Ho2: There is no association between household poverty and obesity among adults.

Ha2: There is an association between household poverty and obesity among adults.

Research Question 3. Is food insecurity associated with obesity among adults?

Ho3: There is no association between food insecurity and obesity among adults

Ha3: There is an association between food insecurity and obesity among adults.

Research Question 4. Does poverty mediate the relationship between food insecurity and obesity among adults?

Ho4: Poverty does not mediate the relationship between food insecurity and obesity among adults.

Ha4: Poverty does mediate the relationship between food insecurity and obesity among adults.

Conceptual Framework

The study was guided by the poverty, food insecurity, and obesity conceptual framework developed by Rutten et al. (2010). The intent of Rutten et al. was to identify and describe the factors that contribute to the interplay between obesity, food insecurity, and poverty, as shown in Figure 5. Rutten et al. described poverty as the broad environmental, social, and political context for food insecurity; obesity as excess body fat, as measured by BMI; and food insecurity as not having access to enough food for all household members at all times.

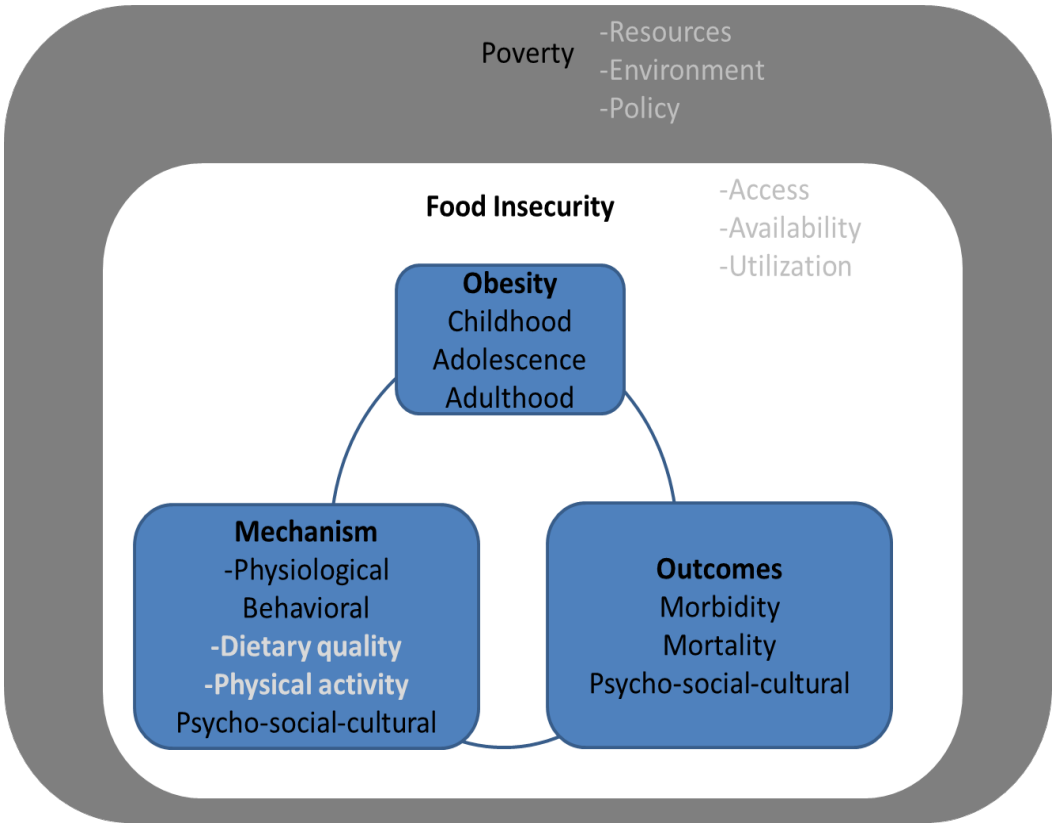

Figure 5. Conceptual framework: poverty, food insecurity, and obesity. Rutten, L.F. et al. (2010). Poverty, food insecurity, and obesity: A conceptual framework for research, practice, and policy. *Journal of Hunger and Environmental Nutrition, 5(*4), 403-415. doi:10.1080/19320248.2010.527275. *Adapted with permission* (Appendix B).

Nature of the Study

The nature of this study was quantitative. A cross-sectional research design was selected to answer the research questions addressing the association between food insecurity, obesity, and poverty among adults in Louisiana. An advantage of a cross-sectional study design is that it allows for the simultaneous comparison of multiple variables. Data collected from the 2012 LA-BRFSS on noninstitutionalized adults living in Louisiana were used for this study. The BRFSS participants are selected using random digit dialing and a multistage cluster probability sampling design to select households. One adult from each household was selected to complete the telephone interview. States weigh data by age, sex, and ethnicity/race of population distribution, including the probability of respondent selection to produce data representing the entire state population. The BRFSS is a cross-sectional telephone survey with a long history of behavioral and chronic disease surveillance. The methodology is discussed in more detail in Chapter 3.

The independent variables were food insecurity and poverty. The dependent variables were food insecurity and obesity. Obesity was measured by the body mass index (BMI) and a binomial variable was derived to classify participants as obese and nonobese. Poverty was measured using household income (less than $25,000 vs. $25,000 or greater) matching U.S. definitions of poverty, and food insecurity was measured as a binomial variable (yes/no) using the BRFSS supplemental Social Context Module. The inferential analyses were controlled for age, race, sex, and urbanicity covariates. The Statistical Analysis System (SAS) version 9.2 was used to perform cross tabulations and logistic regression. To determine whether the distribution of BMI was normal or skewed the quartile distribution was examined.

Definition of Terms

Body mass index (BMI): A reliable measure of body fat calculated using the weight in kilograms divided by the height in meters squared (Stunkard & Wadden, 1993).

Food insecurity: refers to multiple occasions of disrupted eating patterns or reduced food intake of all members of a household because of limited purchase power or other limited resources. The United States Department of Agriculture's Economic Research Center assigned labels to the ranges of food security and food insecurity, whether it is individual, household, or community level. Both low food security and very low food security are included in food insecurity (USDA, 2015).

High food security: Not having any documented indications of limited food access (USDA, 2015).

Marginal food security: Having at least one but no more than two documented indications specific to stress over household food sufficiency or shortage or experiencing little or no indication of food intake or dietary change. In 1995-1997, the National Center for Health Statistics and the U.S. Department of Agriculture operationalized the conceptual definitions and developed a scale to estimate the relative household operational conditions in the U.S. population (Cook & Jeng, 2009).

Low food security or food insecurity without hunger: Having experienced and documented a reduction of a desired, quality, variety of food and little or no indication of a decrease in food consumption (USDA, 1997).

Obesity: A complex abnormal disorder where over a period body fat accumulates excessively in proportion to body size (WHO, 2015). An adult with a BMI between 25 and 29.9 is considered overweight and an adult who has a BMI of 30 or greater is obese (WHO, 2015).

Overweight: Increased body weight compared to height and a standard of acceptable weight (National Research Council, 1989; CDC, 2015).

Poverty: A chronic state of lack; when the total family income is less than the threshold set by the Census Bureau in any given year (U.S. Census Bureau, 2013)

Rural population: Includes all populations, housing, and territory not included within an urban area (U.S. Census Bureau, 2015).

Urban area: An area of densely developed territory encompassing residential, commercial, and other nonresidential urban land uses. These areas are redefined after each decennial census. Urban areas contain at least 50,000 people. Urban clusters contain at least 2,500 and fewer than 50,000 people (U.S. Census Bureau, 2015).

Assumptions

Key assumptions in the study were that all respondents to the Behavioral Risk Factor Surveillance System (BRFSS) gave honest answers regarding their experiences. I assumed that the 2012 Louisiana BRFSS accurately recorded each respondent's information and that the data accurately represented the adult population of Louisiana. I assumed responders without landlines did not differ significantly from responders with landlines.

Limitations

Many studies have limitations that prevent the conclusions from being generalized to larger populations. Potential limitations of this study included the use of self-reported data. BRFSS provides flexible and timely data (Powell-Griner, n.d.); however, self-report can introduce recall bias. Li et al. (2012) found that BRFSS prevalence estimates of current smoking, obesity, hypertension, and uninsured status were similar to prevalence rates in the National Health and Nutrition Examination Survey and National Health

Interview Survey, three highly recognized surveys that do not rely on self-reported data. Another limitation may have been the use of data from random telephone sampling. Households without landlines were automatically excluded from the selection sample. A significant number of households without landlines could yield differences in socioeconomic status and ethnic backgrounds among participants. In an attempt to correct for potential bias caused by telephone sampling, the BRFSS used a post stratification weighing system to adjust for lack of telephone coverage. Conclusions from this study may not be generalizable to households with cell phones. Data collected by other organizations or researchers was for different purposes than the secondary analysis requires. The use of secondary datasets limits the selection of constructs to operationalize the relationship under study.

Scope and Delimitations

Delimitations are used decisions the researcher makes to intentionally narrow the scope of the study. The study was delimited to adults 18 years of age and older who participated in the 2012 LA-BRFSS. The adults were selected because of the limited data available showing the impact of food insecurity on adult households, and because of the inconsistent results between women-led households and food insecurity. Hanson, Sobal, and Frongillo (2007) showed that women are more likely than men to be food insecure are. Women are also more likely to be obese than men (WHO, 2015). Although the literature supports this claim, there are many factors in the relationship between gender and obesity. This study addressed the relationship between food insecurity and obesity and the direct or indirect influence of poverty. The conceptual framework of household food security and household food insecurity and its relation to the food stamp cycle and

body weight was one model that was considered. The family stress model is another model that is suitable to examine the stress on household to obtain a nutrition meal.

Researchers classify poverty in different categories: individual, cultural, or structural, or a combination. Theories posit that individual, cultural, or structures are responsible for poverty; in terms of the study conceptual framework, poverty is the result of a combination of resources, environment, and policy respectively. For example, the individualistic theory is used to explain that poverty results because of the natural characteristics of an individual that are inherent to the individual. Some individuals are born with disabilities or incompetence that limits their ability to compete for resources (Fisher, 1992).

Significance of the Study

This study addressed the gap that Rutten et al. (2010) identified concerning the relationship between poverty, food insecurity, and obesity in an effort to advance knowledge in the discipline and practice. Healthy eating and food systems are essential to the reduction of the incidence of obesity and diet-related chronic diseases, and researchers suggested that the lack of healthy eating and food systems are associated with poverty (Drewnowski & Specter, 2004). A better understanding of associated variables and the roles they play may guide the development of interventions to decrease food insecurity and obesity in urban/rural populations. This study was novel and important because it may help determine to what extent poverty influences food insecurity and obesity.

Implications for positive social change include reduction of the incidence of obesity through identification and prevention of food insecurity factors. The study also may have public health implications for decreasing food insecurity and obesity rates

among urban and rural populations of adults who experience an economic disadvantage. The conceptual framework was an evidence-based model that may guide future research and interventions involving the association between food insecurity, obesity, and poverty. The insight provided by the study may be used to identify the need for gathering information that may lead to a more complete and systematic approach to studying obesity and food insecurity.

Summary and Transition

Obesity is a condition that results in a great economic burden on the United States in both rural and urban areas. Food insecurity and poverty may be positively associated with obesity. I studied the association between poverty, food insecurity, and obesity among adults in Louisiana. Chapter 2 provides a comprehensive review of research that focused on the relationships between food insecurity and poverty, poverty and obesity, and food insecurity and obesity. In addition, I summarize the key themes in the literature and describe how this study filled gaps in the current literature.

Chapter 2: Literature Review

The purpose of this study was to determine whether poverty had a direct or indirect influence on food insecurity and whether adults who live at or below the poverty level were more likely to be obese. The pathways to obesity are diverse and complex. Obesity is a public health concern affecting and predicting a multifaceted group of health outcomes. Food insecurity is another public health concern that influences health outcomes. Although food insecurity and obesity are separate concerns, research suggests they are influenced by poverty (Rutten, Yaroch, Patrick, & Story, 2012). Although individuals living in rural areas are more vulnerable to food insecurity, it is not exclusively a rural problem (Befort et al., 2012). A comprehensive understanding of the direct and indirect influences of poverty associated with food insecurity and obesity is necessary.

In 2010, approximately one-third or 78.6 million of the U.S. population was obese (CDC, 2014), and the Robert Wood Johnson Foundation (RWJF) estimated that half of the adult population will be obese by 2040 (RWJF, 2013). Obesity is associated with the excessive number of calories consumed through food and drink (CDC, 2014). Obesity is a risk factor for cardiovascular diseases (CVD), type 2 diabetes, asthma, and hypertension, as well as other comorbidities (CDC, 2014; Lavie, Milani, & Ventura, 2009).

