

Examining the Relationship between Food Insecurity and Obesity in the United
States Using a Nationally Representative Sample

by

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ABSTRACT

This study examined the relationship between weight status, food insecurity, sex, marital status, and race. The 2013-2014 National Health and Nutrition Examination Survey dataset was analyzed using a multinomial logistic regression and crosstabulations. It was found that those who were low food secure and very low food secure were more likely to be obese. Hispanics including Mexican Americans were more likely to be overweight and obese. Where non-Hispanic Black individuals were more likely to be obese but not overweight. Both non-Hispanic Black and Hispanic including Mexican American individuals were more likely to be food insecure. Females were less likely than males to be overweight but more likely to be obese. Males and females had similar occurrences of all levels of food security. Those who were married were more likely to be both overweight or obese. Those who were not married were more likely to be food insecure.

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CHAPTER I INTRODUCTION

The growing waist line of many in the United States is no secret. Obesity is a major health concern that has continued to grow throughout the years. The World Health Organization (WHO) defines overweight and obesity as “abnormal or excessive fat accumulation that presents a risk to health.” Overweight or obesity can also be defined by body mass index (BMI). Where overweight is a BMI of 25 to 29.9 and obesity is defined as a BMI of 30 or more (Centers for Disease Control and Prevention [CDC] 2017).

Data from the 2015-2016 National Health and Nutrition Examination Survey (NHANES) shows that obesity rates are creeping up to about 40%. The number of people who are obese has nearly doubled in the last thirty years. In the past five years the number has risen by about one percent each year. Obesity affects slightly more women than men (41.1% vs 37.9%) and the rate of obesity in Blacks (46.8%) and Latinos (47%) is about 10% higher than in that of Whites (37.9%) (Trust for Americas Health, 2018).

With obesity comes an array of diseases and health conditions. These include high blood pressure (also known as hypertension), type 2 diabetes, coronary heart disease, and various cancers. Obesity also contributes to all-cause mortality, low quality of life, body pain, and difficulty functioning physically (Centers for Disease Control and Prevention [CDC], 2015).

Low food security means that there were reports of reduced quality, variety, or desirability of diet with little to no reduced food intake. Very low food

security is defined as multiple reports of disrupted eating patterns and reduced food intake that involved hunger. High food security is when no indications of food access problems or limitations are present. Marginal food security is when there are one or two reported indications of anxiety over having enough food or encountering a shortage of food in the household (United States Department of Agriculture [USDA], 2018).

Food insecurity is a lesser known health issue in the United States. With 11.8% of the population facing food insecurity in 2017 it is a clear issue. Nearly six million U.S. households had very low food security and 40 million people lived in food insecure households in 2017. Low food security affected 7.3% of U.S. households in 2017 (United States Department of Agriculture [USDA], 2018).

According to the United States Department of Agriculture (USDA) (2018) households that are food insecure and marginally food secure share that they were worried that food would run out, food that was bought would not last, and they could not afford to buy balanced meals. Households that are food insecure indicated that they cut the size of a meal or skipped a meal, cut or skipped a meal in three or more months, ate less food than they felt they should, were hungry but did not eat, and did not eat for a whole day.

Food insecurity is not a chronic issue, but rather is a recurring issue and over the years it has declined from around 15% in 2011 to 11.8% in 2017 (USDA, 2018). Groups that are at higher risk of food insecurity are households with children, households that are headed by single parents, women or men living

alone, non-Hispanic Blacks and Hispanic individuals, and households with incomes 185 percent below the poverty threshold (USDA, 2018).

Food insecurity can be an acute or chronic issue it and comes with health risks. Gundersen and Ziliak (2015) examined food insecurity and health outcomes in children, non-senior adults, and seniors. The authors found the health risks for food insecure children included birth defects, anemia, lower nutrient intakes, cognitive problems, aggression and anxiety, higher risks of being hospitalized poorer general health, asthma, behavioral problems, depression, suicide ideation, and worsened oral health. Health risks were also found for children who live in marginally food secure households. There were concerns of developmental issues that were expressed by the mothers. Marginally food secure were also more likely to have fair or poor health than fully food secure children.

Gundersen and Ziliak (2015) also found that food insecure adults have associated health risks that include decreased nutrient intakes, increased rates of mental health issues such as depression, diabetes, hypertension, hyperlipidemia, fair to poor health, and poor sleep outcomes. It was also found that mothers who are food insecure are twice as likely to report mental health problems and over three times as likely to report oral health problems when compared to food secure peers. For food insecure older adults, it was found that they have lower nutrient intake, they are more likely to be in fair or poor health, more likely to be depressed, and more likely to have limitations in daily activities compared to food secure seniors. Seniors who are marginally food secure have

reduced nutrient intakes that is roughly equivalent to having 15,000 dollars less income and effects activity of daily living which is almost equivalent to being 14 years older compared to food secure seniors.

Purpose of the Study

The purpose of this study was to examine the relationship of food security, sex, marital status, and race on weight status among adults using National Health and Nutrition Examination Survey (NHANES) 2013-2014 data.

Research Question

When controlling for age, income, and level of education what effect does food security, marital status, sex, and race have on weight status?

Hypothesis

When controlling for age, income, and level of education those who are overweight or obese are more likely to be food insecure, more likely to be not married, more likely to be Black or Hispanic, and are more likely to be female than those who are under or normal weight.

Significance of the Study

This study utilized 2013-2014 NHANES data to examine the relationship of food security status, sex, marital status, and race on weight status among United States adults. This study will add to the literature by examining a large adult age group and help to close gaps in the literature pertaining sex and marital status as well as support past research with more current data.

