The Association of Types of Shift Work and Food Security Status among Overweight and Obese U.S. Adults aged 20-79, NHANES 2005-2010

THESIS

Presented in Partial Fulfillment of the Requirements for the Degree Master of Public Health in the Graduate School of The Ohio State University

By

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Abstract

Among shift workers, being overweight or obese has become an epidemic. Food insecurity or the limited ability to obtain certain types and amounts of nutritional food is also on the rise. Currently, little is known about the association of food security status and being overweight or obese, especially among shift workers. The National Health and Nutrition Examination Survey (NHANES), housed within the Centers for Disease Control and Prevention (CDC), was used to assess this relationship. NHANES collects a representative sample of U.S. adults and children to assess health and nutrition. The survey utilizes a complex, stratified, multistage probability cluster sampling. This retrospective study focuses on data collected from the 2005-2006, 2007-2008 and 2009-2010 surveys. The NHANES study population from these years consisted of 20,497 non-institutionalized men and women aged 20-79 of whom 28.5% (n=5,848) were included in the analysis due to reporting data about shift work.

The objective of this master’s thesis was to assess if the association of types of shift work and/or food security status were linked with overweight or obese among a nationally representative sample of adults aged 20-79. This study displayed the distribution of demographic and health and wellness characteristics by type of shift worked (regular daytime shift, regular evening or night shift and rotating/other shift).
demonstrating that regardless of the attribute, regular daytime shift workers generated the majority of the workforce. The distribution of characteristics by sex revealed the majority of the workforce to be male except for the following: Race=Non-Hispanic Black; marital status=widowed/divorced/separated; BMI=underweight/normal; hours worked last week=less than 35 hours. When using a multivariate model to explore the differences between overweight/obese individuals that worked 35 hours or greater compared to those that worked less than 35 hours a week, age was the only variable that was statistically significant regardless of hours worked (p=0.01; p=0.03, respectively). In the final multivariable logistic regression model, ethnicity/race, sex, age and marital status were found to be statistically significant.

The study’s findings offer support for including a regiment focused around a healthy weight which would help in combating non-modifiable risks factors such as sex, ethnicity/race and age. Future research might consider focusing on earlier recognition of weight increases from a sex-specific standpoint, to help ensure healthier and more feasible options pertaining to food security. Along with a better understanding of the relationship between food insecurity and obesity, a greater potential impact public health policy could be generated to help to improve the health status of U.S. adult shift workers.
Dedication

This thesis is dedicated to my parents, Judith and Robert Eggerichs.

Thank you for your patience and support through this process.
Vita

May 1994 ........................................Hilliard High School

2002....................................................B.S. Health Services Administration

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Publications


Fields of Study

Major Field: Public Health
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CHAPTER 1: INTRODUCTION

1.1 Obesity

Being overweight or obese is an epidemic affecting more than 1.4 billion (35%) adults (ages 20 years and older) worldwide (World Health Organization, 2014). Furthermore, when examining the prevalence of being overweight or obese by sex, significantly more females (21.4%) were found to be overweight or obese than males (14.3%) (World Health Organization, 2014). The World Health Organization (WHO) defines an individual as being overweight or obese by having “excessive amounts of adipose tissue accumulation causing health impairments” (United States Department of Agriculture, 2014). Body mass index (BMI) is a metric calculation utilized worldwide, which is defined as the ratio of weight in kilograms divided by height in meters$^2$ (kg/m$^2$). This measurement is used in classifying levels of adiposity among men and women (Table 1) (National Heart, Lung and Blood Institute, 2014). The WHO “formally recognized obesity as a global epidemic” in 1997 (World Health Organization, 2000). Furthermore, previous literature has projected that by 2030, eighty-six percent of all U.S. adults will be categorized as overweight or obese (Wang, Beydoun, Caballero & Kumanyika, 2008).
Weight Classification | BMI (kg/m²) | Disease Risk** Relative to Normal Weight and Waist Circumference
--- | --- | ---
Underweight | < 18.5 | - | -
Normal | 18.5–24.9 | - | -
Overweight | 25.0–29.9 | Increased | High
Obesity | 30.0 + | High | Very High

*Modified from the NIH version of Classification of Overweight and Obesity by BMI, Waist Circumference, and Associated Disease Risks
** Disease risk for Type 2 Diabetes, Hypertension and CVD.

Table 1. Classification of Weight by BMI, Waist Circumference and Associated Disease Risks

One of the major causes of overweight and obesity is caloric intake. This can be concerning when an imbalance between what is consumed versus what is used by the body which leads to weight gain or loss (United States Department of Agriculture, 2014a). Obesity has been linked with many comorbidities and chronic conditions such as, metabolic syndrome, cardiovascular disease, hyperlipidemia, hypertension, diabetes, disability and stroke. Globally, trends of obesity may be due to the amount of fat in the foods being consumed (United States Department of Agriculture, 2014a). For example, an individual may choose to consume a snack before or during work thinking it is a healthy food choice, such as an energy bar. However, depending on the type and brand of energy bar, the individual could consume as much as 240 plus calories, over 25 grams of sugar, and 45 grams of carbohydrates with very limited amounts of protein or fiber.
Hence, the individual may have falsely felt this was a healthy option. The Dietary Guidelines for American 2010 recommends adults ages 19 and older limit the amount of fat consumed to 20-35% of their total daily calories (CDC, 2015). Along with the total percentage of fat, only 10 percent should be saturated fats. Many over-the-counter or vending machine food items are disproportionately high in saturated fats, trans-unsaturated fatty acids and cholesterol. When considering the amount of protein an individual should consume, the CDC recommends that adult women consume approximately 46 grams compared to adult men who need to consume around 56 grams (CDC, 2015). Finally, carbohydrates provide individuals with the necessary energy to complete daily tasks. The recommended dietary intake of carbohydrates should equate to approximately half of a person’s caloric intake, including whole grains, which tend to be higher in fiber. The recommended amount of fiber in one’s diet is dependent on the individual’s sex as well as age. On average one should consume roughly 14 grams of dietary fiber per 1,000 calories (CDC, 2015). More specifically, females between the ages of 19-30 should consume 28 grams, ages 31-50 should consume 25 grams and over 50 of age should consume around 22 grams of fiber. However, men can decrease the amount of fiber consumed as they age (19-30 years, 34 grams of fiber; 31-50 years, 31 grams of fiber; and over 50 years, 28 grams of fiber) (CDC, 2015).

Another area of concern contributing to the obesity epidemic is the steady decline in physical activity within and outside the workplace (United States Department of Agriculture, 2014a; Chaput J, Sjodin A, Astrup A, Despres J, Bouchard C, Tremblay A, 2010). When caloric intake exceeds energy expenditure, individuals become overweight.
or eventually obese. Over the generations, modes of transportation have changed with more people having access to cars or the bus, versus walking or riding a bicycle to work. Over the last six decades, the economy has changed from growing crops and working in a rural environment, to living and working in the city. Whether this is an office position or in a factory, this transition has led to a more sedentary living style (United States Department of Agriculture, 2014a).

In 2008, the medical costs associated with obesity in the United States totaled an astonishing $147 billion (Finklestein, Trogdon, Cohen & Dietz, 2009; National Institute of Health, 2014). Medical costs associated with being overweight and obese include direct costs such as preventive, diagnostic or treatment-related services, and indirect costs related to loss of income from decreased productivity or restricted activity (Wolf & Colditz, 1998; Wolf, 1998). If the obesity epidemic cannot be reversed, society will be facing a much greater problem given the associated comorbidities among American adults. One previous article projects by 2030, “health-care costs related to being overweight or obese could range from $860 to $956 billion dollars” (Wang, Beydoun, Caballero & Kumanyika, 2008).

The literature continues to support that among the shift worker population, obesity continues to increase (Geliebter, Gluck & Tanowitz, 2000; Parkes, 2001). One suggestion of why this population tends to be overweight or obese centers around the idea that they may be relying on low-cost and/or high energy foods which may lead to overeating the wrong types of foods. An individual may feel, due to lack of nutritional options (local availability) or monetary constraints, there is no other choice. Lowden et
al. stated a lack of evidence concerning dietary recommendations for shift workers which included the appropriate times to consume meals, availability of nutritious foods and possible impairment of metabolism for evening or night shift workers (Lowden, Moreno, Holmback, Lennernas & Tucker, 2010).

1.2 Food Security

Food security has been an international problem for more than a couple of decades now. The World Health Organization (WHO) has focused on this problem, concentrating on three main areas: food availability; food access; and food usage (WHO, 2015). Food availability focuses on the need versus the amount available for a region, or even at the individual household level. Food access, or utilization of resources, asks the question of where the population or individual obtains food necessary for daily nutritional balance and how the population or individual is procuring the food. Lastly, food usage focuses on the knowledge of the population or the individual, which can include reading food labels or how food is metabolized to make sure there is an appropriate balance of nutrients being consumed as well as the amount of water being consumed. Many of the conclusions made through the WHO found there is enough food worldwide; however the problem is in how the food is disseminated. Many times individuals or populations in poverty do not have the required tools to understand how to utilize local resources. There are also situations when people in power do not share the resources making food availability unequal among populations.
In 1984, the President’s Task Force on Food Assistance discussed a lack of consensus on a definition of food security. In working together to develop a supplemental survey, the U.S. Department of Agriculture (USDA) and the United States Department of Health and Human Services (DHHS) assembled recommendations from research scholars, multiple federal agencies and private organizations (National Research Council, 2005). Food security, defined by the USDA is “giving individuals access to healthy food options on a daily basis to achieve a normal and active lifestyle” (United States Department of Agriculture, 2014b). Agreement in defining food security was an important benchmark in the measurement of the assessment of a nutritious diet within a society. Food insecurity refers to a limited ability to secure types and amounts of nutritionally dense food sources due to insufficient household resources (Life Science Research Office, 1990). The United States Census Bureau has included a supplemental food security survey since 1995 as part of the Current Population Survey (CPS). Ten of seventeen questions from the supplement, developed by the (USDA), are focused specifically on adults. Types of questions included if the adult was concerned he/she would run out of food before being able to afford to purchase more, needing to skip a meal or did not have the funds to consume a nutritiously balanced meal.

