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Who is Hungry? Food Security Among Native- Born and Foreign- Born U.S. Residents: 2005-2016

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Master of Public Health

Global Epidemiology

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Bachelor of Science

The Ohio State University

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in Global Epidemiology

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Abstract

Who is Hungry? Food Security Among Native- Born and Foreign- Born U.S. Residents: 2005-2016

By Bridget Katharine Walsh

Background

By determining which populations are at a high risk for food insecurity, aid programs can be tailored to improve food security outcomes.

Objectives

This thesis seeks to establish whether foreign- born individuals are at a different risk of food insecurity in the United States than native- born individuals, to explore time of residence in the United States as it correlates to food security, and to identify covariates of food insecurity in the United States.

Methods

Data from the National Health and Nutrition Examination Survey (NHANES) (2005- 2016) were analyzed using multinomial logistic regression to determine the correlation between both nativity and time since migrating to the United States with food security.

Results

Among the foreign-born population, 22.64% experienced low or very low food security, whereas only 16.73% of the native- born population experienced this ($p < 0.0001$). Nativity was not significantly associated with household food security. Time of residence in the U.S was also not significantly associated with household food security. Most notably, households receiving nutrition- based aid had 2.88 (2.32-3.60) times the odds of experiencing very low food security as those who were not receiving aid.

Conclusions

The data demonstrate that those receiving government nutrition- based assistance are still at a high risk of food insecurity, and that race, ethnicity, and education level are risk factors for food insecurity. This thesis calls for action by the U.S. federal and state governments to further study food security among U.S. residents and improve upon current nutrition- based aid programs to alleviate food insecurity among U.S. residents.

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1 INTRODUCTION

The U.S. government currently spends tens of billions of dollars annually on nutrition assistance programs; however, the prevalence of food insecurity has changed a negligible amount since the mid- 1990's. [2] By determining which populations within the U.S. are at a high risk for food insecurity, the government can adjust and tailor aid programs to provide aid commensurate to the risk of food insecurity. In the future, these programs may be tailored to recent immigrants, migrants, and refugees if the data demonstrate a heightened risk of food insecurity among these populations.

The goal of this thesis is to determine whether the overall risk of food insecurity is greater among foreign born U.S. residents, compared to native born U.S. residents. This thesis also seeks to establish if time since migrating to the U.S. is correlated with the risk of food insecurity among foreign born U.S. residents. The literature demonstrates that transitioning to a new way of life among recent refugees increases risk of food insecurity, however, length of time since relocation as it correlates to risk of food insecurity has not been significantly explored among immigrant and migrant populations. [12] Finally, this thesis aims to establish significant covariates of food insecurity to build a more holistic understanding of food insecurity in the U.S.

Considering the stagnant food insecurity rates within the U.S. despite the significant monetary investments in federal nutrition aid programs (such as WIC and SNAP), it is clear that the programs in place to alleviate food insecurity are not providing a long-term solution but rather a method of nutritional maintenance.[2] This thesis will examine the possible covariates of food insecurity (i.e., nativity and time since migration) and determine if federal nutrition aid programs may be adjusted to serve the highest risk populations.

2 LITERATURE REVIEW

2.1 Introduction

The purpose of this review is four- fold. First, this literature review aims to define what food insecurity is, and how it may take different forms. Second, this literature review explores how food insecurity is measured. Third, this literature review explores the history of food insecurity within the United States of America. Lastly, this literature review addresses comorbidities of food insecurity, particularly those pertaining to this thesis.

2.2 Food Insecurity

While food insecurity can take many forms, it is formally defined by the United States Department of Agriculture as the lack of dependable access to enough food for an active, healthy life. Resources that are typically lacking in food insecure households include money, access to nutrition education, and access to transportation to supermarkets (geographic constraints). Food insecurity can be a constant state in some households, while cyclical in others. This is a result of different work patterns and access to a steady income. [3]

2.3 Measuring Food Insecurity

Measuring food insecurity is a task many have grappled with for the last quarter- century. While millions are affected by food insecurity globally, there has been a consistent challenge in quantifying measurements of said affliction. Proxy measures are often utilized: agricultural production, food storage, children's nutritional status. These measures only capture a small portion of the larger problem. [19] The reality is that food insecurity includes many aspects such as anxiety about uncertain household food supply, insufficient food quality, variety, social acceptability, insufficient food intake, and coping strategies to increase the household food supply. [17] Recently there has been a shift from measuring the objective measures to focusing

on subjective measures, a shift away from using aforementioned proxy measures, and a focus on measuring “inadequate access” to food in order to get a more accurate representation. [19] As a conceptual framework, the three domains of food (in)security are availability, access, and utilization. The shift to focusing on the access component of food insecurity stems from the fact that in the U.S. there is not a national food shortage, there are developed distribution chains in place, and there is not a prevalent issue of unsanitary conditions leading to malabsorption. [15]

The Household Food Insecurity Access Scale (HFIAS) was developed in efforts of the United States Agency for International Development (USAID) Food and Nutritional Technical Assistance (FANTA) Project to develop a universally accepted, user- friendly tool that can measure the access component of household food insecurity. The HFIAS questionnaire (Appendix 1) is a set of nine generic questions that can be adapted to fit the local context as needed, while still being understood as originally intended. While the HFIAS score indicator is a sensitive indicator of incremental changes in household food insecurity, it is likely that stakeholders in food insecurity relief programs would want to know the proportion of food insecure households and if this proportion has changed. [17]

Additional food insecurity measurement efforts have been made by the United States Department of Agriculture (USDA). The Current Population Survey (CPS) conducted in 2018 included tens of thousands of households, selected to be representative of the U.S. population at state and local levels. The survey (Appendix 2) included 18 questions and was used to conduct a statistical analysis of food insecurity among U.S. residents. [3] Additionally, the Economic Research Service (ERS) of the USDA investigated low- income and low- access census tracts across the U.S. to further investigate the access component to food insecurity by exploring distance to the nearest food store among the 12.7 percent of the population classified as low-

income. Defining low- access by 1- and 10- mile distance to the nearest food stores, the ERS developed a quantifiable method to analyze and track the access component of food insecurity. While data varied vastly from state to state between 2010 and 2015, the number of households that filed both low- income census tracts and classified as low- access decreased nationally. [14]

It is important to distinguish not only the distance to the nearest food store, but also the store type. Many low- income neighborhoods have less supermarkets and more small stores. Small stores are likely to have higher prices, especially for fruits and vegetables, and less selection of nutritious options. Without accounting for this increase in price and decrease in selection, simply measuring distance to nearest food store is not a complete depiction of the accessibility domain of food insecurity measures. [15]

2.4 A Recent History of Food Insecurity in the United States

The National Nutritional Monitoring and Related Research Act of 1990 (NNMRR) jump started the efforts of the U.S. government to gather data on and better understand the prevalence of food insecurity. Five years later, the CPS Food Security Supplement (Appendix 2) was conducted and has been conducted annually since December of 2001. Modifications have been made over time, but the core content of the eighteen questions is still the basis of the U.S. Food Security Scale. In 1998 the ERS assumed responsibility for the annual survey and data analysis. From 2003 to 2006, the Committee on National Statistics (CNSTAT) reviewed the food security measurement methods. The review resulted in the affirmation of the methodology used and included several refinement suggestions. [4]

Many countries take a rights-based approach to food; however, the U.S. takes a need-based approach. This means that the U. S. uses programs that directly provide food aid to passive recipients, which has not resulted in any decrease in the nation’s food insecurity rate. A rights-

based approach to food security focuses on altering environments to enable communities to actively participate in securing food. [2]

Since the start of food insecurity measurements in 1995, there have been little changes in annual food insecurity rates. The U.S. government spends over $50 billion annually on food assistance programs including SNAP (formerly known as the Food Stamp Program), WIC, and the National School Lunch Program. There have been specific efforts in the last decade to cut the food insecurity rates in half, from 11.1% to 6%, however, the rates have remained stagnant. [2] This is in part due to the numerous provisions made in 1996 to limit eligibility to welfare, making many immigrant households ineligible to receive aid. These provisions may have cut the government spending on welfare by approximately ten percent, but at the cost of raising the proportion of food insecure households by five percent. [1]

Among the foreign- born U.S. population, eligibility for WIC and SNAP differs from the native- born population. WIC is offered to all citizens who are pregnant, postpartum and breastfeeding women, infants and children up to five years old that meet financial requirements. If not a citizen, individuals who are lawful permanent residents, refugees, victims of trafficking or domestic abuse, asylees, or aliens who have completed 40 quarters of work are also eligible to receive aid from the WIC program. [21] Eligibility for the SNAP program follows the same guidelines as the WIC program, but is not limited to pregnant, postpartum and breastfeeding women, infants and children up to five years old. Rather, it is available to all citizens or non-citizens who are lawful permanent residents, refugees, victims of trafficking or domestic abuse, asylees, or aliens who have completed 40 quarters of work. [21]