CHAPTER II LITERATURE REVIEW

With obesity at around 40% (Trust for Americas Health, 2018) and nearly six million U.S. households having very low food security and 40 million people living in food insecure households in 2017 (USDA, 2018), food insecurity and obesity are both clear issues. These two issues have been shown to have a connection known as the food insecurity obesity paradox. This chapter will review the general literature of food insecurity and overweight/obesity individually, as well as examine their established relationship. The factors of race, gender, and marital status will be examined more in depth in the final section regarding their relationship with food insecurity and overweight/obesity.

Food Insecurity

Current Status of the United States

The United States Department of Agriculture USDA defines four types of food security, two types are under the category of food secure which are high food security and marginal food security. The two that are under the category of food insecurity are low food security and very low food security. In 2017 there were 40 million people who lived in food insecure households and 5.8 million households that had very low food security (USDA, 2018). Food insecurity often effects certain demographics such as single parents (mainly mothers), those with low income ($\leq 185\%$ below the federal poverty line), people who live alone, households with children, and Hispanic or non-Hispanic individuals (Gundersen & Ziliak, 2015). Using 2003-2014 NHANES data Lee, Scharf, and DeBoer (2018) found that among 20-39 year old individuals, those that were

Hispanic or Black had a higher proportion of food insecurity compared to those who were White.

Of the 40 million people who lived in food insecure households in 2017, 15.7% of those households had children, 30.3% were headed by a single women, 19.7% were headed by a single man, 13.9% were women living alone, 13.4% were men living alone, 21.8% were non-Hispanic Black, 18% were Hispanic households, and 30.8% had incomes 185% below the federal poverty line (USDA, 2018).

Food Security Status Defined

Food security is having access to enough food at all times for an active healthy life for all members of the household (USDA, 2018). According to the USDA high food security is defined as having no reported indications of food access problems or limitations. Marginal food security is having one or two reported indications of anxiety over food sufficiency or shortage of food in the household and there is little or no indication of changes in diet or food intake. Both high food security and marginal food security had the former label of food security. Low food security is having reports of reduced quality, variety, or desirability of diet and little to no indications of reduced food intake. Very low food security is having reports of multiple indications of disrupted eating patterns and reduced food intake. Prior to the updated definitions very low food security was food insecurity with hunger, low food insecurity was food insecurity without hunger, and marginal food security and fully food secure were food secure. (USDA, 2018).

Diet Composition of Those Who Are Food Insecure

Various studies that have examined food insecurity in multiple contexts, some examining diet. A study conducted in California utilizing veterans of the U.S. military examined common dietary practices and found that of the 11,011 participants 4.89% were at or below 200% of the federal poverty line and food insecure, 2.35% participated in Supplemental Nutrition Assistance Program (SNAP), and 71.13% were overweight or obese. Those that lived in poverty and with food security reported the highest intakes of fast food and soda and the lowest intakes of fruits and vegetables. Males reported higher intakes of fast food and soda when compared to females. People who participated in SNAP had an average of 31% lower intake of fruits and vegetables than those who did not participate (Becerra, Hassija, & Becerra, 2016).

Gundersen and Ziliak (2015) examined food insecurity and health outcomes found overall that those who were food insecure or marginally food secure all had lower nutrient intakes than those who were food secure for all age groups (children, non-senior adults, and seniors). Nguyen, Shuval, Bertmann, & Yaroch (2015) conducted a study that involved 8,333 adults that participated in SNAP and found that the food insecure adults had a significantly lower Healthy Eating Index 2010 score than those with full food security. The authors also found that among SNAP participants they had a higher intake of sugar (22 vs 18.7 teaspoons) and a higher intake of empty calories (787.9 vs 731.5). Diets that consist of fast foods and sodas, are lower in nutrient density, and are higher in empty calories and sugar. Such diets often lead to being overweight or obese

and a diagnosis of diseases that are associated with a higher weight status and poor diet (Harvard T.H. Chan School of Public Health, 2019).

Health Impact of Food Insecurity

Due to the poor diet that often comes with food insecurity there are many negative health implications that occur. Gundersen and Ziliak (2015) conducted a literature review and found that among adults, food insecurity was associated with increased rates of mental health problems, lower nutrient intakes, diabetes, hypertension, hyperlipidemia, fair or poor health, and poor sleep outcomes. Similar results were found among older adults with the addition of limitations in activities of daily living. Analysis of data from 2003-2014 NHANES found that among 20-39 year old individuals, those who were food insecure had higher odds of having diabetes or being pre-diabetic (Lee et al., 2018).

Overweight and Obesity

Definition and Current Status of United States

The WHO defines overweight and obesity as “abnormal or excessive fat accumulation that presents a risk to health” (World Health Organization, n.d.). Body mass index (BMI) can be used to define weight status, where overweight is a BMI of 25 to 29.9 and obesity is defined as a BMI of 30 or more (CDC, 2017). From 2015-2016 the obesity rate in the United States was around 40% which is about 93.3 million adults. The health conditions that come along with obesity are heart disease, stroke, type 2 diabetes, various, cancers,

and other conditions as well as increased risk of all cause-mortality and reduced quality of life (CDC, 2015).