The prevalence of food insecurity over the past 18 years has shown an overall increase with the largest increase taking place during 2007-2008 (Figure 1) (Coleman-Jensen, Gregory, Singh, 2014). Approximately 14.3% U.S. households were food insecure in 2013 (United States Department of Agriculture, 2014a). Food insecurity is broken down into two groups, low food security and very low food security. When
referring to the adults in the household, low food security equated to the adult having received enough nutritionally dense food as so not to have needed to make changes in eating patterns or the need to seek out other resources to obtain food (i.e. food pantries). Seventeen and a half million U.S. households were considered to have had low food security (8.7%) or very low food security (5.6%) in 2013 (United States Department of Agriculture, Economic Research Service, 2015). Very low food security is defined, again for adults in this study, as food-insecure households where abnormal eating patterns were found within the household in one or more individuals due to lack of resources (i.e. money) (United States Department of Agriculture, 2014a).

![Figure 1. Trends in Prevalence Rates of Food Insecurity and Very Low Food Security in U.S. Households, 1995-2013](image)

Prevalence rates for 1996 and 1997 were adjusted for the estimated effects of differences in data collection screening protocols used in those years.

1.3 Shift Work

The definition of shift work is regular employment outside of the typical 8:00 a.m. to 6:00 p.m. work day (Kryger, Roth & Dement, 2005). According to 2004 data from the Bureau of Labor Statistics, “almost 15.5 million Americans fulfilled the role of shift worker, which included working an evening, night, rotating, or other employer arranged irregular schedule” (National Institute for Occupational Safety and Health, 2014). Depending on the type of organization for which the individual works, the majority of the time worked defines what the particular shift time encompasses (i.e. 8:00 to 4:00 p.m. would constitute a regular day shift. When describing the healthcare setting, for example, typical shifts are from 7:00 a.m. to 3:00 p.m., 3:00 p.m. to 11:00 p.m. and 11:00 p.m. to 7:00 a.m. Other organizations such as schools or businesses may have day shifts from 7:00 a.m. to 3:00 p.m. or 8:00 a.m. to 5:00 p.m. The type of shift and time the shift starts may have a large impact on the individual.

Research on shift work and long work hours has shown associations with fatigue, performance (LaDou, 1982), health risks (National Institute for Occupational Safety and Health, 2014) and medical conditions, such as obesity (Brum, Filho, Schnorr, Bottega & Rodrigues, 2015). The exact mechanisms linking shift work to obesity are still unclear. However, some hypotheses include: reduced leisure time physical activities; increased alcohol consumption; difficulty in maintaining a healthy diet; increased consumption of energy-dense foods to combat fatigue and reduced amount and/or quality of sleep (Smith, Fritschi, Reid, & Mustard, 2013; Antunes, Levandovski, Dantas & Hidalgo, 2010; Marshall, Glozier, & Grunstein, 2008; Lowden, Moreno, Holmback, Lennernas &
Tucker, 2010). Many of the strategies previously used to promote healthy eating have focused on the individual taking responsibility (e.g. behavior change or education) (Amani & Gill, 2013). However, a few organizations have chosen to implement actual work environment changes in order to have healthier food options available.

In 2013, a systematic review of 15 studies assessing shift work, nutrition and obesity found consistency among all studies, except one (extremely small sample size) supporting a strong association between nutritional status and obesity among shift workers (Amani & Gill, 2013). “In the workplace, obesity is an important driver of costs associated with absenteeism, sick leave, disability, injuries and healthcare claims” (Schmier, Jones & Halpern, 2006).

1.4 Study Objectives

As briefly discussed above, food insecurity and obesity has been well described among adults in the literature. However, food insecurity among shift workers has not been well researched. To the best of my knowledge, there is no literature examining the prevalence of food insecurity in a large nationally representative sample of shift workers. Therefore, the purpose of this study was to address the lack of scientific knowledge and evidence of food insecurity and obesity among shift workers.

The objective of this master’s thesis was to assess if the association of types of shift work and/or food security status were linked with being overweight or obese among a nationally representative sample of adults aged 20-79 years. It is hypothesized that a regular evening shift or regular night shift will have a higher prevalence of being
overweight or obese when compared to other shifts. It is also hypothesized that a regular evening shift or regular night shift will have a higher prevalence of food insecurity when compared to other shifts worked.
CHAPTER 2: METHODS

2.1 Study Design and Population

Among the programs found within the Centers for Disease Control and Prevention (CDC) is the National Health and Nutrition Examination Survey (NHANES). This program utilizes a representative sample from the contiguous United States in order to better assess health and nutrition within the adult and pediatric populations (CDC, 2014). The survey utilizes a complex, stratified, multistage probability cluster sampling that examines on average 5,000 participants annually to help account for any unequal selection process (CDC, 2014). Oversampling is used to recruit hard-to-reach populations such as lower income, the elderly, and underrepresented minority groups. Research supports the rates in which individuals aged 55 and over that remain employed continues to grow. Data collected from the U.S. Census Bureau in 2012 reported 38.1% of the population 55 years of age or over as still working with a subset of 17.6% as being 65 years or older (U.S. Census Bureau, 2012). The NHANES data from which this thesis is based also showed an increase in percentage of participants aged 65 and over (2005-2006=15.0%; 2007-2008=20.9%) (National Health and Nutrition Examination Survey, 2009). The variable age, when coded through NHANES, generated two age groups, 0-79 years and 80 years or older. Given the second group was topcoded at 80 years of age and
very small, the individuals were not included in this study. The subjects included in this study are participants between 20 and 79 years of age, non-institutionalized and reported working.

NHANES gathers a wealth of information through both interviews and examinations. In 1999 NHANES data became continuous. Therefore, data collected prior to 1999 is not considered comparable due to changes in survey implementation and design. This retrospective study will focus on data collected from the 2005-2006, 2007-2008 and 2009-2010 surveys. The six year span includes similar coding and available data for all variables of interest, which was not available yet for the 2011-2012 cycle.

2.2 Measurements and Variable Descriptions

2.2.1 Body Mass Index

The primary outcome measure was body mass index (BMI), which was calculated utilizing the following equation: (mass (kg)/(height(m))^2) (Table 1) as measured at a mobile examination center (MEC). Height and weight are measured by trained healthcare technicians. Height is measured though the use of a digital stadiometer while weight is recorded through a calibrated digital scale. The NHANES variable containing this information was a continuous variable, BMXBMI. For the current analysis, BMXBMI was recoded to generate two categories: overweight/obese (individuals with a BMI > 25.0 and underweight/normal (individuals ≤ 25.0).
2.2.2 *Shift Work*

The independent variable was type of shift worked. NHANES assessed this via questionnaire which asked, “Which of the following best describes the hours you usually work at your main job or business (OCQ265)?” Study participants were classified into five categories: (1) A regular daytime schedule, (2) a regular evening shift, (3) a regular night shift, (4) a rotating shift, (5) another schedule, (6) refused, (7) don’t know and (8) missing. For this study, shift type was collapsed into three categories and recoded: regular daytime shift; regular evening/regular night shift; and rotating/other shift.

2.2.3 *Dependent Variables*

Dependent variables included: age, sex, education level, marital status, ethnicity/race and a food security assessment. The age (RIDAGEYR) variable through NHANES was collected as a continuous variable. Data collected on participant’s sex (RIAGENDR), included the option of male or female. Education level (DMDEDUC2) was assessed with the question, “What is the highest grade or level of school completed or the highest degree received?” The original variable was coded as: less than 9th grade, 9-11th grade (included 12th grade with no diploma); high school grad/GED or equivalent; some college or AA degree and college graduate or above, refused, don’t know or missing. The education variable was recoded as: less than 9th grade and/or high school/GED; some college or associates degree or more. Marital status (DMDMARTL) was asked of both sexes and categorized as: married; widowed; divorced; separated: never married: living with partner: refused or don’t know. The marital status variable was recoded into the
following responses: married; widowed/divorced/separated; never married or living with partner. The variable race/ethnicity (RIDRETH1) collected from NHANES data was categorized as: Mexican American; Other Hispanic; Non-Hispanic White; Non-Hispanic Black and Other race-including Multi-Racial.

2.2.3.1 Food Security

It was not possible to represent food insecurity and hunger with a single indicator. Alternately, the USDA was able to collect data through the use of a survey, which was distributed to each individual in the household. “Based on the severity level of different indicators such as experiences (i.e. running out of food) or behavior (i.e. perceived anxiety over insufficient quantities of available food, weight loss or illness) related to food insecurity” (Bickel, Nord, Price, Hamilton & Cook, 2000).

The adult food security categories were determined through a composite score from the following ten yes/no question topics: (1) worried participant would run out of food, (2) food didn't last, (3) couldn't afford balanced meals, (4) cut size or skip meals, (5) how often participant cut size/skip meals, (6) ate less than participant should, (7) hungry but didn't eat, (8) lost weight due to no money for food, (9) did not eat whole day and (10) how often participant did not eat for day. The variable names were as listed as followed for each of the ten questions related to the FSDAD variable: FSD032a; FSD032b; FSD032c; FSD041; FSD052; FSD061; FSD071; FSD081; FSD092 and FSD102, respectively. The questions were then recoded as follows:
1 = Adult full food security: no affirmative response in any of these items and/or
adult marginal food security: 1-2 affirmative responses
2 = Adult low food security: 3-5 affirmative responses and or adult very low food
security: 6-10 affirmative responses

Individual-level food security questions were self-reported to a healthcare technician in
the MEC using a 24-hour food questionnaire.