In the following sections, I review previous research focused on factors associated with the poverty, food insecurity, and obesity relationship. This review addresses the gap in the literature and the body of research on the link between food insecurity and obesity and the broad mechanisms of poverty. To understand the relationship better, I used a conceptual framework to guide this review.

The literature review is organized in five main sections. In Section 1, I describe obesity, its key risk factors, and its impact on health. In the second section, I describe the components of food insecurity, including food systems, access, and availability. Section 3, I provide an intensive review of poverty. Section 4 addresses the association between food insecurity and BMI, including a critical review of literature and recurrent themes and findings. I examine the epidemiology and pathophysiology of obesity in rural and urban areas, and the risk factors associated with the food insecurity and obesity relationship. In the fifth section of the literature review, I summarize findings and explain the importance of the study.

Literature Research Strategy

The literature search strategy included Internet searches through professional public health and research organizations such as the CDC, WHO, USDA, Census Bureau, and relevant peer-reviewed journals. I conducted an exhaustive search of Academic Search Premier, Walden University's EBSCO databases; Science Direct, Google Scholar, and Pub-Med. Key terms used individually or in combination included *poverty*, *low income*, *disparities*, *food insecurity*, *obesity*, *overweight*, *food security*, *hunger*, *rural areas*, *urban areas*, *economic hardship*, *socioeconomic status (SES*), *income inequality*, and *body mass index (BMI).* Initially, I searched for *poverty*, *food insecurity*, and *obesity* for 2009 to 2015. However, the search yieled limited literature. Then I expanded the search using other terms such as *low income*, *economic hardship*, and *body mass index*. The search yielded numerous references, including full text, peer-reviewed, and national reports. Over 100 articles were used in the study.

Conceptual Framework

Several contextual variables are involved in the food insecurity and obesity relationship. The poverty, food insecurity, and obesity conceptual framework provides a rationale for the relationship. Poverty, limited access to adequate food, socioeconomic disparities, and health behaviors play a role in the relationship between food insecurity and obesity (Champagne et al., 2007; Connell et al., 2007; Rutten et al., 2010). Rutten et al. (2010) defined poverty as the chief influence in the relationship between food insecurity and obesity.

Poverty is identified in the framework as the broad environmental, social, and political context of food insecurity (Rutten et al., 2010). This framework includes both the direct and indirect influences of poverty on food insecurity, obesity, mechanisms, and outcomes (Rutten et al., 2010). Available resources, environment, and policy are the three main factors of poverty. The likelihood of food-insecure households is complicated by several factors occuring together, such as single-parent homes, the number of children, unpredictable household income, and inconsistent household composition (Gunderson & Ziliak, 2014). The framework illustrates a cycle of communal influence among the psychosocial culture, behavioral (diet quality), and physiological mechanisms.

Availability, access, and affordability are some intermediate variables related to the food insecurity and obesity relationship (Siegel, Ali, Srinivasiah, Nugent, & Narayan, 2014). For example, the increase in the number of food deserts in rural areas may cause convenience stores and fast food restaurants to become outlets for meals, thereby increasing the likelihood of the consumption of low quality foods (Tagtow & Hinkle, 2008).

Theories on Poverty

Poverty is the lack of necessities. Basic food, shelter, medical care, and safety are necessary for survival. These necessities can be relative, depending on who is asked. Poverty differences exist across gender, ethnicity, age, location (rural and urban), and income source. Understanding that poverty goes beyond the economic scope will provide a better understanding of the linkage between poverty and health outcomes, including food insecurity and obesity. According to Rutten et al. (2008), the conceptual framework has both direct and indirect influences on poverty in every mechanism and outcome in the framework. Therefore, it is necessary to examine the source of poverty to gain a clearer understanding of the relationship between poverty, food insecurity, and obesity. To this end, the federal government established a statistical measure as to the minimum annual income to feed a family of four (Fisher, 1992). The federal poverty guidelines are updated annually to keep up with increasing costs of living (Fisher, 1992).

Another definition of poverty in U.S. populations is income before taxes, which does not include capital gains or noncash benefits. For example, public housing, Medicaid, and food stamps are not considered. The poverty, food insecurity, and obesity framework proposes that resources, environment, and policies must be considered when comprehensively describing poverty. The causes of poverty, how populations become impoverished, and why they are unable to overcome poverty has been examined using several theories (Blank, 2003; Shaw, 1996).

In 1963-1964, Orshansky (1965) used the Department of Agriculture's 1955 Household Food Consumption Survey to develop poverty thresholds. There were some challenges in determining the actual poverty level, as some argued whether noncash benefits should be included. For several years, Orshansky (as cited in Fisher, 1992)

sought to find a common ground for the measure of poverty. Orshansky (as cited in Fisher, 1992) stated, "if it is not possible to state unequivocally 'how much is enough,' it should be possible to assert with confidence how much, on an average, is too little" (p. 44). At this point, poverty thresholds were determined as the primary version of the federal poverty measure with the other version being the poverty guidelines.

Lewis (as cited in Fisher, 1992) introduced the culture of poverty theory as a self-perpetuating cycle that defines how impoverished individuals feel, act, think, and behave. The culture of poverty theory states that living in conditions of persistent poverty may lead to the development of a culture or subculture adapted to those conditions. Lewis proposed that the structural cause of the development of a culture of poverty on a population is actually the burden of poverty itself, which in turn becomes autonomous, as behaviors and attitudes developed within a culture of poverty are adapted in later generations through socialization processes. The structural theory states that it is the failure of the structures (educational facilities, economic growth, and labor market opportunities) in the society that causes poverty among people (Fisher, 1992). Although these theories have their relevance, they all address the strong influence poverty has on behavior and accessible resources in any given population.

Poverty, Food Insecurity, and Obesity

Epidemiology of Obesity

Obesity is excess body fat and is a central factor in the pathophysiology of most cardiovascular diseases (CVD) (Ogden, Yanovski, Carroll, & Flegal, 2007). Obesity increases the risk for the development of nonalcoholic fatty liver disease, insulin-resistant diabetes mellitus, CVD, endocrine problems, and certain forms of cancers (Ogden et al., 2007). Obesity is described as a body mass index (BMI) of 30 or greater (calculated as

weight in kilograms divided by height in meters squared) and is associated with the highest mortality rates (Rutten et al., 2010). A BMI between 20 and 25 kg/m^2 is normal weight. A BMI between 25 and 30 kg/m^2 is overweight. Food intake, exercise, genetic determinants, and environmental factors are major etiological factors for the development of obesity (Rutten et al., 2010).

In high-income developed countries, overweight and obesity rates are more likely to be prevalent in disadvantaged regions and among populations with lower income, low education status, and social class (Conklin, Forouhi, Brunner, & Monsivais, 2014). Obesity produces staggering implications for individuals, families, businesses, the health care system, and society (National Advisory Committee on Rural Health and Human Services, 2005). Ogden et al. (2007) provided some estimates of the prevalence of obesity and trends in different age classifications by comparing data from NHANES 1999-2000 and 2001-2002 with the NHANES 2003-2004. Ogden et al. were successful in analyzing weight measurements for 4,431 adults who were 20 years of age and older. The findings indicated that 17.1 % of children and adolescents were overweight, and 32.2% of adults were obese. The obesity prevalence for young males and adolescents increased from 14% to 18.2%.

Ogden and Carroll (2010) conducted a similar study and found that in 2009-2010 more than one third of the adults and almost 17% of the youth were obese. Ogden and Carroll did not find any changes in the obesity prevalence among adults or youth from 2007-2008 to 2009-2010. There was no difference in obesity prevalence among men and women. In addition, Ogden and Carroll found that adults age 60 years and older were more likely to be obese than younger adults.

Examination of Food Insecurity

Food insecurity exists in millions of households across the United States. According to the Food Research and Action Center (2010), food insecurity disproportionately affects rural households and lower income households. In 2008, households with annual incomes below 185% of the poverty line showed that food insecurity was more than four times as prevalent compared to households with incomes above that range (ERS, 2008).

Some organizations have attempted to define food access in relationship to food insecurity. Rolls, Drewnowski, and Ledikwe (2005) suggested that increased fruit and vegetable consumption might improve weight status over a period of time. The challenge in rural areas is ensuring healthy food options are the routine, easy choice (Committee on Accelerating Progress in Obesity Prevention, 2012; Rolls et al., 2005). For example, many obesity risk factors are disproportionate among minority, low-income, less educated, and rural populations. Some of these inequalities are credited to the high prevalence of obesity among those populations (Institute of Medicine of the National Academies, 2012). In the United States, limited availability of healthy and affordable foods and the built environment are credited for the increasing obesity epidemic, and these factors may be somewhat beyond personal responsibility (Rolls et al., 2005). Areas characterized by poor access to healthy and affordable foods are food deserts; however, the degree to which food deserts exist is still debated (Beaulac, Krisjansson, & Cummins, 2007). Food deserts may contribute to some social and spatial disparities in obesity and other diet-related health outcomes (Beaulac et al., 2007).

Food Insecurity and Dietary Behavior

Food environment factors such as food prices, government assistance programs, and proximity to convenience stores or restaurants may influence food choices and diet quality. The recognition of the multifaceted environmental, social, and behavioral factors is clearly an indication of the complexity of the link between those factors and health outcomes. Food insecurity encompasses not only food choices, dietary habits, and diet quality; it also includes uncertainty to secure the next meal. A variety of personal factors such as socioeconomic status, educational level, age, sex, and cultural preferences are associated with food choices and diet quality (Connell et al., 2006). Drewnowski and Specter (2004) stated that income and prices have an effect on food choices, dietary habits, and diet quality. The results of a study Drewnowski and Specter conducted indicated that income disparities had more of an effect on the quality of the diets than the total energy intake. For example, food purchased by low-income households differed significantly from food purchased by high-income households.

Food insecurity may increase patterns of overconsumption of high-fat foods, high-sugar foods, and beverages (Gittelsohn, Rowan, & Gadhoke, 2012; Park, Onufrak, Sherry, & Blanck, 2014). The overconsumption of these high-calorie foods and beverages significantly contributes to the obesity challenge faced in the United States (Park et al., 2014). Hartline-Grafton, Rose, Johnson, Rice, and Webber (2009) agreed that food insecurity may lead to weight gain because the least expensive food items are typically high in calories and low in nutrients . Energy intake and food choice as they relate to obesity are addressed in terms of physiology, biology, and behavior. There is a strong correlation between racial/ethnic and socioeconomic disparities and diet quality, obesity, and diet-related diseases (Neff, Palmer, McKenzie, & Lawrence, 2009). In a study

conducted in 36 counties in the Lower Mississippi Delta region, a predominantly rural, minority, and traditional agricultural region of Arkansas, Louisiana, and Mississippi, Connell et al. (2007) found that food insecurity was associated with lower quality diet. Drewnoski and Specter (2004) examined psychological factors including inadequate nutritional knowledge, the consumption of high-fat foods in search of comfort, and excessive vulnerability to the external environment, which includes easy access to unhealthy food options.

Examination of Rural and Urban Areas

Although obesity is a national challenge, obesity prevalence rates are higher in rural areas (Befort et al., 2012). A rural infrastructure is diverse in terms of culture, society, economic, and ethnicity (Acharya, n.d.). Challenges that are common among rural populations include limited transportation and availability of healthy foods, lack of public health funding and infrastructure, and barriers to access and environmental physiognomies (RAC, 2014). Many of these challenges also contribute to the obesity challenges in rural populations (Befort et al., 2012; Moore et al., 2008; Nord, Coleman-Jensen, & Gregory, 2014).

Approximately 70 million people or at least 23% of U.S. population live in rural areas (Befort et al., 2012). Befort et al. (2012) indicated that rural and urban areas have distinctive characteristics in social, behavioral, and environmental determinants of obesity. Rural populations are more likely to be less educated, older, and have lower income than urban populations; these socioeconomic factors are associated with higher obesity prevalence in rural populations (Befort et al., 2012; Eberhardt & Pamuk, 2004). There are significant differences in chronic disease and mortality rates between rural and urban areas, thus potentially contributing to geographic health disparities (Befort et al.,

2012). Befort et al. also found that a diet high in calories from fat was the greatest predictor of obesity and a major contributor to the high obesity rates in rural America, more so than in U.S. cities. The Rural Assistance Center (2014) agrees that rural residents are more inclined to eat diets higher in fat and calories and have less access to services that promote healthy eating.

Food Availability in Rural and Urban Areas

Another factor in food insecurity is instability of food availability. According to the Rural Poverty Report of 2011, decreases in crop production in rural areas contributed to increases in food insecure households. Small-scale farming and droughts are forces of change and common themes that exist in rural populations. Crop production decline and the decrease in purchasing power is another combination that contributes to food insecurity in rural populations (Rural Poverty Report, 2011).