2.5 Food Insecurity and Comorbidities

Food is an essential for life; without secure food access, a plethora of problems arise. At the turn of the century, a study analyzed the physical, psychological, and sociofamilial consequences of food insecurity at the individual, household, and social levels. At the individual level, physical consequences included fatigue, spikes in stress levels, and increased illness. Psychologically, fear of losing custody of children, feelings of isolation due to not being able to host friends and extended family for meals, and unhappiness surrounding mealtimes were the most prevalent consequences of food insecurity. At the household level, sociofamilial consequences included disrupted parent- child dynamics, distorted means of food acquisition, and compromised diets among food insecure households. [8]

On the social level, physical consequences manifested in the form of diminished concentration at school and work, absence at school and work due to increased illness, and a lack of health care due to focusing resources to acquire food. Psychologically, feelings of isolation, powerlessness, and even anti- government sentiment were present among many food insecure households. All of the aforementioned consequences significantly limit community capacity for social and economic development. [8]

Due to the increased stress found among those facing food insecurity, the subsequent increase in cortisol production, and the increased likelihood of consuming calorie dense foods when attainable in expectation of future food shortage, increases in visceral fat and onset of type 2 diabetes is highly associated with food insecurity. Over a five-year period (1999-2004), the prevalence of diabetes in the U.S. was found to be 2.8% higher among food insecure households. [16] Poor diabetes management is highly associated among food insecure diabetics, largely due to the difficulty in following a diabetic diet when food insecure. [11] Severity of food insecurity

also correlates with diabetes prevalence. The high cost of diabetes medication and supplies leave food insecure diabetics faced with choosing diabetes management or purchasing food. Mildly food insecure households have a 10% diabetes prevalence but severely food insecure households have a 16.1% diabetes prevalence. [7]

The American Diabetes Association recommends a low- fat and high- fiber diet mainly consisting of fruits, vegetables, and whole grains. There is evidence to show that in small neighborhood food stores, which are frequently the option in low- income, high food- insecure neighborhoods, these food choices are in short supply and are more expensive than high- fat alternatives. [9] A 2011 cross- sectional analysis demonstrated that as housing instability increased, diabetes self- efficacy, or one's belief in his or her ability to manage one's own diabetes, decreased. The decrease in diabetes self- efficacy as food insecurity increases was attributed to the inability to afford nutritious food, prepare nutritious meals, and eat in regular intervals. [18]

Iron deficiency anemia is another chronic comorbidity of food insecurity, particularly among children. A study examining data from NHANES participants from 1999-2004 found that children ages 12- 15 years old in food insecure households were 2.95 times more likely to experience iron deficiency anemia than children in food secure households. It is hypothesized that children of this age range suffer higher levels of iron deficiency anemia than children of younger age groups also facing food insecurity because food may not be reserved specifically for older family members as it is often done for young children. [5]

2.6 Demographic Trends of Food Insecurity

Latino households, especially those with young children are at risk for food insecurity. Approximately 56% of Latino households with children were food insecure whereas only 36% of

Latino households without children were food insecure. [13][20] Low maternal education is also a predictor of food insecurity among Latino households. [20] Recent, undocumented immigrants, however, are likely to be more vulnerable to food insecurity than long- term Latino residents and Latino citizens. Many Latinos are seasonal workers, so food insecurity may not be a year- long problem for Latino households, but rather a problem in the winter when there are less work options. [10] Food insecurity was found to be more than four times more prevalent in Latino households of seasonal farmworkers than in the general U.S. population. [13] Additionally, when looking at households of seasonal farm workers on the border (as opposed to throughout the entire continental U.S.), food insecurity was reported in 82% of households and hunger was reported in nearly half of households. [20] Among Latino households that are subject to food insecurity, young children are likely to have a lower intake of low- fat milk and vegetables, and a higher intake in tortillas and beans. It was found that despite varying levels of food insecurity, the proportion of households with traditional Mexican foods did not vary (tortillas, beans, rice), but the proportion of fruits, vegetables, whole- wheat bread and eggs did vary. [10]

African Americans are also subject to a higher risk of food insecurity. A 2002 study found that in primarily White neighborhoods there was a higher number of supermarkets compared to African American neighborhoods. There was also a positive correlation between number of supermarkets in one's neighborhood to intake of fruits and vegetables. As a result of increased risk of food insecurity, African Americans have between 2 to 4 times the diabetes complications as Whites. East Harlem is a neighborhood of New York City that is 40% African American and 50% Latino. The Upper East Side neighborhood of New York City is 84% White and only 2% African American. It was found that while East Harlem has over twice as many food stores per capita as the Upper East Side, less that one in five stores in East Harlem carried

recommended foods for diabetics (high- fiber bread, low- fat milk, diet soda) whereas nearly 60% of all food stores in the Upper East Side carried said recommended foods. [9] The disparities in African American and Latino neighborhoods of the U.S. are conducive to the disproportionately large number of food- insecure households among minorities.

Single mother households, especially those with non- resident fathers are at high risk for food insecurity. There are over 6 million children in the U.S. with non- resident fathers, who are food insecure. In addition to aforementioned risk factors that minorities face, food insecurity is largely attributable low household income. Receiving child support was only statistically significantly associated with a lower likelihood that the adult of the household would have to skip meals or reduce meal size. Child support payments may reduce the severity of food insecurity; however, it is not enough to remove the burden altogether. Additionally, only when visits with the non- resident father exceeded once per week was there a negative correlation to aspects of food insecurity. Less frequent visits with the father are important to the child's overall health regardless of a lack of statistically significant correlation to a decrease in food insecurity. [6] Immigrant and first- generation citizen families are most likely to have a non- U.S. resident father, meaning immigrants or new U.S. citizens also suffer from a higher risk of food insecurity than established, long time U.S. residents.

Refugees are among those disproportionately affected by food insecurity in the U.S. When looking at a group of Cambodian refugees in Massachusetts, the food insecurity rate was more than 50% greater than for the national average and over twice the crude food insecurity rate for the state of Massachusetts. It is important to note that the area of Massachusetts in which the refugees were placed had many established Cambodian markets, so lack of access is not probable cause of food insecurity in this community. In all refugee communities, high rates of depression

and stress are common and linked to food insecurity. Additionally, widowed women experience higher rates of food insecurity even when income and depression are controlled for. There are disproportionately high numbers of widows in refugee communities as many refugees are fleeing violence which claims the lives of many adult men. Depression, seen in a large proportion of widows, and poverty are likely the main factors that subject not only the Cambodian refugees mentioned but all refugee communities to higher prevalence of food insecurity. [12]

3 Study Objectives

This thesis will primarily explore the differences in risks of food insecurity among foreign- born U.S. residents compared to native- born U.S. residents. It has been established in the literature that minorities are disproportionately affected by adverse health risks and outcomes including food insecurity. The covariates of race / ethnicity, sex, education level, poverty income ratio, presence of children in the household, age, and government nutrition- based assistance received will all be controlled for in the analysis. Examination of these covariates as they are associated with food security will be included in the analysis to shape a more holistic understanding of food security in the U.S.

It is hypothesized that being a foreign- born U.S. resident is a risk factor of food insecurity. Establishing which households are at risk of food insecurity will aid in development of policies and community programs designed to combat food insecurity among at risk migrant and established populations.

A secondary analysis addressing time since migrating to the U.S. as a risk factor of food insecurity will also be conducted in this thesis. The covariates of race / ethnicity, sex, education level, poverty income ratio, presence of children in the household, age, and government nutrition- based assistance received will all be also controlled for in the secondary analysis.

It is hypothesized that a shorter time since migrating to the U.S. will correlate to a higher risk of food insecurity. Establishing trends of food insecurity as they correlate to time since migrating to the U.S. will enable nutrition- based aid programs to help migrants determined to be at the greatest risk of food insecurity accordingly.

4 Data

4.1 Population

The National Health and Nutrition Examination Survey (NHANES) is a study designed to assess the health and nutrition of the noninstitutionalized civilian population of the United States [1]. Participants are located across the United States, in 30 counties per two- year cross section. The sample is selected to represent the noninstitutionalized civilian U.S. population (all ages and ethnicities) using a complex, multistage probability sampling design. This complex design includes the use of primary sampling units and segmentation within these sampling units. In order to produce representative statistics from collected data, NHANES oversamples individuals over the age of 60 years old, as well as individuals of Asian, Hispanic, and African descent, as deemed appropriate per cross section. The NHANES survey includes several questionnaires regarding food security, health status, health conditions, behaviors, income, healthcare access, physical activity, immunizations and more.

The primary sampling units in the NHANES survey are the selected counties, or a group of contiguous counties if the counties are small. Within each primary sampling unit, clusters of households are selected to participate in the survey as deemed appropriate to represent the desired population. Each year, when counties across the U.S. are selected for participation, local health and government officials are notified of the upcoming survey. Households in the study area receive a letter from the National Center for Health Statistics (NCHS) Director to introduce the survey and the opportunity to participate. Households that agree to participate partake in two components of the survey: an administered interview within their household and a physical examination including laboratory testing from a mobile examination clinic. Participants receive compensation and a report of their medical findings. All information collected in the survey is

kept confidential. Participants' privacy is protected by public laws. Data collected from 2005 – 2016 will be pooled in this thesis to be representative of as much of the U.S. population as possible and to evaluate trends over time. The data from 2016 is the most recent food security data available.