Obesity has individual and societal costs. According to the CDC the medical cost for obesity in 2008 was \$147 billion (Trust for Americas Health, 2018). As with all health conditions certain demographics are at higher risk than others. Those of Hispanic heritage and non-Hispanic Blacks are at a higher risk of obesity than Whites or Other races. Women also have a slightly higher risk than that of men (Centers for Disease Control and Prevention [CDC], 2018; Trust for Americas Health, 2018). Those who have a lower income are more likely to be obese than those who earn more; 33% of adults who earn less than \$15,000 a year are obese compared to 24.6% who earn at least \$50,000 a year (State of Obesity, n.d.).

Overweight/Obesity Demographically

Looking at obesity demographically, women have a slightly higher rates of obesity than men (41.1% vs 37.9%). Age groups are relatively equal with 20-39 being the lowest at 35.7%, 40-59 42.8%, and 60 and over being 41%. For race Blacks and Latinos have the highest percentages 46.8% and 47%, Whites are at 37.9%, and Asians are the lowest with 12.7% (Trust for Americas Health, 2018).

Food Insecurity and Obesity

Relationship between Food Insecurity and Overweight/Obesity

In recent years the food insecurity overweight and obesity paradox has become recognized and has been studied more frequently. There have been studies that examined food insecurity and overweight and obesity in contexts such as differences in gender, the health outcomes of food insecurity, dietary practices of those affected, and effects on pregnant women, among others (Becerra et al., 2016; Franklin et al., 2012; Gundersen & Ziliak, 2015; Hernandez, Reesor, & Murillo, 2017; Liu et al., 2015).

Franklin, et al. (2012) examined the predictors of food insecurity and obesity. They found that people who are food insecure and marginally food secure have a higher BMI and are more likely to be overweight or obese than food secure counterparts. Rural residents of the Appalachian Ohio area who were food insecure had a significantly higher BMI and obesity, especially women. In a convenience sample of 200 low income parents it was found that half of the participants reported household food insecurity and two thirds of the adults were obese. It was also found that adults who were food insecure were 2.5 times more likely to be obese than food secure counterparts. The authors also found in a sample of 200 parents half were food insecure and about two thirds were obese.

Various studies have shown that marginal food security, low food security, and very low food security all have a relationship with the food insecurity and weight status. In a study where 13.2% were marginally food secure, 17.2% were low food secure, and 10.5% were very low food secure those of all levels of food

insecurity had significantly higher BMIs and were more likely to be obese than those who were food secure (Nguyen et al., 2015). A study conducted on women in California showed that of the food insecure women those who were in the very low food security category had the highest prevalence of obesity and women who were low food secure had the second highest prevalence (Ryan-Ibarra, Sanchez-Vaznaugh, Leung, & Induni, 2016).

In a study of adults from 12 states, the following demographics that were food insecure also had a significantly higher prevalence of obesity those over the age of 30, women, non-Hispanic whites, non-Hispanic Blacks, and non-Hispanic other races, adults with some college education or college degree, those with a reported household income less than 25,000 dollars or 50,000-74,000 dollars, those who were employed or retired, students, homemakers, and adults with no or two children in the household (Pan, Sherry, Njai, & Blanck, 2012).

Low-income is a main contributor to food insecurity. Among low-income Hispanic subgroups where 54% of the sample was food secure, food insecurity was significantly associated with overweight or obesity among Mexican American women (Smith, Colón-Ramos, Pinard, & Yaroch, 2016). In low-income older adults it was found that of food insecure women 40% were obese and 26% were normal weight. There were no statistically significant differences among men pertaining to weight status and food insecurity. However in adjusted models it was found that for men those who were food insecure had 42% lower odds of

being overweight compared to normal weight and 41% lower odds of being overweight or obese compared to normal weight (Hernandez et al., 2017).

Among food insecure households, food insecurity is associated with being overweight or obese for mothers. However, this does not hold true for fathers, or for women and men with no children. Food insecurity has been associated with a higher BMI among young women but not young men (Food Research and Action Center, 2015).

Sex and Obesity

There have been several studies that have looked at the relationship between gender, food insecurity, and obesity, yielding mixed results. Franklin, et al. (2012) reported conflicting findings between genders pertaining to food security and weight status. Males that experienced very low food insecurity were less likely than food secure males to be overweight or obese. Marginally food secure males had a higher mean BMI than food secure males and showed a tendency to be overweight or obese. When looking at women, comparing fully food secure women with those who are of low food security, the low food secure women were more likely to be obese. A similar result was found with marginally food secure women. Those who were marginally food secure were more likely to be overweight compared to food secure women.

Franklin et al. (2012) found that among women all levels of food insecurity were significantly associated with a higher BMI and being overweight when compared to fully food secure women. Women who experienced marginal food security or food insecurity without hunger were significantly more likely to be

obese than fully food secure women. Results of a multivariate analysis showed that women experiencing food insecurity with hunger were 67% more likely to be overweight and women who were marginally food secure and food insecure without hunger were 58% and 76% more likely to be obese. With men similar results were found. Men who experienced marginal food security were 1.43 times more likely to be obese than those who were fully food secure. Although it was also found that those who were food insecure without hunger were significantly more likely to have a lower BMI and a smaller proportion of the sample groups was over weight of obese when compared to those who were fully food secure.

Women who are pregnant and food insecure are also at higher risk to be obese and have related health issues. Pregnant women who are food insecure were three times more likely to be severely obese before pregnancy than those who were food secure and women who are food insecure are twice as likely to experience gestational diabetes. Obesity in early pregnancy was significantly and positively associated with food insecurity (Franklin et al., 2012). Food insecurity during pregnancy is also associated with a greater weight gain during pregnancy and a greater postpartum weight, especially in women who were obese before pregnancy (Food Research and Action Center, 2015). Laraia, Siega-Riz, and Gundersen (2010) found that marginally food secure pregnant women are also at risk for obesity when compared to fully food secure women. They also found that women who lived in food insecure households gained about four pounds more and were subject to a higher gestational weight gain ratio than women from food secure households.