In both urban and rural populations, health is measured by indicators of mortality, morbidity, lifestyle behaviors, and other health-related risk factors; however, these adverse events are significantly greater in rural populations (Eberhardt & Pamuk, 2004). Evidence suggests these poor health and lifestyle factors are associated with low income (Eberhardt & Pamuk, 2004). In 1970, Hansen stated that rural areas are often the last areas to experience new technologies, and low wages and competitive pricing dominate production of such. In an *obesogenic* environment, high-energy foods are consumed in greater proportions. The reduction of energy density is associated with an effective approach to weight management, as laboratory and clinical trial data suggests (Rolls, Drewnowski, & Ledikwe, 2005). The status of local food environments is particularly important in food insecure populations (Freedman & Bell, 2009).

Association Between Poverty, Food Insecurity, and Obesity

Poverty and Food Insecurity

Generally, female-headed households, age, and lower socioeconomic status are associated with obesity and food insecurity. Freedman and Bell (2009) found that, in 2007, households with incomes below the poverty line had higher food insecurity rates, and those rates were higher than the food insecure national average. In addition, 30.2% of female-led households with children were food insecure, and 22.2% African American and 20.1% Hispanic households were insecure. Freedman and Bell suggest that food insecurity is associated with an increased risk for obesity in both adults and children.

According to Shah (2014), global hunger is an indicator of world poverty. People with less access to health care, education, and other services are usually the poorest. Individuals who are economically disadvantaged also suffer from problems of hunger, malnutrition, and disease. These individuals find themselves in the cycle of poverty because they have little representation in public and political debates. The Food and Agriculture Organization (FAO) of the United Nations (2014) states that to relieve a population of hunger is to alleviate poverty, assuming poverty is credited for hunger. Increasing food production will not resolve the worldwide food insecurity challenge if it is not done in conjunction with the addition of resources that limit poverty (FAO, 2014).

Food insecurity and poverty are different concepts although they may be directly related. Bhattacharya, Currie, and Haider (2004) found that health outcomes among older adults were more likely to be associated with food insecurity than child outcomes. The association between poverty and obesity outcomes is inverse among older adults; poverty was associated with lower BMI among older adults but higher BMI among children. In addition, poverty was more likely to be associated with health outcomes of younger

children than older children were. Bhattacharya, Currie, and Haider showed that poverty is just one factor that is associated with food insecurity. As shown in the conceptual framework from Rutten et al. (2010), poverty portrays a direct association with food insecurity but there may be other indirect influences. Pampel, Krueger, and Denney (2014) suggest that socioeconomic status could influence health outcomes. Coleman-Jensen, Gregory, and Singh (2013) stated that higher unemployment, lower household assets, and certain demographic characteristics are associated with food insecurity while linked to limited access to adequate and nutritious food. According to the Department of Economic and Social Affairs (2014), these components are indicators of poverty.

Poverty and Obesity

Higher priced foods are sold at convenience stores and small, independent stores as they are more prevalent in low-income and African American communities. According to Piontak and Schulman (2014), Southern households in larger rural areas, have the highest food insecurity rates. In a study conducted by Connell et al. (2007), several counties in the lower Mississippi Delta are food deserts due to the limited access to large retail food distributions centers. In this region over two-thirds of low-income households are located farther than 30 miles from a supermarket or large food retailer (Champagne et al., 2007; Connell et al., 2007).

Food prices and diet costs may mediate the socioeconomic status gradient correlated with diet quality (Darmon & Drewnowski, 2008). Dietary energy density is one index of the overall quality of the diet. An economic analysis indicated that higher food prices located in low income and rural neighborhoods suggest that energy-dense diets cost less than healthier diets (Darmon & Drewnowski, 2015). Furthermore, market basket surveys indicate that individuals with limited spending power and availability may

have limited ability to buy healthy foods (Jetter & Cassady, 2006). Market basket surveys encompass food availability, cost, nutritional adequacy, and quality, and study individual households, the community, the nation, and the world. Jetter and Cassady (2006) found limited access to whole-grain foods, low fat cheese, and lean ground meat with less than 10% fat, in neighborhoods where smaller grocery stores existed. French (2003) suggested that food choices are influenced by cost, convenience, and taste. Sarlio-Lahteenkora and Lahelma (2001) examined the relationship between body size and trends of economic disadvantage. They suggest that constraints in income likely limit the available dietary options in economically disadvantaged areas.

Food Insecurity and Obesity

There is evidence supporting the link between food insecurity, obesity, and poor health outcomes. Gunderson (2013) explains that demographic and socioeconomic factors are consistently associated with food insecurity. Income is a key factor of food insecurity. In part, food insecurity may be the result of the national economic crisis during 2001-2012. During this time, high calorie food purchases increased as the unemployment rates increased. Research suggests that food insecure households involuntarily shift to unhealthy coping strategies, depending on the time of the month or availability and access to healthy food (Sarlio-Lahteenkorva & Lahelma, 2001).

The relationship between food insecurity and obesity across gender is inconsistent; food insecurity is more prevalent among women and more likely to be associated with obesity among women compared to men (Franklin et al, 2012; Wilde & Peterman, 2006). More research is needed to determine whether food insecure individuals are obese due to the increased tendency to purchase inexpensive, high calorie-dense foods, or whether scarcity increases the tendency of these individuals to overeat in

periods when there is abundance (Fernandez et al., 2014). Cook et al. (2013) used the Household Food Security Scale and the Early Childhood Longitudinal Study-Kindergarten Cohort data to confirm that women in marginally food-secure households were significantly different from women in food secure households on all socio-demographic characteristics. Few studies have explored the physiological, behavioral, and psycho-social-culture associated with the food insecurity, obesity, and poverty. However, Cook et al. (2013) found that several socio-demographic and psychosocial indicators were significantly associated with higher odds of both marginal food security and food insecurity. To this end, Cook and colleagues (Cook et al., 2013) argue that marginal food security is clearly underestimated affecting health outcomes at the same rate as food insecurity. Casey et al. (2006) examined the NHANES 1999-2002 in a sample of 6995 children and found an association between food insecurity and overweight/obesity.

The availability of foods has shifted to highly refined and excessive processed foods, and meat and dairy products containing extreme levels of saturated fats (Moubarac, Martins, Claro, Levy, & Cannon, 2012). In the study conducted by Moubarac et al. (2012), food supplies and diets were highly concentrated with high energy density foods and these high levels exceeded the World Health Organization's upper limit recommendations of unhealthy foods. According to Friel and Ford (2015), the global shift has been a parallel trend with the high consumption of unhealthy food options, which may be contributing to the obesity challenge in the U.S. Thow, Leeder, and Swinburn (2010) agreed that the current obesity challenge emulates increasingly *obesogenic* food environments, long-term sedentary lifestyles, and low energy expenditures.

Behavioral Risk Factors

Physical Activity, Dietary Quality, Psychosocial Factors, and Obesity

Some distinct psychiatric conditions contribute to obesity. There are bidirectional associations between mental health and obesity with levels of obesity, gender, age and socioeconomic status as key risk factors (National Obesity Observatory [NAO], 2011). Some may question whether obesity is a cause of mental health disorders, or mental health is a cause of obesity. According to the NOO (2011), the mediating factors for obesity and mental health are dieting, weight cycling, and low self-esteem.

According to Florez, Duboqitz, Ghosh-Dastidar, Beckman, and Collins (2015), depression symptomatology is a factor that is associated with obesity across varied age groups. The directionality of the association is unclear. However, Florez et al. (2015) found that weight reduction and improved diet might promote mental health. Robertson, Davies, and Winefield (2015) found an association between specific BMI categories and depression; a lack of social well-being might contribute to or maintain atypical BMI. An observation study conducted by Klurfeld (2015), suggests that while there are many factors correlated with high meat consumption, the relationship between meat consumption and chronic disease is unclear.

Gap in Literature Between Gender and Food Insecurity

There are differences in food insecurity by gender where financial difficulties have a strong effect on obesity among women. Conklin et al. (2014) examined the link between cumulative financial hardships and weight gain and health behaviors using the Whitehall II Study. Using data collected from 3,701 British adults with chronic trends of difficulty paying bills or lack of money for food, they found that persistent hardships over a 10.9 year period were associated with adjusted mean weight change in women, but no

constant patterns in men. In the follow up to this study, 46% of the women had gained 5kg or greater. Women that consistently reported insufficient money for food had significantly greater odds of gaining five or more kilograms compared to those who did not report financial hardships. Junxiu et al. (2015) found that food insecurity is associated with insulin resistance in adults without diabetes, and this effect varies by gender in normal-weight and overweight/obese populations. The study included 5,533 adults 20 years of age and older (2,742 men and 2,791 women) without diabetes from the 2005-2010 National Health and Nutrition Examination Survey.

Literature on Methodology

Sarlio-Lahteenkorva and Lahelma (2001) found that lower household income, recent unemployment, and economic problems in childhood were all predictors of food insecurity. Using five items, hunger was classified around economic fears and experiences and sufficient food supply during the past 12 months. Combined ratings of those with affirmative responses on four to five items were classified as hungry.

Several secondary analyses of the BRFSS used logistic regression to examine associations. While data from the BRFSS examined food insecurity and obesity, not many studies have examined these two factors as well as their association with poverty (household income) and geographical location (urban and rural). My study examined these independent and dependent variables. Prior studies also did not examine income as key independent variables but only as a covariate. Other covariates examined in the literature included sociodemographic and behavioral factors.

Body mass index is a measure of weight adjusted for height. Although an imperfect tool, it does not distinguish overweight due to excess fat mass from overweight due to excess lean mass; it is a commonly used measure for assessing obesity in adults

(Must & Anderson, 2006). A study by Bautista-Castano, Mokina-Cabrillana, Montoya-Alonso, and Serra-Majem (2004), defined obesity as a continuous variable when assessing factors that could predict a successful completion of the weight loss program. The Guidelines of the American Clinics for the Identification, Evaluation and Treatment of Obesity and Overweight in Adults of the U.S. Expert Committee on Obesity, report that patients were categorized into the following groups: Group one was overweight: BMI between 25 and 29.9 kg/m^2; Group 2 included obesity grade I measured as a BMI between 30 and 34.9 kg/m^2; Group 3 was obesity grade II with BMI measured between 35 and 39.9 kg/m^2; and Group 4 was obesity grade III wich measured at BMI $\geq$ 40 kg/m^2. The classification are listed below in Table 1.

Table 1

Classification of Overweight and Obesity by BMI

	Classification of Obesity	BMI kg/m^2
Underweight		<18.5
Normal		18.5-24.9
Overweight		25.0-29.9
Obesity	I	30.0-34.9
	II	35.0-39.9
Extreme Obesity	III	>40

Source: World Health Organization (2015). BMI Classification. Retrieved from http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

BMI is measured in several ways such as categorical, continuous, or dichotomous measure. Martin-Fernandez, Caillavet, and Lhuissier (2014) used participants' BMI (calculated from self-reported height and weight) as a continuous variable and a dichotomous variable. In their study, age, race, health behaviors (i.e., alcohol, smoking, physical activity) were included as confounding variables and the ratio of poverty to income were assessed by questionnaire. Orshanksky (1965) reported that the U.S.

determined poverty by comparing the actual household income to the poverty line, which was primarily a multiple of the income needed to purchase an economical amount of food (Orshansky, 1965). In the study by Martin-Fernandez, et al. (2014), the poverty to income ratio was used as an index of socioeconomic status and calculated on the basis of family income and family size; in the age to poverty ratio, income was included in the analysis as continuous variable.

Summary and Transition

This review of literature reinforces the scarcity of available research on the link between poverty, food insecurity, and obesity. Although some information is available for women, limited information exists on the influence of the relationship among children and men and in rural areas. A trend appears to support a relationship between food insecurity and obesity and food insecurity and poverty; however, the relationship between all three factors remains a gap in the literature.

A quantitative approach examined whether poverty might directly influence food insecurity while food insecurity has a direct influence on obesity. The scarcity of research on this topic suggests the need to examine how the cyclic state of poverty can influence food insecurity and weight status. Limited quantitative and qualitative studies exist; however, many of the studies have been cross-sectional using data from the NHANES. There is a need for more studies to build upon evidence-based food insecurity and obesity prevention interventions. The poverty, food insecurity, and obesity burden represents the substantial challenge that researchers, public health officials, and policy makers must tackle by researching different components at same time to build upon the existing research.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to examine the association between poverty, food insecurity, and obesity. Food insecurity may be measured by food access, availability, utilization, the instability of food insecurity over a given time period, or a combination of these metrics (Jones et al., 2013; Rutten et al., 2010). In this chapter, I describe the data collection method used in the BRFSS, study design and approach, instrumentation, sampling method, target population, and study variables. Self-reported measures of food insecurity, household income level, and BMI were examined among a sample of the adult population in Louisiana.