2.3 Data Analysis

Data were transferred from SAS transport files (SAS Institute, Cary, NC) into STATA
13.1 (STATA Corp., College Station, TX) for analysis. Datasets of the three continuous
cycles (of 2 years each) were merged into a single file. The complex sample survey
design parameters were defined using the 6-year exam weights from the data collected.
A subpopulation of adults’ aged 20-79 currently employed and self-identified as a shift
worker was generated. Variables coded “missing,” “refused” or “don’t know” were not
included in the subpopulation criteria. The three combined coded variables generated an
average of 47.25% (2005-2006=45.35%; 2007-2008=46.98%; 2009-2010=49.19%)
reduction in the sample size. For this study, shift type was collapsed into three categories
and recoded: regular daytime shift; regular evening/regular night shift; and rotating/other
shift. To assess the potential relationship between study variables, multivariable logistic
regression was performed. Backwards selection was implemented to identify significant
variables related to the outcome. Variables were removed from the model based on the
Wald p-value >0.05. Effect modification was assessed through the generation of an
interaction term. A separate model assessed for the possible interaction between type of shift worked and food security score, which was found to be not statistically significant at a p-value of 0.10.

Descriptive analyses of the outcome and independent variables were performed to describe the population by the type of shift worked as well as by sex. Bivariate logistic regression analyses were conducted to determine if the independent variable, type of shift worked was significantly associated with the outcome, overweight or obese. Variables with \( p < 0.25 \) on univariate analysis were included in the baseline multivariable logistic regression model. To test for confounding, if the variable was found to have a 10% or greater change in the outcome the variable was kept in the model. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test (Hosmer, Lemeshow & Sturdivant, 2013). Statistical tests with \( p \) values ≤ 0.05, or confidence intervals (CI) excluding 1.00 were considered statistically significant. The final model was adjusted for food security, shift type, ethnicity/race, sex, age and marital status.
CHAPTER 3: RESULTS

3.1 Descriptive Analysis

The NHANES study population consisted of 20,497 men and women ages 20-79 of whom 28.5% (n=5,848) were included in the analysis from the 2005-2010 NHANES dataset. This analysis included only individuals that self-identified as having described their work schedule as a type of shift (i.e. regular day shift, regular evening shift, regular night shift, etc.) and hence, being employed. The initial populations consisted of 20,497 participants in which 10,167 were excluded due to non-employment. Another 4,482 were excluded due to not identifying a type of shift worked, leaving an eligible subpopulation of 5,848. Table 2 displays the distribution of demographic and health and wellness characteristics by shift type/work schedule. Regardless of characteristic, regular daytime shift workers generated the majority of the U.S. workforce. Sex was not statistically significant (p=0.17). Among regular daytime shifts there were more males (53.11%) than females (46.89%). Among regular evening or night shift workers a larger percentages were male (57.24%) compared to females (42.76%). Among rotating or other shift there were more reported males (56.72%) than females (43.28%). Ethnicity/race was
statistically significant (p=0.01). Among regular daytime shift workers, there were significantly more self-identified Non-Hispanic Whites (70.03%) compared to Other Hispanics (4.41%), Mexican Americans (9.15%), Non-Hispanic Blacks (9.99%) and Other/Multi-Racial (6.42%) combined. Among regular evening or night shifters, Non-Hispanic Whites (62.83%) reported the largest percentage to Other Hispanics (5.83%), Mexican Americans (8.23%), Non-Hispanic Blacks (16.92%) and Other/Multi-Racial (6.19%). Among rotating or other shift workers, there were considerably more Non-Hispanic Whites (70.83%) compared to Other Hispanics (3.85%), Mexican Americans (7.01%), Non-Hispanic Blacks (12.73%) and Other/Multi-Racial (5.58%) combined.

Education level was also found to be statistically significant at a p-value of 0.01. Regardless of the type of shift worked, more participants had some college or more in terms of education (regular daytime shift, 62.72%; regular evening or night shift, 52.02%; rotating/other shift, 64.12) compared to a high school/GED or less level of education (regular daytime shift, 37.28%; regular evening or night shift, 47.98%; rotating/other shift, 35.88%). Marital status was statistically significant with a p-value of 0.01. Among regular daytime shift workers, there were significantly more people that identified with a marital status of married (62.07%) compared to widowed/divorced/separated (13.58%), never married (15.52%) and living with a partner (8.83%) combined. Among regular evening or night shift workers, more participants reported a marital status of married (42.14%) compared to widowed/divorced/separated (15.06%), never married (30.89%) and living with a partner (11.91%). Among rotating or other shift workers, there were more self-identified married (53.78%) compared to widowed/divorced/separated
never married (23.60%) and living with a partner (7.69%). The mean overall age among regular daytime shift workers was 42.11 years with a standard error of the mean (SEM) 0.27 compared to a regular evening or night shift (37.03 years, SEM=0.90) or rotating/other shift (40.86 years, SEM=0.72).

Health and well-being measurements included food security, BMI and the number of hours worked last week. The variable food security was based on a 10 question composite score where less than three affirmative responses equated to a full/marginal level and greater than or equal to three confirmatory responses corresponded to a low/very low level. The variable food security was found to be statistically significant (p=0.01). Regardless of the type of shift worked, more individuals reported a food security level of full or marginal (regular daytime shift, 92.60%; regular evening or night shift, 88.00%; rotating/other shift, 92.28) compared to a food security of low or very low (regular daytime shift, 7.40%; regular evening or night shift, 12.00%; rotating/other shift, 7.72%). The variable BMI was not statistically significant (p=0.20). Among regular daytime shifts there were found to be more overweight or obese individuals (67.55%) when compared to underweight or normal weight (32.45%). Among regular evening or night shift workers a significantly larger percentage was overweight or obese (70.55%) versus underweight or normal weight (29.45%). Among rotating or other shift there were more reported individuals obese or overweight (65.54%) compared to underweight or normal weight (34.46%). The variable hours worked was statistically significant (p=0.01). Among regular daytime shifts there were more reported individuals that worked greater than or equal to 35 hours weekly (53.02%) compared to those who
worked less than 35 hours (46.98%). Among regular evening or night shift workers more people identified having worked greater than or equal to 35 hours last week (65.53%) compared to those who worked less than 35 hours (34.47%). Among rotating or other shifts more individuals reported having worked greater than or equal to 35 hours the previous week (67.12%) compared to those who worked less than 35 hours (32.88%).
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Regular Daytime Shift %&lt;sup&gt;a&lt;/sup&gt; (n=4,405)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Regular Evening or Night Shift %&lt;sup&gt;a&lt;/sup&gt; (n=486)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Rotating/Other Shift %&lt;sup&gt;a&lt;/sup&gt; (n=957)&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Sex</strong> (p=0.17)</td>
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<td></td>
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<tr>
<td>Male</td>
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<td>57.24</td>
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<tr>
<td>Female</td>
<td>46.89</td>
<td>42.76</td>
<td>43.28</td>
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<tr>
<td><strong>Ethnicity/Race</strong> (p=0.01)</td>
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<tr>
<td>Non-Hispanic White</td>
<td>70.03</td>
<td>62.83</td>
<td>70.83</td>
</tr>
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<td>Other Hispanic</td>
<td>4.41</td>
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<td>3.85</td>
</tr>
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<td>Mexican American</td>
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<td>7.01</td>
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<tr>
<td>Non-Hispanic Black</td>
<td>9.99</td>
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<tr>
<td>Other/Multi-Racial</td>
<td>6.42</td>
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<td>5.58</td>
</tr>
<tr>
<td><strong>Education Level</strong> (p=0.01)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>High School/GED or less</td>
<td>37.28</td>
<td>47.98</td>
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<tr>
<td>Some College or more</td>
<td>62.72</td>
<td>52.02</td>
<td>64.12</td>
</tr>
<tr>
<td><strong>Marital Status</strong> (p=0.01)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Married</td>
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<td>42.14</td>
<td>53.78</td>
</tr>
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<td>14.93</td>
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<td>30.89</td>
<td>23.60</td>
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<td>Living with Partner</td>
<td>8.83</td>
<td>11.91</td>
<td>7.69</td>
</tr>
<tr>
<td><strong>Age (Years)</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-79</td>
<td>42.11(0.27)</td>
<td>37.03(0.90)</td>
<td>40.86(0.72)</td>
</tr>
<tr>
<td><strong>Health and Wellbeing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food Security</strong>&lt;sup&gt;c&lt;/sup&gt; (p=0.01)</td>
<td></td>
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</tr>
<tr>
<td>Full/Marginal</td>
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<td>88.00</td>
<td>92.28</td>
</tr>
<tr>
<td>Low/Very Low</td>
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<td>12.00</td>
<td>7.72</td>
</tr>
<tr>
<td><strong>Body Mass Index</strong>&lt;sup&gt;d&lt;/sup&gt; (p=0.20)</td>
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</tr>
<tr>
<td>Overweight/Obese</td>
<td>67.55</td>
<td>70.55</td>
<td>65.54</td>
</tr>
<tr>
<td>Underweight/Normal</td>
<td>32.45</td>
<td>29.45</td>
<td>34.46</td>
</tr>
<tr>
<td><strong>Hours Worked Last Week</strong> (p=0.01)</td>
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</tr>
<tr>
<td>&lt; 35 hours</td>
<td>46.98</td>
<td>34.47</td>
<td>32.88</td>
</tr>
<tr>
<td>≥ 35 hours</td>
<td>53.02</td>
<td>65.53</td>
<td>67.12</td>
</tr>
</tbody>
</table>