A study that examined gender disparities pertaining to the food insecurity overweight and obesity paradox found that among 5,506 low income older adults, women who were food insecure were more likely to be obese than food secure women (40% vs 32%). Analyses revealed that males who were food insecure had 42% lower odds of being overweight compared with normal weight and 41% lower odds of being overweight or obese compared with normal weight. It was also found that among low-income older women food insecurity did not predict elevated weight status (Hernandez et al., 2017). It was found in the baby boomer generation females are 1.4 times more likely to have a higher BMI than females who were food secure and no association between food insecurity and overweight/obese was found for males (Food Research and Action Center, 2015).

Smith, Colon-Ramos, Pinard, and Yaroch (2016) conducted a study that focused on low-income Hispanic individuals. They found that food insecurity was significantly associated with overweight or obesity among Mexican American women but not Mexican American men. A study that looked at 12 states found that of that 66,553 adult participants 19% were food insecure. Of the participants that were food insecure women were more likely to be obese than men (Pan et al., 2012). Ryan-Ibarra, Sanchez-Vaznaugh, Leung, and Induni (2016) conducted a study that looked at women who were 18 years and older and found that low and very low food security were positively associated with overweight and obesity when compared to food secure women.

There is more literature examining food insecurity and overweight and obesity among women than among men. The studies that have examined the relationship between food insecurity and overweight and obesity among men have found conflicting results or no statistically significant differences (Food Research and Action Center, 2015; Franklin et al., 2012; Hernandez et al., 2017).

Race

When examining race and the relationship between food insecurity and overweight and obesity, various studies have shown that those who are Hispanic, or Black have a higher risk of elevated weight status than White individuals. A study that examined overweight and obesity pertaining to birthplace and length of residence in the United States found that food insecure women were more likely to be immigrants and socioeconomically disadvantaged when compared to food secure women. Those that were very low food secure had the highest prevalence of obesity and the second highest was that of women with low food security (Ryan-Ibarra et al., 2016). In a 12 state study it was also found that food insecure adults had a significantly higher prevalence of obesity in non-Hispanic White, non-Hispanic Black, and Other non-Hispanic races (Pan et al., 2012).

Among low-income Hispanic women food insecurity was significantly associated with overweight or obesity among Mexican American women but not Mexican American men or non-Mexican groups (Smith et al., 2016). In low-income older adults, women who are Black or Hispanic had higher odds of being overweight or obese and among men those who were Hispanic

had higher odds of being overweight or obese (Hernandez et al., 2017). A study conducted in Bronx, New York found that women who identified as Other race were more likely to be food insecure than those who identified as Black or White. Also, Black women were more likely to be obese than White women. The researchers did not find statistical differences in demographics when examining food insecurity and obesity together (Sirotin, Hoover, Shi, Anastos, & Weiser, 2014).

Although the USDA (2018) suggests that race is tied to the food insecurity overweight and obesity paradox, studies have often controlled for race leading to a gap in the research supporting that food insecurity, overweight and obesity, and race have a connection. More research is needed in this area.

Marital Status

Franklin et al. (2012) found that divorced men were at a significantly higher risk than never married men to live in a household with very low food insecurity. Marital status interacts with gender such that women who were food insecure while married, partnered, or widowed were significantly more likely to be obese than those who were food secure and never married women. The authors also found that among 200 low-income parents it was found that 7 in 10 were single parents and half reported food insecurity. Although the USDA states that those who are single heads of households with children and who live alone are at a higher risk of food insecurity (United States Department of Agriculture [USDA], 2018), there is an informational gap in whether food insecurity, overweight/obesity, and marital status have a significant relationship.

Summary

From reviewing the literature, there is a clear relationship between food insecurity and being overweight or obese. The literature also clearly demonstrates that gender, race, and marital status are clearly linked to elevated weight status in relation to food insecurity. The studies reviewed all used data prior to 2013-2014, while this study will add to current literature by utilizing more recent data and examining if the relationship between food insecurity, marital status, gender, race and weight status. This study will also examine the more recent data to test the hypothesis, when controlling for age, income, and level of education those who are overweight or obese are more likely to be food insecure, more likely to be not married, more likely to be Black or Hispanic, and are more likely to be female than those who are under or normal weight

CHAPTER III METHODOLOGY

The purpose of this study was to examine the relationship of food insecurity, sex, marital status, race, and overweight/obesity in adults using the National Health and Nutrition Examination Survey (NHANES) 2013-2014 data.

Participants and Data Source

This study used the 2013-2014 National Health and Nutrition Examination Survey (NHANES) (National Center for Health Statistics). This survey combines, questionnaires, interviews, and physical exams to assess the health and nutritional status of adults and children in the United States. The survey uses a sample of about 5,000 people a year that can act as a national representation of the United States. This is conducted by using a complex, stratified, multistage probability cluster sampling design (Center for Disease Control and Prevention [CDC], 2017). The National Center for Health Statistics (NCHS) is responsible for producing the health statistics of the NHANES. All participants of the survey sign consent forms to show that they are informed and understand the procedures and reasoning behind the survey. Ethics Review Board approval was continued for the 2013-2014 NHANES from the 2011-2012 NHANES protocol (CDC, 2017; CDC, 2017; Vaccaro & Huffman, 2017).