Research Design and Approach

The research design of this study was quantitative cross-sectional. The quantitative approach was selected over the qualitative approach because I wanted to examine the relationship between the variables of interest (Hopkins, 2000). I used secondary data from the 2012 LA-BRFSS to examine the association between poverty, food insecurity, and obesity. The BRFSS was selected because of the current public availability of the data and its relevance to the main research questions. Poverty and food insecurity were the independent variables, and obesity and food insecurity were the dependent variables. A cross-sectional design is widely used in epidemiological studies in which the prevalence of health conditions is examined on a representative population. The approach is a survey at one point in time and is a nonexperimental research design. There were no time or resource constraints anticipated for this study.

Setting and Sample

The study population is a representative sample of adults in the state of Louisiana in the year 2012. Participants share information on their risk behaviors related to health, chronic health conditions, and use of preventive services. All state health departments ask participants a set of core questions; however, states have the option to include additional modules. The data from Louisiana were selected because Louisiana is one of few states that included the Social Context Module to the core BRFSS questionnaire. This module contains information on measures of poverty, food insecurity, and obesity among others.

Sample Size and Power Calculation

The sample size was calculated using OpenEpi version 3.01 (Dean, Sullivan, & Soe, 2013). OpenEpi is a free software that provides statistics for counts and measurements in descriptive and analytic studies, stratified analysis with exact confidence limits, matched pair and person-time analysis, sample size and power calculations, random numbers, sensitivity, specificity, and other evaluation statistics, R x C tables, and chi-square for dose-response.

In this study, the population of interest was the adult population living in Louisiana. A type II error occurs when there is a lack of sufficient sample size. Because this study included secondary data, there was no need to calculate the sample size. The sample size for this study was 9,068. However, power calculations were necessary. The power of a study is determined by the sample size, alpha level, and effect size. Power is the probability of when the null hypothesis is truly false, a statistical test will reject the null hypothesis. Therefore, as power increases the probability of making a type II error decreases. Power analysis was conducted to measure the likelihood of a type II error. The probability of a type II error is denoted by β and power is calculated as power = $1 - \beta$.

The following provide the sample size *n* and margin of error *E*:

$$x = Z(c/100)2\ r\ (100\text{-}r)$$

$$n = \text{N x}/((N\text{-}1)E2 + x)$$

$$E = \text{Sqrt}[(N - n)x/\ n(N\text{-}1)]$$

G*Power 3.1.9.2 was used to establish the power of the study, thereby minimizing the chances of making a type II error. The following factors affect the power of a study: parametric tests, multiple groups to compare, increased magnitude of difference between groups, increased variation in the sample, bigger sample size, and smaller *p* value required for statistical significance. Statistical power greater than 80% is generally acceptable. Power is typically set at 80% or 90% when a fixed value is used in computing sample size. A higher power requires a larger sample size. For this study, a statistical power of 90% and an alpha level of 0.05 were sufficient. The average odd ratio 2.5 based on similar studies in literature review was used to compute the effect size. Sullivan and Feinn (2012) suggested that as the effect size decreases, the sample size increases.

Data Collection

The BRFSS is an ongoing nationwide cross-sectional telephone survey of U.S. noninstitutionalized civilian adults age 18 years and older with a household landline. Although the BRFSS was initiated in 1985, the state of Louisiana did not implement it until 1990. BRFSS was developed from a collaboration between federal, state, and independent experts. BRFSS, administered and supported by the CDC Behavioral Surveillance Branch, is collected in all 50 states, the District of Columbia, and three territories (Puerto Rico, Guam, and the U.S. Virgin Islands) and is used to collect data on the prevalence of health risk behaviors. State health departments manage data collection

with guidelines from the CDC. BRFSS-LA 2012 contains archived data from 2012 and consists of self-reported data on obesity and food insecurity.

Approximately 8,000 interviews are conducted in Louisiana annually. BRFSS-LA uses the WinCATI (Computer Assisted Telephone Interviewing). Interviewers are trained on strict adherence to the script. Residential telephone numbers are obtained through random-digit dialing. Respondents are selected randomly from the sample of selected individuals. To reduce nonresponse, 15 call attempts are made to telephone numbers that do not result in a completed interview or are not identified as nonworking telephone numbers. Participants are not compensated monetarily. The BRFSS questionnaire is set at 20 minutes. The length of the BRFSS questionnaire is not determined by the number of questions but by time. Survey developers recommend survey administration time at a maximum of 20 minutes to receive good response rates (BRFSS, 2012). The LA BRFSS is conducted through the Department of Health and Hospitals (DHH) of Louisiana and the Louisiana Bureau of Primary Care and Rural Health. I contacted the Louisiana BRFSS Coordinator to request access and permission to use the data.

Survey Instrument and Materials

The BRFSS was developed by the National Center for Chronic Disease Prevention and Health Promotion, other CDC centers, and federal agencies. The BRFSS has three parts. The core component consists of the fixed core, rotating core, and emerging core. The second part is the optional modules. The third component is the state-added questions. This study included the core questions and the Social Context optional module from the 2012 LA-BRFSS.

Operational Measures

Table 2 illustrates the description of the items in the survey and the operational measures derived as dependent, independent, and control variables. The dependent variables were obesity and food insecurity. Obesity was calculated using a formula from height and weight. In the BRFSS questionnaire, these measures are self-reported. Food insecurity was operationalized into a binomialvariable measured as ever food insecure and food secure. Repondendents answered “always, usually, sometimes, rarely, never”when asked “How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals?

Table 2

Description of Operational Measures for Poverty, Food Insecurity, Obesity, and Demographic Factors

Variables	Survey Question	Response Category	Type of Variable
BMI	Derived variable	1=BMI ≥ 30	Binomial
Food Insecurity	How often in the past 12 months, would you say you were worried or stressed about having enough money to buy a nutritious meal?	1= Ever food insecure (yes) 0= Food secure (no)	Binomial
Employment status	Current employment status	1 Employed for wages 2 Self-employed 3 Out of work 1 year+ 4 Out of work <1 year 5 A homemaker 6 A student 7 Retired 8 Unable to work 9 Refused	Nominal
Household income	Annual household income from all sources	Less than $10,000 Less than $20,000 Less than $25,000 Less than $35,000 Less than $50,000 Less than $75,000 $75,000 or more	Ordinal Binomial
Household Size	#Adults in Household # Children in Household		Continuous
Gender	Self-identified gender	1=Male 2=Female	Nominal
Age	Age in years	Age 18 – 24 years Age 25 - 34 Age 35 - 44 Age 45 - 54 Age 55 - 64 Age 65 or older	Ordinal
Race/Ethnicity	Group best represents race	1 White 2 Black or African American 3 Asian 5 American Indian, Alaska Native 6 Other Notes: Specify_____ 9 Refused	Nominal
	County of residence	Name of county	Nominal
	Zip Code of residence	5-digit number	Nominal

Validity and Reliability of the Instrument

Li et al. (2012) used three national health surveys (BRFSS, NHANES, and NHIS) to compare the prevalence estimates of selected health indicators and chronic diseases or conditions in the United States. Li et al. found that across the three surveys similar prevalence estimates of current smoking, obesity, hypertension, and no health insurance were seen with absolute differences ranging from 0.7% to 3.9% (relative differences: 2.3% to 20.2%). Due to the many different topics and questions in the BRFSS, the validity may vary for some sections or modules within the survey. In previous analyses of smaller groups, racial groups were not included because of a low percentage of participation, which may not have accurately represented the entire group.

Statistical Analysis

The statistical analysis that was most appropriate for this study was logistic regression. Logistic regression is used when the dependent (outcome) variable has a binomial distribution. Obesity (BMI ≥30 kg/m2) was the main dependent variable and was measured as 1=obese and 0=nonobese. In this study, food insecurity was a dependent and independent variable depending on the research question. Independent and mediating variables included poverty, geographic location (urban/rural), and demographic variables including age and gender. Logistic regression models were used to examine the association between obesity and food insecurity, poverty and food insecurity, and poverty and obesity. This type of analysis was useful because outcomes of interest (food insecurity, poverty) were classified as binary outcomes (yes/no).

Research Questions and Hypotheses

1. Is poverty associated with food insecurity among adults?

Ho1: There is no association between household poverty and food insecurity among adults.

Ha1: There is an association between household poverty and food insecurity among adults.

Statistical Plan: The independent variable was poverty (measured as household income under $25,000 or $25,000 and above); the dependent variable was food insecurity (Yes = 1, No = 0). Covariates included gender (male = 1, female = 2), age (age groups), and geographic location (urban = 1, rural = 0). The statistical test was logistic regression. The null hypothesis was rejected if the significance level associated with the beta coefficient was $p <= .05$.

2. Is poverty associated with obesity among adults?

Ho2: There is no association between household poverty and obesity among adults.

Ha2: There is an association between household poverty and obesity among adults.

Statistical Plan: The independent variable was poverty (measured as household income under $25,000 or $25,000 and above); the dependent variable was obesity (1=obese, 0=nonobese). Covariates included gender (male = 1, female = 2), age (age groups), and geographic location (urban = 1, rural = 0). The statistical test was logistic regression. The null hypothesis was rejected if the significance level associated with the beta coefficient was $p <= .05$.

3. Is food insecurity associated with obesity among adults?

Ho3: There is no association between food insecurity and obesity among adults

Ha3: There is an association between food insecurity and obesity among adults.

Statistical plan: The independent variable was food insecurity (yes = 1, no = 0); the dependent variable was obesity (1=obese, 0=nonobese). Covariates included gender (male = 1, female = 2), age (age groups), geographic location (urban = 1, rural = 0), and poverty (measured as household income under $25,000 or $25,000 and above). The statistical test for this hypothesis was logistic regression. The null hypothesis was rejected if the significance level associated with the beta coefficient was $p >= .05$.

Research Question 4. Does poverty mediate the relationship between food insecurity and obesity among adults?

Ho4: Poverty does not mediate the relationship between food insecurity and obesity among adults.

Ha4: Poverty does mediate the relationship between food insecurity and obesity among adults.

Statistical plan: The independent variable was poverty (measured as household income under $25,000 or $25,000 and above); the dependent variables were food insecurity (yes = 1, no = 0) and obesity (1=obese, 0=nonobese). Covariates included gender (male = 1, female = 2), age (age groups), and geographic location (urban = 1, rural = 0). The statistical test was logistic regression analysis. The null hypothesis was rejected if the significance level associated with the beta coefficient was $p <= .05$.

Logistic Regression Analysis

Logistic regression analysis is used when the dependent (outcome) variable has a binomial distribution (Downer and Richardson, 2009). When examining the relationship

between household income and food insecurity status (outcome variable), logistic regression analysis was possible with binomial derived variables. However, Campbell (1991) described food insecurity as a predictor variable. Furthermore, Campbell describes food insecurity as an undesired outcome irrespective to impact on health.

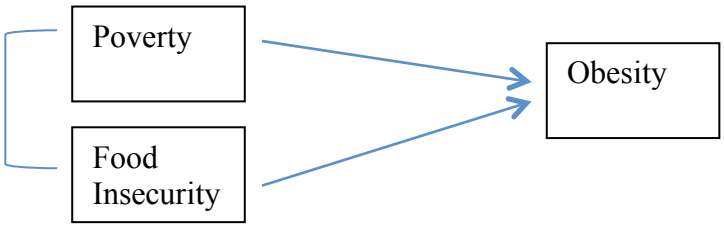

Figure 6. Poverty and food insecurity influences obesity.

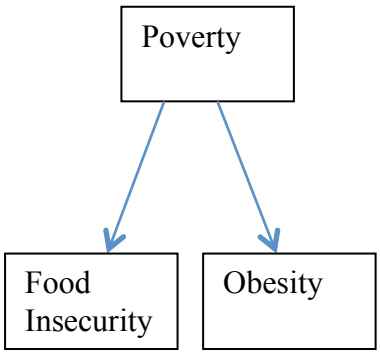

Figure 7. Poverty influences food insecurity and obesity.

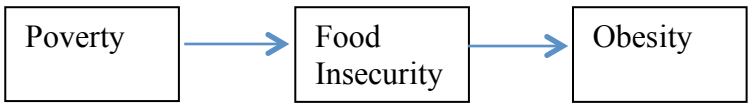

Figure 8. Poverty influences food insecurity, which influences obesity.