4.2 Data Collection

The NHANES data utilized in this thesis consist entirely of demographic data and food security questionnaire data. The food security questionnaire was conducted via interview in participants' homes. The health interview staff consisted of healthcare officials including physicians, dentists, health technicians, and additional dietary and health staff. Many of the health interviewers were bilingual and spoke both English and Spanish. A proxy provided information for survey participants who were under 16 and for participants who could not answer the questions themselves. Participants over 16 years old and emancipated minors were interviewed directly.

A computer system using desktop computers and wide- area networking collected and processed all NHANES data. This eliminated the need for paper forms and manual coding operations. This system allowed interviewers to use tablet computers with electronic pens. Touch-sensitive computer screens let respondents enter their own responses to certain sensitive questions in complete privacy.

4.3 Demographic Data

Demographic data was collected for all participants. As it pertains to this thesis, country of birth, education level, length of time in the U.S., age, race/ ethnicity, sex,

children in household, family poverty income ratio, and whether government nutrition-based assistance has been received in the last year will be analyzed.

4.31 Independent Variables

The country of birth variable was presented in question form: “In what country were you born?” The answer choices included “Born in 50 US states or Washington, DC,” “Other,” “Refused,” and “Don’t Know.” If none of the above was chosen, the answer choice was coded as missing. For the purposes of this thesis, response will be recoded as “Native Born” if the participant recorded “Born in 50 US states or Washington, DC,” and “Foreign Born” if the participant recorded “Other.” If the participant did not select either of the aforementioned choices the data will be coded as missing and will not be included in statistical analysis as this is the exposure in question.

The length of time in U.S. variable was presented as a prompt: “Length of time the participant has been in the US.” Answer choices included “less than 1 year”, five- year increments from one to twenty years, ten- year increments from twenty to fifty years, “more than 50 years”, “refused”, “don’t know”, and missing. For the purposes of this thesis, data will be recategorized as “less than one year”, “1- 4.9 years”, “5-10 years”, and “more than 10 years” for all foreign- born participants that provided an answer. Native- born participants’ value will be coded as “Lifetime.”

4.32 Covariates

The education level variable was measured with one question that read: “What is the highest grade or level of school {you have/SP has} completed or the highest degree {you have/s/he has} received?” Answer choices included “Less than 9th grade”, “9-11th grade

(Includes 12th grade with no diploma)", "High school graduate/GED or equivalent", "Some college or AA degree", "College graduate or above", "Refused", "Don't Know", and if none of the aforementioned choices were selected, the data was coded as a missing value. For the purposes of this thesis, answers including "Less than 9th grade", "9-11th grade (Includes 12th grade with no diploma)" will be recoded as "less than high school graduate", "High school graduate/GED or Equivalent" and "Some college or AA degree" will be recoded as "High School Graduate/ GED or Equivalent", and "College graduate or above" will be recorded as is. All other responses for "Refused", "Don't Know", or missing values will be recoded as missing values.

For the purposes of this thesis, the Food Security Questionnaire child food security variable will be used to indicate if there are children in the household for data collected between 2005 – 2010 as the number of children five years old or younger and the number of children ages 6 – 17 years old variables were not included in the survey until 2011. This will be adequate for this thesis as the presence of children in the household is only relevant as it pertains to food insecurity in this analysis. If the value for the child food security variable is zero or missing, it will be coded as no children in the household for observations collected between 2005 – 2010. If a value other than zero or missing is coded for the child food security variable the observation will be coded as children in the household. For observations collected between 2011 – 2016, if the value for both the number of children five years old or younger and the number of children ages 6 – 17 years old variables is coded as 0 or missing, it will be coded as no children in the household. If any other value is provided for said variables, it will be recoded as children in the household.

The family poverty income ratio variable (PIR) was calculated by dividing family/ household income by the poverty guidelines specific to the survey year. The Department of Health and Human Services (HHS) poverty guidelines were used as the poverty measure to calculate this ratio. If family income was reported as a range, the midpoint of the range was used to compute the ratio. The values were not computed if the income data were missing. The data was recorded as a continuous range of values from 0-5. Below 1 indicates the household falls in the federal poverty range while 1 or greater indicates the household income is at or above the poverty threshold for that specific household size. For the purposes of this thesis, this variable will be categorized as less than 1, 1-1.3, 1.31-2, greater than 2. A PIR of 1.3 is the cutoff for eligibility of a household to receive government food assistance such as Supplemental Nutrition Assistance Program (SNAP). A PIR of 2 indicates the household income is 200% of the federal poverty level.

The age variable was recorded for the household reference person (in years). This was recorded as a continuous variable and was recorded as is.

The sex variable recorded the sex for the household reference person. Male (coded as 1) and Female (coded as 2) were the two answer choices, and missing values were coded as ".". The variable was recorded as is for the purposes of this thesis.

The race / ethnicity variable recorded the race and ethnicity of the household reference person. The answer choices were "Mexican American", "Other Hispanic", "Non-Hispanic White", "Non- Hispanic Black", "Other Race- Including Multi-Racial", and "Missing." For the purposes of this thesis, the coding of this variable will remain as is.

4.4 Food Questionnaire Data

4.41 Dependent Variable

As part of the household interview, the participant responded to the U.S. Food Security Survey Module questions. There are 18 questions for households with children and 10 questions for households without children (Appendix 3). Questions refer to the entire household, not just the NHANES interview participant. A categorical household-level variable was created to characterize the overall food security status for the entire household. For the purposes of this thesis, household food security will be analyzed with the originally coded 1-4 scale designated by NHANES (Appendix 3). Household food security will be the only food security variable explicitly included in the statistical analysis of this thesis. This will capture a wholistic view of the overall phenomena of food insecurity experienced by the participants' households as it captures the severity of the overall experience of food insecurity rather than the specific characteristics of food insecurity.

4.42 Covariates

Whether each survey participant has received government nutrition- based assistance in the last twelve months is included as a covariate in this analysis. The food security questionnaire included two variables which were both accounted for. The Food Stamp / SNAP variable was collected as a question: "In the last 12 months, did {you/you or any member of your household} receive Food Stamp/ SNAP benefits?". The answer choices were "Yes," "No," "Refused," "Don't Know," and "Missing." For the purposes of this thesis, the "Yes" and "No" responses will be coded as is, and all other responses or missing values will be coded as missing. The WIC variable was collected as a question: "In the last 12 months, did {you/you or any member of your household} receive benefits from the WIC program, that is, the Women, Infants and Children

program?". The answer choices were "Yes," "No," "Refused," "Don't Know," and "Missing." For the purposes of this thesis, the "Yes" and "No" responses will be coded as is, and all other responses or missing values will be coded as missing. A new variable was created for the purposes of the analysis. A variable to address if any form of government nutrition- based aid was received by the household in the last twelve months was coded from the Food Stamp/ SNAP and WIC variables. If the respondent answered "Yes" for either the Food Stamp/ SNAP or WIC variables (or for both variables) they were coded as "Yes" for receiving government nutrition-based aid in the last twelve months. If the respondent answered "No" for both the Food Stamp/ SNAP or WIC variables, they were coded as "No" for receiving government nutrition- based aid in the last twelve months. If the respondent was coded as missing for both the Food Stamp/ SNAP or WIC variables, they were coded as missing data for receiving government nutrition-based aid in the last twelve months.

5 METHODOLOGY

5.1 Ethics

All data used in this thesis were collected in the National Health and Nutrition Examination Survey (NHANES). The National Center for Health and Statistics (NCHS) Research Ethics Review Board (ERB) reviewed and approved the survey and all accompanying methods prior to data collection, following protocols #2005-06 and #2011-17. All data is open source and deidentified. Emory University IRB approval was not required for accessing these data.

5.2 Data Preparation

A serial cross-sectional analysis of U.S. residents from the National Health and Nutrition Examination Survey (NHANES) 2005-2016 (n=60,936), a nationally representative population-based survey, was conducted. The data from six consecutive two- year cross sections were combined to include all data collected from 2005 through 2016.

The proportional odds assumption was tested for the outcome of household food security and was not met. As a result, the models were tested using multinomial logistic regression, rather than ordinal regression. All statistical analyses were carried out using SAS software (version 9.4).

The variables SDMVPSU and SDMVSTRA created as part of the NHANES survey created clusters and stratum respectively for each observation. Each observation was also assigned a weight (by the variable MEC2YR) to represent the population according to the characteristics presented by the respondent. Because the MEC2YR variable accounts for the weight of each observation for the two- year cross section, and six cross sections are included in the analysis, a new weight variable was coded for the purposes of this thesis. The variable

MEC12YR is equivalent to 1/6 of the MEC2YR value. Complex survey design was accounted for by use of survey procedures and application of survey weights, clusters, and stratum in analysis.