Selected Measures

This study used food security as the main independent variable of interest and overweight or obesity as the main outcome of interest. The additional variables of interest included marital status, race, and sex. While the control variables were, age, income, and level of education.

Demographics

The demographic variables in this study were gender, race, marital status, income, age, and level of education. The total number of participants in this study was N=5769. Sex was categorized as male (47.8%) and female (52.2%). Race was recoded into categories of Hispanic including Mexican American (22.1%), non-Hispanic White (42.8%), non-Hispanic Black (20.4%), and Other (14.6%). Marital status was recoded into married (51.4%) and not married (48.6%). Not married included never married, living with partner, divorced, and separated. Education level was recoded into less than high school (21.6%), high school (22.6%), and some college or above (55.8%). Data was analyzed for those age 20 years and older with an average of $M = 49.11$ $SD = 17.56$.

Income

Income was measured by a poverty ratio of family income and household size. Poverty was recoded into categories of 0% to 100% of the poverty line, 101% to 200% of the poverty line, and 201% to 300% of the poverty line, 301% to 400% of the poverty line, and 401% and above. The 2013 and 2014 poverty guidelines for the 48 contiguous states and the District of Columbia are shown in appendix C (Office of the Assistant Secretary for Planning and

Evaluation [ASPE] & United States Department of Health and Human Services [HHS], n.d.).

Body Mass Index

Weight status was classified by Body Mass Index (BMI) which is a person's weight in kilograms divided by the square of height in meters. BMI is not a direct measure of body fat, but it is moderately correlated with direct measures of body fat. BMI is divided into these standard weight categories for adults 20 years and older below 18.5 is underweight, 18.5 to 24.9 is normal or healthy weight, 25.0 to 29.9 is overweight, and 30.0 and above is obese (CDC, 2017). Body Mass Index will be recoded into the categories of not overweight or obese (including underweight and normal weight), overweight, and obese.

Level of Food Security

Food security status was measured by an adult food security category taken from the NHANES dataset. Adult food security was calculated by the number of affirmative responses to 10 items. These 10 items consisted of questions pertaining to food not lasting, worry about running out of food, not being able to afford balanced meals, cutting the size of or skipping meals, how often meals were skipped or cut, if less was ate than should have been, if they were hungry but did not eat, if weight was lost because they didn't have money for food, and if they did not eat for an entire day. See appendices for more information on measurement of level of food security.

Data Analysis

IBM's SPSS version 25 analysis module was used to analyze the 2013-2014 NHANES data. The control variables were age, income, and education level. The dependent variable was weight status (overweight or obese). The independent variables were food insecurity status, sex, race, and marital status. A descriptive analysis was used to analyze descriptive statistics of the data. Multinomial logistic regression was used to examine the likelihood of overweight/obesity weight status based on level of food security as well as marital status, race, and gender. A crosstabulation was conducted to compare food security status, sex, race, and marital status.

CHAPTER IV RESULTS

A multinomial logistic regression was conducted on BMI categories to predict the effect of food security, sex, race, and marital status on BMI when controlling for age, income, and level of education. The Nagelkerke pseudo R-Square was 0.098. Not being overweight or obese was used as a reference category for the analysis. See Table 1 for more information on all variables pertaining to parameter estimates and odds ratios, Table 2 for results of crosstabulation of weight status and all variables, and Table 3 for crosstabulation of food security status and all variables.

Demographics

A chi-square test of independence was performed to examine the relation between weight status and age, weight status and poverty, and weight status and education. The relation between weight status and age was significant, $X^2(2, N = 5769) = 37.83, p = < .001$. For every ten years a person's BMI goes up by 0.10. The relation between weight status and poverty was significant, $X^2(8, N = 5769) = 18.85, p = .016$. Those who were obese were more likely to be between 101% to 400% of the poverty line than those who were below 101% and above 401%. The relation between weight status and education was not significant, $X^2(4, N = 5769) = 2.74, p = .602$.

Logistic Regression

A chi-square test of independence was performed to examine the relation between weight status and food security status, weight status and race, weight status and sex, and weight status and marital status. The relation between weight status and food security status was significant, $X^2 (6, N = 5692) = 15.86, p = .015$. Those who were low food secure (45.8%) or very low food secure (45%) were more likely to be obese. The relation between weight status and race was significant, $X^2 (6, N = 5769) = 244.75, p = <.001$. Those who were non-Hispanic Black or Hispanic including Mexican American were more likely to have an elevated weight status. The relation between weight status and sex was significant, $X^2 (2, N = 5769) = 77.42, p = <.001$. Females were more likely to be obese but less likely to be overweight. The relation between weight status and marital status was significant, $X^2 (2, N = 5766) = 22.08, p = <.001$. Those who were not married were less likely to have an elevated weight status.

The multinomial logistic regression revealed that overall those who are food insecure are more likely to be obese but not more likely to be overweight. People who were low food secure (45.8%) were 1.4 times [95% CI = 1.07, 1.72] more likely than people who were fully food secure to be obese (35.2%). When compared to those who are fully food secure (35.2%) those who were very low food secure (45%) were 1.4 times [95% CI = 1.08, 1.85] more likely to be obese. Marginal food security (40.8%) was not significant for obesity when compared to those who were fully food secure. Likewise, very low food security, low food security, and marginal food security were not significant for overweight weight

status when compared to those who were fully food secure. Examining sex revealed that females (26.8%) were 0.7 times [95% CI = 0.58, 0.77] less likely when compared to males (37.8%) to be overweight. However, when examining obesity females (42%) were 1.2 [95% CI = 1.06, 1.4] times more likely when compared to males to be obese (33.1%).