Threats to External and Internal Validity

The use of secondary data could potentially introduce some concerns about external validity. To guard against confounding of other variables, certain variables are controlled or minimized. BRFSS only includes non-institutionalized adults age 18 years and older in a household with a telephone line or have access to a cellular telephone that introduced a selection bias at this point. To ensure data quality, those administering the BRFSS survey must agree to follow the protocol developed by the CDC. The BRFSS staff and the CDC periodically review the dataset for errors and data variations before releasing it. Additionally, BRFSS uses weighting methods to ensure accurate sample representation and adjustments for nonresponse bias.

Known proportions of age, race, ethnicity, gender, geographic region, and other known characteristics of a population was accounted for in the BRFS data. BRFSS used post stratification to weigh BRFSS survey data with data collected from 1984 to 2010. However, after 2010 post stratification was replaced with a ranking method to account for additional population characteristics including education level, marital status, and home ownership of respondents. Weight data reduce errors in the outcome estimates.

Ethical Procedures

Although this study analyzed secondary data, it did not contain any personal identifiers except the respondent's zip code, used to determine geographical location. The data were aggregated to maintain confidentiality. Data were requested from the LA-BRFSS program for the year 2012 core questions and optional *Social Context Module* on adults. Once the proposal was approved and IRB approval received, data were reviewed and analyzed. The IRB approval number for this study is 12-15-15-0138694. Personal identifiers were kept confidential and protected according to the Public Health Service

Act (42 USC 242K), the Confidential Information Protection and Statistical Efficiency Act (PL 107-347) and the Privacy Act of 1974 (5 USC 552A). Researchers must test and refine survey processes at the highest ethical standards. This research study maintained the standards. The data were stored on a password-protected computer, kept for the minimum of 5 years, and then destroyed.

Findings from this study were shared with the dissertation committee and review boards. Findings will also be shared with states with high obesity rates with recommendations that the social context module of the BRFSS be collected regularly. Some states with increasing obesity rates, specifically the state of Mississippi do not collect data on food security on a national level.

Summary and Transition

This chapter presented the methodology of the study. The research design of the study consisted of a quantitative cross-sectional approach using secondary data analysis to test the hypotheses. Information from the participants of the 2012 LA-BRFSS was used for the study population. Logistic regression analyses were performed to examine the relationship and influence between household income, food insecurity status, and obesity. The next chapters present the results and discussion of the results.

Chapter 4: Results

Introduction

The purpose of this study was to examine the association between poverty, food insecurity, and obesity in the adult population in Louisiana. There is a relationship between obesity and food insecurity, and poverty and obesity; however, there is limited research on the influence of both poverty and food insecurity on obesity. In this study, I analyzed data from the 2012 LA-BRFSS, an ongoing, state-based survey conducted by a random-digit dialed telephone system that included the Social Context Optional Module. This chapter provides a description of the characteristics of the Louisiana population, in addition to logistic regression analyses, assumptions and hypothesis testing findings, and a summary. I describe the data collection and data management processes and present descriptive statistics of the study sample, detailed statistical analyses with tables and graphs for each of the research questions, and a summary of the results.

I used a quantitative cross-sectional survey design to examine the relationship between poverty, food insecurity, and obesity. I evaluated the mediating effects of poverty on the relationship between food insecurity and obesity. I examined self-reported measures of food insecurity, poverty (measured as household income level under $25,000), and obesity (BMI) among the adult population in Louisiana. Statistical Analysis System (SAS) version 9.2 was used for descriptive, regression analyses, and to apply design weights to the data to represent the entire state.

Data Management

Geographic Location

I sorted the file based on the 2010 census data to ascending to get the zip codes grouped by percentages of the rurality and urbanicity of the zip code. ProximityOne

(www.proximityone.com) is a data analytic company that uses the census data to develop geodemographic-economic data and analytical tools that others can apply to diverse data in a decision-making and analytical framework. ProximityOne develops custom demographic/economic estimates and projections, develops geographic and geocoded address files, and assists with impact and geospatial analyses. Software, data, methodologies have been used in the past to analyze data integrated with other data. I retrieved a list of all zip codes including the corresponding city and county from the state of Louisiana. I printed out all of the zip codes in Louisiana and used the map to write the zip codes by hand. Then I looked at the maps and corresponding zip codes and matched them with the zip codes based on ERS-USDA definitions of rural and urban. I then created a new variable in the flat file for geographic location specifying rural and urban. I named the rural and urban variable in the analytic file. I recoded rural as 0 and urban as 1.

Income and Food Insecurity

Both income and food insecurity had a substantial amount of missing data. The sample consisted of N=9068 participants in the social context module. About 16% of the observations were missing values on household income and 12% on food insecurity. Mandal and Stasny (2004) suggested that unless a sample is very large (over 30,000 observations), imputing income may not be successful. Imputation procedures refer to replacing missing data with the mean of the group and the larger the population the more likely it represents all the income strata. Kalton & Kasprzyk, (1989) found that imputing data could be computationally intensive and time consuming. Finally, the BRFSS uses weights to represent the total state population. As a result, I used a complete case analysis in which only observations with no missing values on household income and food insecurity were included in the analysis, being satisfied that this sample retained

sufficient power to detect significant differences.

Descriptive Analysis

There were 9,068 participants to the 2012 LA-BRFSS telephone survey. The data represented about two-thirds (67.5%) of the female and one-third (32.5%) of the male population of Louisiana. Approximately 68% of the sample was 25 to 64 years of age. Almost three-fourths (70%) of the population was overweight or obese. Over a fifth (21%) did not have health insurance. Sixty-one percent were non-Hispanic White and 31% were non-Hispanic Black. Almost half (45%) of the population were unemployed, and about a third (31%) had annual incomes of less than $25,000.

Variable Derivation

The main outcome variable used for analysis was obesity. Obesity is defined using an individual's BMI, categorized as either obese (BMI $\geq$ 30) or not obese (BMI $<$ 30). One-third (33.7%) of the sample were obese, and 61.7% were not obese. Food insecurity was used as an outcome and as an independent variable. It was defined by using participant responses to "How often in the past 12 months, would you say you were worried or stressed about having enough money to buy a nutritious meal?" Those who were never stressed or worried were categorized as food secure, and those who were always, usually, sometimes, or rarely worried were categorized as food insecure. About a fourth of the sample (24.6%) were grouped as food insecure, and 63.5% were food secure. In terms of geographic location, 39.9% were in a rural setting.

The independent variables used for analysis were age in years (ordinal), gender (male/female), and geographic location (urban/rural). All statistical models controlled for these three demographic variables. Additional independent variables included food insecurity and poverty. Household income was recoded as a binomial variable where

19.1% had an income less than $25,000, and 67.8% had an income of $25,000 or higher. Those with income less than $25,000 were considered low poverty or poverty, and those with an income of $25,000 or more was considered nonpoverty or high income. Table 3 presents the distribution of the study variables. The descriptive analyses are presenting using both the unweighted and weighted frequencies. The logistic regression analyses were weighted to represent the total Louisiana population for the year 2012.

Table 3

Sociodemographic Characteristics of Louisiana Adults, 2012

Age groups	Unweighted *N*	Unweighted %	Weighted %	95% CI
18-24	392	4.35	13.74	12.25-15.23
25-44	1717	19.06	34.54	32.84-36.24
45-64	3677	40.81	34.14	32.67-35.62
≥65	3223	35.78	17.57	16.68-18.47
Race/ethnicity				
Non-Hispanic white	5934	65.93	61.74	60.05-63.43
Non-Hispanic black	2653	29.47	31.35	29.72-32.98
Hispanic	183	2.03	3.53	2.75-4.32
Other race	231	2.57	3.38	2.74-4.02
Gender				
Male	2950	32.53	48.29	46.60-49.98
Female	6118	67.47	51.71	50.02-53.40
Annual household income				
< $ 25,000	1450	15.99	31.93	12.98-15.4
≥ $ 25,000	6150	67.82	52.98	31.15-34.25
Don't know/Not sure/Missing	1468	16.19	15.09	13.85-16.33
Education level				
Less than high school	1358	15.01	18.80	17.28-20.32
High school	3156	34.88	34.18	32.58-35.79
More than high school	4534	50.11	47.02	45.34-48.68
Employment status				
Employed	3890	42.90	54.08	52.42-55.74
Unemployed	420	4.63	6.51	5.57-7.45
Retired	2838	31.30	16.79	15.89-17.69
Student	185	2.04	5.72	4.68-6.75
Other	1735	19.13	16.91	15.70-18.12
Health insurance coverage				
Yes	7542	83.47	78.38	76.87-79.90
No	1494	16.53	21.61	20.10-23.13
Body mass index (kg/m^2)				
Not Obese (BMI <30)	5599	64.68	35.53	33.87-37.18
Obese (≥30.0)	3057	35.32	35.39	33.73-37.04
Geographic Location				
Urban	5185	58.89	57.18	55.83-58.53
Rural	3619	41.11	39.91	38.31-41.51
Food Insecurity				
Secure	5755	72.08	63.46	62.22-64.70
Insecure	2229	27.92	24.58	22.79-26.37

Source: Behavioral Risk Factor Surveillance System, Social Context Module

Research Questions and Hypotheses

For each research question, I used a logistic regression model to determine whether the independent variables significantly predict the binary outcome, after adjusting for the demographic variables of sex, age, and geographic location. One of the main assumptions of logistic regression is the dependent variable must be binary. This assumption was met in using obesity (obese vs. not obese), food insecurity (no or yes), and poverty (income below $25,000 vs. income ≥ $25,000) as dependent variables.

1. Is poverty associated with food insecurity among adults?

Hypotheses 1_O: There is no difference between poverty and food insecurity among adults.

Hypotheses 1_A: There are differences between poverty and food insecurity among adults.

To answer Research Question 1, I examined the relationship between food insecurity and poverty level controlling for participant sex, age, and geographic location. The results showed that sex and age were both significantly associated with food insecurity. Results indicated that females had 1.68 higher odds of food insecurity than males (OR & 95% CI = 1.68 [1.48, 1.91], $p < 0.0001$), and for every one-unit increase in age (age group), food insecurity decreased (OR & 95% CI = 0.97 (0.97 – 0.98), $p < 0.0001$). Geographic location was not associated with food insecurity ($p = 0.887$). Adjusting (or controlling) for sex, age, and geographic location, poverty was a significant indicator of food insecurity ($p < 0.0001$). Specifically, the odds of being food insecure were about 4 times greater for those with an income less than $25,000 compared to those with an income above $25,000 (OR & 95% CI = 4.0 (3.49 – 4.58)). Table 4 shows the results of the logistic regression model. Overall, lower income levels were associated

with higher odds of food insecurity. As a result, the null hypothesis was rejected, indicating that poverty significantly predicted the odds of food insecurity among adults as measured by the 2012 LA-BRFSS.

Table 4

Logistic Regression of Poverty as Predictor of Food Insecurity

		β	S.E.	Wald	df	Sig.	Exp(β)
Step 1[a]	Sex (Female)	0.52	0.07	61.99	1	< 0.0001	1.68
	Age	-0.03	0.002	200.93	1	< 0.0001	0.98
	Geographic (Rural)	0.01	0.06	0.02	1	0.887	1.01
	Income (< $25,000)	1.36	0.07	400.05	1	< 0.0001	4.00
	Constant	-0.11	0.12	0.80	1	0.372	

Source: 2012 Louisiana BRFSS adults, controlling for sex, age, and geographic location

2. Is poverty associated with obesity among adults?

Hypotheses 2_O: There are no differences between poverty and obesity among adults.

Hypotheses 2a: There are differences between poverty and obesity among adults.

To answer Research Question 2, I examined the relationship between poverty level and obesity after controlling for sex, age, and geographic location of the participants. Results showed that age and geographic location were both significantly associated with obesity. Table 5 shows that for every one-unit increase in age group, obesity decreased (OR & 95% CI = 0.99 (0.98 – 0.99), $p < 0.0001$), and those living in rural areas had higher odds of obesity compared to those living in urban areas (OR & 95% CI = 1.23 (1.11 – 1.36), $p < 0.001$). Sex was not associated with food insecurity ($p = 0.706$). Adjusting for sex, age and geographic location, income level was a significant indicator of obesity ($p < 0.0001$). The odds of being obese were about 1.5 times greater for those with an income below $25,000 compared to those with an income above

$25,000 (OR & 95% CI = 1.55 (1.37 – 1.75)). As a result, the null hypothesis was rejected indicating that household poverty level significantly predicted the odds of obesity among adults as measured by the 2012 LA-BRFSS.