5.21 Missing Values

Complete case analysis was used to ensure the sample was consistent among analyses. An indicator variable was created to signify a complete case, and these were the only observations used in all analyses. There were 10,512 (17.25%) observations excluded in the analyses due to a missing value for one or more of the variables in the model. Because none of the covariates individually consisted of a significant portion of the missing values, all were included in the analysis. In total, 50,424 survey responses were included in the analysis, representing a U.S. population of 244,378,616.

Among the 10,512 observations excluded due to missing values, 849 (1.39%) were due to missing data on household food security, 30 (0.05%) were due to missing data on place of birth, and 544 (0.89%) were due to missing data on time since migrating to the U.S. Among the covariates controlled for, 2,152 (3.53%) observations were excluded due to missing data on education level, 5,101 (8.37%) observations were excluded due to missing data on poverty income ratio, and 8,404 (13.79%) observations were excluded due to missing data on government- nutrition based assistance received in the last twelve months.

This analysis pertains primarily to the independent variable of birthplace. Only 0.05% of observations were missing data on birthplace. Additionally, only 1.22% of native- born individuals and 2.12% of foreign- born individuals were missing data on the outcome of household food security. Because of the low percentage of missing values for the exposure and outcome, it can be reasonably determined how the complete case analysis biases the results. Of

the 544 missing observations of time since migrating to the U.S., 100% of these were among foreign- born individuals, consisting of 4.47% of all foreign- born individuals in the study. 3.38% of native- born individuals and 4.13% of foreign- born individuals were missing data on education level. 7.27% of native- born individuals and 13.00% of foreign- born individuals were missing data on poverty income ratio.13.44% of native- born individuals and 15.25% of foreign- born individuals were missing data on government- nutrition based assistance received in the last twelve months.

Because less than five percent of foreign- born and native- born individuals had missing data for time in the U.S. and education level, this is not enough to bias the results. There is a larger percentage of missing values for aid received in the last twelve months, however, the percentage of native- born and foreign- born individuals missing data is comparable. This results in minimal effects on the results of the analysis. Nearly twice as many native- born individuals were missing data on the poverty income ratio as foreign- born individuals. The difference between native- born and foreign- born individuals missing values may introduce bias to the results, however, the overall percentage of missing values for the poverty income ratio is low, thus minimizing said bias. This is further explored in Tables 3b and 3c.

5.3 Descriptive Methods

The descriptive breakdown of the population represented from the data was calculated using survey procedures. The weighted percentages of the represented population demographics were calculated using frequency procedures in SAS. Cross tabulations of each covariate with birthplace (foreign and native born) were run to calculate weighted percentages for each subgroup as well as the total survey represented population. The standard errors for each of the weighted percentages were also reported.

5.4 Analytical Methods

The outcome of household level food insecurity was compared among foreign born and native- born U.S. residents. The covariates of household poverty- income ratio (PIR), education level, sex, age, children in the household, race/ ethnicity, and government nutrition-based aid received (Aid) were included as covariates for household level food security.

$$\ln\left[\frac{P(FSDHH=g|X)}{P(FSDHH=1\,|X)}\right] = \alpha_g + \beta_{g1} * Place\ of\ Birth + \gamma_{g1} * Race\ |\ Ethnicity + \gamma_{g2} * Sex + \gamma_{g3} * Education\ Level + \gamma_{g4} * Age + \gamma_{g5} * PIR + \gamma_{g6} * Children\ in\ the\ Household + \gamma_{g7} * Aid$$

$$g= 2,3,4$$

$$X = \ place\ of\ birth, race/ethnicity, sex, education\ level, age, PIR, children\ in\ the\ household, Aid$$

The reference category for the outcome of household level food security was set at 1 or "Full Food Security." The reference categories for each of the categorical covariates are as follows: a nativity of "Native Born", an education level of "College Graduate or Above", a PIR of greater than two, no children in the household, a race/ ethnicity of "non- Hispanic White", male sex, and aid not received in the last 12 months.

$$\ln\left[\frac{P(FSDHH = g|X)}{P(FSDHH = 1\,|X)}\right] = \alpha_g + \beta_{g1} * Time\ in\ the\ U.S. + \gamma_{g1} * Race|\ Ethnicity + \gamma_{g2} * Sex + \gamma_{g3} * Education\ Level + \gamma_{g4} * Age + \gamma_{g5} * PIR + \gamma_{g6} * Children\ in\ the\ Household + \gamma_{g7} * Aid$$

$$g= 2,3,4$$

$$X = \ Time\ in\ the\ U.S., race/ethnicity, sex, education\ level, age, PIR, children\ in\ the\ household, Aid$$

For the secondary analysis, assessing if time since migrating to the U.S. has an effect on food insecurity, the same covariates were included as in the primary analysis. The level "Lifetime" that was assigned to native born participants was used as the reference time in the U.S. Place of birth was not included in the model due to collinearity with the time in the U.S.

variable. The reference categories for the outcome of household level food security and the remaining covariates remained consistent with the primary analysis.

5.5 Robustness Check

Whether including income or the poverty income ratio in the model unduly affected our results was explored in preparing the models for analysis. Both income and poverty income ratio were run in bivariate analyses with the outcome of household food security. While there were trends between household food security and the tested variables, neither income nor poverty income ratio were perfect predictors for household food security. That is, for all levels of household food security, there were varying income levels as well as varying poverty income ratios.

Model variation tests were conducted to assess how results changed when income was removed from the model, and when different operationalization for income was used (Table 1). It was found that the greatest variation in results between the three model variants was between Model 2 and Model 3 with a 14.7% difference in odds when looking at very low food security and an 11.2% difference in odds when looking low food security (for foreign- born individuals compared to native- born individuals). All other variations were less than 6.5% (Table 1).

Table 1: Model Variation Test of Household Level Income Related Variables*

Model Name	Variable Used in the Model	Marginal Food Security[§] AOR (95% CI)	Low Food Security[§] AOR (95% CI)	Very Low Food Security[§] AOR (95% CI)
1	**Income**	1.141 (0.992-1.313)	1.137 (0.996-1.297)	0.880 (0.717-1.079)
2	**Poverty Income Ratio**	1.127 (0.988-1.286)	1.103 (0.959-1.268)	0.828(0.681-1.008)
3	**No Income Variable**	1.192 (1.049-1.354)	1.226 (1.072-1.401)	0.950 (0.782-1.153)

* NHANES 2005- 2016: n = 50,424, N = 244,378,616

[§] Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

Controlling for poverty income ratio does not unduly alter the outcome compared to the outcome when controlling for income. The explicit household size per respondent is not provided in demographic data. It is, however, used to calculate the poverty income ratio. It is supported to use the poverty income ratio because the poverty income ratio accounts for income and household size, which is more important to consider than income alone when looking at household level food security.

6 RESULTS

6.1 Demographic Characteristics

The characteristics of the NHANES participants are presented in Table 2. From 2005 – 2016, the NHANES survey participants consisted of a mostly fully food secure population (72.1%). Among the foreign-born population, 22.64% faced either low or very low food security, whereas only 16.73% of the native- born population faced low or very low food security. The majority of the overall population, both foreign- born and native- born, was non-Hispanic White (61.51%), had children in their household (64.59%), had a poverty income ratio of greater than twice the poverty line (59.59%), were high school graduates or the equivalent (52.99%), and were native born (85.85%). Among the foreign- born population, the majority had been in the U.S. for more than ten years (65.85%), were Mexican American (29.76%) or other Hispanic (20.54%), had children in the household (67.24%), had a poverty income ratio greater than twice the poverty line (46.64%), were high school graduates (38.86%), and were fully food secure (64.00%). The mean age among native- born individuals was 31.61 years, whereas the mean age among foreign- born individuals was 39.17 years. This differs from expected values as the native- born NHANES participants had a right skewed aged distribution whereas the foreign-born NHANES participants had a normal age distribution. When looking at participants 18 years or older, the mean age of native- born participants was 47.88 years and the mean age of foreign-born participants was 46.93 years.