Examining race, Hispanic including Mexican American individuals were 1.6 times [95% CI = 1.29, 1.95] more likely when compared to non-Hispanic White individuals to be overweight (36.1% vs 32.8%). Individuals in the Other race category were 0.5 times [95% CI = 0.42, 0.63] less likely to be overweight (29.3%) when compared to non-Hispanic White individuals (32.8%). When compared to non-Hispanic White individuals, non-Hispanic Black individuals (47.2%) were 1.5 times [95% CI = 1.26, 1.83] more likely to be obese. Likewise, Hispanic including Mexican American individuals (42.4%) were 1.5 times [95% CI = 1.27, 1.88] more likely to be obese. When compared to non-Hispanic White individuals, Other race individuals (18.3%) were 0.3 times [95% CI = 0.23, 0.36] less likely to be obese. When compared to non-Hispanic White individuals, non-Hispanic Black individuals revealed no significant results pertaining to overweight weight status.

Examining marital status revealed, when compared to those who were not married those who were married (34.3%) were 1.3 times [95% CI = 1.12, 1.52] more likely to be overweight (29.6%). Similarly, those who were married were 1.2 times [95% CI = 1.06, 1.4] more likely to be obese (37.5%).

Crosstabulation

Examining food security status in relation to all other variables using crosstabulation revealed interesting results. A chi-square test of independence was performed to examine the relations between food security status and all variables. The relation between food security status and marital status was significant, $X^2 (3, N = 5689) = 139.32, p = <.001$. Those who were not married were more likely to be very low food secure (10.4%), low food secure (13.8%), or marginally food secure (11.6%). The relation between food security status and race was significant, $X^2 (9, N = 5692) = 249.93, p = <.001$. Hispanic including Mexican American individuals (58.5%) and non-Hispanic Black (65.3%) individuals were less likely to be fully food secure than non-Hispanic White individuals (76.1%) and Other race individuals (83.2%).

The relation between food security status and sex was not significant, $X^2 (3, N = 5692) = 4.87, p = .182$. Males and females had similar occurrences of all levels of food security. The relation between food security status and weight status was significant, $X^2 (6, N = 5455) = 38.86, p = <.001$. Those who were obese (66.2%) were less likely to be food secure than those who were overweight (73.5%) or not overweight or obese (73.9%).

The relation between food security status and education was significant, $X^2 (6, N = 5685) = 280.6, p = <.001$. Those who had an education level of some high school (55.8%) were less likely to be food secure than those who had a high school diploma or equivalent (65.6%) and those who had some college or above (79.2%). The relation between food security status and poverty was significant,

$X^2 (12, N = 5313) = 1092.51, p = <.001$. As poverty level went down food security level went up.

Table 1

Parameter Estimates and Odds Ratios of All Variables

Independent Variables	Overweight			Obese		
	<i>B</i>	<i>S.E.</i>	<i>OR (95%CI)</i>	<i>B</i>	<i>S.E.</i>	<i>OR (95% CI)</i>
Food Security						
Very Low Food Security	0.04	0.15	1.04 (0.77-1.40)	0.35	0.14	1.41 (1.08-1.85)*
Low Food Security	-0.03	0.13	0.98 (0.75-1.27)	0.30	0.12	1.35 (1.07-1.72)*
Marginal Food Security	0.14	0.13	1.14 (0.89-1.47)	0.15	0.12	1.17 (0.92-1.48)
Fully Food Secure	-	-	-	-	-	0
Race						
Other	-0.67	0.10	0.51 (0.42-0.63)*	-1.26	0.12	0.28 (0.23-0.36)*
Hispanic including Mexican American	0.46	0.11	1.56 (1.29-1.95)*	0.43	0.10	1.54 (1.27-1.89)*
non-Hispanic Black	0.04	0.10	1.04 (0.85-1.28)*	0.42	0.10	1.52 (1.26-1.83)*
non-Hispanic White	-	-	-	-	-	-
Marital Status						
Married	0.27	0.08	1.30 (1.12-1.52)*	0.35	0.08	1.41 (1.22-1.64)*
Not Married	-	-	-	-	-	-
Sex						
Female	-0.40	0.07	0.67 (0.58-0.77)*	0.195	0.07	1.22 (1.06-1.34)*
Male	-	-	-	-	-	-
Age						
Age	0.01	0.002	1.01 (1.01-1.02)*	0.009	0.002	1.009 (1.005-1.013)*
Poverty						
0% to 100% of poverty line	-0.08	0.12	0.925 (0.73-1.18)	0.14	0.12	1.152 (0.91-1.46)
101% to 200% of poverty line	0.06	0.11	1.065 (0.86-1.33)	0.35	0.11	1.418 (1.14-1.76)*
201% to 300% of poverty line	0.07	0.13	1.076 (0.84-1.38)	0.38	0.12	1.463 (1.15-1.86)*
301% to 400% of poverty line	0.11	0.13	1.117 (0.88-1.43)	0.26	0.13	1.293 (1.01-1.65)*
401% + of poverty line	-	-	-	-	-	-
Education						
Less than high school	0.002	0.11	1.002 (0.81-1.24)	-0.11	0.10	0.893 (0.73-1.09)
High school	-	-	-	-	-	-
Some college and above	0.002	0.10	0.998 (0.83-1.20)	0.03	0.09	1.032 (0.86-1.24)

Note: *B*= Parameter Estimate, *S.E.*= Standard Error, *OR*= Odds Ratio 95%, *CI*= 95% Confidence Interval, *= $p \leq .05$