Table 5

Logistic Regression of Poverty as a Predictor of Obesity

		β	S.E.	Wald	df	Sig.	Exp(β)
Step 1[a]	Sex (Female)	0.02	0.05	0.14	1	0.706	1.02
	Age	-0.01	0.002	32.87	1	< 0.0001	0.99
	Geographic Income	0.21	0.05	16.92	1	< 0.0001	1.23
	< $25,000	0.43	0.06	49.31	1	< 0.0001	1.55
	Constant	-0.25	0.09	7.08	1	0.008	

Source: 2012 Louisiana BRFSS adults, controlling for sex, age, and geographic location

3. Is food insecurity associated with obesity among adults?

Hypothesis 3o: There is no association between food insecurity and obesity among adults.

Hypothesis 3a: There is an association between food insecurity and obesity among adults.

To answer Research Question 3, I examined the relationship between food insecurity and obesity after controlling for sex, age, and geographic location of the participants. Similar to Research Question 2, the results showed that age and geographic location were both associated with obesity. For every one-unit increase in age group, obesity decreased (OR & 95% CI = 0.99 (0.98 – 0.99), $p < 0.0001$), and those living in rural areas had higher odds of obesity compared to those living in urban areas (OR & 95% CI = 1.19 (1.08 – 1.31), $p < 0.001$). Sex was not associated with food insecurity ($p = 0.865$). When controlling for sex, age, and geographic location, food insecurity was a significant indicator of obesity ($p < 0.0001$). The odds of being obese were about 1.6

times greater for those who were food insecure compared to those who were food secure (OR & 95% CI = 1.55 (1.40 – 1.73)). Table 6 shows the results of the logistic regression model. As a result, the null hypothesis was rejected, indicating food insecurity significantly predicted the odds of obesity among adults as measured by the 2012 LA-BRFSS.

Table 6

Logistic Regression of Food Insecurity as a Predictor of Obesity

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Sex (female)	-0.01	0.05	0.03	1	0.865	0.99
	Age	-0.01	0.002	33.20	1	< 0.0001	0.99
	Geographic (Rural)	0.17	0.05	12.02	1	0.001	1.19
	Food Insecurity (Insecure)	0.44	0.05	12.02	1	< 0.0001	1.55
	Constant	-0.27	0.10	7.22	1	0.007	0.76

Source: 2012 Louisiana BRFSS adults, controlling for sex, age, and geographic location

4. Does poverty mediate the relationship between food insecurity and obesity among adults?

Hypothesis 4o: Poverty does not have a mediating effect on the relationship between food insecurity and obesity among adults.

Hypothesis 4a: Poverty does have a mediating effect on the relationship between food insecurity and obesity among adults.

Research Question 4 evaluated the mediating effect of poverty in the relationship between, food insecurity and obesity, after controlling for demographic variables. To test for mediation, three logistic regression models were obtained. First, the outcome (obesity) was regressed on the predictor variable of food insecurity. The results of this

model can be seen for Research Question 3 in Table 7, where food insecurity significantly predicted obesity ($\beta = 0.44$, $p < 0.0001$). In the second logistic regression model, the potential mediator (poverty) was regressed on the predictor variable of food insecurity, while adjusting for sex, age, and geographic location. Table 7 shows the results of this model, where food insecurity significantly predicted poverty (income <$25,000, $\beta = 1.39$, $p < 0.0001$). The third regression model involved regressing the outcome (obesity) simultaneously onto the predictor of food insecurity, and the potential mediator of poverty. Table 8 shows the results of this model, where both food insecurity ($\beta = 0.29$, $p < 0.0001$) and poverty ($\beta = 0.39$, $p < 0.0001$) significantly predicted obesity. The null hypothesis was rejected indicating poverty mediated the association between food insecurity and obesity among adults as measured by the 2012 LA-BRFSS.

Table 7

Logistic regression for Test of Mediation (model 2) Predicting Poverty

		β	S.E.	Wald	df	Sig.	Exp(β)
Step 1[a]	Sex (Female)	0.60	0.08	55.91	1	< 0.0001	1.83
	Age	0.02	0.002	106.57	1	< 0.0001	1.02
	Geographic (Rural)	0.21	0.07	9.92	1	0.002	1.24
	Food Insecurity (Insecure)	1.39	0.07	399.40	1	< 0.0001	4.01
	constant	3.92	0.16	581.26	1	< 0.0001	

Source: 2012 Louisiana BRFSS adults, controlling for sex, age, and geographic location

Table 8

Logistic Regression for Test of Mediation (Model 3) Predicting Obesity

		β	S.E.	Wald	df	Sig.	Exp(Bβ
Step 1[a]	Sex (Female)	-0.03	0.06	0.32	1	0.569	0.97
	Age	-0.01	0.002	32.15	1	< 0.0001	0.99
	Geographic (Rural)	0.17	0.05	9.76	1	0.002	1.18
	Food Insecurity	0.29	0.06	23.50	1	< 0.0001	1.34
	Income (< $25,000)	0.39	0.07	31.02	1	< 0.0001	1.47
	Constant	-0.20	0.11	3.35	1	0.067	

Source: 2012 Louisiana BRFSS adults, controlling for sex, age, and geographic location

The test for a mediation effect indicated that food insecurity predicted both obesity ($\beta = 0.44$, $p < 0.0001$) and poverty ($\beta = 1.39$, $p < 0.0001$), and in the presence of poverty food insecurity continued to predict obesity but its effect was substantially reduced ($\beta = 0.29$, $p < 0.0001$). The reduction in the effect of food insecurity on obesity when adding poverty (measured as income) to the model, indicates a partial mediation effect of poverty on the relationship between obesity (measured by BMI) and food insecurity (Figure 9).

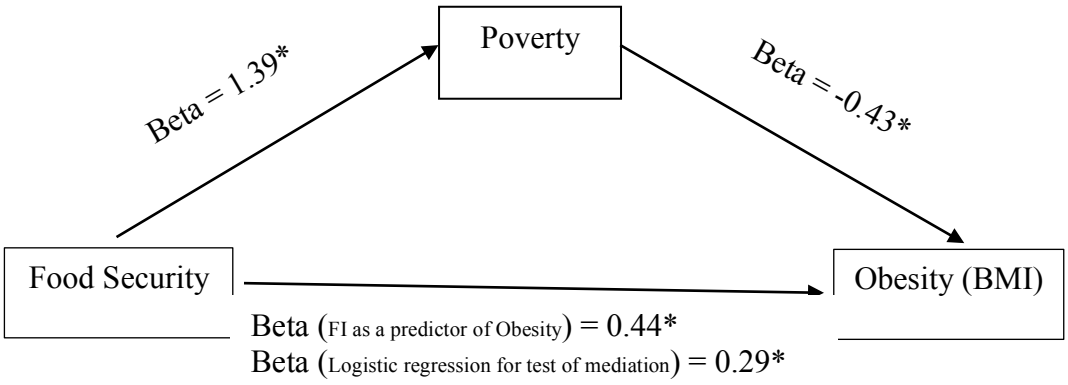

Figure 9. Mediation effect of poverty on the relationship between food insecurity and obesity. β = *0.43 where poverty is a predictor of obesity (Table 5) without food insecurity in the model; β = 0.44 where food insecurity is a predictor of obesity (Table 6) without poverty in the model;* and β = 1.39 where food insecurity is a predictor of poverty (Table 7). The logistic regression testing for mediation indicated poverty mediated (β = 0.39) the association between food insecurity and obesity (β = 0.29) (Table 8, *$p < 0.05$).

Summary and Transition

The purpose of this study was to examine the association between poverty, food insecurity, and obesity. Food insecurity may be measured by food access, availability, utilization, the instability of food insecurity over a given time period, or a combination of these metrics. The results showed that sex and age have predictive properties when accounting for the relationship between food insecurity, poverty and obesity. Furthermore, all four of the null hypotheses were rejected indicating poverty is a significant predictor for food insecurity when accounting for other demographic variables such as sex, age, and geographic location, as well as the obesity status. In Chapter 5, I discuss the interpretation of the findings contrasted with peer-reviewed literature. The limitations, recommendations for future research in this area, and implications for social change are discussed.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Obesity is growing at an alarming rate within the U. S. population. In 2010, approximately one third (78.6 million) of the U.S. population was obese (CDC, 2014). The Robert Wood Johnson Foundation (RWJF, 2013) projected that half of the adult U.S. population will be obese by 2040. Obesity-related health care costs are estimated at around $210 billion per year, representing 21% of the total national health care budget (RWJF, 2013). Previous research suggests that poverty and food insecurity both contribute to obesity rates (Coleman-Jensen et al., 2014; Economic Research Service, 2014; Leung et al., 2014). To address the obesity crisis facing the United States and create positive social change, researchers must study the interaction of these variables more closely. I investigated the association between poverty, food insecurity, and obesity to test the hypothesis of a cyclical relationship between the variables.

Food insecurity is characterized by worry about the next meal due to lack of finances or lack of food availability. When studying food insecurity, it is important to consider the influences contributing to food choices, dietary habits, and dietary quality. Previous research showed that people living in poverty display higher rates of food insecurity and experience poor health outcomes such as obesity (Coleman-Jensen et al., 2014; Economic Research Service, 2014; Leung et al., 2014). Sarlio-Lahteenkorva and Lahelma (2001) identified possible reasons for this relationship between food insecurity and obesity. Sarlio-Lahteenkorva and Lahelma found that households experiencing food restriction tend to compensate for a lack of food by eating high-fat diets. Ross and Hill (2013) found that economic hardship might be associated with increased body weight. This is largely due to the low cost of fast foods and unavailability of healthy food options

(RAC, 2014). Poverty, food insecurity, and obesity are growing public health concerns within the United States. When reviewing the literature, I observed that the relationship between all three variables was not research adequately. I addressed this research gap by conducting a cross-sectional analysis of the 2012 BRFSS in Louisiana.

When examining food insecurity and poverty as predictors of obesity, it is helpful to focus on rural areas because this population displays disproportionately higher rates of obesity, food insecurity, and poverty within the United States. According to the Food Research and Action Center (2010), food insecurity has the highest impact on rural households and low-income households. Although obesity is a national public health concern, obesity occurs at higher rates in rural areas than in urban areas (Befort et al., 2012). One especially significant factor contributing to this trend is the concept of a food desert. Areas lacking easy access to healthy food options are food deserts. The availability of healthy food options relies on adequate infrastructure such as large supermarkets. Previous research indicated that over 65% of low-income households in the Southeastern United States are located more than 30 miles from a supermarket or large food retailer (Champagne et al., 2007; Connell et al., 2007; Kaufman, 1999). It is common in rural areas to lack easy access to a large supermarket, causing residents to resort to purchasing their food at convenience stores or restaurants where there are few healthy options.

Although previous scholars identified poverty as a determinant of obesity and investigated the link between poverty and food insecurity, gaps remained in the research addressing the cyclical relationship between poverty, food insecurity, and obesity. Previous studies indicated gender differences: Compared to men women are more likely to be affected by food insecurity and obesity (Franklin et al., 2012; WHO, 2015; Wilde &

Peterman, 2006). Additional research was needed to determine whether food-insecure individuals are obese due to the increased tendency to purchase cheap, high-calorie foods or whether scarcity of food increased the tendency of individuals to overeat in periods of abundance (Fernandez et al., 2014). In the United States, limited availability of healthy and affordable foods and lack of social infrastructure to promote healthy eating have been credited for the increasing obesity rates, and researchers have noted that these factors may be beyond personal responsibility (Rolls et al., 2005).

The current study addressed four main questions: (a) Is poverty associated with food insecurity among adults? (b) Is poverty associated with obesity among adults? (c) Is food insecurity associated with obesity among adults? (d) Does poverty mediate the relationship between food insecurity and obesity among adults? I focused on adult residents in rural Louisiana, and my findings supported previous studies indicating poverty may significantly predict food insecurity and poverty and food insecurity may contribute to obesity. Finally, poverty contributed to both obesity and food insecurity. The cyclical relationship between poverty, food insecurity, and obesity was confirmed.

Interpretation of the Findings

Research Question 1: Is poverty associated with food insecurity among adults?

The purpose of this research question was to determine whether poverty contributes to food insecurity. Women experienced food insecurity at higher rates than men did. These findings supported previous studies indicating 30.2% of households with single-mother family structure were food insecure (Freedman & Bell, 2009). I also found that younger adults were affected more by food insecurity than older adults were. Defining poverty as an annual income less than $25,000, I found that people living below the poverty line were almost 4 times more likely to experience food insecurity than those

living above the poverty line. This implies that poverty is a significant contributor to food insecurity among adults in Louisiana.

Research Question 2: Is poverty associated with obesity among adults?

The purpose of this research question was to determine whether poverty contributed to obesity. The results indicated that younger adults were more likely to be affected by obesity than older adults were, and adults living in rural areas had higher rates of obesity than adults living in urban areas did. These findings supported previous studies indicating higher rates of obesity among rural populations (Befort et al., 2012). According to the findings, poverty contributed to obesity. Those living in poverty were almost 2 times more likely to experience obesity.