Table 2: Demographics of U.S Residents from 2005 - 2016 *

	Foreign-Born Weighted Percent (SE)	Native- Born Weighted Percent (SE)	Total Weighted Percent (SE)	P – Value**
Household Level Food Security				
Full Food Security§	64.00 (1.34)	73.38 (0.77)	72.06 (0.78)	
Marginal Food Security§	13.35 (0.68)	9.90 (0.35)	10.39 (0.34)	
Low Food Security§	16.34 (0.84)	10.61 (0.40)	11.42 (0.40)	<0.0001
Very Low Food Security§	6.30 (0.54)	6.12 (0.27)	6.14 (0.26)	
Education Level				
Less Than High School Graduate	33.35 (1.41)	16.48 (0.69)	18.86 (0.70)	
High School Graduate / GED or Equivalent	38.86 (1.18)	55.31 (0.70)	52.99 (0.68)	< 0.0001
College Graduate or Above	27.79 (1.50)	28.22 (1.08)	28.16 (1.04)	
Poverty Income Ratio* **				
< 1	27.39 (1.21)	17.31 (0.68)	18.68 (0.68)	
1 – 1.3	9.90 (0.59)	7.80 (0.28)	8.09 (0.27)	< 0.0001
1.31 – 2	16.07 (0.65)	13.25 (0.45)	13.64 (0.41)	
> 2	46.64 (1.52)	61.64 (1.07)	59.59 (1.05)	
Age (Years)				
Mean (SE)	39.17 (0.33)	31.61 (0.26)	37.03 (0.25)	<0.0001
Children in Household				
Yes	67.24 (1.27)	64.16 (0.71)	64.59 (0.66)	0.0269
No	32.76 (1.27)	35.84 (0.71)	35.41 (0.66)	
Race / Ethnicity				
Mexican American	29.76 (2.13)	8.02 (0.72)	11.10 (0.90)	
Other Hispanic	20.54 (1.69)	3.74 (0.32)	6.12 (0.52)	
Non- Hispanic White	16.27 (1.00)	68.97 (1.53)	61.51 (1.61)	<0.0001
Non- Hispanic Black	7.40 (0.81)	14.23 (1.02)	13.26 (0.88)	
Other / Multiracial	26.03 (1.73)	5.05 (0.28)	8.02 (0.44)	
Sex				
Male	48.10 (0.50)	47.02 (0.27)	47.17 (0.23)	0.0753
Female	51.90 (0.50)	52.98 (0.27)	52.83 (0.23)	
Time in the United States				
Less than 1 year	3.49 (0.33)	0.00 (0.00)	0.49 (0.05)	
1 – 4.9 years	13.21 (0.76)	0.00 (0.00)	1.87 (0.15)	
5 – 10 years	17.45 (0.65)	0.00 (0.00)	2.47 (0.17)	-
More than 10 years	65.85 (1.09)	0.00 (0.00)	9.32 (0.42)	
Lifetime (Native Born)	0.00 (0.00)	100.00 (0.00)	86.43 (0.65)	

* NHANES 2005- 2016: n = 50,424, N = 244,378,616

**P- Value pertains to differences between Foreign- Born Values and Native- Born Values

***Poverty Income Ratio is the total family income divided by the poverty threshold (Poverty Income ratio of 1.0 means the family income is equal to the poverty threshold)

§ Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

Table 3a: Bivariate Analysis of Food Insecurity Among U.S. Residents from 2005-2016*

	Full Food Security[§] Adjusted Odds Ratio (95% CI)	Marginal Food Security[§] Adjusted Odds Ratio (95% CI)	Low Food Security[§] Adjusted Odds Ratio (95% CI)	Very Low Food Security[§] Adjusted Odds Ratio (95% CI)
Nativity				
Native Born	Ref	Ref	Ref	Ref
Foreign Born	Ref	1.547 (1.361-1.759)	1.767 (1.550-2.014)	1.181 (0.975-1.431)

* NHANES 2005- 2016: n = 50,424, N = 244,378,616

[§] Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

Table 3b: Odds of Food Insecurity Among U.S. Residents from 2005-2016*

Characteristics	Full Food Security[§] Adjusted Odds Ratio (95% CI)	Marginal Food Security[§] Adjusted Odds Ratio (95% CI)	Low Food Security[§] Adjusted Odds Ratio (95% CI)	Very Low Food Security[§] Adjusted Odds Ratio (95% CI)
Nativity				
Native Born	Ref	Ref	Ref	Ref
Foreign Born	Ref	1.136 (1.000-1.290)	1.145 (1.007-1.303)	0.862 (0.710-1.045)
Education Level				
Less Than High School Graduate	Ref	4.365 (3.555-5.358)	11.318 (8.738-14.660)	10.122 (7.272-14.091)
High School Graduate / GED / Equivalent	Ref	3.197 (2.624-3.894)	5.537 (4.304-7.124)	4.564 (3.353-6.212)
College Graduate or Above	Ref	Ref	Ref	Ref
Age (Years)				
Mean (SE)	Ref	0.993 (0.991-0.996)	0.992(0.990-0.995)	0.991 (0.989-0.994)
Children in Household				
Yes	Ref	1.209 (1.017 -1.438)	1.558 (1.306-1.859)	0.801 (0.666-0.964)
No	Ref	Ref	Ref	Ref
Race / Ethnicity				
Mexican American	Ref	2.305 (1.928-2.755)	2.570 (2.110 -3.130)	1.817 (1.430 -2.308)
Other Hispanic	Ref	2.361 (1.933-2.883)	2.359 (1.943-2.864)	2.124 (1.612-2.799)
Non- Hispanic White	Ref	Ref	Ref	Ref
Non- Hispanic Black	Ref	2.358 (2.035-2.733)	2.466 (2.122 -2.865)	2.360 (1.953-2.851)
Other / Multiracial	Ref	1.383 (1.122-1.705)	1.493 (1.185-1.882)	1.466 (1.131 -1.899)
Sex				
Male	Ref	Ref	Ref	Ref
Female	Ref	1.091 (1.036-1.149)	1.048 (0.979-1.121)	1.066 (0.981-1.159)

* NHANES 2005-2016: n = 50,424, N = 244,378,616

[§] Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

Table 3c: Odds of Food Insecurity Among U.S. Residents from 2005-2016*

Characteristics	Full Food Security§ Adjusted Odds Ratio (95% CI)	Marginal Food Security§ Adjusted Odds Ratio (95% CI)	Low Food Security§ Adjusted Odds Ratio (95% CI)	Very Low Food Security§ Adjusted Odds Ratio (95% CI)
Nativity				
Native Born	Ref	Ref	Ref	Ref
Foreign Born	Ref	1.127 (0.988-1.286)	1.103 (0.959-1.268)	0.828 (0.681-1.008)
Education Level				
Less Than High School Graduate	Ref	2.133 (1.714-2.654)	3.963 (2.925-5.367)	2.866 (2.052-4.003)
High School Graduate / GED or Equivalent	Ref	2.219 (1.829-2.693)	3.115 (2.354-4.124)	2.262 (1.656-3.092)
College Graduate or Above	Ref	Ref	Ref	Ref
Poverty Income Ratio**				
< 1	Ref	2.880 (2.431-3.410)	5.088 (4.264-6.070)	8.304 (6.090-11.322)
1 – 1.3	Ref	3.032 (2.467-3.728)	4.091 (3.334 -5.020)	7.882 (5.809-10.695)
1.31 – 2	Ref	2.785 (2.259-3.434)	3.674 (3.041-4.437)	4.885 (3.759-6.349)
> 2	Ref	Ref	Ref	Ref
Age (Years)				
Mean (SE)	Ref	0.996 (0.994-0.999)	0.997(0.995-1.000)	0.996 (0.993-1.000)
Children in Household				
Yes	Ref	1.053 (0.873-1.270)	1.276 (1.058-1.537)	0.587 (0.473-0.727)
No	Ref	Ref	Ref	Ref
Race / Ethnicity				
Mexican American	Ref	1.857 (1.541-2.238)	1.856 (1.524-2.260)	1.268 (0.965-1.667)
Other Hispanic	Ref	1.908 (1.518-2.398)	1.724 (1.394-2.133)	1.515 (1.125-2.040)
Non- Hispanic White	Ref	Ref	Ref	Ref
Non- Hispanic Black	Ref	1.768 (1.508-2.074)	1.613 (1.363-1.909)	1.419 (1.153-1.746)
Other / Multiracial	Ref	1.262 (1.013-1.571)	1.319 (1.063-1.638)	1.286 (0.992 -1.270)
Sex				
Male	Ref	Ref	Ref	Ref
Female	Ref	1.032 (0.982-1.085)	0.978 (0.908-1.055)	0.965 (0.878-1.061)
Government Nutrition-Based Assistance				
Received in the Last 12 Months	Ref	2.017 (1.704-2.386)	2.346 (2.033-2.706)	2.882 (2.310-3.594)
Not Received in the Last 12 Months	Ref	Ref	Ref	Ref

* NHANES 2005-2016: n = 50,424, N = 244,378,616

**Poverty Income Ratio is the total family income divided by the poverty threshold (Poverty Income ratio of 1.0 means the family income is equal to the poverty threshold)

§ Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

6.2 Association Between Place of Birth and Food Security

In a simple bivariate analysis, it was found that there was a significant association between nativity and household food security (Table 3a). The odds of experiencing marginal or low food security for the household of a foreign- born U.S. resident was 1.55 and 1.77, respectively, times the odds of such experiences for the household of a native- born U.S.

resident. The odds of experiencing very low food security were not significantly different among foreign- born and native- born U.S. resident households.

In a minimally controlled model (Table 3b) the variables of poverty income ratio and government nutrition- based assistance received were not controlled for. All other covariates in the full model were controlled for. This model resulted in a significant association of nativity and household food security for marginal and low household food security, but not for very low food security. The odds of a foreign- born individual's household experiencing marginal food security is 1.14 times the odds of a native- born individual's household experiencing marginal food security. The odds of a foreign- born individual's household experiencing low food security is 1.15 times the odds of a native- born individual's household experiencing marginal food security. Controlling for age, sex, education level, race/ ethnicity, and children in the household yielded results that were closer to the null hypothesis than the bivariate analysis results but were still significantly different for marginal and low food security. The odds of experiencing very low food security remained not significantly different between households of native- born and foreign- born individuals.