Table 2*Crosstabulations Weight Status and Other Variables*

	Not		
	Weight Status	Overweight/Obese	Overweight
			Obese
Food Security			
Very Low Food Secure		114 (27.1%)	117 (27.9%)
Low Food Secure		157 (26.4%)	165 (27.8%)
Marginally Food Secure		158 (27.5%)	182 (31.7%)
Fully Food Secure		1214 (31.4%)	1290 (33.4%)
			1363 (35.2%)
Race			
Other		416 (52.4%)	233(29.3%)
Hispanic including Mexican American		263 (21.5%)	442 (36.1%)
non-Hispanic Black		281 (24.8%)	318 (28%)
non-Hispanic White		709 (30%)	775 (32.8%)
			882 (37.3%)
Sex			
Female		900 (31.2%)	771 (26.8%)
Male		769 (29.2%)	997 (37.8%)
			1211 (42%)
			872 (33.1%)
Marital Status			
Married		809 (28.2%)	982 (34.3%)
Not Married		860 (32.4%)	786 (29.6%)
			1073 (37.5%)
			1009 (38%)
Poverty			
0% - 100% of poverty line		361 (30.9%)	340 (29.1%)
101% - 200% of poverty line		353 (27.1%)	405 (31.1%)
201% - 300% of poverty line		195 (28%)	217 (31.1%)
301% - 400% of poverty line		185 (29.6%)	210 (33.6%)
400%+ of poverty line		453 (34.7%)	449 (34.4%)
			466 (39.9%)
			545 (41.8%)
			285 (40.9%)
			230 (36.8%)
			403 (30.9%)
Education			
Some high school		323 (27.1%)	398 (33.4%)
High school or equivalent		342 (27.8%)	385 (31.3%)
Some college or above		1002 (32.4%)	985 (31.8%)
			470 (39.5%)
			505 (41%)
			1106 (35.8%)

Table 3*Crosstabulations Food Security Status and Other Variables*

	Food Security Status			
	Very Low	Low	Marginal	Full
Weight Status				
Not Overweight/Obese	114 (6.9%)	157 (9.6%)	158 (9.6%)	1214 (73.9%)
Overweight	117 (6.7%)	165 (9.4%)	182 (10.4%)	1290 (72.5%)
Obese	189 (9.2%)	272 (13.2%)	234 (11.4%)	1363 (66.2%)
Race				
Other	34 (4.1%)	47 (5.7%)	58 (7%)	690 (83.2%)
Hispanic including Mexican American	108 (8.6%)	245 (19.6%)	166 (13.3%)	733 (58.5%)
non-Hispanic Black	100 (8.6%)	141 (12.1%)	164 (14%)	763 (65.3%)
non-Hispanic White	193 (7.9%)	191 (7.8%)	201 (8.2%)	1858 (76.1%)
Sex				
Female	233 (7.8%)	346 (11.6%)	317 (10.7%)	2075 (69.8%)
Male	202 (7.4%)	278 (10.2%)	272 (10%)	1969 (72.4%)
Marital Status				
Married	147 (5%)	242 (8.3%)	268 (9.1%)	2273 (77.6%)
Not Married	288 (10.4%)	381 (13.8%)	321 (11.6%)	1769 (64.1%)
Poverty				
0% - 100% of poverty line	211 (17.3%)	280 (23%)	208 (17.1%)	520 (42.7%)
101% - 200% of poverty line	156 (11.4%)	191 (14%)	203 (14.9%)	817 (59.8%)
201% - 300% of poverty line	37 (5.1%)	74 (10.1%)	78 (10.7%)	542 (74.1%)
301% - 400% of poverty line	15 (2.4%)	28 (4.4%)	39 (6.2%)	551 (87%)
400%+ of poverty line	2 (.1%)	18 (1.3%)	28 (2.1%)	1315 (96.5%)
Education				
Some high school	131 (10.7%)	243 (19.9%)	166 (13.6%)	683 (55.8%)
High school or equivalent	119 (9.2%)	162 (12.5%)	163 (12.6%)	847 (65.6%)
Some college or above	183 (5.8%)	219 (6.9%)	259 (8.2%)	2510 (79.2%)

CHAPTER V DISCUSSION

This study examined the effect of food security, marital status, gender, and race on weight status when controlling for age, income, and level of education. This study found that very low and low food security was related to obesity. Females and males had a similar occurrence of all food security levels but, females are more likely to be obese and males are more likely to be overweight. Those who were married were more likely to have an elevated weight status but those who were not married had a lower occurrence of being fully food secure.

Food Security, Weight Status, and all Other Variables

This study found that those who were very low food secure and low food secure were more likely to be obese, where marginal food security didn't have a relation to obesity. There were also no significant findings when examining overweight weight status and food security status. These results differ slightly from previous studies. Franklin et al. (2012) found that people who were very low food secure, low food secure, or marginally food secure were more likely to be obese or overweight than food secure counterparts. Similarly, Nguyen et al. (2015) found that those of all levels of food insecurity (very low, low, and marginal) were all more likely to be obese than those who were food secure.

This study found that females were more likely be obese, but males were more likely to be overweight. When comparing males and females for food security status females and males had similar percentages of all levels of food security. These results differ from findings by Smith, Colon-Ramos, Pinard, and

Yaroch (2016) where it was found that food insecurity was associated with overweight and obesity among Mexican American women but not men. However, this study supports findings from Pan et al. (2012) where food insecure women were more likely to be obese than men.