Research Question 3: Is food insecurity associated with obesity among adults?

The purpose of this research question was to evaluate the relationship between food insecurity and obesity and determine whether food insecurity leads to obesity. Similar results were found associating young adults and those living in rural areas with highest rates of obesity. The results indicated that food insecurity was a significant predictor of obesity. Those individuals living with food insecurity were almost 2 times more likely to be obese than food-secure individuals.

Research Question 4: Does poverty mediate the relationship between food insecurity and obesity among adults?

This research question addressed the cyclical relationship between poverty, food insecurity, and obesity. Results affirmed the results from the previous research questions: Food insecurity predicts obesity. When considering how poverty may influence the relationship between obesity and food insecurity, I found that poverty and food insecurity both predict obesity. However, the effect of food insecurity as a predictor of obesity

slightly decreased when poverty was added to the equation. Although the effect was still significant, it is noteworthy that poverty slightly decreased the influence of food insecurity on obesity.

Three of the four research questions included poverty as an independent variable to investigate the extent to which poverty influenced or predicted food insecurity and obesity, as well as the interrelationship of the three variables. When considering how poverty predicts food insecurity, I found that people living in poverty were 6 times more likely to experience food insecurity either on a regular basis or intermittently. This finding supports previous research, as well as the contextual framework of the study indicating poverty as the most influential determinant of food insecurity. When evaluating how poverty influences obesity, I found that people living in poverty were almost 2 times more likely to be obese. Of those who were in poverty and experiencing food insecurity, the findings indicated that those people were also more likely to be obese. The third research question, using food insecurity as the independent variable, addressed how food insecurity predicts obesity. The results indicated that individuals who experience regular or intermittent food insecurity are almost 2 times more likely to be obese.

Rutten et al. (2010) proposed the cyclical relationship between poverty, food insecurity, and obesity, naming poverty as the biggest factor in the equation. Rutten et al. found that poverty contributes to food insecurity, which in turn contributes to obesity. In the current study, I investigated the direct relationships between poverty and food insecurity, poverty and obesity, and food insecurity and obesity. Answers to the fourth research question provided empirical evidence of the cyclical relationship between poverty, food insecurity, and obesity, fulfilling the original intention of the study and

supporting the hypothesis of Rutten et al. The results of this study further supported previous research demonstrating gender and age differences in rates of obesity, poverty, and food insecurity, as well as higher rates of obesity in rural populations (Befort et al., 2012; Bhattacharya et al., 2004; Conklin et al., 2014; Franklin et al., 2012; Freedman & Bell, 2009; Wilde & Peterman, 2006). However, the results from the current study varied slightly from previous findings.

Conklin et al. (2014) found that women who reported financial hardship were more likely than men to gain weight due to food insecurity were. Freedman and Bell (2009) found that women were more likely than men to experience food insecurity were. Based on these findings, it would be logical to assume food insecurity caused by poverty is more likely to affect women, and those affected women are more likely to be obese. However, only the results from Research Question 1, addressing the relationship between poverty and food insecurity, indicated higher rates of food insecurity in women. Results from the third research question, addressing the relationship between food insecurity and obesity, did not show gender differences. This suggests that, according to the current study, the influence of poverty on food insecurity is the only relationship to demonstrate gender differences. The relationship between food insecurity and obesity did not affect women more than men.

Bhattacharya et al. (2004) found that poverty was a predictor of obesity in children, but poverty was a predictor of low BMI in elderly populations. Although children were not included in the current study, the results for Research Questions 2 and 3 addressing the relationship between poverty and obesity, and food insecurity and obesity, indicated higher rates of obesity in younger adults. Because the current study's population was 18 years and older, the youngest adults included in the data analysis may

still be considered adolescents. With each year in age, the rates of obesity went down. In this way, the current study may support previous research indicating poverty as a predictor of obesity in children and adolescents. However, discrepancies still exist in the literature. Ogden and Carroll (2010) produced data opposing the theory that younger adults display higher rates of obesity than older adults were. Ogden and Carroll found that adults 60 years and older were more likely to be obese than younger adults. The current study may support the conclusion by Bhattacharya et al. (2004) that youth populations in poverty are more likely to be obese, but it contrasts with Ogden and Carroll's (2010) conclusion that obesity rates are higher in elderly populations. In the current study, with each year in age, obesity rates went down. One explanation for this discrepancy could be that Ogden and Carroll (2010) did not study obesity in relation to poverty, but as a variable on its own. If this is true, it may demonstrate the significance poverty plays in rates of obesity. When poverty is added to the equation, it increases the risk of being obese in all age groups.

The purpose of the study was to develop an evidence-based model that may guide future research and interventions involving the relationship between food insecurity, obesity, and poverty. The results of the study may lead to a more complete and systematic approach to studying obesity and food insecurity. The conceptual framework of the study was developed based on the conclusions of Rutten et al. (2010), who identified poverty as the chief influence in the mutual relationship between food insecurity and obesity. My findings indicated that poverty was a significant determinant of food insecurity and obesity and are supported by the literature. However, there was an insignificant difference in the conclusions that could be studied further.

When considering the cyclical interplay of poverty, food insecurity, and obesity, I found that poverty decreased the influence of food insecurity as a predictor of obesity. Although the influence of food insecurity was significant in predicting food insecurity and obesity, this was a noteworthy finding. This finding may suggest that people experiencing food insecurity due to financial hardship are less likely to be obese than those experiencing food insecurity due to a lack of food availability. Although data supported the alternative hypothesis that poverty mediates the relationship between food insecurity and obesity, this finding may also extend the current literature when it comes to recommendations for addressing food insecurity in rural populations. This is especially important when considering implications for this study.

Because a large portion of Louisiana is rural, it is especially significant to consider factors contributing to high obesity rates found in rural populations. When focusing on rural areas classified as food deserts, the approach to combating food insecurity and obesity would be vastly different than addressing the problem from a financial assistance perspective. Tagtow and Hinkle (2008) suggested the increase in the number of food deserts in rural areas might cause convenience stores and fast food restaurants to become outlets for meals, increasing the likelihood of residents consuming low-quality foods. The challenge in rural areas is ensuring healthy food options is the routine, easy choice (Committee on Accelerating Progress in Obesity Prevention, 2012; Rolls et al., 2005). The general availability of foods has largely shifted to highly refined and excessively processed foods containing extreme levels of saturated fats (Moubarac et al., 2012). Jetter and Cassady (2006) revealed that there is limited access to whole-grain foods, low-fat cheese, and lean ground meat in neighborhoods with smaller grocery stores. When addressing obesity caused by limited healthy food access in rural

populations, it may be necessary to focus first on making healthy foods more accessible. After accessibility is addressed, concerns related to purchasing power may be addressed.

Limitations of the Study

Limitations of this study included the use of self-reported data, secondary data sets, and random telephone sampling. The data used for this study was from the Louisiana Behavior Behavioral Risk Factor Surveillance System (BRFSS) 2012, a random telephone survey. Self-reported data can introduce recall bias. For example, when addressing rates of food insecurity, the survey asked, “In the past 30 days, have you been concerned about having enough food for you or your family?” Questions that rely on self-report are affected by the participant’s ability to remember instances of food insecurity within the last 30 days, but also may be influenced by personal interpretation of the question and the variables involved. One definition of food insecurity involves the ability to obtain food in a socially acceptable way (Campbell, 1991). The most obvious example would be theft; however, stealing is a socially unacceptable way to obtain food. Any given survey participant may view stealing food as a viable option and therefore report no food insecurity within the past 30 days. Survey participants' lack of knowledge about the definitions of food insecurity and poverty may have contributed to disparities in the data. Shame may be another influence on self-report measures when collecting data on sensitive topics, even though the survey is completed anonymously.

Another limitation of the current study may be the use of the data from random telephone sampling. Households without landlines were excluded from the selection sample. A significant number of households without landlines could yield differences in socioeconomic status and ethnic backgrounds among participants. Those in rural areas are likely to have less representation in the sample. Depending on why residents do not

have a landline telephone, there will be unknown statistical contributions of the sample in studying the relationship between poverty, food insecurity, and obesity. Households without landline telephones may be deeper in poverty than those with landlines may and could significantly contribute to the data investigating the role of poverty in the relationship of food insecurity and obesity.

The use of secondary data sets may also limit the research spectrum when attempting to target certain variables, such as poverty, food insecurity, and obesity. Without developing the survey questions on my own, the current study is limited in the relevant information the data source was designed to collect. The study is also limited in its ability to investigate the variable relationship between poverty, food insecurity, and obesity, as the questionnaire was developed as a general census and was not intending to investigate the specific variable relationship the current study sought to address. The current study was not able to investigate causes of poverty, food insecurity, or obesity based on the secondary data. Catering survey questions to the specific variables studied is important when developing a comprehensive model of the cyclical relationship between poverty, food insecurity, and obesity.

The current study also does not account for the varying levels of food insecurity and poverty. Previous research indicated, at least among women, that marginal food insecurity was just as significant as food insecurity (Cook et al., 2013). Considering the varying gradients of food insecurity and poverty may be significantly influential in predicting obesity risk.

Due to the many different topics and questions in the BRFSS, the validity may vary for some sections or modules within the survey. The module used to conduct the current research was an optional sub-module that is not included in all state surveys. This

may hinder the ability to generalize the findings because similar data would be unavailable for states that chose not to include this specific sub-module, which investigates rates of poverty, food insecurity, and obesity, among other things.

Although there are limitations and this study was not experimental so there is no way to claim that poverty causes food insecurity, which in turn causes obesity, the sheer number of participants included in this study makes it possible to generalize these results to the entire population, at least among rural areas within the United States.

Recommendations

Further research is needed to investigate the above stated limitations, and to determine precisely why food insecurity puts an individual at a higher risk for obesity. Based on the current body of literature, it is unclear if food insecure individuals are more likely to be obese due to an increased tendency to purchase cheap, high calorie-dense foods, or if scarcity increases the tendency of these individuals to overeat in periods of abundance (Fernandez et al., 2014). It may be a combination of both: those living in poverty may purchase higher calorie foods over-saturated with sugars and artificial sweeteners, and may binge in periods of abundance. When studying binge-eating behaviors in individuals who report financial hardship, Conklin et al. (2014) found that women who experienced difficulty paying bills were more likely to binge eat, and consequently more likely to be obese. This may support the hypothesis that there is a combination effect: low-income households may purchase cheaper food that may be unhealthy and may consume larger quantities of that food in periods of perceived abundance. However, further research is necessary to provide empirical evidence to inform effective intervention strategies.

Identifying specific causes of food insecurity will better inform intervention and prevention programs. Social and government programs looking to inform the public about obesity risk can target urban and rural areas in different ways. For example, in urban areas they may focus less on the contribution of food availability since transportation and access are not as much of a challenge in urban areas. Instead, it may be more effective to focus urban intervention programs on cost-effective nutritious meal planning. In rural areas, the availability and access may be a major contributor to food insecurity. Perhaps programs targeting rural populations should focus more on improving access and availability of healthy food options in order to address the way food insecurity contributes to obesity.

The Rural Assistance Center (RAC) identified specific challenges that are common among rural populations: limited transportation and availability of healthy foods, lack of public health funding and infrastructure, barriers to access, and environmental physiognomies (RAC, 2014). Rural populations are especially difficult to reach when it comes to implementing positive social change, as rural areas are commonly sparsely populated. Researchers and government officials should continue investigating ways to introduce food availability and easy access among these populations to address the growing rates of obesity further.

The availability of foods has largely shifted to highly refined and excessively processed foods, with meat and dairy products containing extreme levels of saturated fats (Moubarac et al., 2012). The Rural Assistance Center (2014) agrees that rural residents are more inclined to eat diets higher in fat and calories and have less access to services that promote healthy eating. Befort et al. (2012) revealed that a diet high in calories from fat was the biggest predictor of obesity and a major contributor to the high obesity rates

in rural America. In general, rural populations tend to be less educated, older, and have lower income than urban populations. Psychological mechanisms contributing to the relationship between food insecurity and obesity are explained through inadequate nutritional knowledge, the consumption of high-fat foods in search of comfort, and excessive vulnerability to the external environment, including easy access to unhealthy food options (Drewnoski & Specter, 2004). To address these disparities, education is important. Viable solutions to decrease behavioral influences on obesity include implementing nutritional programs that teach about the importance of nutrition, how to navigate nutritional labeling, and cost-effective meal planning. Further research is needed to investigate specific causes of food insecurity within the rural populations. Future studies can investigate the most effective intervention strategies specific to rural and urban populations.

Poverty, limited access to adequate food, socioeconomic disparities, and health behaviors all play a role in the relationship between food insecurity and obesity (Champagne et al., 2007; Connell et al., 2007; Rutten et al., 2010). Small, independent grocers and convenience stores selling higher priced foods are more prevalent in low-income and rural communities making it difficult to access and afford healthy food options. Government standards may be implemented requiring small food retailers to provide customers with healthy, affordable food selection. To address the lack in infrastructure, public service funding can be distributed to create better access to large food retailers.

Implications for positive social change were at the forefront of this study. Although further research is needed, the implications of the current study may include reduction of the incidence of obesity through identification and prevention of factors

contributing to food insecurity. The study also may have public health implications for decreasing food insecurity and obesity rates among urban and rural populations of adults who experience an economic disadvantage by providing an evidence-based model of the cyclical relationship between poverty, food insecurity, and obesity. Siegal et al. (2014) found availability, access, and affordability is all influential variables when considering the relationship between food insecurity and obesity. From 2009 to 2010, more than one-third of adults and almost 17% of children were obese (Ogden & Carroll, 2010). To address the alarming rates of obesity within the United States, we must urgently consider ways to address food availability and affordability, as well as increase access to attractive healthy food options. Government programs that provide financial assistance to low income households, like Food Stamps, may not be adequate in addressing national issues of poverty, food insecurity, and obesity, particularly in rural areas.

Among rural populations, the limited availability of healthy food options may be a slightly more pressing predictor of obesity than poverty. Over 65% of low-income households in the Southeastern region of the United States are located more than 30 miles from a supermarket or large food retailer (Champagne et al., 2007; Connell et al., 2007; Kaufman, 1999). With sparse public transportation and high rates of poverty, it seems perhaps more common for rural residents to be limited in their dietary selection due to lack of availability and access to healthy food options. When considering the compounding influence of food availability (the presence of a large supermarket with healthy food options) and access (being able to get to that supermarket), it starts to become clear why we may notice higher rates of obesity in rural areas.

Conclusion

Factors such as socioeconomic status, food systems, food availability, and dietary intake may directly influence the relationship between food insecurity and obesity (Befort et al., 2012; Connell et al., 2007; Freedman & Bell, 2009). When seeking effective intervention and prevention strategies all of these factors must be considered. Obesity prevalence has progressively increased presenting the burden of disease and disability (Dixon, 2010). Obesity poses a major public health concern in the United States due to the increased risk associated with multiple chronic diseases. Obesity produces staggering implications for individuals, families, businesses, the healthcare system, and society overall (National Advisory Committee on Rural Health and Human Services, 2005). In 2014, every state within the US had an obesity prevalence of 20% or higher. The previous research demonstrates the urgency of addressing the obesity epidemic. This study is important as it documented the relationship between poverty, food insecurity, and obesity in a state with high prevalence of obesity. This cross-sectional study fulfilled the contextual framework of the study by building an evidence-based model of the interactions of poverty, food insecurity, and obesity. These findings could promote positive social change by informing program intervention strategies that may reduce the burden of obesity in states with disproportionately high rates of poverty and obesity. In high-income countries, such as the United States, overweight and obesity rates are more likely to be prevalent in disadvantaged regions and among populations with lower income, low education status, and social class (Conklin, Forouhi, Brunner, & Monsivais, 2014). It is important to focus on these populations when attempting to address the growing obesity rates within the United States, and worldwide. With approximately 23% of the United States being rural, and a disproportionate number of these residents

displaying high rates of obesity, food insecurity, and poverty, it may be especially important to focus on rural areas when developing intervention strategies.

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Appendix A: BRFSS Questionnaire and Social Context Module

I need to randomly select one adult who lives in your household to be interviewed. How many members of your household, including yourself, are 18 years of age or older?

__ Number of adults
If "1,"
Are you the adult?
If "yes,"
Then you are the person I need to speak with. Enter 1 man or 1 woman below (Ask gender if necessary). **Go to page 5.**
If "no,"

Is the adult a man or a woman? Enter 1 man or 1 woman below. May I speak with **[fill in (him/her) from previous question]**? **Go to "correct respondent" on the next page.**

How many of these adults are men and how many are women?
__ Number of men
__ Number of women
The person in your household that I need to speak with is .

Section 8: Demographics

8.1 What is your age?
(108-109)
_ _ Code age in years
0 7 Don‘t know / Not sure
0 9 Refused

8.2 Are you Hispanic or Latino?
(110)
1 Yes
2 No
7 Don‘t know / Not sure
9 Refused

8.3 Which one or more of the following would you say is your race?
(111-116)
(Check all that apply)
Please read:
1 White
2 Black or African American
3 Asian
4 Native Hawaiian or Other Pacific Islander
5 American Indian or Alaska Native
Or
6 Other [specify]_____

Do not read:
8 No additional choices
7 Don‘t know / Not sure
9 Refused
CATI note: If more than one response to Q8.3; continue. Otherwise, go to Q8.5.

8.4 Which one of these groups would you say best represents your race?
(117)
Please read:
1 White
2 Black or African American
3 Asian 2012 BRFSS/Final/January 27, 2011
4 Native Hawaiian or Other Pacific Islander
5 American Indian or Alaska Native
Or
6 Other [specify]_____
Do not read:
7 Don‘t know / Not sure
9 Refused

8.7 How many children less than 18 years of age live in your household?
(120-121)
_ _ Number of children
8 8 None
9 9 Refused

8.9 Are you currently…?
(123)
Please read:
1 Employed for wages
2 Self-employed
3 Out of work for more than 1 year
4 Out of work for less than 1 year
5 A Homemaker
6 A Student
7 Retired
Or
8 Unable to work
Do not read:
9 Refused
8.10 Is your annual household income from all sources—
(124-125)
If respondent refuses at ANY income level, code „99" (Refused)
Read only if necessary:
0 4 Less than $25,000 **If "no," ask 05; if "yes," ask 03**
($20,000 to less than $25,000)
0 3 Less than $20,000 **If "no," code 04; if "yes," ask 02**
($15,000 to less than $20,000)
0 2 Less than $15,000 **If "no," code 03; if "yes," ask 01**
($10,000 to less than $15,000)
0 1 Less than $10,000 **If "no," code 02** 2012 BRFSS/Final/January 27, 2012 18
0 5 Less than $35,000 **If "no," ask 06**
($25,000 to less than $35,000)
0 6 Less than $50,000 **If "no," ask 07**
($35,000 to less than $50,000)
0 7 Less than $75,000 **If "no," code 08**
($50,000 to less than $75,000)
0 8 $75,000 or more
Do not read:
7 7 Don't know / Not sure
9 9 Refused
8.11 About how much do you weigh without shoes?
(126-129)

NOTE: If respondent answers in metrics, put "9" in column 126.
Round fractions up
_ _ _ _ Weight
(pounds/kilograms)
7 7 7 7 Don't know / Not sure
9 9 9 9 Refused
8.12 About how tall are you without shoes?
(130-133)
NOTE: If respondent answers in metrics, put "9" in column 130.
Round fractions down
_ _ / _ _ Height
(f t / inches/meters/centimeters)
7 7/ 7 7 Don't know / Not sure
9 9/ 9 9 Refused
8.13 What county do you live in?
(134-136)
_ _ _ ANSI County Code (formerly FIPS county code)
7 7 7 Don't know / Not sure
9 9 9 Refused 2012
8.14 What is the ZIP Code where you live? (137-141)
_ _ _ _ _ ZIP Code
7 7 7 7 7 Don't know / Not sure
9 9 9 9 9 Refused

8.22 Indicate sex of respondent. Ask only if necessary.
(151)
1 Male **[Go to next section]**
2 Female **[If respondent is 45 years old or older, go to next section]**
How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals? Would you say you were worried or stressed--- (465)

Please read:
1 Always
2 Usually
3 Sometimes
4 Rarely
5 Never
Do not read:
8 Not applicable
7 Don't know / Not sure
9 Refused

Appendix B: Permission Letter from Louisiana BRFSS Coordinator

Bobby Jindal
GOVERNOR

Kathy H. Kliebert
SECRETARY

State of Louisiana
Department of Health and Hospitals
Office of Public Health

November 13, 2015

To Whom It May Concern,
Ms. Tamicka Walls has permission to use the Louisiana Behavior Risk Factor Surveillance System datasets from 2011 through 2014. This is publically available data, collected by each state under the coordination of the CDC.

By signing below, Ms. Walls has agreed to protect the confidentiality of the respondents whose information is included in the above named datasets. Specifically, zipcode information should never be used to identify any individual respondent. All data reporting is to be done using aggregate data.

Laurie M.

Laurie M. Freyder MPH
BRFSS Coordinator
Office of Public Health
Louisiana Department of Health & Hospitals

I agree to protect the confidentiality of the respondents whose information is included in the above named datasets. Specifically, zipcode information should never be used to identify any individual respondent. All data reporting is to be done using aggregate data.

Tamicka Walls

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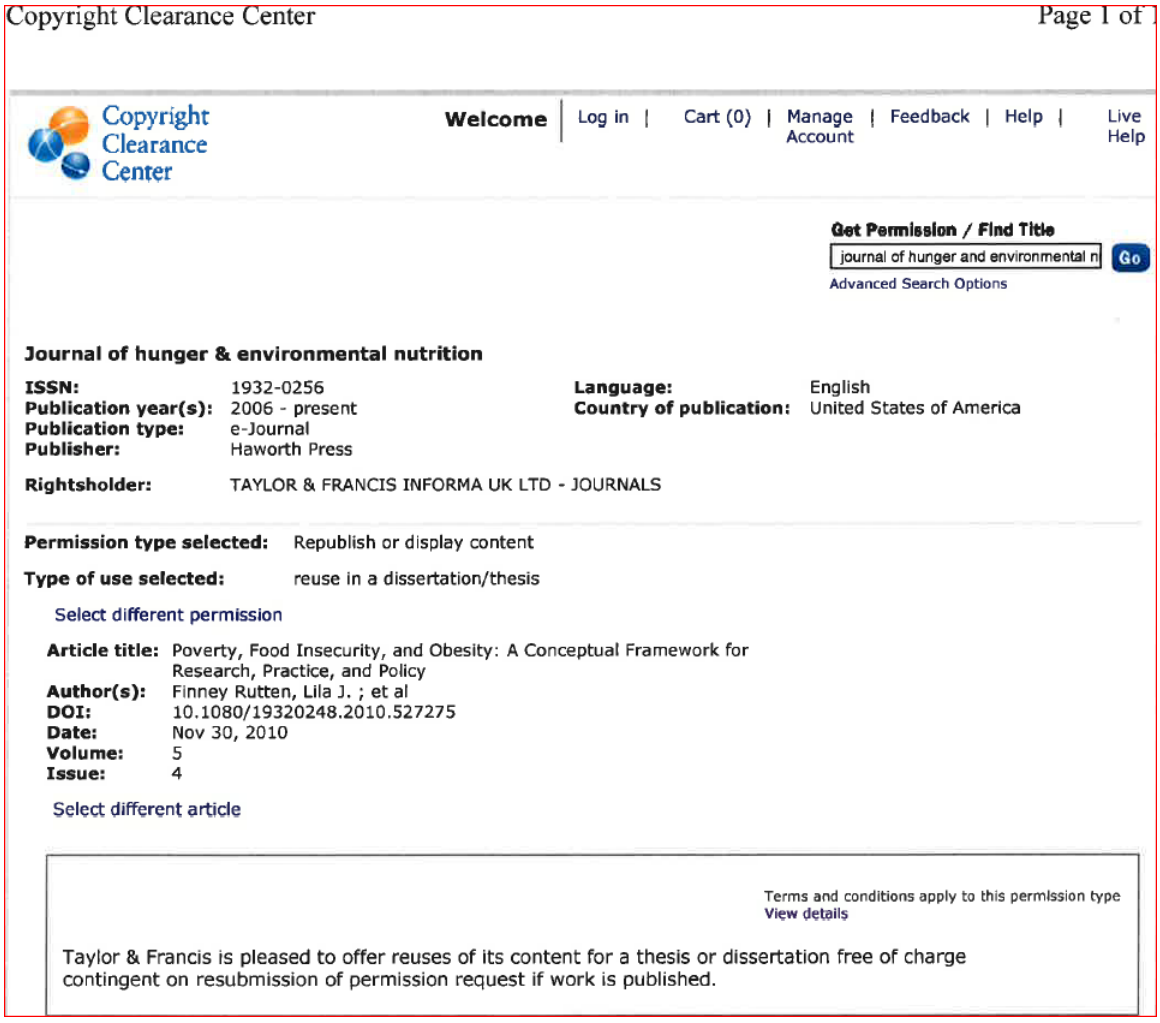
Appendix C: Permission Letter from Copyright Clearance Center-Model usage



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