When analyzing place of birth as it correlates to food security in a fully controlled model (Table 3c), the odds of a foreign- born individual's household having marginal food security compared to full food security was 1.13 times the same odds for a native- born individual's household and was not statistically significant (Table 3c). The odds of experiencing low (1.10) and very low (0.83) food security among a foreign- born individual's household was also not statistically significantly different from that of a native- born individual's household (Table 3c). This model differs from the minimally controlled model in that it controls for the poverty income ratio of the household as well as if government nutrition- based assistance was received in the

last year (in addition to all of the covariates controlled for in the minimally controlled model). Controlling for additional covariates pertaining to the income of the household yielded null results for all levels of household food insecurity.

6.3 Covariates Correlating to Food Insecurity

The odds of experiencing low or very low food security (compared to full food security) for households of individuals that were high school graduates (or equivalent) but not college graduates were 3.12 and 2.26, respectively, the odds of experiencing the same levels of food insecurity for households of college graduates. The odds of experiencing low food security for households of individuals that did not graduate high school were 3.96 the odds of experiencing low food security among households of college graduates.

As expected, households with a poverty income ratio below 1.0 experienced significantly higher odds of food insecurity of all levels compared to households with a poverty income ratio greater than 2.0. The same is true for households with a poverty income ratio between 1.0 and 1.3 (above poverty level but still eligible for government nutrition assistance programs). For households with a poverty income ratio greater than 1.3 but less than 2.0 (not eligible for government nutrition assistance programs), the odds of experiencing very low food security were 4.89 times the odds of households with a poverty income ratio greater than 2.0. Their odds of experiencing marginal and low food security were 2.79 and 3.67, respectively, times the odds of experiencing the same levels of food insecurity for households with a poverty income ratio greater than 2.0.

Households with children were found to have 1.28 times the odds of experiencing low food security compared to households with no children. Conversely, households with children were found to have only 0.59 times the odds of experiencing very low food security compared to

households with no children, showing the presence of children to be associated with lower odds of experiencing very low food security.

The odds of experiencing food insecurity at all levels was most different among households of Hispanic individuals who were not Mexican American compared to households of non- Hispanic White individuals. The odds of experiencing marginal, low, and very low food security (compared to full food security) for households of Hispanic individuals (who were not Mexican Americans) were 1.91, 1.72, and 1.52, respectively, times the odds of said afflictions for households of non- Hispanic White individuals. Similarly, for households of Mexican American individuals, the odds of experiencing marginal, low, and very low food security (compared to full food security) were 1.86, 1.86, and 1.27, respectively, times the odds of that for households of non- Hispanic White individuals.

Strikingly, households that have received government nutrition- based assistance in the last twelve months are over twice as likely to experience food insecurity (at any level) as those who have not received such aid. Most notably, households that have received aid in the last year are still nearly three times as likely to experience very low food security (AOR 2.88: 2.31-3.59) as those who have not received aid in the last year.

Table 4: Food Insecurity Based on Time in the U.S. Among U.S. Residents*

	Full Food Security[§] Adjusted Odds Ratio (95% CI)	Marginal Food Security[§] Adjusted Odds Ratio (95% CI)	Low Food Security[§] Adjusted Odds Ratio (95% CI)	Very Low Food Security[§] Adjusted Odds Ratio (95% CI)
Time in the U.S.				
< 1 Year	Ref	1.111 (0.651-1.897)	1.055 (0.595-1.870)	0.813 (0.384-1.723)
1 – 4.9 Years	Ref	1.367 (0.986-1.896)	1.171 (0.894-1.533)	0.976 (0.552-1.728)
5 – 10 Years	Ref	1.186 (0.916-1.534)	1.167 (0.907-1.502)	0.935 (0.615-1.422)
>10 years	Ref	1.061 (0.917-1.227)	1.075 (0.918-1.258)	0.765 (0.627-0.933)
Lifetime (Native Born)	Ref	Ref	Ref	Ref
Education Level				
Less Than High School Graduate	Ref	2.173 (1.717-2.658)	3.965 (2.927-5.371)	2.871 (2.056-4.009)
High School Graduate / GED or Equivalent	Ref	2.227 (1.834-2.703)	3.119 (2.356-4.128)	2.270 (1.661-3.103)
College Graduate or Above	Ref	Ref	Ref	Ref
Poverty Income Ratio**				
< 1	Ref	2.866 (2.416-3.400)	5.081 (4.255-6.066)	8.275 (6.066-11.289)
1 – 1.3	Ref	3.022 (2.457-3.719)	4.086 (3.331-5.012)	7.864 (5.792-10.675)
1.31 – 2	Ref	2.780 (2.253-3.429)	3.671 (3.038-4.435)	4.877 (3.749 -6.345)
> 2	Ref	Ref	Ref	Ref
Age (Years)				
Mean (SE)	Ref	0.997 (0.994-0.999)	0.997 (0.995-1.000)	0.997 (0.993-1.000)
Children in Household				
Yes	Ref	1.057 (0.877 -1.275)	1.277 (1.059-1.539)	0.588 (0.474-0.730)
No	Ref	Ref	Ref	Ref
Race / Ethnicity				
Mexican American	Ref	1.866 (1.548-2.248)	1.857 (1.523-2.265)	1.274 (0.969 -1.674)
Other Hispanic	Ref	1.916 (1.523-2.411)	1.727 (1.394-2.140)	1.522 (1.130-2.050)
Non- Hispanic White	Ref	Ref	Ref	Ref
Non- Hispanic Black	Ref	1.769 (1.508-2.075)	1.613 (1.363-1.909)	1.420 (1.154-1.746)
Other / Multiracial	Ref	1.259 (1.011-1.568)	1.319 (1.062-1.638)	1.283 (0.990 -1.664)
Sex				
Male	Ref	Ref	Ref	Ref
Female	Ref	1.032 (0.982-1.085)	0.978 (0.908-1.054)	0.965 (0.878-1.061)
Government Nutrition-Based Assistance				
Received in the Last 12 Months	Ref	2.021 (1.707-2.392)	2.346 (2.034-2.707)	2.886 (2.316-3.596)
Not Received in the Last 12 Months	Ref	Ref	Ref	Ref

* NHANES 2005-2016: n = 50,424, N = 244,378,616

**Poverty Income Ratio is the total family income divided by the poverty threshold (Poverty Income ratio of 1.0 means the family income is equal to the poverty threshold)

[§] Full food security: no affirmative response for items in Appendix 3; Marginal food security: 1-2 affirmative responses; Low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children; Very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children

6.4 Time in the U.S. as It Correlates to Food Security

The time since a foreign- born individual has migrated to the U.S. did not correlate to statistically significantly different odds of experiencing marginal or low household food security compared to native- born individuals, with one exception. Households of foreign- born individuals who have been in the U.S. for more than 10 years were found to have only 0.77 times

the odds of experiencing very low food security compared to households of native- born individuals. (Table 4)

7 Discussion

7.1 Main Findings

In this thesis, the primary objectives were to first determine if the risk of food insecurity is greater among households of foreign- born U.S. residents compared to households of native-born U.S. residents and secondly to establish if time since migrating to the U.S. is correlated with the risk of household food insecurity among foreign- born U.S. residents. This thesis also aimed to explore covariates of food insecurity to determine significant associations. There was not a significant difference in odds of marginal, low, or very low food security between households of native- born and foreign- born U.S. residents.

The odds of very low food security among households of foreign- born U.S. residents who had been in the U.S. for greater than ten years were only 76.5% the odds of very low food security among households of native- born U.S. residents (AOR 0.77: 0.63-0.93). For all other levels of food insecurity and times since migrating to the U.S., there was not a statistically significantly different odds of food insecurity between households of foreign- born and native-born U.S. residents. This is consistent with the literature. Both a 2001 study focusing on Latino immigrants in California and a 2013 study focusing on Cambodian refugees in Massachusetts found that new migrants and refugees experienced greater food insecurity. [10] [12] Whether struggling to transition to the U.S. food environment or experiencing inconsistent access to food due to seasonal household food shortages, it was found that food insecurity was most prominent among recently arrived U.S. residents. [10] [12] The data assert households of individuals who have been in the U.S. for longer periods of time have lower odds of experiencing food security.