<sup>a</sup>= Weighted Proportions, unweighted n based on subpopulation  
<sup>b</sup>= Continuous Variable, Mean(SEM)  
<sup>c</sup>= Food Security (10 question composite score): Full/Marginal < 3 affirmative responses; Low or Very Low ≥ 3 affirmative responses  
<sup>d</sup>= BMI (mass(kg)/height(m))<sup>2</sup>: Overweight/Obese > 25.0; Underweight/Normal ≤ 25.0

Table 2. Distribution of Characteristics of U.S. Adults, aged 20-79 years, by Type or Work Schedule, NHANES 2005-2010 (n=5,848)
Table 3 reports the distribution of characteristics among adults aged 20-79 by sex. The demographic ethnicity/race was found to be statistically significant (p=0.01). Among males, there were significantly more self-identified Non-Hispanic Whites (69.11%) compared to Other Hispanics (4.50%), Mexican Americans (10.33%), Non-Hispanic Blacks (9.75%) and Other/Multi-Racial (6.31%). Similarly, among females there were a greater percentage of Non-Hispanic Whites (70.10%) compared to Other Hispanics (4.37%), Mexican Americans (6.84%), Non-Hispanic Blacks (12.48%) and Other/Multi-Racial (6.21%). Education level was found to be statistically significant (p=0.01). Among both sexes, more participants had some college or more in terms of education (male, 57.99%; female 66.85%) compared to a high school/GED or less level of education (male, 42.01%; female, 33.15%). Marital status was statistically significant (p=0.01). Among males, there were significantly more people that were married (61.387%) compared to widowed/divorced/separated (9.98%), never married (18.69%) and living with a partner (9.95%) combined. Likewise, among females, there were more individuals that reported a marital status of married (56.33%) versus widowed/divorced/separated (18.55%), never married (17.45%) and living with a partner (7.67%). The mean age of adult males was 41.23 years (SEM=0.36) which was almost identical to females (41.78, SEM=0.30).

Food security was found to be not statistically significant (p=0.19). Among both sexes, more individuals reported a food security level of full or marginal (male, 91.82%; female, 92.58%) compared to a food security of low or very low (male, 8.18%; female, 7.42%). BMI was found to be statistically significant (p=0.01). Among males there
were found to be more overweight or obese individuals (72.88%) versus underweight or normal weight (27.12%). Among females a larger percentage was found to be overweight or obese (61.15%) compared to underweight or normal weight (38.85%). The variable shift type was found not to be statistically significant (p=0.17). Among males a larger percentage reported having worked a regular daytime shift (74.02%) when compared to a regular evening or regular night shift (8.80%) and a rotating or other shift (17.18%). Similarly, among females identified having worked a regular daytime shift (76.84%) versus a regular evening or regular night shift (7.74%) and a rotating or other shift (15.42%). Hours worked was statistically significant (p=0.01). Among males there were more individual that reported having worked less than 35 hours (53.25%) compared to those who worked greater than or equal to 35 hours weekly (46.75%). In comparison, among females more individuals identified having worked greater than or equal to 35 hours last week (64.95%) versus those who worked less than 35 hours (35.05%).
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male %(^a) (n=3161)(^a)</th>
<th>Female %(^a) (n=2687)(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity/Race (p=0.01)</strong></td>
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<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>69.11</td>
<td>70.10</td>
</tr>
<tr>
<td>Other Hispanic</td>
<td>4.50</td>
<td>4.37</td>
</tr>
<tr>
<td>Mexican American</td>
<td>10.33</td>
<td>6.84</td>
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<td>Non-Hispanic Black</td>
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<td>Other/Multi-Racial</td>
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<td><strong>Education Level (p=0.01)</strong></td>
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<tr>
<td>High School/GED or less</td>
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<tr>
<td>Some College or more</td>
<td>57.99</td>
<td>66.85</td>
</tr>
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<td><strong>Marital Status (p=0.01)</strong></td>
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<tr>
<td>Married</td>
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<td>56.33</td>
</tr>
<tr>
<td>Widowed/Divorced /Separated</td>
<td>9.98</td>
<td>18.55</td>
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<td>Never Married</td>
<td>18.69</td>
<td>17.45</td>
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<tr>
<td>Living with Partner</td>
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<td>7.67</td>
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<tr>
<td><strong>Age (Years)</strong>(^b)</td>
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<td></td>
</tr>
<tr>
<td>20-79</td>
<td>41.23 (0.36)</td>
<td>41.78 (0.32)</td>
</tr>
<tr>
<td><strong>Health and Wellbeing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food Security(^c) (p=0.19)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full/Marginal</td>
<td>91.82</td>
<td>92.58</td>
</tr>
<tr>
<td>Low/Very Low</td>
<td>8.18</td>
<td>7.42</td>
</tr>
<tr>
<td><strong>Body Mass Index(^d) (p=0.01)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight/Obese</td>
<td>72.88</td>
<td>61.15</td>
</tr>
<tr>
<td>Underweight/Normal</td>
<td>27.12</td>
<td>38.85</td>
</tr>
<tr>
<td><strong>Shift Type (p=0.17)</strong></td>
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<td>76.84</td>
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<tr>
<td>Regular Evening or Night</td>
<td>8.80</td>
<td>7.74</td>
</tr>
<tr>
<td>Rotating or Other</td>
<td>17.18</td>
<td>15.42</td>
</tr>
<tr>
<td><strong>Hours Worked Last Week</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(p=0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 35 hours</td>
<td>53.25</td>
<td>35.05</td>
</tr>
<tr>
<td>(\geq 35) hours</td>
<td>46.75</td>
<td>64.95</td>
</tr>
</tbody>
</table>

\(^a\) = Weighted Proportions, n based on subpopulation  
\(^b\) = Continuous Variable, Mean(SEM)  
\(^c\) = Food Security (10 question composite score): Full/Marginal < 3 affirmative responses; Low or Very Low \(\geq 3\) affirmative responses  
\(^d\) = BMI (mass(kg)/(height(m))\(^2\): Overweight/Obese > 25.0; Underweight/Normal \(\leq 25.0\)  

Table 3. Distribution of Characteristics of U.S. Adults, aged 20-79 years by Sex, NHANES 2005-2010 (n=5,848)
3.2 Multivariable Analysis

Table 4 examined the differences between overweight/obese individuals that worked greater than or equal to 35 hours compared to those that worked less than 35 hours a week. The odds of overweight/obesity among those that worked greater than, or equal to, 35 hours weekly and had a reported food security score of “low/very low”, were 1.49 (95% CI=0.88-2.51) higher compared to individuals with a “full/marginal” food security. However, the odds of overweight/obesity among adults that worked less than 35 hours a week and had a food security score of “low/very low” were 0.73 (95% CI=0.46-1.14) lower compared to individuals with a “full/marginal” food security score. Among those who were employed greater than or equal to 35 hours weekly, adults that worked a regular evening/night shift were 0.68 (95% CI=0.31-1.49) times less likely to be overweight or obese compared to those that worked a regular daytime shift. Conversely, among those who worked greater than or equal to 35 hours weekly, adults that worked a rotating or other shift type were 1.67 (95% CI=0.94-2.98) times more likely to be overweight or obese compared to those having worked a regular day shift. Among those who were employed less than 35 hours a week and worked a regular evening/night shift the odds were 0.60 (95% CI=0.28-1.31) times less likely to be overweight or obese compared to those who worked a regular daytime. On the contrary, among those who worked less than 35 hours a week and worked a rotating or other shift type the odds were 1.19 (95% CI=0.76-1.85) times more likely to be overweight or obese compared to those who worked a regular day shift.
Ethnicity/race was not statistically significant. Among adults that worked 35 or greater hours weekly, when compared to Non-Hispanic White, “Other” Hispanic (OR=0.65, 95% CI=0.33-1.29), Mexican American (OR=0.54, 95% CI=0.24-1.21) and Non-Hispanic Black (OR=0.65, 95% CI=0.37-1.16) were at lower odds of being overweight or obese. One exception was Other/Multi-Racial (OR=1.05, 95% CI=0.49-2.26). Furthermore, among adults that worked less than 35 hours, when compared to Non-Hispanic White, “Other” Hispanic (OR=1.52, 95% CI=0.84-2.74) and Other/Multi-Racial (OR=2.11, 95% CI 0.87-5.12) were at higher odds of being overweight or obese. Finally, individuals that worked less than 35 hours weekly and were Mexican American (OR=0.60, 95% CI=0.30-1.20) or Non-Hispanic Black (OR=0.60, 95% CI=0.30-1.20) had a lower odds of being overweight or obese, when compared to Non-Hispanic White.

Among those that worked 35 hours or greater, adults with some amount of college or more compared to “high school/GED or less” as the level of education, had a 1.16 (95% CI=0.82-1.64) times higher odds of being overweight or obese. Similarly, among adults with some amount of college or more compared to “high school/GED or less,” those that worked less than 35 hours had a 1.19 (95% CI=0.73-1.93) times higher odds of being overweight or obese.

Age was statistically significant regardless of hours worked (p=0.03). Among individuals that were employed 35 or greater hours weekly, for every one year increase there was a 0.97 (95% CI 0.95-0.99) odds of being overweight or obese, after controlling for food security score, shift type, ethnicity, level of education sex and marital status. Similarly, for those who worked less than 35 hours a week, for every one year increase
there was a 0.98 (95% CI 0.96-1.00) lower odds of being overweight or obese. Among participants that worked greater than or equal to 35 hours a week, females had 2.07 (95% CI 1.24-3.45) higher odds of being overweight or obese compared to males (p=0.01). Among individuals employed less than 35 hours weekly, females had 1.39 (95% CI 0.92-2.10) greater odds of being overweight or obese compared to males.

Lastly, with respect to marital status, among those who worked 35 hours or greater weekly, those who were widowed, divorced or separated had a 1.74 (95% CI=1.04-2.93) higher odds of being overweight or obese compared to those who were married; which was also found to be statistically significant (p=0.04). Among adults that worked 35 hours or greater weekly, those that were never married had a 1.23 (95% CI=0.72-2.10) times higher odds of being overweight or obese compared to those who were married. Among participants that worked 35 hours or greater weekly those that lived with a partner had a 1.88 (95% CI=0.76-4.65) times higher of being overweight or obese compared to those that were married. Among those who worked less than 35 hours weekly, those who were widowed, divorced or separated had a 1.23 (95% CI=0.72-2.09) times higher odds of being overweight or obese compared to those who were married. Interestingly, among adults that worked less than 35 hours a week, those that were never married had a 2.61 (95% CI=1.60-4.27) greater odds of being overweight or obese compared to those who were married (p=0.01). Among participants that worked less than 35 hours weekly and lived with a partner there was a 1.71 (95% CI=0.49-6.04) higher odds of being overweight or obese compared to being married.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Overweight/Obesity OR (95% CI)</th>
<th>Overweight/Obesity OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full/Marginal</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Low/Very Low</td>
<td>1.49 (0.88, 2.51)</td>
<td>0.73 (0.46, 1.14)</td>
</tr>
<tr>
<td>Shift Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Day</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Regular Evening /Night</td>
<td>0.68 (0.31, 1.49)</td>
<td>0.60 (0.28, 1.31)</td>
</tr>
<tr>
<td>Rotating or Other</td>
<td>1.67 (0.94, 2.98)</td>
<td>1.19 (0.76, 1.85)</td>
</tr>
<tr>
<td>Ethnicity/Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
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<td>1.0</td>
</tr>
<tr>
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<td>1.52 (0.84, 2.74)</td>
</tr>
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<td>Mexican American</td>
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<td>0.60 (0.30, 1.20)</td>
</tr>
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<td>Non-Hispanic Black</td>
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<td>0.60 (0.30, 1.20)</td>
</tr>
<tr>
<td>Other/Multi-Racial</td>
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<td>2.11 (0.87, 5.12)</td>
</tr>
<tr>
<td>Education</td>
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<td></td>
</tr>
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<td>High School/GED or less</td>
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<td>1.0</td>
</tr>
<tr>
<td>Some College or more</td>
<td>1.16 (0.82, 1.64)</td>
<td>1.19 (0.73, 1.93)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-79 years</td>
<td><strong>0.97 (0.95, 0.99)</strong></td>
<td><strong>0.98 (0.96, 1.00)</strong></td>
</tr>
<tr>
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<td></td>
<td></td>
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<tr>
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<td>1.0</td>
</tr>
<tr>
<td>Female</td>
<td><strong>2.07 (1.24, 3.45)</strong></td>
<td>1.39 (0.92, 2.10)</td>
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<td>Marital Status</td>
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<td>1.0</td>
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<td>Widowed/Divorced/Separated</td>
<td><strong>1.74 (1.04, 2.93)</strong></td>
<td>1.23 (0.72, 2.09)</td>
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<tr>
<td>Never Married</td>
<td>1.23 (0.72, 2.10)</td>
<td><strong>2.61 (1.60, 4.27)</strong></td>
</tr>
<tr>
<td>Living with Partner</td>
<td>1.88 (0.76, 4.65)</td>
<td>1.71 (0.49, 6.04)</td>
</tr>
</tbody>
</table>

*Adjusted for Food Security Score, Shift Type, Ethnicity/Race, Level of Education, Age, Sex and Marital Status.

**p <0.05

Table 4. Multivariate Model to Explore the Odds of Being Overweight/Obese by Hours Worked among Adults, NHANES 2005-2010 (n=5,848)
3.2.1 Final Logistic Regression Model

Table 5 displays the final multivariable logistic regression model in the analysis of overweight and/or obese adults from 2005-2010 using NHANES data. Food security score was not significantly associated with obesity (p=0.72). Adults who had a food security score of “low/very low” had a 1.05 (95% CI=0.82-1.34) greater odds of being overweight or obese compared to adults with a food security score of “full/marginal,” after adjustment for all other variables in the model. With respect to shift type, adults who worked a regular evening or night shift were 0.76 (95% CI=0.57-1.01) less likely to be overweight or obese than adults who worked a regular day shift after all other variable were adjusted, which also reflected a borderline p-value of 0.06. Adults who worked a rotating or “other” shift were 1.08 (95% CI=0.94-1.25) times more likely to be overweight or obese than adults who worked a regular day shift, after adjustment for all other variable in the model.

All ethnicity/race categories were found to be statistically significant (Other Hispanic, p=0.02; Mexican American, p=0.01; Non-Hispanic Black, p=0.01; Other/Multi-Racial, p=0.01. Adults who were “Other” Hispanic (OR=0.70, 95% CI=0.52-0.95); Mexican American (OR=0.59, 95% CI=0.47-0.74) and Non-Hispanic Black (OR=0.55, 95% CI=0.45-0.66) had lower odds of being overweight or obese compared to Non-Hispanic Whites, when all other variables were controlled for. Among adults who were overweight or obese, Other/Multi-Racial had 2.22 (95% CI=1.58-3.12) times greater odds when compared to Non-Hispanic Whites. The odds of being overweight or obese among females was 1.77 (95% CI=1.53-2.04) times higher.
compared to males (p=0.01). Age was found to be statistically significant with p-value of 0.01. For every one year increase in age there was a 0.98 (95% CI 0.97-0.98) decrease in the odds of being overweight or obese. With respect to marital status, compared to adults who were married, those who were widowed/divorced/separated were 1.27 (95% CI=1.05-1.54) more likely to be overweight or obese; which was also statistically significant (p=0.02). Furthermore, the odds of being overweight or obese among the never married were 1.46 (95% CI=1.16-1.83) higher compared to the odds of being overweight or obese among those who were married (p=0.01). Lastly, adults who reported living with a partner were 1.47 (95% CI=1.09-1.99) more likely, than those who had been married, to be overweight or obese (p=0.01).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Overweight/Obese OR (95% CI)</th>
<th>Overweight/Obese* OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Security</td>
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<td></td>
</tr>
<tr>
<td>Full/Marginal</td>
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<td>1.00</td>
</tr>
<tr>
<td>Low/Very Low</td>
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<td>1.05 (0.82, 1.34)</td>
</tr>
<tr>
<td>Shift Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Day</td>
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<td>1.00</td>
</tr>
<tr>
<td>Regular Evening /Night</td>
<td>0.87 (0.68, 1.12)</td>
<td>0.76 (0.57, 1.01)</td>
</tr>
<tr>
<td>Rotating or Other</td>
<td>1.10 (0.96, 1.27)</td>
<td>1.08 (0.94, 1.25)</td>
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<tr>
<td>Other Hispanic</td>
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<td>0.70 (0.52, 0.95)**</td>
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<td>0.55 (0.45, 0.66)**</td>
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<td>2.22 (1.58, 3.12)**</td>
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</tr>
<tr>
<td>Female</td>
<td>1.77 (1.53, 2.04)**</td>
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<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-79 years</td>
<td></td>
<td>0.98 (0.97, 0.98)**</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Widowed/Divorced/Separated</td>
<td>1.27 (1.05, 1.54)**</td>
<td></td>
</tr>
<tr>
<td>Never Married</td>
<td>1.46 (1.16, 1.83)**</td>
<td></td>
</tr>
<tr>
<td>Living with Partner</td>
<td>1.47 (1.09, 1.99)**</td>
<td></td>
</tr>
</tbody>
</table>

*Adjusted for Level of Food Security, Shift Type, Ethnicity/Race, Level of Education, Sex and Age.

**p <0.05

Table 5. Final Model, Multivariable Logistic Regression Analysis for the Odds of Being Overweight/Obese among U.S. Adults, aged 20-79 years, NHANES 2005-2010 (n=5,848)
CHAPTER 4: DISCUSSION AND CONCLUSION

4.1 Discussion of Results

There are many known factors that result in individuals becoming overweight or obese. The current study addressed the association of shift work and food security among overweight and obese individuals in a nationally representative sample of adults. The 2005-2010 NHANES dataset included 20,497 men and women aged 20-79 of which 26.0% (n=5,848) were included in the current analysis. Demographic characteristics found to be statistically significant included: race/ethnicity (p=0.01); education level (p=0.01); marital status (p=0.01); food security score (p=0.01) and hours worked in the last week (p=0.01) when comparing type of shift worked (regular daytime shift; regular evening or night shift; rotating or other shift).

A multivariate logistic regression model further explored variables within overweight and obese individuals by hours worked (greater than or equal to 35 compared to less than 35 hours a week). The individuals, regardless of hours worked, when self-identified as having worked a “rotating or other shift” had higher odds of being overweight or obese. Among individuals that worked greater than or equal to 35 hours a week, females had 2.07 (95% CI 1.24-3.45) higher odds of being overweight or obese.
compared to males which was found to statistically significant (p=0.01). As noted from a previous study by Luckhaupt et al, the prevalence of obesity among working individuals has risen over the last decade with close to 28% of the population being affected (Luckhaupt S, Cohen M, Li J, Calvert G, 2014). Lastly, with respect to marital status, among those who worked 35 hours or greater weekly, the self-identified category of widowed, divorced or separated was found to be 1.74 (95% CI=1.04-2.93) times higher for overweight or obese compared to married; which was also found to statistically significant (p=0.04). Among adults that worked 35 hours or greater weekly, the category of never married was found to be 1.23 (95% CI=0.72-2.10) times higher for being overweight or obese compared to married. Among participants that worked 35 hours or greater weekly that identified as living with a partner were found to be 1.88 (95% CI=0.76-4.65) times higher for being overweight or obese compared to married.

Interestingly, among adults that worked less than 35 hours a week, the category of never married was found to be 2.61 (95% CI=1.60-4.27) times greater for being overweight or obese compared to married (p=0.01). In contrast, a study which focused on marital status and health in the United States, observed the age-adjusted prevalence of overweight or obesity was lower for widowed (53.4%, SE=2.95) and divorced/widowed (54.7%, SE=0.65) (Schoenborn C, 2004).

The final adjusted logistic regression model analysis focused on overweight and obesity among U.S. adults aged 20-79 years old. The interaction of food security and any shift type was not found to be statistically significant. After adjusting the model for all other variables, neither food security score nor shift type was found to be statistically
associated with being overweight or obese from this sample. However, in previous research there has been a strong relationship established between shift work and being overweight or obese, especially when deciding how to obtain food (Winkler E, 2010). Lack of time during the day as well as limited knowledge on how to properly prepare meals may indirectly drive an individual to make poor choices such as the purchase of fast food or more of “convenient” style approaches to nutrition, such as frozen dinners (Carlson A, Kinsey J, Nadav C, 2002; Harnack, L, Jeffery R, Boutelle K, 2000). One explanation for this could be the location of fast food establishments within walking distance of individual’s place of employment or residence. Americans seem to continue relying on commercially prepared meals rather than purchasing ingredients in order to prepare home cooked meals (Kant AK, Graubard BI, 2004). Lack of preparation and meal planning during off time between shifts may also play a role in poor, last minute food decisions (Sturm, 2004).

The variable ethnicity was found to be significant predictor in the adjusted model (Other Hispanic, p=0.02; Mexican American, p=0.01; Non-Hispanic Black, p=0.01; Other/Multi-Racial, p=0.01) when all other variables were controlled. This finding is in contrast to previous research by Ogden et al, in which Non-Hispanic Blacks had the highest rate of age-adjusted obesity (47.8%), Non-Hispanic Whites 32.6% and Hispanic at 42.5% (Ogden C, Carroll M, Kit B, Flegal K, 2014). One explanation for differences could be the small number of respondents that self-identified with an ethnicity/race other than Non-Hispanic White (n=4068) compared to Other Hispanic (n=260), Mexican American (n=510), Non-Hispanic Black (n=643) and Other/Multi-Racial (n=367).
Sex and age were found to be significant predictors in the adjusted model as well as the model that explored the amount of hours worked (p=0.01). This was consistent with findings by the CDC and the prevalence of obesity among females and males (Ogden C, Carroll M, Kit B, Flegal K., 2012). Another study where Franklin et al performed a literature review revealing 19 studies performed since 2005 found food insecurity and obesity were associated among women (Franklin B, Jones A, Love D, Puckett S, Macklin J, White-Means S., 2012). When compared to 20-39 year olds, as individuals aged there was a decrease in the odds of becoming overweight or obese. This is in contrast to other previous research in relation to age where obesity was found to be higher among adults aged 40-59 years old (39.5%) than adults aged 20-39 (30.3%) or adults over 60 (35.4%) adults (Ogden CL, Carroll MD, Kit BK, Flegal KM, 2014). Marital status was also found to be predictor of being overweight or obese in the present study. Adults who reported living with a partner were most likely to be overweight or obese compared to being married (OR=1.47, 95% CI=1.09-1.99).

4.2 Study Strengths and Limitations

As with any study there are strengths and limitations. The primary strength of this study was the use of a large, national sample of U.S. adults that included accurate BMI measurements obtained from trained technicians according to standard protocols, making our findings more generalizable. The primary limitation of this study is the cross-sectional design of this retrospective study. The utilization of NHANES data does not allow drawing of conclusions in terms of temporality or causal effects when assessing the
relationships between food security score and/or shift work and the outcome of being overweight or obese. Further, as with any survey, the collected data were self-reported and consequently may introduce information bias into the study. Individuals who are food insecure may not have responded accurately to some or all questions in NHANES pertaining to food security. Because of this, the true number of adults classified by NHANES to have a “low/very low” food security score may actually be higher, leading to differential misclassification. Another possible limitation to this study was unclear demarcation between differences in “shift length worked.” For example, depending on how the individual defined the shift worked, one could have worked 3pm to 11pm for two weeks and 10am to 6pm for the next two weeks, either self-identifying with evening shift or rotating shift. There was also no documentation found stating how long the individual had worked in the identified shift. Lastly, this study could have non-responder bias. To the best of my knowledge there was no demographic information obtained on those who chose not to partake in the survey, hence it is unknown whether these individuals differ from the participants who did respond.

4.3 Conclusions

The association of types of shift work and/or food security status with overweight or obese among adults aged 20-79 was assessed in the current study. To the best of our knowledge, this is the first study to assess this relationship utilizing NHANES data. Multivariable logistic regression modeling identified statistically significant associations between ethnicity/race, sex and age and being overweight or obese within this population.
The data collected on food security can be used with other survey information to assess the need for different types of programs to help address food security at different levels (National Research Council, 2005). Although based on these results, type of shift work and/or food security score were not found to be statistically associated with being overweight or obese; it is important to always maintain a healthy weight to help maintain a quality-of-life that allows individuals to be productive in society. Therefore, the study’s findings offer support for including a regiment focused around a healthy weight which would help in combating non-modifiable risks factors such as sex, ethnicity/race and age. Future research might consider focusing on earlier recognition of weight increases from a sex-specific standpoint, to help ensure healthier and feasible options pertaining to food security. Finally, this study has the potential to better understand the relationship between food insecurity and obesity generating a potential to impact public health policy improving the health status of U.S. adults.
LIST OF REFERENCES


APPENDIX A

NHANES EXAMPLE QUESTIONS
NHANES Example Questions

SEQN - Respondent sequence number

**Variable Name:**
SEQN

**SAS Label:**
Respondent sequence number

**English Text:**
Respondent sequence number

**Target:**
Both males and females 16 YEARS - 150 YEARS

OCD150 - Type of work done last week

**Variable Name:**
OCD150

**SAS Label:**
Type of work done last week

**English Text:**
(SP Interview Version) In this part of the survey I will ask you questions about {your/SP's} work experience. Which of the following {were you/was SP} doing last week . . . (Family Interview Version) The next questions are about {your/NON-SP HEAD'S/NON- SP SPOUSE'S} current job or business. Which of the following {were you/was} {NON-SP HEAD/NON-SP SPOUSE} doing last week . . .

**Target:**
Both males and females 16 YEARS - 150 YEARS

<table>
<thead>
<tr>
<th>Code or Value</th>
<th>Value Description</th>
<th>Skip to Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Working at a job or business,</td>
<td>OCQ180</td>
</tr>
<tr>
<td>2</td>
<td>With a job or business but not at work,</td>
<td>OCQ210</td>
</tr>
<tr>
<td>3</td>
<td>Looking for work, or</td>
<td>OCD390G</td>
</tr>
<tr>
<td>Code or Value</td>
<td>Value Description</td>
<td>Skip to Item</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>4</td>
<td>Not working at a job or business?</td>
<td>OCQ380</td>
</tr>
<tr>
<td>7</td>
<td>Refused</td>
<td>OCD390G</td>
</tr>
<tr>
<td>9</td>
<td>Don't know</td>
<td>OCD390G</td>
</tr>
<tr>
<td>.</td>
<td>Missing</td>
<td></td>
</tr>
</tbody>
</table>

OCQ180 - Hours worked last week at all jobs

**Variable Name:**
OCQ180

**SAS Label:**
Hours worked last week at all jobs

**English Text:**
How many hours did {you/SP} work last week at all jobs or businesses?

**English Instructions:**
ENTER NUMBER OF HOURS

**Target:**
Both males and females 16 YEARS - 150 YEARS

**Hard Edits:**
1 to 168

<table>
<thead>
<tr>
<th>Code or Value</th>
<th>Value Description</th>
<th>Skip to Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 125</td>
<td>Range of Values</td>
<td></td>
</tr>
<tr>
<td>77777</td>
<td>Refused</td>
<td></td>
</tr>
<tr>
<td>999999</td>
<td>Don't know</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>Missing</td>
<td></td>
</tr>
</tbody>
</table>
OCQ200 - Check Item

Variable Name: OCQ200
SAS Label: Check Item
English Text: English Instructions:
BOX 1. CHECK ITEM OCQ200: IF HOURS IN OCQ180 \(\leq 34\), OR REFUSED (CODE 77777), OR DON'T KNOW (CODE 99999), CONTINUE. OTHERWISE, GO TO OCD230.
Target: Both males and females 16 YEARS - 150 YEARS

OCQ210 - Usually work 35 or more hours per week

Variable Name: OCQ210
SAS Label: Usually work 35 or more hours per week
English Text: {Do you/Does SP} usually work 35 hours or more per week in total at all jobs or businesses?
Target: Both males and females 16 YEARS - 150 YEARS

<table>
<thead>
<tr>
<th>Code or Value</th>
<th>Value Description</th>
<th>Skip to Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Refused</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Don't know</td>
<td></td>
</tr>
</tbody>
</table>
OCQ265 - Which best describes hours worked?

**Variable Name:**
OCQ265

**SAS Label:**
Which best describes hours worked?

**English Text:**
Which of the following best describes the hours {you/SP} usually {work/works} at {your/his/her} main job or business?

**English Instructions:**
INTERVIEWER INSTRUCTION: IF THE RESPONDENT SAYS "FLEXTIME", ETC., PROBE TO DETERMINE WHETHER THE SHIFT THAT IS WORKED ACTUALLY FALLS IN A DAY, EVENING, NIGHT, OR ROTATING SHIFT CATEGORY BEFORE CODING IT AS "ANOTHER SCHEDULE."

**Target:**
Both males and females 16 YEARS - 150 YEARS

<table>
<thead>
<tr>
<th>Code or Value</th>
<th>Value Description</th>
<th>Skip to Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A regular daytime schedule</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A regular evening shift</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A regular night shift</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A rotating shift</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Another schedule</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Refused</td>
<td></td>
</tr>
<tr>
<td>Code or Value</td>
<td>Value Description</td>
<td>Skip to Item</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>9</td>
<td>Don't know</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>Missing</td>
<td></td>
</tr>
</tbody>
</table>

FSDAD - Adult food security category

**Variable Name:**
FSDAD

**SAS Label:**
Adult food security category

**English Text:**
Adult food security category for last 12 months

**English Instructions:**
Calculated on household level.

**Target:**
Both males and females 0 YEARS - 150 YEARS

<table>
<thead>
<tr>
<th>Code or Value</th>
<th>Value Description</th>
<th>Skip to Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AD full food security: 0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AD marginal food security: 1-2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AD low food security: 3-5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AD very low food security: 6-10</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>Missing</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

STATA Code
*Eggerichs-Thesis 2015*

*NHANES 2005-2010 data - 6 year thesis (3 cycles)*

/*/1. Convert data from .xpt to .dta files/*

*data year 2005-2006
*Demographics data - Demographics and sample weights (DEMO_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\DEMO_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\DEMO_F.dta"

*Examination data - Body measures (BMX_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\BMX_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\BMX_F.dta"

*Questionnaire data - Food Security (FSQ_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\FSQ_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\FSQ_F.dta"

*Questionnaire data - Occupation Questionnaire (OCQ_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\OCQ_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\OCQ_F.dta"

*Questionnaire data - Diet behavior and nutrition (DBQ_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\DBQ_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\DBQ_F.dta"

*Questionnaire data - Smoking (SMQ_F.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\SMQ_F.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\SMQ_F.dta"

*data year 2007-2008
*Demographics data - Demographics and sample weights (DEMO_E.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\DEMO_E.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\DEMO_E.dta"

*Examination data - Body measures (BMX_E.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\BMX_E.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\BMX_E.dta"

*Questionnaire data - Food Security (FSQ_E.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\FSQ_E.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\FSQ_E.dta"

*Questionnaire data - Occupation Questionnaire (OCQ_E.XPT)*
*fdause "D:\EPI IV-Indep Project\Raw Data\OCQ_E.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\OCQ_E.dta"

*Questionnaire data - Diet behavior and nutrition (DBQ_E.XPT)*
*Questionnaire data - Smoking (SMQ_E.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\SMQ_E.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\SMQ_E.dta"

*Data year 2009-2010*
*Demographics data - Demographics and sample weights (DEMO_D.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\DEMO_D.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\DEMO_D.dta"

*Examination data - Body measures (BMX_D.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\BMX_D.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\BMX_D.dta"

*Questionnaire data - Food Security (FSQ_D.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\FSQ_D.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\FSQ_D.dta"

*Questionnaire data - Occupation Questionnaire (OCQ_D.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\OCQ_D.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\OCQ_D.dta"

*Questionnaire data - Diet behavior and nutrition (DBQ_D.XPT)*
fdause "D:\EPI IV-Indep Project\Raw Data\DBQ_D.xpt", clear
save "D:\EPI IV-Indep Project\Converted Data\DBQ_D.dta"

*Questionnaire data - Smoking (SMQ_D.XPT)*
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save "D:\EPI IV-Indep Project\Converted Data\SMQ_D.dta"

*/2. Merge datasets/*
use "D:\EPI IV-Indep Project\Converted Data\DEMO_D.dta"
use "D:\EPI IV-Indep Project\Converted Data\DEMO_F.dta", clear
keep seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl indhhin2 wtint2yr wtme2yr sdmvpsu sdmvstra
append using "D:\EPI IV-Indep Project\Converted Data\DEMO_D.dta",
keep(seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl indhhin2 wtint2yr wtme2yr sdmvpsu sdmvstra)
save "D:\EPI IV-Indep Project\Converted Data\demo_4yr", replace

use "D:\EPI IV-Indep Project\Converted Data\demo_4yr.dta"
use "D:\EPI IV-Indep Project\Converted Data\DEMO_E.dta", clear
keep seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl indhhin2 wtint2yr wtme2yr sdmvpsu sdmvstra
append using "D:\EPI IV-Indep Project\Converted Data\DEMO_E.dta",
keep(seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl indhhin2 wtint2yr wtme2yr sdmvpsu sdmvstra)
save "D:\EPI IV-Indep Project\Converted Data\demo_6yr", replace

use "D:\EPI IV-Indep Project\Converted Data\BMX_D.dta"
use "D:\EPI IV-Indep Project\Converted Data\SMQ_D.dta"
use "D:\EPI IV-Indep Project\Converted Data\SMQ_F.dta", clear
keep seqn smq020 smq040
append using "D:\EPI IV-Indep Project\Converted Data\SMQ_D.dta",
keep(seqn smq020 smq040)
save "D:\EPI IV-Indep Project\Converted Data\SMQ_4yr", replace

use "D:\EPI IV-Indep Project\Converted Data\SMQ_4yr.dta"
use "D:\EPI IV-Indep Project\Converted Data\SMQ_E.dta", clear
keep seqn smq020 smq040
append using "D:\EPI IV-Indep Project\Converted Data\SMQ_E.dta",
keep(seqn smq020 smq040)
save "D:\EPI IV-Indep Project\Converted Data\SMQ_6yr", replace

use "D:\EPI IV-Indep Project\Converted Data\demo_6yr.dta", clear
sort seqn
save "D:\EPI IV-Indep Project\Converted Data\demo_6yr.dta", replace

use "D:\EPI IV-Indep Project\Converted Data\bmx_6yr.dta", clear
sort seqn
save "D:\EPI IV-Indep Project\Converted Data\bmx_6yr.dta", replace

use "D:\EPI IV-Indep Project\Converted Data\fsq_6yr.dta", clear
sort seqn
save "D:\EPI IV-Indep Project\Converted Data\fsq_6yr.dta", replace

use "D:\EPI IV-Indep Project\Converted Data\ocq_6yr.dta", clear
sort seqn
save "D:\EPI IV-Indep Project\Converted Data\ocq_6yr.dta", replace

use "D:\EPI IV-Indep Project\Converted Data\dbq_6yr.dta", clear
sort seqn
save "D:\EPI IV-Indep Project\Converted Data\dbq_6yr.dta", replace

use "D:\EPI IV-Indep Project\Converted Data\smq_6yr.dta", clear
sort seqn
merge 1:1 seqn using "D:\EPI IV-Indep Project\Converted
Data\smq_6yr.dta"
drop _merge
save "D:\EPI IV-Indep Project\Converted Data\merge1.dta", replace
use "D:\EPI IV-Indep Project\Converted Data\merge1.dta"
sort seqn
merge seqn using "D:\EPI IV-Indep Project\Converted Data\fsq_6yr.dta"
drop _merge
save "D:\EPI IV-Indep Project\Converted Data\merge2.dta", replace
use "D:\EPI IV-Indep Project\Converted Data\merge2.dta"
sort seqn
merge seqn using "D:\EPI IV-Indep Project\Converted Data\ocq_6yr.dta"
drop _merge
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use "D:\EPI IV-Indep Project\Converted Data\merge3.dta"
sort seqn
merge seqn using "D:\EPI IV-Indep Project\Converted Data\dbq_6yr.dta"
drop _merge
save "D:\EPI IV-Indep Project\Converted Data\merge4.dta"
use "D:\EPI IV-Indep Project\Converted Data\merge4.dta"
sort seqn
merge seqn using "D:\EPI IV-Indep Project\Converted Data\bmx_6yr.dta"
drop _merge
save "D:\EPI IV-Indep Project\Converted Data\FINAL-6yr.dta"

keep seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl
indhhin2 indfmpir wtint2yr wtmec2yr sdmvpsu sdmvstra bmxwt bmxht bmxbmi
bmxwaist fsd032c fsd052 fsd071 fsdad ocq210 ocq265 dbd895 dbd091 smq020
smq040

use "D:\EPI IV-Indep Project\Converted Data\SMQ_6yr.dta"
merge 1:1 seqn smq020 smq040
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keep(seqn smq020 smq040)
save "D:\EPI IV-Indep Project\Converted Data\SMQ_4yr", replace

*//3. Save variables of interest//*
keep seqn sddsrvyr riagendr ridageyr ridreth1 dmdeduc2 dmdmartl
indhhin2 indfmpir wtint2yr wtmec2yr sdmvpsu sdmvstra bmxwt bmxht bmxbmi
bmxwaist fsd032c fsd052 fsd071 fsdad ocq210 ocq265 dbd895 dbd091 smq020
smq040

save "D:\EPI IV-Indep Project\STATA\6_Year_Thesis.dta", replace
*Use 6_Year_Thesis dataset*
******************************************************************************
****

*//4. Assessment of variables//*
set more off
describe // Quick list of all variables in dataset//
codebook // More detailed information about each variable in dataset//
tab fsdad
tab ocq265
sum bmbxbmi, detail //Body mass index (kg/m**2)
*generate food security variable-binary*
tab fsdad
gen fsdadcat=.
    replace fsdadcat=0 if fsdad==1
    replace fsdadcat=0 if fsdad==2
    replace fsdadcat=1 if fsdad==3
    replace fsdadcat=1 if fsdad==4
label var fsdadcat "Food Security Categories"
label define fsdadcat 0 "Full or Marginal" 1 "Low or Very Low"
label values fsdadcat fsdadcat
tab fsdadcat
tab fsdad

*generate shiftwork variable-4 categories*
tab ocq265
gen ocq265cat=.
    replace ocq265cat=0 if ocq265==1
    replace ocq265cat=1 if ocq265==2
    replace ocq265cat=2 if ocq265==3
    replace ocq265cat=3 if ocq265==4
    replace ocq265cat=3 if ocq265==5
label var ocq265cat "Shift Type"
label define ocq265cat 0 "Regular Daytime Shift" 1 "Regular Evening Shift" 2 "Regular Night Shift" 3 "Rotating or Other Shift"
label values ocq265cat ocq265cat
tab ocq265cat

*generate shiftwork variable-3 categories*
tab ocq265
gen ocq265cat3=.
    replace ocq265cat3=0 if ocq265==1
    replace ocq265cat3=1 if ocq265==2
    replace ocq265cat3=1 if ocq265==3
    replace ocq265cat3=2 if ocq265==4
    replace ocq265cat3=2 if ocq265==5
label var ocq265cat3 "Shift Type"
label define ocq265cat3 0 "Regular Daytime Shift" 1 "Regular Evening Shift or Regular Night Shift" 2 "Rotating or Other Shift"
label values ocq265cat3 ocq265cat3
tab ocq265cat3

*generate BMI variable-binary*
sum bmxbmi, detail
generate BMI=1 if bmxbmi!=. & bmxbmi<18.5
    replace BMI=2 if bmxbmi>=18.5 & bmxbmi<25
    replace BMI=3 if bmxbmi>=25 & bmxbmi<30
    replace BMI=4 if bmxbmi!=. & bmxbmi>=30
tab BMI
gen BMIcat=.
    replace BMIcat=0 if BMI==1
    replace BMIcat=0 if BMI==2
    replace BMIcat=1 if BMI==3
    replace BMIcat=1 if BMI==4
tab BMIcat
   recode BMIcat (0=1) (1=0)

label define BMIcat 0 "Overweight or Obese" 1 "Underweight or Normal Weight"
label values BMIcat BMIcat

sum bmxbmi

*generate sex variable-binary*

generate sex=.
   replace sex=0 if riagendr==1
   replace sex=1 if riagendr==2
label define sex 0 "Male" 1 "Female"
label values sex sex
label variable sex "Sex"

*generate age variable-3 categories*

sum ridageyr, detail
   gen age=0 if ridageyr!=. & ridageyr >=20 & ridageyr <40
   replace age=1 if ridageyr >=40 & ridageyr <60
   replace age=2 if ridageyr >=60 & ridageyr <80
   label define age 0 "20-39" 1 "40-59" 2 "60-79"
   label var age "Age"

*generate education level-binary*

generate education=.
   replace education=0 if dmdeduc2==1
   replace education=0 if dmdeduc2==2
   replace education=0 if dmdeduc2==3
   replace education=1 if dmdeduc2==4
   replace education=1 if dmdeduc2==5
   replace education=. if dmdeduc2==7
   replace education=. if dmdeduc2==9
label define education 0 "High School/GED or less" 1 "Some College or more"

*generate marital status-4 categories*

generate marital=.
   replace marital=0 if dmdmartl==1
   replace marital=1 if dmdmartl==2
   replace marital=1 if dmdmartl==3
   replace marital=1 if dmdmartl==4
   replace marital=2 if dmdmartl==5
replace marital=3 if dmdmartl==6
replace marital=. if dmdmartl==77
replace marital=. if dmdmartl==99

tab marital
label define marital 0 "Married" 1 "Widowed/Divorced/Separated" 2 "Never married" 3 "Living with partner"
label var marital "Marital Status"
label values marital marital

*generate ethnicity variable-5 categories*

tab ridreth1

gen ethnic=.
replace ethnic=0 if ridreth1==1
replace ethnic=1 if ridreth1==2
replace ethnic=2 if ridreth1==3
replace ethnic=3 if ridreth1==4
replace ethnic=4 if ridreth1==5

tab ethnic
recode ethnic (0=2) (1=1) (2=0) (3=3) (4=4)

tab ethnic
label define ethnic 0 "Non-Hispanic White" 1 "Other Hispanic" 2 "Mexican American" 3 "Non-Hispanic Black" 4 "Other Race-Including Multi-Racial"
label var ethnic "Race/Ethnicity"
label value ethnic ethnic

tab ethnic

*generate interaction term for shiftwork type and food security

gen fsdadcat_ocq265cat3=fsdadcat*ocq265cat3

*//The association of obesity, characterized by BMI, and food security among adult, shiftworkers aged 20-79//*

*//Variables I am interested for this investigation:
*Main exposure: shiftwork (ocq265cat)
*Main outcome: BMI status (BMICat)
*Covariates/potential confounders: sex, education level, race/ethnicity, age, education level, marital status*
*Interaction variable: food security (fsdadcat)//*

set more off
//Unweighted univariates//
tab1 ocq265cat if ridageyr>=20 & ridageyr<=79, missing

*generate subpopulation variable*
gen subpop = 0
   replace subpop = 1 if ocq265cat!=. & ocq265cat!=7 & ocq265cat!=9 & ridageyr!=. & ridageyr>=20 & ridageyr<=79
   // Created subpopulation of adult aged 20-79 and shift workers //

//Sample weights: here we use wtmec6yr because our data are from the
MEC exam and includes 6 yrs of data//
summarize wtmec2yr, detail
gen MEC6YR = 1/3*wtmec2yr
summarize MEC6YR, detail

//Setting the design parameters//
svyset [pweight=MEC6YR], strata(sdmvstra) psu(sdmvpsu) vce(linearized)
set more off

//Table variables - weighted proportions//
//weighted n for each shiftwork category//
set more off
svy, subpop(if subpop==1): tab ocq265cat
svy, subpop(if subpop==1): proportion fsdadcat, over(ocq265cat)
svy, subpop(if subpop==1): proportion BMICat, over(ocq265cat)
svy, subpop(if subpop==1): proportion sex, over(ocq265cat)
svy, subpop(if subpop==1): proportion ethnic, over(ocq265cat)
svy, subpop(if subpop==1): proportion marital, over(ocq265cat)
svy, subpop(if subpop==1): mean ridageyr, over(ocq265cat)

//Table variables - (rows across and p-values-preference for tables)
//weighted n for each collapsed shiftwork categories//
set more off
svy, subpop(if subpop==1): tabulate ocq265cat3
svy, subpop(if subpop==1): tabulate fsdadcat ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): tabulate BMICat ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): tabulate sex ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): tabulate ethnic ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): tabulate education ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): tabulate marital ocq265cat3, row format(%7.4f)
svy, subpop(if subpop==1): mean ridageyr, over(ocq265cat3)
svy, subpop(if subpop==1): anova ridageyr, over(ocq265cat3)
svy, subpop(if subpop==1): tabulate hrsworked ocq265cat3, row format(%7.4f)

//Table stratified by sex - weighted proportions//
svy, subpop(if subpop==1): tabulate sex
svy, subpop(if subpop==1): tabulate fsdadcat sex, row format(%7.4f)
svy, subpop(if subpop==1): tabulate BMIcat sex, row format(%7.4f)
svy, subpop(if subpop==1): tabulate ocq265cat3 sex, row format(%7.4f)
svy, subpop(if subpop==1): tabulate ethnic sex, row format(%7.4f)
svy, subpop(if subpop==1): tabulate education sex, row format(%7.4f)
svy, subpop(if subpop==1): tabulate marital sex, row format(%7.4f)
svy, subpop(if subpop==1): mean ridageyr, over(sex)

svy, subpop(if subpop==1): tabulate hrsworked sex, row format(%7.4f)
*total number of men and women = 5848

***********************************************************************
*Stratify by hours worked*
***********************************************************************

svy, subpop(if subpop==1 & hrsworked==0): logistic BMIcat i.ocq265cat3 i.fsdadcat sex i.ethnic education i.marital ridageyr
svy, subpop(if subpop==1 & hrsworked==1): logistic BMIcat i.ocq265cat3 i.fsdadcat sex i.ethnic education i.marital ridageyr

***********************************************************************
* Analysis - Backwards Logistic Regression in Survey Data
***********************************************************************

*Overweight/Obese adults
set more off

*Crude model
svy, subpop(if subpop==1): logistic BMIcat i.ocq265cat3 fsdadcat

*Confounding*
* 100 x absolute value of [OR(unadjusted) - OR(adjusted)] / OR(adjusted) = greater than or equal to 10%*
*confsvy - part of autocalculation through STATA*
svy, subpop(if subpop==1): logit BMIcat i.ocq265cat3 fsdadcat sex i.ethnic education i.marital ridageyr i.fsdadcat_ocq265cat3

*full model
svy, subpop(if subpop==1): logistic BMIcat i.ocq265cat3 i.fsdadcat sex i.ethnic education i.marital ridageyr i.fsdadcat_ocq265cat3
*estimates store full_model*

*Elimination of interactions (alpha = 0.10)-based on Wald test given survey data
svy, subpop(if subpop==1): logistic BMIcat i.ocq265cat3 fsdadcat sex i.ethnic education i.marital ridageyr
*test full_model*

*model without education*
svy, subpop(if subpop==1): logistic BMIcat i.ocq265cat3 fsdadcat sex i.ethnic i.marital ridageyr

*all remaining variables significant alpha = 0.05
******************************************************************************
**Final logit model**
svy, subpop(if subpop==1): logit BMIcat i.ocq265cat3 fsdadcat sex i.ethnic i.marital ridageyr
******************************************************************************

*Distribution of Ethnicity*
svy, subpop(if subpop==1): tabulate ethnic
tab ethnic