Examining marital status this study found that those who were not married were less likely than those who were married to be overweight or obese. The opposite was shown when examining food security status and marital status, those who were not married had a higher percentage of very low food security, low food security, and marginal food security, and the lowest percentage of fully food security. These results are similar to current USDA (2018) information stating that those who are single heads of households with children and who live alone are at higher risk of food insecurity. This study's findings are dissimilar to findings by Franklin et al. (2012) where women who were food insecure while married, partnered, or widowed were significantly more likely to be obese than those who were food secure never married women.

Pertaining to race this study found that those who were Hispanic including Mexican American were more likely to be overweight or obese and that non-Hispanic Black individuals were more likely to be obese but not overweight. It was also found that Other race was less likely to be overweight or obese. When examining food security status and race, non-Hispanic Blacks and Hispanics including Mexican Americans had higher percentages of very low food security, low food security, marginal food security, and the lowest percentages of fully food secure compared to non-Hispanic Whites and Other race individuals. These

results are similar to previous findings from Pan et al. (2012) where non-Hispanic Black individuals who were food insecure had a higher prevalence of obesity. However, the results differed in that non-Hispanic White and Other non-Hispanic individuals who were food insecure also had a higher prevalence of obesity. This study supports findings by Hernandez et al. (2017) where among Hispanic individuals who were food insecure, they had a higher odds of being overweight or obese. This study also supports information from the USDA (2018) in that non-Hispanic Black and Hispanic individuals are more likely to be very low food secure or low food secure.

Other helpful findings of this study included that as poverty level went up so did food security level. Also, as education level went up so did food security status. This shows that both poverty level and education level are directly related to food security status.

Limitations

A limitation of the study is using data from questionnaires. Although questionnaires are a popular way of collecting data it is self-reported and can be inaccurate due to poor recall, poor estimations, or social desirability. Another limitation of this study was not being able to run a complex samples logistic regression due to low sample size in subsets of the data that resulted in violation of model assumptions.

Recommendations and Conclusion

The purpose of this study was to examine the relationship of food security status, sex, marital status, and race on weight status among adults using National Health and Nutrition Examination Survey (NHANES) 2013-2014 data. It was found that food security status, marital status, sex and race have a negative impact on weight status. This study supports current literature and expands on findings related to marital status and sex. Future studies should consider deeper investigation into food consumption in relation to weight status, food security status, race, sex, and marital status. It is well known that the type and amount of food that is consumed directly impact weight status as well as health (Harvard T.H. Chan School of Public Health, 2019). Conducting a study that examines these factors will help further the knowledge base of food insecurity and its relating factors. By doing this work, health education and health promotion professionals will have the information needed to better serve those who are directly affected by food insecurity. Directly targeting populations will allow for a reduction in food insecurity and its relating negative health outcomes.

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APPENDICES

APPENDIX A

Ethics Board Approval Letter



National Health and Nutrition Examination Survey

NCHS Research Ethics Review Board (ERB) Approval*

Survey Name/Date	NCHS IRB/ERB Protocol Number or Description
NHANES 2017-2018	Protocol #2018-01 (Effective beginning October 26, 2017)
	Continuation of Protocol #2011-17 (Effective through October 26, 2017)
NHANES 2015-2016	Continuation of Protocol #2011-17
NHANES 2013-2014	Continuation of Protocol #2011-17
NHANES 2011-2012	Protocol #2011-17
NHANES 2009-2010	Continuation of Protocol #2005-06
NHANES 2007-2008	Continuation of Protocol #2005-06
NHANES 2005-2006	Protocol #2005-06
NHANES 1999-2004	Protocol #98-12
NHANES III	Institutional Review Board (IRB) approval and documented consent was obtained from participants
NHANES II	Underwent internal human subjects review, but IRB approval using current standards was not obtained.
NHANES I	Underwent internal human subjects review, but IRB approval using current standards was not obtained.
NHES	Underwent internal human subjects review, but IRB approval using current standards was not obtained.

* In 2003, the NHANES Institutional Review Board (IRB) changed its name to the NCHS Research Ethics Review Board (ERB).

Related Sites

APPENDIX B

Adult Food Security Category

FSDAD (Adult food security category):

Count affirmative responses in these 10 items: FSD032a, FSD032b, FSD032c, FSD041, FSD052, FSD061, FSD071, FSD081, FSD092, and FSD102. Derive the codes as the following:

- 1 = Adult full food security: no affirmative response in any of these items.
- 2 = Adult marginal food security: 1-2 affirmative responses.
- 3 = Adult low food security: 3-5 affirmative responses
- 4 = Adult very low food security: 6-10 affirmative responses

For households without children under the age of 18, their household food security category (FSDHH) should be identical to their adult food security category (**FSDAD**).

APPENDIX C

Poverty Guidelines

2013 Poverty Guidelines

PERSONS IN FAMILY/HOUSEHOLD	POVERTY GUIDELINE
1	\$11,490
2	15,510
3	19,530
4	23,550
5	27,570
6	31,590
7	35,610
8	39,630
For families/households with more than 8 persons, add \$4,020 for each additional person.	

Note: Source = <https://aspe.hhs.gov/2013-poverty-guidelines>

2014 Poverty Guidelines

PERSONS IN FAMILY/HOUSEHOLD	POVERTY GUIDELINE
1	\$11,670
2	15,730
3	19,790
4	23,850
5	27,910
6	31,970
7	36,030
8	40,090
For families/households with more than 8 persons, add \$4,060 for each additional person.	

Note: Source = <https://aspe.hhs.gov/2014-poverty-guidelines>