7.2 Covariates of Food Insecurity

Among all of the variables in the model, poverty income ratio, education level, race and ethnicity, and receiving government nutrition- based assistance were found to be most strongly associated to food insecurity. When looking at poverty income ratio, it may seem intuitive that a low poverty income ratio would correlate to low food security. This thesis established that a household below the poverty line (poverty income ratio < 1) has 8.30 (95% CI: 6.09 – 11.32) times the odds of experiencing very low food security as a household with a poverty income ratio > 2.0 (holding nativity and all other covariates in the model constant). Likewise, a household above the poverty line but still eligible for government nutrition- based assistance (poverty income ratio: 1.0-1.3) has 7.88 (95% CI: 5.81- 10.70) times the odds of experiencing very low food security as a household with a poverty income ratio > 2.0 (Table 3c). When considering these data with the results of the covariate of receiving government nutrition- based aid, a clear trend is observed. It must be noted that when meeting financial requirements of a poverty income ratio of 1.3 or less, the entire foreign- born population is not eligible for aid while the entire native- born population is eligible. Undocumented or unlawful residents are only eligible to receive such aid if included in one of the specified groups: refugees, victims of trafficking or domestic abuse, asylees, or aliens who have completed 40 quarters of work. [21] Because not all undocumented and unlawful residents are not eligible to receive aid, the resulting odds of experiencing food insecurity among those receiving aid compared to those not receiving aid may be an underestimate. This is because there are households that meet the financial requirements to receive aid but not the legal requirements and are therefore grouped with those not receiving aid.

It is established that households that have received government nutrition- based aid in the last year are nearly three times as likely to experience very- low food security as those who have

not received such aid (AOR 2.88 95% CI: 2.31-3.59). Likewise, households that have received aid in the last year are 2.35 (2.03-2.71) times as likely to experience low food security as those who have not received aid in the last year.

These data (and the data from the poverty income ratio covariate) indicate that the government nutrition- based aid programs currently in place (such as WIC and SNAP) are not successful in alleviating food insecurity for eligible U.S. residents. This could be due to several factors. First, in the NHANES survey, the answer to eighteen questions (Appendix 3) are all considered to determine the level of food security for each respondent. Some of these eighteen questions are subjective and include phrases such as "I worried…" and some elicit recall bias as they ask the respondent to think back over the last twelve months. The interpretation of such subjective phrases and bias that is present in recalling distant periods of time may result in the overestimation of food insecurity per household. The high odds of food insecurity among households with a low poverty income ratio could be indicative of challenging enrollment in government nutrition- based aid programs. Even so, among households enrolled in government nutrition- based aid programs, elevated odds of food insecurity are observed. It is important to note that households above the government nutrition- based aid program eligibility cutoff (poverty income ratio 1.31-2.0) have 4.89 (95% CI: 3.76-6.35) times the odds of experiencing very low food security as households above twice the poverty level (poverty income ratio > 2.0). This indicates that the poverty income ratio cutoff for eligibility for government nutrition- based aid programs needs to be higher than the current set cutoff point of a poverty income ratio equal to 1.3 in order to reach all households severely affected by food insecurity.

In addition to potentially difficult enrollment and low eligibility cutoffs, the structure of aid programs must be evaluated. Aid recipients should not have such high odds of food

insecurity. Additional covariates in the model give insight into possible considerations for restructuring aid programs.

Education level was also found to strongly correlate with varying levels of food insecurity. It was found that households of high school graduates (or the equivalent) had 3.12 (95% CI: 2.34- 4.12) times the odds of experiencing low food security as households of college graduates (holding all other covariates in the model constant). This signifies that even with the same poverty income ratio, a college graduate's household has lower odds of experiencing food insecurity compared to households of those who have graduated high school but not graduated college. While low maternal education has been found to be a predictor of food insecurity, these results extend this predictor beyond maternal education to the education level of any household representative. [20] This especially valuable when examining households that are single parent households or households without children.

Additionally, the covariates of race and ethnicity were found to be significantly correlated with food insecurity at all levels. Households of those who identified as Mexican American (AOR: 1.86), other Hispanic (AOR: 1.72), or non- Hispanic Black (AOR: 1.61) were all nearly twice as likely to experience low food security compared to households of those who identify as non- Hispanic White. This is consistent with what has been established in the literature. [13] Looking at Hispanic households in the U.S., those gaining income from migrant farm work are among the most affected from food insecurity. [20]

While additional research is necessary to develop best practices in approaching food insecurity, the results of this analysis suggest community- based aid may be more effective than individual income- based aid in alleviating food insecurity, especially among Hispanic and non-Hispanic Black neighborhoods.

7.3 Time in the U.S. as it Pertains to Food Security

It was found that the odds of very low food security were lower for households of foreign- born U.S. residents within their first year in the U.S. compared to households of native-born U.S. residents. While these results were not statistically significant, this suggests that the aid available to first year U.S. residents is successful in reducing severe cases of food insecurity. Evaluating aid for first year migrants may be a successful tool in adjusting nutrition-based aid policies for foreign- born U.S. residents of over one year to result in lower levels of food insecurity.

7.4 Strengths and Limitations

There were several limitations of this thesis. The first limitation of this thesis is that there is likely an underestimation of food insecurity among foreign born individuals. The fear of legal repercussions prevents many undocumented immigrants from taking part in the census or the NHANES survey, resulting in an underestimation of certain population demographics. This limitation results in bias towards the null hypothesis that there is no difference in odds of food security among foreign- born and native- born U.S. residents. It is estimated that approximately 23% of the foreign- born population is undocumented. [22] The NHANES data is intentionally selected to be fully representative of the entire non- institutionalized population of the U.S. but does not collect data on visa type or documentation status. Without this data, it cannot be determined exactly how the lack of documentation among some foreign- born residents affects the weighting and true representation of the U.S. population by the NHANES data. It can, however, be estimated that less than 23% of the foreign- born population would decline participating in the NHANES survey due to fear of legal repercussions because it is assumed that not every undocumented immigrant would decline participation.

A second limitation is that the country of birth for each foreign- born participant is not collected in the NHANES survey. Country of birth is a variable that may give further insight to trends in the experience of food insecurity and thus should have been considered in the model. While lacking this information does not introduce bias to the study with the main research question, it limits the understanding of food security to apply to all foreign- born individuals, rather than to classify foreign- born individuals by country or region of birth to further understand the odds food insecurity among U.S. residents.

A third limitation of this thesis is that only the nativity of the household representative is recorded in the NHANES survey. The household representative in some cases is the head of household but was not exclusively the head of household among NHANES participants. It is likely that many households with a foreign- born representative also have household members that are native- born. It is also likely that some of the households with a native- born representative have some foreign- born household members. Without data on nativity of each household member, it cannot be explored how having household members of varying nativities affects food insecurity differently than having a household of entirely foreign- born or entirely native- born individuals. Because the frequency of households with residents of varying nativities in the NHANES study is unknown, it cannot be determined if this introduces bias towards or away from the null hypothesis that there is no difference in odds of food insecurity between foreign- born and native- born U.S. residents. This limits the understanding of the correlation of the odds of food insecurity of an entire household to the nativity of a single household representative.

A final limitation of this thesis is that the race / ethnicity variable in the NHANES dataset is coded so that the race of individuals who identify as Hispanic is unknown. This limitation does

not introduce bias into the model; however, it does limit the understanding of exactly how race acts as a covariate of food insecurity among Hispanic U.S. residents. Race is identified among participants who identify as non- Hispanic, which gives insight into race as a covariate among the non- Hispanic ethnic group. According to the U.S. Census, 76.3% of Hispanic individuals in the U.S identify as White. [23] Because the NHANES data is weighted to represent the entire U.S. population, it can be inferred that this is also true among the Hispanic NHANES participants. While including the racial identities of the Hispanic NHANES participants would be best practice to fully understand how race and ethnicity is associated with food security, this limitation does not bias results or significantly alter the analysis. The limited race and ethnicity variable is still valuable to include in the model as it provides a more well-rounded understanding of race as a covariate of food insecurity in the U.S. at large than if this was not included in the analysis at all.

A strength of this thesis is the use of a serial cross section. By including six consecutive two- year cross sections, this thesis allows for an understanding of food insecurity as a pattern in the U.S., as opposed to a single cross section indicating a point-in-time understanding of food insecurity during a given two- year period. While this may conflate the experience of food insecurity among households that have different experiences across a twelve- year period, such as experiencing the effects of a recession, the understanding of the persistence of food insecurity despite national economic and social changes is an important part of understanding food insecurity in the U.S. at large.

7.5 Public Health Implications

The analysis showed households that are above the poverty line and still eligible for government nutrition- based assistance, and households that are below the poverty line and

eligible for government nutrition- based assistance are still more likely to experience very low food security than households with a poverty income ratio that is over 200% the poverty line. When accounting for aid received in the last year, households that had received aid were over two times as likely to experience marginal and low food security and nearly three times as likely to experience very low food security compared to households that had not received aid. This indicates that the current approach to government nutrition- based assistance is ineffective in alleviating even the most extreme forms of food insecurity.

A qualitative study assessing what is successful and what is challenging for government nutrition- based assistance recipients is needed to accurately explain this phenomenon. This does, however, support the finding that despite the tens of billions of dollars spent annually on government nutrition- based assistance programs, the prevalence of food insecurity has been unwavering over the last thirty years. [2] Because of not only the significant financial contribution of the government, but also the extreme burden of food insecurity among U.S. residents with a low poverty income ratio, it should be of utmost importance to further research this trend in the U.S.

Additionally, it was found that households that are not eligible for government nutrition-based assistance due to a poverty income ratio greater than 1.3 but have a poverty income ratio of less than 2 are still at a higher risk for very low food security. This indicates that assessing the cutoff level of eligibility for government nutrition- based assistance programs could indicate that raising the cutoff level may alleviate food insecurity among households with a poverty income ratio of 1.3- 2.0. A further quantitative analysis of poverty income levels and experiences of food insecurity is needed to inform a specific cutoff level that is appropriate to alleviate food insecurity among households that are at a heightened risk of experiencing food insecurity.

The correlation of education level with food insecurity may motivate further studies on food security as it pertains to neighborhoods across the U.S. while accounting for average education level per neighborhood. Because this analysis controls for all other covariates included in the model, poverty income ratio is held constant when looking at education level as a covariate of food insecurity. This means lower wages corresponding to jobs that require lower education levels do not explain the heightened risk of food insecurity seen among individuals who have not graduated college. Education trends are typically seen across geographical areas: residents of one neighborhood may have an average education level of college graduate, while residents of another neighborhood have an average education level of high school graduate or possibly less. Exploring correlations between food insecurity by neighborhood in the U.S. while accounting for education levels is one possible method to further explaining this observed risk. Furthermore, collecting data on food insecurity by neighborhood can give important insight into specifically which neighborhoods would most greatly benefit from the addition of supermarkets and other nutrition- based aid resources.

The data demonstrated that households consisting of Hispanic and non- Hispanic Black individuals are at a higher risk of low food security compared to households of non- Hispanic White individuals. As established in the literature, primarily white neighborhoods have a higher number of supermarkets than neighborhoods that are primarily non- Hispanic Black. [9] The data in this thesis suggest that further examination of food resources in primarily Hispanic and non- Hispanic Black neighborhoods is an important step in alleviating food insecurity. By adding additional supermarkets and food resources to primarily Hispanic and non- Hispanic Black neighborhoods, gaps in food security could be addressed at the community level rather than at the household level.

7.6 Conclusion

When examining food security among U.S. residents over a twelve- year period, it was found that there is not a significant difference in odds of experiencing food insecurity among households of foreign- born individuals compared to households of native- born individuals. Time since migrating to the U.S. was not significantly associated with food security. The data demonstrated that households eligible for government nutrition- based assistance are still at a high risk of food insecurity, and that race, ethnicity, and education level are clear risk factors for food insecurity. This thesis calls for action on part of the U.S. federal and state governments to further study food security among U.S. residents and improve upon current nutrition- based aid programs in order to minimize the experience of food insecurity among U.S. residents. This may be achieved through both qualitative and quantitative analyses of programs in place, as well as the development of community- based aid programs.

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Appendix 1: HFIAS Questionnaire

For each of the following questions, answer in the last 30 days whether it has 0 (never or rarely) or 1 (sometimes, often, mostly, or always) has happened to you.

Household Food Insecurity Access Scale (HFIAS) domains and generic questions

A. Anxiety and uncertainty about household food access:
   1. Did you worry that your household would not have enough food?

B. Insufficient quality (includes variety, preferences, and aspects of social acceptability):
   2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?
   3. Did you or any household member eat just a few kinds of food day after day because of a lack of resources?
   4. Did you or any household member eat food that you did not want to eat because a lack of resources to obtain other types of food?

C. Insufficient food intake and its physical consequences:
   5. Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?
   6. Did you or any other household member eat fewer meals in a day because there was not enough food?
   7. Was there ever no food at all in your household because there were no resources to get more?
   8. Did you or any household member go to sleep at night hungry because there was not enough food?
   9. Did you or any household member go a whole day without eating anything because there was not enough food?

Appendix 2: Current Population Survey- Food Security Survey

The Current Population Survey was conducted in 2018. This survey serves as an example of a tool used to measure food insecurity in the U.S.

Questions Used To Assess the Food Security of Households in the CPS Food Security Supplement

1. "We worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?
2. "The food that we bought just didn't last and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?
3. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?
4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)
5. (If yes to question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)
7. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)
8. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)
9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (Yes/No)
10. (If yes to question 9) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

(Questions 11-18 were asked only if the household included children age 0-17)

11. "We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?
12. "We couldn't feed our children a balanced meal, because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?
13. "The children were not eating enough because we just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months?
14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food? (Yes/No)
15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)
16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (Yes/No)
17. (If yes to question 16) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
18. In the last 12 months did any of the children ever not eat for a whole day because there wasn't enough money for food? (Yes/No)

Coding of Responses

Questions 1-3 and 11-13 are coded as affirmative (i.e., possibly indicating food insecurity) if the response is "often" or "sometimes." Questions 5, 10, and 17 are coded as affirmative if the response is "almost every month" or "some months but not every month." The remaining questions are coded as affirmative if the response is "yes."

Assessing Food Security Status in Households without Children

Households without children are classified as *food insecure* if they report 3 or more indications of food insecurity in response to the first 10 questions; they are classified as having *very low food security* if they report 6 or more food-insecure conditions out of the first 10 questions.

Assessing Food Security Status in Households with Children Age 0-17

Households with children are classified as *food insecure* if they report 3 or more indications of food insecurity in response to the entire set of 18 questions; they are classified as having *very low food security* if they report 8 or more food-insecure conditions in response to the entire set of 18 questions.

The food security status of children in the household is assessed by responses to the child-referenced questions (questions 11-18). Households reporting two or more of these conditions are classified as having *food insecurity among children*. Households reporting five or more are classified as having *very low food security among children*.

Appendix 3: NHANES Food Insecurity Questionnaire Variables

FSD032a- {I/we} worried whether {my/our} food would run out before {I/we} got money to buy more. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD032b- The food that {I/we} bought just didn't last, and {I/we} didn't have enough money to get more food. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD032c- {I/we} couldn't afford to eat balanced meals. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD032d- (I/we) relied on only a few kinds of low-cost foods to feed {CHILD'S NAME / THE CHILDREN} because there wasn't enough money for food. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD032e- (I/we) couldn't feed {CHILD'S NAME / THE CHILDREN} a balanced meal, because there wasn’t enough money for food. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD032f- {CHILD'S NAME WAS /THE CHILDREN WERE} not eating enough because there wasn't enough money for food. [“SOMETIMES TRUE” OR “OFTEN TRUE”]

FSD041-In the last 12 months, since last {DISPLAY CURRENT MONTH AND LAST YEAR}, did {you/you or other adults in your household} ever cut the size of your meals or skip meals because there wasn't enough money for food? [“YES”]

FSD052- How often adults cut size/skip meals: [“ALMOST EVERY MONTH” OR “SOME MONTHS BUT NOT EVERY MONTH”]

FSD061- In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? [“YES”]

FSD071- [In the last 12 months], were you ever hungry but didn't eat because there wasn't enough money for food? [“YES”]

FSD081- [In the last 12 months], did you lose weight because there wasn't enough money for food? [“YES”]

FSD092- [In the last 12 months], did {you/you or other adults in your household} ever not eat for a whole day because there wasn't enough money for food? [“YES”]

FSD102- How often adults did not eat for day: [“ALMOST EVERY MONTH” OR “SOME MONTHS BUT NOT EVERY MONTH”]

FSD111-In the last 12 months, since {DISPLAY CURRENT MONTH AND LAST YEAR}, did you ever cut the size of {CHILD'S NAME's/any of the children's} meals because there wasn't enough money for food? [“YES”]

FSD122- [In the last 12 months], did {CHILD'S NAME/any of the children} ever skip meals because there wasn't enough money for food? [“YES”]

FSD132- How often did this (child skip meals) happen? [“ALMOST EVERY MONTH” OR “SOME MONTHS BUT NOT EVERY MONTH”]

FSD141- In the last 12 months, {was CHILD'S NAME/were any of the children} ever hungry but there wasn't enough money for food? [“YES”]

FSD146- [In the last 12 months], did {CHILD'S NAME/any of the children} ever not eat for a whole day because there wasn't enough money for food? [“YES”]

FSDHH- Household Food Security

- Count affirmative responses in these 18 items: FSD032a, FSD032b, FSD032c, FSD032d, FSD032e, FSD032f, FSD041, FSD052, FSD061, FSD071, FSD081, FSD092, FSD102, FSD111, FSD122, FSD132, FSD141, and FSD146. Derive the codes as the following:
- 1 = Household full food security: no affirmative response in any of these items.
  2 = Household marginal food security: 1-2 affirmative responses.
  3 = Household low food security: 3-5 affirmative responses for household without children under the age of 18; 3-7 affirmative responses for household with children.
  4 = Household very low food security: 6-10 affirmative responses for household without children under the age of 18; 8-18 affirmative responses for household with children.
- Households with children where no valid response was provided to any of the questions about children’s food security were classified using the specifications for households without children.

Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Questionnaire (or Examination Protocol, or Laboratory Protocol). Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2005-2016, https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx