The Causes, Consequences, and Future of Senior Hunger in America

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Table of Contents

Executive Summary i

I. Introduction and Project Objectives 1

II. The Extent of Food Security among Senior Americans 2

A. Data from the Current Population Survey 4

B. Distribution and Prevalence of Food Insecurity among all Senior Households 5

C. Links between Poverty and Food Insecurity among Senior Households 10

D. Links between Race, Ethnicity and Food Insecurity among Senior Households 12

E. Links between Food Stamp Receipt and Food Insecurity among Senior Households 15

F. Links between Family Structure and Food Insecurity among Senior Households 16

G. Links between Geographic Location and Food Insecurity among Senior Households 16

III. The Determinants of Senior Hunger 19

A. Differences in Food Insecurity by Poverty Status 24

B. Demographic Profiles of Hunger Risk 28

IV. Health Consequences of Senior Hunger from the NHANES 31

A. Review of Previous Research 31

B. Data from NHANES 33

C. Descriptive Associations Between Food Insecurity and Health Outcomes 34

D. The Effect of Food Insecurity on Health Outcomes 37

E. Social Isolation and Food Insecurity 40

Table of Contents

V. Food Insecurity and Wealth, Health, and Food Expenditures in the PSID 41

A. Wealth and Food Insecurity 43

B. Food Spending and Food Insecurity.....47

C. Health and Food Insecurity 58

VI. The Future of Hunger in 2025 49

VII. Conclusion 54

Appendix.....57

References.....73

Executive Summary

Hunger is a serious threat facing millions of seniors in the United States. Despite this important public health threat, we know very little about the face of hunger among seniors, the causes of senior hunger, its consequences for the well-being of seniors, or what will happen in the next twenty years with respect to hunger among senior Americans. Although federally-funded programs including the Elderly Nutrition Program (ENP) and the Food Stamp Program are designed to address food security and nutritional needs among senior Americans, studies demonstrate high levels of need still exist among seniors. Thus, it is important to expand our understanding of hunger among seniors in order to help develop strategies to reduce it.

With the generous financial support of a grant from the Meals On Wheels Association of America Foundation (MOWAAF) to the University of Kentucky Center for Poverty Research (UKCPR) and Iowa State University, in this report we analyzed the causes, consequences, and future of senior hunger in America. Specifically, we addressed the following questions:

- *What is the extent of hunger among seniors across the United States?* While annual reports on food insecurity indicate the proportion of senior persons suffering from hunger, no research has examined the status of seniors at more disaggregated levels. We examined subgroups by age, income, wealth, employment status, race/ethnicity, family structure, social isolation, geography, and receipt of food stamps, shedding light on the prevalence of hunger among seniors across a broad spectrum of characteristics.

- *What are the causes and attendant nutrition and health consequences of senior hunger?* An extensive literature has emerged which examines the causes of food insecurity and hunger in the general population and the nutrition and health consequences of food insecurity and hunger for the general population. There has, however, been very little work on these topics for seniors. We identified characteristics associated with hunger among seniors and presented a series of profiles for those most likely to experience hunger. We also examined the consequences of hunger on the well being of seniors, including outcomes related to nutrition, health, and food spending.

- *What is the future of hunger among the elderly over the next 20 years?* The proportion of elders in the American population will increase at a much faster rate than other age groups over the coming decades. Along with increasing numbers, there will be a sharp increase in the proportion of elders who are older, in particular those over the age of 85. In this report, we made projections 20 years into the future regarding food insecurity among seniors.

The Face of Senior Hunger in America

Using data from the 2001-2005 Current Population Survey (CPS), a nationally representative survey of over 50,000 households per year, along with the Core Food Security Module, we examined the characteristics of persons aged 60 and over who were (a) marginally food insecure; (b) food insecure and thus at-risk of hunger; and (c) very low food secure and thus suffering from hunger. In the United States through the mid 2000s we found that

- Over 5 million seniors—11.4 percent of all seniors—experienced some form of food insecurity (i.e., were marginally food insecure). Of these, about 2.5 million were at-risk of hunger, and about 750,000 suffered from hunger due to financial constraints.

- Some groups of seniors are more likely to be at-risk of hunger. Relative to their representation in the overall senior population, those with limited incomes, under age 70, African-Americans, Hispanics, never-married individuals, renters, and persons living in the South are all more likely to be at-risk of hunger.

- While certain groups of seniors are at greater-risk of hunger, hunger cuts across the income spectrum. For example, over 50% of all seniors who are at-risk of hunger have incomes above the poverty line. Likewise, it is present in all demographic groups. For example, over two-thirds of seniors at-risk of hunger are white.

- There are marked differences in the risk of hunger across family structure, especially for those seniors living alone, or those living with a grandchild. Those living alone are twice as likely to experience hunger compared to married seniors. One in five senior households with a grandchild (but no adult child) present is at-risk of hunger compared to about one in twenty households without a grandchild present.

- Seniors living in non-metropolitan areas are as likely to experience food insecurity as those living in metropolitan areas, suggesting that food insecurity cuts across the urban-rural continuum.

The Causes of Senior Hunger in America

Although the summary statistics paint a detailed portrait of food insecurity across a number of economic and demographic characteristics of senior households, we also estimated formal statistical models of the determinants of food insecurity and hunger. The models move beyond simple associations and help answer questions such as "what is the effect of age on the probability of food insecurity holding income, race, education, and other factors constant?" With the estimated model parameters we then constructed a number of profiles of hypothetical senior households with varying degrees of hunger risk.

Our results of the causes of food insecurity from the 2001-2005 Current Population Survey revealed that seniors were more likely to be at-risk of hunger if they were

- *A young senior between the ages of 60 and 64.* For example, seniors age 80 and older were 2.1 percentage points less likely to be food insecure compared to 60-64 year olds. That is, an 84 year old is over one-third less likely to be at-risk of hunger than a 64 year old on the baseline food insecurity rate of 5.6 percent.

- *Living at or below the poverty line.* Households above 200 percent of the poverty line have nearly a 15 percentage point lower probability of being marginally food insecure than those living below the poverty line, a 6 percentage point lower probability of being food insecure, and a 2 percentage point lower probability of being very low food secure.

- *A high school dropout.* Holding income and other factors constant a high school graduate is 20 percent less likely to be at risk of hunger compared to a high school dropout, and a college graduate is 40 percent less likely.

- *An African-American or Hispanic.* All else equal, African-Americans were 4.2 percentage points more likely to be food insecure than white persons, or nearly 75 percent above the baseline rate of 5.6 percent. Hispanics were about 20 percent more likely to be at-risk of hunger compared to whites, though were at no greater risk of currently experiencing hunger.

- *Divorced or separated, or living with a grandchild.* Marriage offered protection against food insecurity on a scale comparable to a high school diploma; that is, married couples were at about a 20 percent reduced probability of being at risk of hunger. Those seniors living with a grandchild; however, were about 50 percent more likely to be at risk of hunger compared to those with no grandchild.

- *Renters.* Homeowners have access to resources not similarly available to those seniors who rented, and thus homeowners faced about one-half the odds of being at-risk of hunger relative to the baseline.

We supplemented our analysis of the determinants of food insecurity in the CPS with data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES) to examine the effects of social isolation on senior hunger and with data from the 1999–2003 Panel Study of Income Dynamics (PSID) to examine the effects of liquid assets and net worth on food insecurity. We found that after controlling for other factors, seniors without access to emotional and financial support are substantially more likely to suffer from hunger (about 50 percent more) and seniors with net worth in excess of $100,000 are much less likely to suffer from hunger.

The Health Consequences of Senior Hunger

There has been extensive work looking at the causes and consequences of nutrient-related deficiencies and other health outcomes among the elderly. However, much less research has been conducted on the health-related consequences of food insecurity among the elderly. We used data from the 1999-2002 National Health and Nutrition Examination Survey to examine the health consequences of hunger for Americans over the age of 60.

The outcomes considered that relate to nutrients were energy intake, protein, vitamin A, vitamin C, thiamin, riboflavin, vitamin B6, calcium, phosphorous, magnesium, and iron. These were all based on individual's self-reports of their food consumption for two full days. We also examined outcomes related to obesity including body mass index, arm circumference, tricep skinfold, and subscapular skinfold. The final set of outcomes examined were based on individuals' self-reports of diabetes, general health (excellent, very good, good, fair, or poor), depression, diabetes, and ADL limitations.

After controlling for other risk factors for poor health we find that seniors experiencing some form of food insecurity are

- *Significantly more likely to have lower intakes of energy and major vitamins.* This holds across all the nutrient intake measures we considered. The effects are very strong. For example, across all the measures, the effect of being marginally food insecure is over twice as large (and generally much larger) than a move in income from one-to-two times the poverty line.

- *Significantly more likely to be in poor or fair health.* In comparisons of excellent or very good health versus good, fair, or poor health and comparisons of excellent, very good, or good health versus fair or poor health, we find a strong effect of marginal food insecurity. For sake of comparison, being marginally food insecure is similar to not having graduated from high school.

- *More likely to have limitations in activities of daily living (ADL).* Marginally food insecure are much more likely than fully food secure seniors to have ADL limitations. The effects are again strong – being marginally food insecure is roughly equivalent to being 14 years older.

As a check on the robustness of the health results, we used data on similar health outcomes from the PSID and found results that broadly corroborate those from the NHANES. We also used data from the PSID to estimate the effect of food insecurity on household food expenditures adjusted for the food needs as determined by the USDA Thrifty Food Plan. On average a marginally food insecure family spends about 60 percent less on food relative to needs, and a family that is very low food secure spends 88 percent less. However, once we controlled for other factors that determine food spending we no longer find a statistically significant link between food insecurity and food expenditures.

The Future of Senior Hunger

To project the future of senior hunger in America in 2025, we used data from both the 1980s and 2000s in the CPS and population projections from the U.S. Census Bureau. We employed a projection technique that was based on our results from the determinants of food insecurity. Specifically we developed a three-step procedure based on a parsimonious group of seven economic and demographic variables that affected hunger– whether someone was a homeowner, whether a person lived in a poor household, the gender of an individual, the age of an individual, whether a person lived alone, the race of an individual, and whether the person graduated from high school. The first step involved relating food insecurity among seniors in the early 2000s to their age cohorts twenty years prior in the 1980s. The second step involved predicting food insecurity for each age cohort twenty years in the future based on demographic and economic data from the 2000s. The third and final step required weighting the predictions by the U.S. Census's projections of the size each age group two decades in the future.

Our baseline projections indicate that

- In 2025, an estimated 9.5 million senior Americans will experience some form of food insecurity, about 75 percent higher than the number in 2005.
- In 2025, an estimated 3.9 million senior Americans will be at-risk of hunger.
- In 2025, an estimated 1 million senior Americans will suffer from hunger.

The baseline projections are quite robust to more complicated prediction models and suggest that in the absence of significant economic or policy reforms the percentage of seniors at risk of hunger in 2025 will be of comparable magnitude to the present.

Conclusion

This report represented an important contribution to our understanding of senior hunger in America. Much work remains to be done, however, in efforts to ensure that no senior be at risk of going without food. We identify two key areas for future research. First, we need to be kept up-to-date on the extent of senior hunger along with the determinants and consequences of senior hunger. If the population of seniors was relatively static, such research would not be as relevant. But this is not the case – the population of seniors is changing rapidly, both in size and composition. Thus, we anticipate that issues of senior hunger will change as well. In response, we recommend an annual updating of this report. Such a report would allow MOWAAF to identify the implications of these rapid changes among seniors. Second, we found some striking, and heretofore undocumented, results that the probability of food insecurity declined along the age gradient, that it rose significantly for those seniors living with a grandchild, and that it rose significantly for those socially isolated. Further research into the causal mechanisms of these processes is merited in order for MOWAAF, ENP, the Food Stamp Program, and related organizations to better target food-related services to those in need.

I. Introduction and Project Objectives

Hunger is a serious public health threat facing hundreds of thousands of seniors in America. Despite this threat facing our country, we know very little about the extent of hunger, its consequences for the well-being of seniors, or what will happen in the next twenty years with respect to hunger among senior Americans. Although federally-funded programs including the Elderly Nutrition Program (ENP) and the Food Stamp Program are designed to address food security and nutritional needs among senior Americans, studies demonstrate high levels of need remain among seniors. Thus, it is important to expand our understanding of hunger among seniors in order to help develop strategies to reduce it. With the generous financial support of the Meals on Wheels Association of America Foundation (MOWAAF), the University of Kentucky Center for Poverty Research (UKCPR) and Iowa State University has undertaken a project addressing the extent of hunger among seniors, its causes and consequences, and the future of senior food security over the next 20 years. In this report, we present findings for the following three broad questions:

What is the extent of hunger among seniors across the United States? While annual reports on food insecurity indicate the proportion of senior persons suffering from hunger, no research has examined the status of seniors at more disaggregated levels. This omission seems particularly surprising as previous research on disaggregated displays of hunger in the United States have found high levels of hunger among some groups (e.g., single parents with children) alongside low levels among other groups (e.g., married couples with children). We examine subgroups by age, income, employment status, race/ethnicity, family structure, geography, and receipt of food stamps, shedding light on the prevalence of hunger among seniors across a broad spectrum of characteristics. Understanding the extent of hunger across seniors is especially important to the MOWAAF as they seek to raise awareness, solicit funding support from non-public sources, and develop specific programmatic and broad policy recommendations to address the issue.

What are the causes and attendant nutrition and health consequences of senior hunger? An extensive literature has emerged which examines the causes of food insecurity and hunger in the general population and the nutrition and health consequences of food insecurity and hunger for the general population. There has, however, been very little work on these topics for seniors. And what work has been done has used smaller-scale cross-sectional datasets, hunger measures other than the official measures used by Federal government, or both. This limits the ability of MOWAAF to effectively ascertain who among seniors

are most likely to suffer from hunger and how and why hunger matters for seniors. This then constrains the Foundation's ability to fully articulate to policymakers why senior hunger in America is a serious problem. In this report we identify characteristics associated with hunger among seniors and present a series of profiles for those most likely to experience hunger. In a separate set of analyses, we examine the consequences of hunger on the well being of seniors, including nutritional and health outcomes and differences among hungry and non-hungry seniors on measures of daily functioning.

What is the future of hunger among the elderly over the next 20 years? The proportion of elders in the American population will increase at a much faster rate than other age groups over the coming decades. Along with increasing numbers, there will be a sharp increase in the proportion of elders who are older, in particular those over the age of 85. The size of this age group is currently about 3 million; by 2050, it is estimated that over 19 million Americans will be over 85. MOWAAF is particularly interested in this group since a disproportionate number of meals distributed by MOWAA go to these older Americans. In this report, we make projections 20 years into the future regarding food insecurity among seniors.

In the next section we define food security and insecurity and our approach to its use in our analyses. We also discuss food insecurity levels for all senior households (those with heads over 60 years of age), and by subgroup.[1] In Section III we present the findings from multivariate analyses that allow us to simultaneously control for the effects of these characteristics on food security levels among seniors. Sections IV and V present the results of our analyses of the health and nutrition consequences of senior hunger. Section VI contains our projections of senior hunger in the year 2025. We offer concluding comments in Section VII on the implications of our research for identifying, reaching, and serving seniors at-risk of hunger in the United States.

II. The Extent of Food Insecurity among Senior Americans

We begin our analysis by defining our measure of food insecurity and detailing who among senior Americans is considered food insecure and/or suffering from hunger. Food security has been defined by the Economic Research Service (ERS) of the USDA as access by all members of a household to food sufficient for a healthy life, including at a minimum "the ready availability of nutritionally adequate and

1. Although studies examining the senior population often define seniors as those over 65, we are interested in elderly households with heads over 60 since seniors over 60 are eligible for Elderly Nutrition Program services. MOWAA is the largest association representing senior nutrition service providers in the United States.

safe foods, and the assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)." To wit, the ERS definition of food insecurity is "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson, 1990).

Food insecurity is measured along a continuum by using survey responses to the Core Food Security Module (CFSM) in the Current Population Survey. To calculate the official food insecurity rates in the U.S. for families without children (defined over a 12 month period) the CSFM poses a series of 10 questions (18 questions with children present).[2] Each question is designed to capture some aspect of food insecurity and, for some questions, the frequency with which it manifests itself. Examples of questions include: "I worried whether our food would run out before we got money to buy more," (the least severe item), "Did you or the other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food," "Did you ever lose weight because there wasn't enough money for food," and "Did you ever not eat for a full day three or more times" (the most severe item). The questions and responses used to determine household food security status are included in Appendix Table 1.

There are numerous categorizations of food security status that have been made based on these 10 questions. As summarized in Table 1 (page 4), in this report we begin with four mutually exclusive categories: fully food secure, which means the respondent reports no food security problems; marginally food secure, which means the respondent answers affirmatively to one or two questions; low food secure, which means the respondent answers affirmatively to 3–5 questions on the CFSM; and very low food secure, which means that the respondent answers affirmatively to six or more questions. From these four categories we form the two, non-mutually exclusive, summative categories of marginally food insecure, which combines the three categories of marginally food secure, low food secure, and very low food secure, and food insecure, which combines the narrower categories of low food secure and very low food secure. For most of our analysis we focus on the three categories of marginally food insecure, food insecure, and very low food secure. In general, the food insecure group is considered to be at-risk of hunger and the very low food secure group is considered to be suffering from hunger.

2. Most households with seniors will fall into this category of "households without children." Of course, some households with an elder will also have children. For these households, we use the full set of 18 questions in the CFSM.

Table 1: Food Security Categories

	Number of Affirmative Responses to CFSM	Combinations of Mutually Exclusive Categories
Mutually exclusive categories		
Fully food secure	0	
Marginally food secure	1-2	
Low food secure	3-7 (households with children) 3-5 (households without children)	
Very low food secure	8 or more (households with children) 6 or more (households without children)	
Non-mutually exclusive categories		
Marginally food insecure	1 or more	Marginally food secure Low food secure Very low food secure
Food insecure	3 or more	Low food secure Very low food secure

II. A. Data from the Current Population Survey

Data on the extent of hunger among senior Americans is derived from the CFSM in the Current Population Survey (CPS) for the years 2001-2005.[3] The CPS is a nationally representative survey conducted by the Census Bureau for the Bureau of Labor Statistics, providing employment, income and poverty statistics. In December of each year, 50,000 households respond to a series of questions on the CFSM in addition to questions about food spending and the use of government and community food assistance programs. Households are selected to be representative of civilian households at the state and national levels, and thus do not include information on individuals living in group quarters including nursing homes or assisted living facilities. Multiple years are pooled together for this analysis due to the limited sample size of certain subpopulations in any given year, for example African Americans over age 85.[4] In general, a household is observed in two successive years in the CPS. Since multiple years are being used in this paper, to ensure that no household is included more than once, the sample includes households observed for the second time in 2001 through 2005. Excluding households with heads younger than 60, the pooled sample includes 50,330 senior households between the ages of 60 and 90.

3. The CFSM has been in at least one month in the CPS in every year since 1995. To avoid issues of seasonality and changes in various other aspects of survey design (e.g., the screening questions), only the five most recently available December Supplements are used in this project.
4. There was no reason to believe the responses for households administered the survey over different years should differ substantially over the short time period studied, therefore, data were pooled across years in the interest of obtaining a sufficiently large sample for certain demographic categories of interest.

Table 2 (page 6) contains weighted averages of selected characteristics, where the weight is the sample person weight provided in the CPS survey and is used to adjust the averages to reflect the whole population age 60 and over. Among seniors in America 11.4 percent are classified as marginally food insecure, 5.6 percent are classified as food insecure, and 1.7 percent are very low food secure. These percentages translate into over 5 million seniors who are marginally food insecure, about 2.5 million of whom are at-risk of hunger and about 750,000 who are presently experiencing hunger. About 11 percent of seniors are poor, but a plurality has annual incomes that place them above two times the poverty line. Over a quarter of the sample refused or failed to provide data on their incomes, and our regression models in the next section will account for this missing data. Most in the sample are white, are homeowners, live in a metropolitan statistical area, and are retired. The households are fairly evenly distributed across age categories, education levels, and regions, with the exception of the South where over one-third of seniors reside. About two-thirds of seniors are formally retired, and just under a quarter are employed. Slightly more than one-half of households contain women as the head of household, about 27 percent of householders are living alone, and slightly less than 4 percent have a grandchild present in the household.

Figure 1 (page 7) demonstrates the food insecurity rates by year for the full sample of households with a head 60 years of age or older. Rates of food insecurity have remained relatively constant over the period with respect to each of the three food security measures, suggesting no major changes over time in the fraction of seniors at risk of hunger during the early 2000s.

II. B. Distribution and Prevalence of Food Insecurity among all Senior Households

Table 3 (page 8) presents descriptive statistics on the distribution of senior Americans across the three levels of food insecurity. Each subcategory in the table sums to 100 percent for the respective food insecurity status. For example, one question the table answers is "Among the very low food secure, what fraction of that population has income below poverty and what fraction has income above poverty?" In this case Table 3 shows that over 48 percent report income below the poverty line, 36 percent report income above the line, and 16 percent do not report income (and thus some lie above and some below the line). Although poverty status is a clear predictor of hunger, the problem is by no means restricted to the poor as slightly above 9 percent of very low food secure households have annual incomes above twice the poverty line. Clear majorities of the food insecure across categories are white, non-Hispanics, are under

Table 2. Selected Characteristics of Senior Americans in the Current Population Survey, 2001–2005

	Percent
Marginally Food Insecure	11.40
Food Insecure	5.60
Very Low Food Secure	1.70
Income Categories	
Below 50% of the Poverty Line	1.76
Between 50% and 100% of the Poverty Line	8.25
Between 100% and 200% of the Poverty Line	18.92
Above 200% of the Poverty Line	43.64
Missing Income	27.43
Racial Categories	
White	87.33
African American	9.16
Other	3.51
Hispanic Ethnicity	6.40
Marital Status	
Married	62.44
Widowed	26.51
Divorced or Separated	9.86
Never Married	1.19
Homeowner	84.91
Geographic Location	
Non-Metro	22.33
Northeast	20.51
Midwest	23.26
South	36.86
West	19.37
Age	
60 to 64	25.98
65 to 69	21.04
70 to 74	18.09
75 to 79	16.08
80 and older	18.81
Employment Status	
Employed	22.33
Unemployed	0.92
Retired	68.15
Disabled	8.60
Education Level	
Less Than High School	24.25
High School Diploma	35.56
Some College	20.62
College Degree	19.57
Food Stamp Recipient	3.07
Grandchild or Parent Present	
No Grandchild and Parent Present	96.34
Grandchild and Parent Present	2.41
Grandchild Present	1.25
Female	56.03
Living Alone	27.39

Note: Percentages within categories may not sum to 100% because of rounding.

More than 9% of senior households at greatest risk for hunger have annual incomes above twice the poverty line.

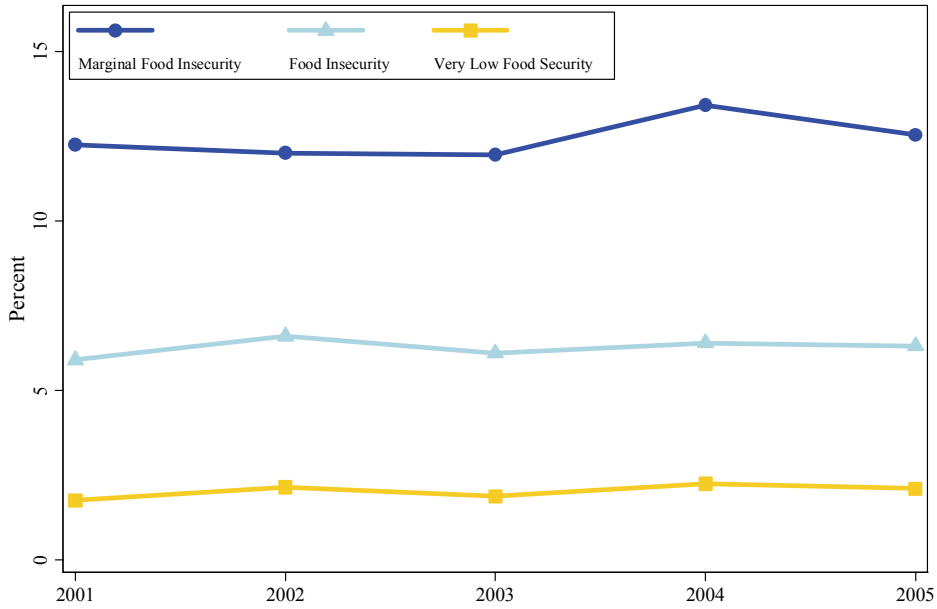


Figure 1. Food Insecurity Rates for Seniors, 2001-2005

age 70, are currently or previously married, are women, are retired or disabled, live in metro areas, do not receive food stamps, and do not have a grandchild present in the household. However, African Americans, Hispanics, the disabled, widows, food stamp recipients, and those living alone are over-represented in all categories of food insecurity relative to their population shares (reported in Table 2).

Table 4 (page 9) details the prevalence of food insecurity for the full sample. The difference from Table 3 is that in Table 4 we answer questions such as "Among those with income below 50% of the poverty line, what fraction are marginally food insecure, food insecure, or very low food secure?" In other words we examine each row and compare across columns. The categories do not sum to 100 percent because the remaining fraction of households in each category are food secure (not shown in the table). Consistent with previous research on the general population, Table 4 demonstrates the protective effect of economic resources on food security among the elderly. Just over 1.5 percent of the sample with income above twice the poverty line is characterized as food insecure, and fewer than one in 200 of these households (0.35 percent) experience very low food security. In stark contrast, 21 percent of households between 50-100% of the poverty line, and nearly three in ten (27.0 percent) households below 50% of the poverty line are food insecure. One in ten households with income below 50% of the poverty line experiences very low food security. Approximately one in twenty households headed by a white person experience food insecurity, and 1.3 percent are very low food secure. In contrast, nearly one in six African

Relative to their representation in the population, African Americans, Hispanics, food stamp recipients, the disabled, widows and seniors living alone are over-represented among the non-food secure.

Table 3. Distribution of Food Insecurity Rates by Categories for Seniors

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Income Categories			
Below 50% of the Poverty Line	6.70	8.50	11.18
Between 50% and 100% of the Poverty Line	27.44	30.69	36.82
Between 100% and 200% of the Poverty Line	33.08	30.12	26.99
Above 200% of the Poverty Line	14.94	12.20	9.10
Missing Income	17.85	18.49	15.91
Racial Categories			
White	72.94	67.63	66.12
African American	22.28	27.46	29.46
Other	4.79	4.82	4.42
Hispanic	13.67	14.83	11.48
Marital Status			
Married	45.88	42.33	35.23
Widowed	34.52	34.84	35.67
Divorced or Separated	16.69	19.37	23.95
Never Married	2.91	3.47	5.15
Homeowner	66.20	60.68	51.60
Geographic Location			
Non-Metro	24.59	24.69	23.76
Northeast	18.28	16.88	16.66
Midwest	19.47	18.72	17.74
South	43.29	45.94	46.67
West	18.95	18.46	18.93
Age			
Less than 70	49.39	54.84	56.41
Between 70 and 80	34.48	31.35	29.91
More than 80	16.13	13.82	13.69
Employment Status			
Employed	13.69	13.62	9.12
Unemployed	2.02	2.44	3.06
Retired	60.61	55.26	52.34
Disabled	23.68	28.68	35.48
Food Stamp Recipient	16.90	21.38	27.36
Grandchild or Parent Present			
No Grandchild and Parent Present	92.22	90.99	92.45
Grandchild and Parent Present	4.35	4.58	4.58
Grandchild Present	3.43	4.43	2.98
Female	61.28	59.69	58.88
Living Alone	35.29	36.33	43.97
Education			
Less than High School	48.69	51.76	51.99
High School only	31.56	29.42	27.85
Some College	13.92	13.98	14.99
College Degree more	5.83	4.84	5.17

Table 4. Rates of Food Insecurity among Seniors by Various Characteristics

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	11.40	5.60	1.70
Year			
2001	11.02	5.22	1.35
2002	10.95	5.80	1.77
2003	10.96	5.62	1.61
2004	12.46	5.75	1.88
2005	11.56	5.56	1.87
Income Categories			
Below 50% of the Poverty Line	43.35	27.03	10.79
Between 50% and 100% of the Poverty Line	37.90	20.82	7.58
Between 100% and 200% of the Poverty Line	19.93	8.91	2.42
Above 200% of the Poverty Line	3.90	1.57	0.35
Missing Income	7.42	3.77	0.99
Racial Categories			
White	9.52	4.34	1.29
African American	27.72	16.83	5.46
Other	15.55	7.69	2.14
Hispanic Status			
Hispanic	24.35	12.98	3.05
Non-Hispanic	10.51	5.10	1.61
Marital Status			
Married	8.20	3.70	0.93
Widowed	14.53	7.17	2.21
Divorced or Separated	18.89	10.72	4.00
Never Married	27.41	15.99	7.13
Homeownership Status			
Homeowner	8.90	4.00	1.03
Renter	25.54	14.59	5.45
Metropolitan Location			
Non-Metro	12.55	6.19	1.80
Metro	11.06	5.43	1.67
Region			
Northeast	10.16	4.61	1.38
Midwest	9.54	4.51	1.30
South	13.39	7.00	2.15
West	11.16	5.33	1.66
Age			
Less than 70	11.98	6.53	2.04
Between 70 and 80	11.51	5.14	1.49
More than 80	9.80	4.11	1.24
Employment Status			
Employed	6.99	3.41	0.70
Unemployed	25.16	14.89	5.67
Retired	10.14	4.54	1.31
Disabled	31.41	18.68	7.02
Food Stamp			
Recipient	62.68	38.94	15.12
Non Recipient	9.78	4.54	1.52
Grandchild or Parent Present			
No Grandchild and Parent Present	10.61	5.11	1.59
Grandchild and Parent Present	20.03	10.29	3.14
Grandchild Present	30.34	19.13	3.93
Gender			
Female	12.46	5.96	1.79
Male	10.00	5.13	1.59
Living Arrangement			
Living Alone	14.69	7.43	2.72
Not Living Alone	10.16	4.91	1.31
Education			
Less than High School	22.89	11.95	3.64
High School only	10.12	4.63	1.33
Some College	7.69	3.80	1.23
College Degree more	3.40	1.39	0.45

American households is food insecure, and over one in five are food insecure or very low food secure. Likewise, about one in eight Hispanic households (the head may be of any race) is food insecure compared with about 5 percent of non-Hispanic households. Those dwelling in metro areas are about as likely to be food insecure as those in non-metropolitan areas suggesting there is neither an urban nor rural bias toward food insecurity.

Greater food security is also associated with homeownership, which may be considered an additional measure of economic security. Only 4 percent of homeowners are food insecure compared with 14.6 percent of renters, and only one in one-hundred homeowners suffer from hunger compared to one in twenty renters. Food stamp receipt is only available for those with low incomes and assets, and those who receive food stamps are far more likely to be food insecure than those not receiving food stamps.[5] Family status also presents some marked contrasts. Married heads fare best in terms of food security and never-married heads worst; those widowed are somewhat better off than those who are divorced or separated. Extended or multigenerational households may form among the poor as a way to adapt to economic setbacks or increase household resources (Angel and Tienda, 1982; Crimmins and Ingegneri, 1990; Hofferth, 1984). However, these households are at much greater risk of food insecurity as about one in ten senior households with at least one grandchild and child present and one in five senior households with a grandchild but no child present are food insecure compared to about one in twenty households without a grandchild present. At the same time, those living alone are twice as likely to experience very low food security compared to those living with other household members (the latter includes married couples). Education, like income, appears to be protective of food security as a high school drop-out is three times more likely to be at-risk or to experience hunger than a high school graduate.

Seniors living in non-metropolitan areas are as likely to experience food insecurity as those living in metropolitan areas.

II. C. Links between Poverty and Food Insecurity among Senior Households

We now examine in greater detail the prevalence of food insecurity along a variety of dimensions including income level, race and ethnicity, and family structure. We begin by examining trends in food insecurity by poverty status in Figure 2 (page 11). Figure 2 clearly demonstrates that families living in

5. Even among those who are eligible for food stamps, the proportion of food insecure households among recipients is higher than among non-recipients. This is due to factors such as adverse selection (Gundersen and Oliveira, 2001) and misreports of food stamp receipt (Gundersen and Kreider, 2008).

poverty are three times as likely to be marginally food insecure relative to the average household over age 60 (shown in Figure 1), and at least two times as likely to be food insecure or very low food secure. There is no evidence, however, of any change in food insecurity trends among poor seniors in the first half of the decade.

An alternative representation of food insecurity by poverty status is found in Figures 3–6 (page 12-14). The pie charts present the distribution of food insecurity for elderly households using the mutually exclusive categories defined in Table 1. Those households facing the most extreme poverty (incomes below 50% of the poverty line) experience the highest rates of hunger; 10 percent are characterized as very low food secure, compared with 7 percent of households with incomes between 50-100% of the poverty line, and 2.3 percent of households between 100-200% of the poverty line. The majority of those above 200% of the poverty line are fully food secure.

Appendix Tables 2, 3 and 4 provide further detail on differences for the pooled sample of senior households by level of poverty. From these tables we see among households living in poverty that characteristics associated with greater food security are white, non-Hispanic or widowed heads, the employed or retired, homeowners, and those living in non-metropolitan areas. In addition, living without a grandchild, and getting by without food stamps are equated with greater food security. Perhaps surprising, living alone or being a woman is associated with greater food security, but only if household income is less than 200 percent of poverty. Although 12.8 percent of poor elderly heads over 80 years of age are food insecure

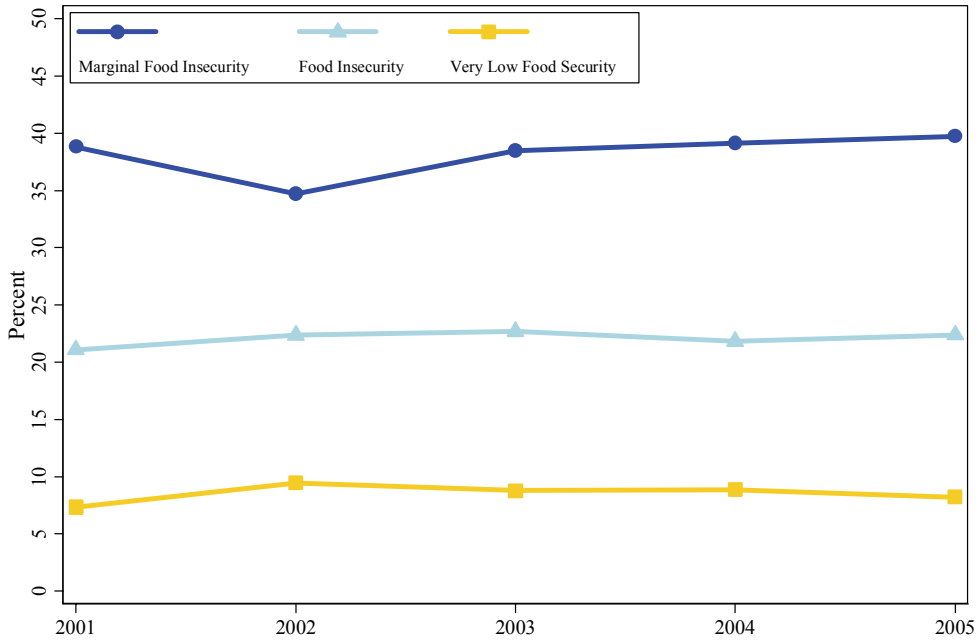


Figure 2. Food Insecurity Rates for Seniors with Incomes Below Poverty Line, 2001-2005

(Appendix Table 2), the prevalence of food insecurity rises to 19.8 percent among those households with heads between 70-80 years old, jumping to 29 percent among those age 60-70. In the regression models below we find robust evidence that the risk of food insecurity is greatest for the youngest seniors. We find similar patterns in Appendix Tables 3 and 4, where food security across all characteristics increases with income. The sharp decline in food insecurity as income increases is justification for treating households discretely by income in our models estimating the probability of food insecurity, presented Section III.

II. D. Links between Race, Ethnicity and Food Insecurity among Senior Households

In Figures 7–8 (page 15) we present trends in food insecurity rates for households headed by an African-American or person of Hispanic ethnicity. Of note is African-American households are two to two-and-a-half times as likely to be in one of the three categories as the typical senior household in Figure 1, and Hispanics have similar negative odds of food security except for very low food security. Interestingly, Hispanics are the only group to demonstrate a secular decline in food insecurity in the first half of the 2000s. This is consistent with the general improvement in the economic status of Hispanics, which were the only demographic group to document lower rates of poverty in the recent poverty report by the

Figure 3: Distribution of Food Insecurity

Income Less than 50 Percent of the Poverty Line

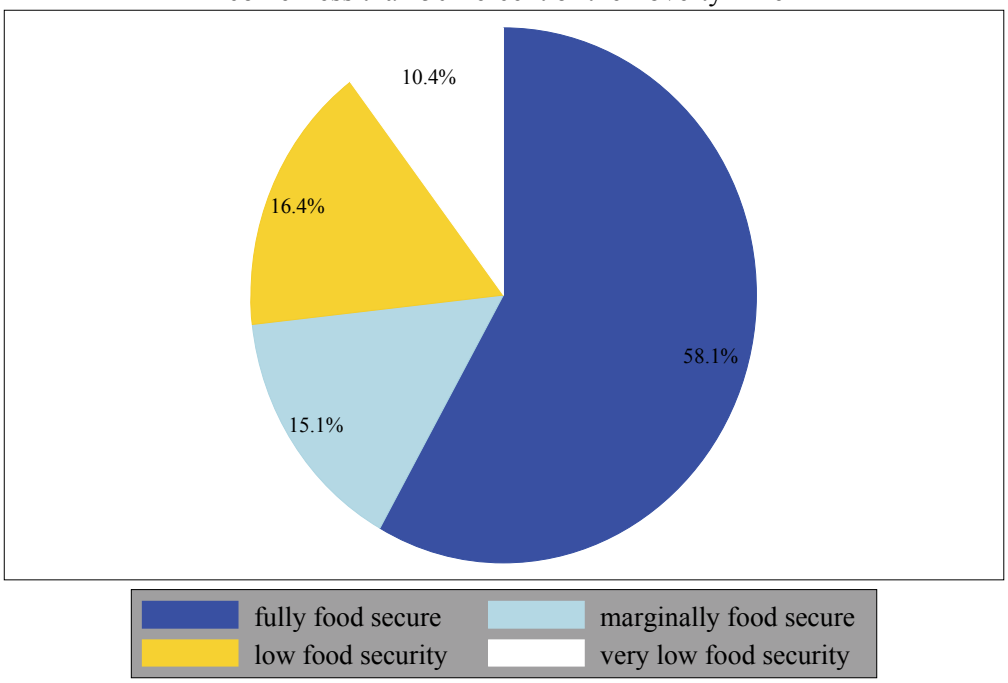


Figure 4: Distribution of Food Insecurity

Income Between 50 and 100 Percent of the Poverty Line

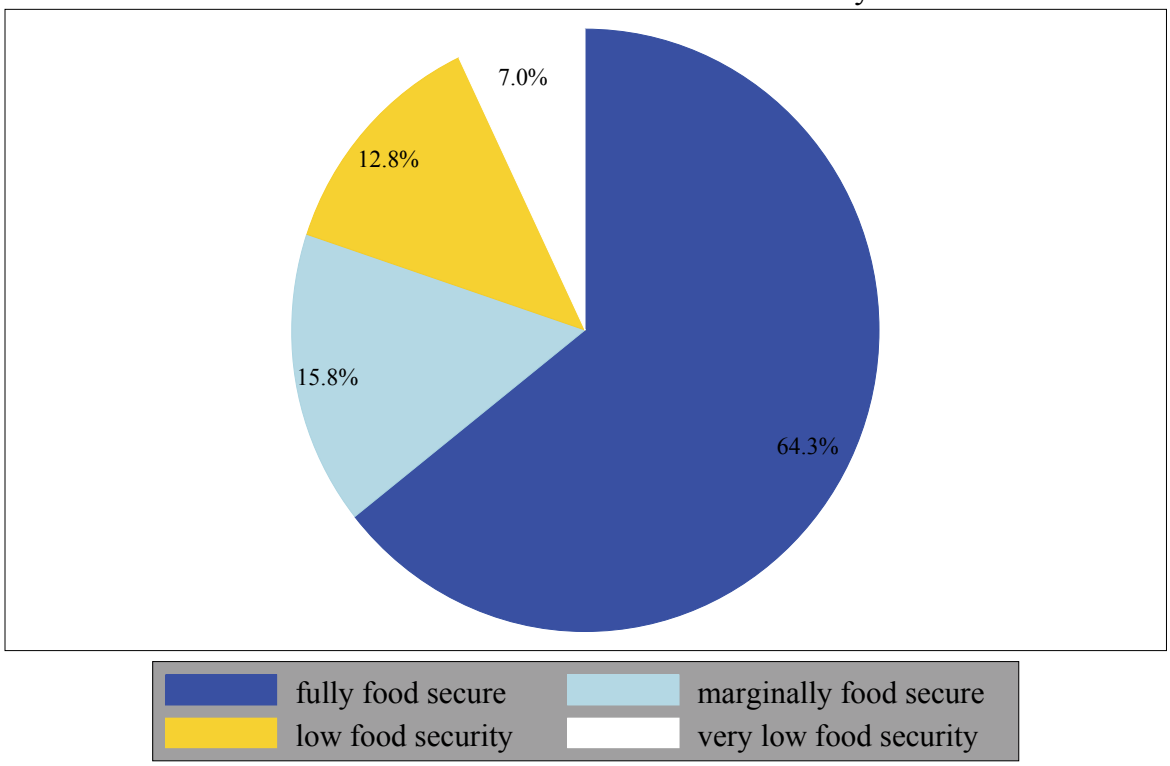


Figure 5: Distribution of Food Insecurity

Income Between 100 and 200 Percent of the Poverty Line

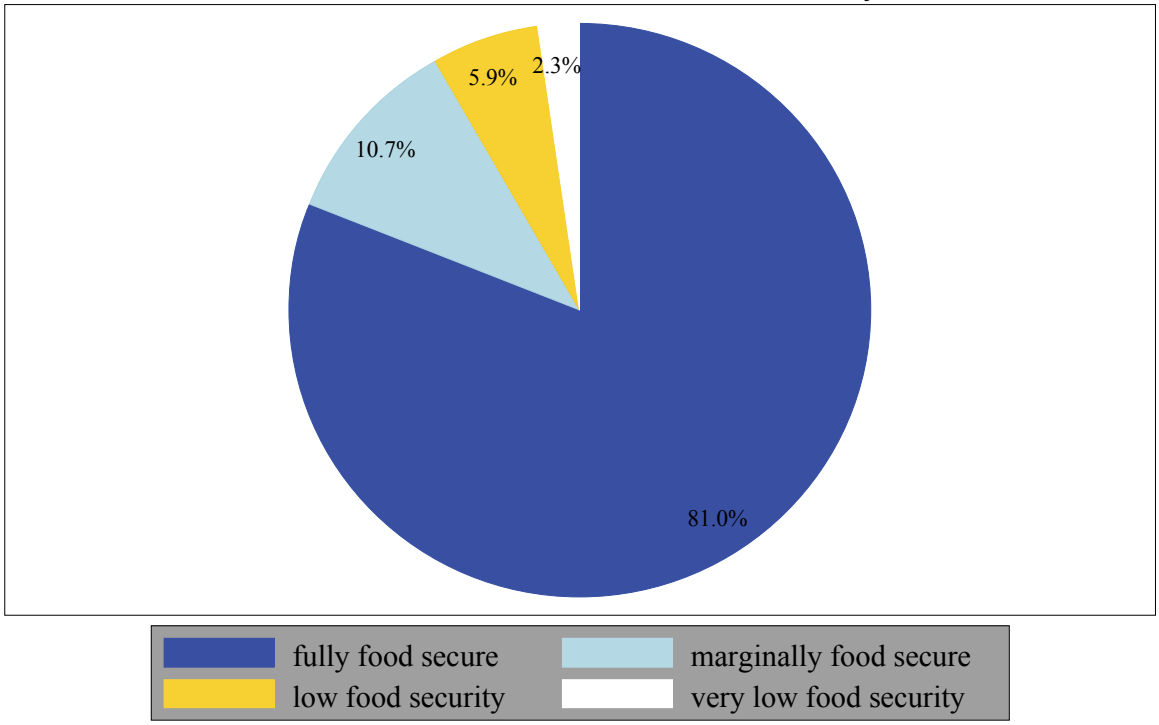
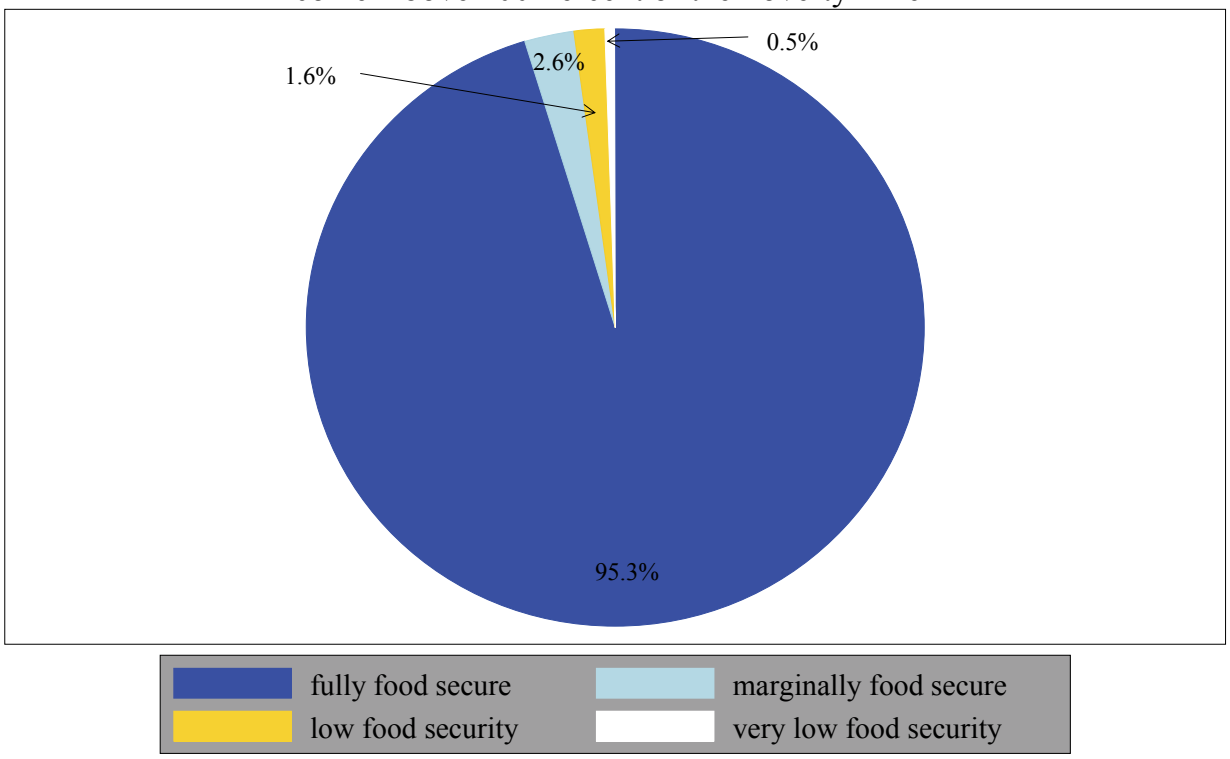


Figure 6: Distribution of Food Insecurity
Income Above 200 Percent of the Poverty Line



U.S. Census Bureau.[6]

The severity of poverty is important among both African Americans and Hispanics, though especially so for African Americans. Appendix Table 5 shows that very poor African American households (those living below 50% of the poverty line) experience high rates of food insecurity (more than one in two African American households are food insecure compared to 20 percent of Hispanics), although the sample size for this subgroup is small and the prevalence value must be interpreted with caution. On the other hand, African American households above 200% of the poverty line are much less likely to experience food insecurity or hunger; the prevalence is approximately 4 percent and 1 percent, respectively. The comparable values for Hispanics (see Appendix Table 6) are 4 percent for food insecurity and close to one percent for very low food secure, suggesting that the greatest divides across race and ethnicity are amongst the very poor. Similar to the full sample in Table 1, Appendix Tables 5 and 6 show that both African Americans and Hispanics are more likely to be food secure if they are married; the prevalence of food insecurity is similar among those who are widowed or divorced, and is highest among those who are never married or who are living alone.

6. http://www.census.gov/prod/2007pubs/p60-233.pdf

II. E. Links between Food Stamp Receipt and Food Insecurity among Senior Households

Although the majority of food insecure households were not receiving food stamps during the survey year, among seniors receiving food stamps Appendix Table 7 shows that almost four in ten (38.9 percent) are food insecure. Figure 9 (page 16) demonstrates graphically that this level of insecurity has remained relatively constant over the five years studied. Nearly 16 percent of senior households receiving food stamps experience very low food security—a rate that is twice as large as that for the population of seniors living in poverty (see Table 2).

The greatest divides for food insecurity across race and ethnicity are among the very poor.

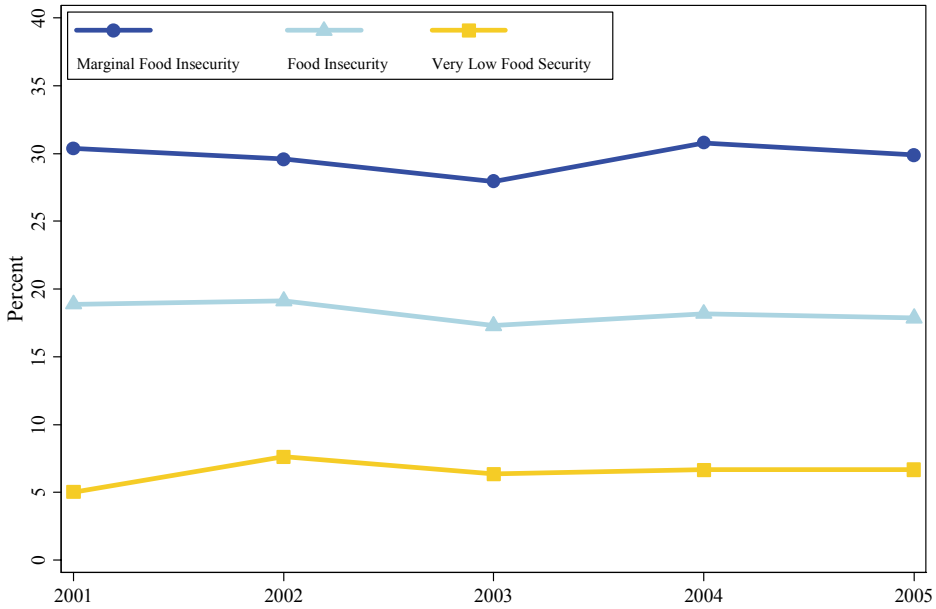


Figure 7. Food Insecurity Rates for Black Seniors, 2001-2005

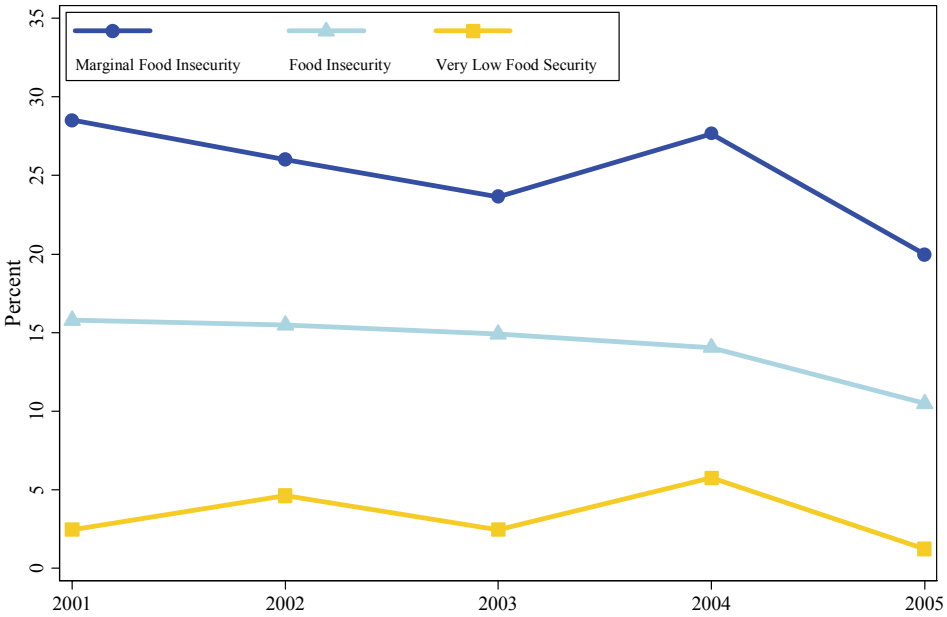


Figure 8. Food Insecurity Rates for Hispanic Seniors, 2001-2005

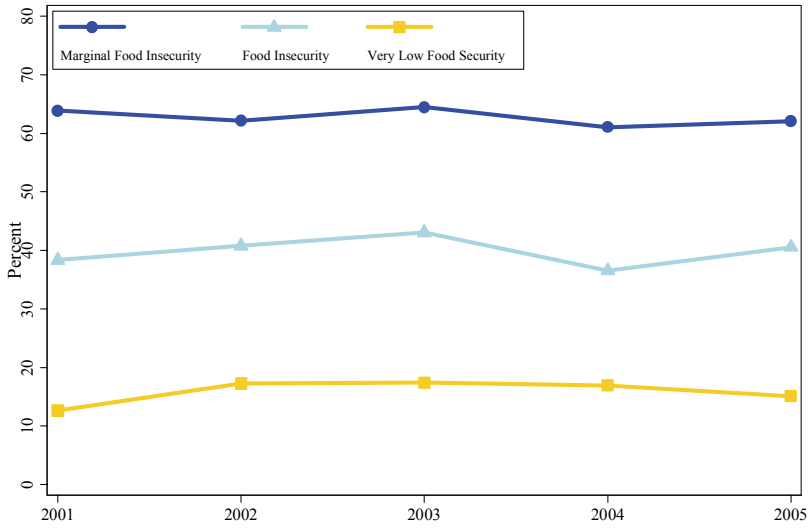


Figure 9. Food Insecurity Rates for Seniors Receiving Food Stamps, 2001-2005

Those living with a grandchild appear similar to food stamp recipients and those in poverty insofar as they experience higher rates of food insecurity than the full sample, regardless of the characteristic considered.

II. F. Links between Family Structure and Food Insecurity among Senior Households

In our examination of food insecurity rates among CPS respondents we highlight both marital status (Appendix Table 8) and the presence of a grandchild (Appendix Tables 9 and 10 and Figures 10 and 11, page 17). Appendix Tables 9 and 10 demonstrate that the severity of food insecurity is much greater among those living with a grandchild, especially in cases where only grandchildren (but no parent or parents) are present. For example, among all married couples in Table 4 about 3.7 percent are food insecure; this figure jumps to 12 percent when a grandchild is present (Appendix Table 9). Those living with a grandchild appear similar to food stamp recipients and those in poverty insofar as they experience higher rates of food insecurity than the full sample, regardless of the characteristic considered.

II. G. Links between Geographic Location and Food Insecurity among Senior Households

The percentage of senior households experiencing food insecurity varies widely across states. The maps in Figures 12–14 (page 18) displaying food insecurity across each category (marginal food insecurity, food insecurity, and very low food security) reveal that with few exceptions, senior households in the South experience the highest rates of food insecurity. Regardless of the severity of food insecurity, Mississippi, South Carolina and Arkansas always rank among the three states experiencing the greatest prevalence of food insecurity. The states with the lowest prevalence of food insecurity among the three

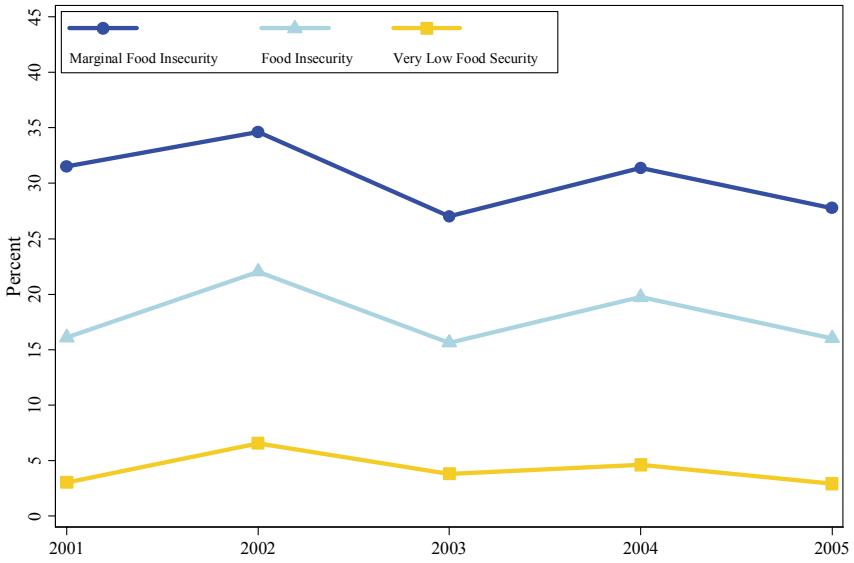


Figure 10. Food Insecurity Rates for Seniors with Grandchildren Present, 2001-2005

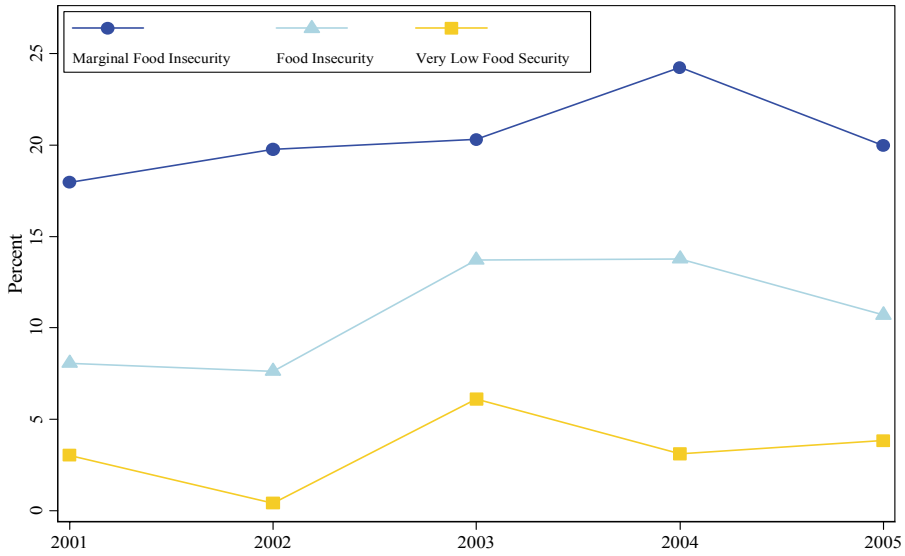


Figure 11: Food Insecurity Rates for Seniors with Grandchildren and Parents, 2001-2005

measures include the Plains states of Colorado, Nebraska, the Dakotas, and Minnesota, and the Eastern seaboard states of New Hampshire, Connecticut, Delaware and Virginia. Fewer than one percent of Louisiana's elderly household experience very low food security, positioning the state second only to South Dakota on the most extreme measure of food insecurity, yet Louisiana ranks fifth "worst" overall when considering households that experience marginal food insecurity.[7]

As shown in Table 3 about three quarters of non-food secure senior households are located in metropolitan areas. Examining the entire sample of senior households in Table 4, food security does not

7. For more on the relationship between food insecurity and state level characteristics and policies, see Bartfeld and Dunifon, 2006.

Figure 12: State Marginal Food Insecurity Rates for Seniors, 2001-2005

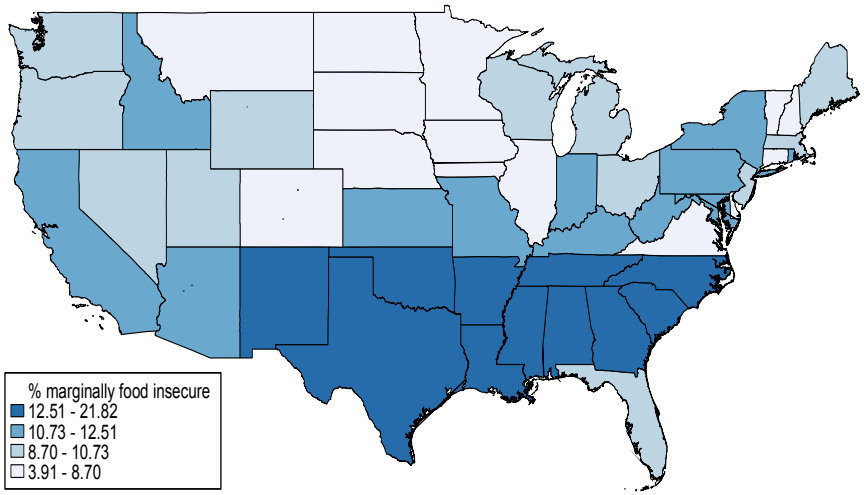


Figure 13: State Food Insecurity Rates for Seniors, 2001-2005

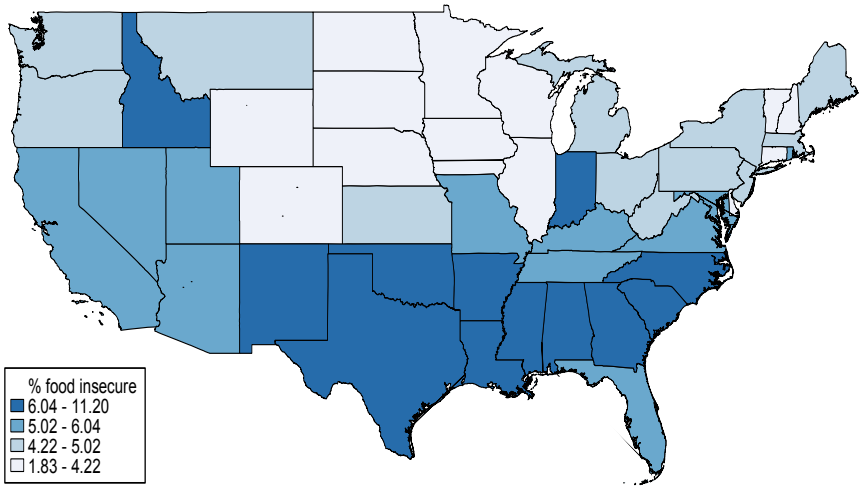
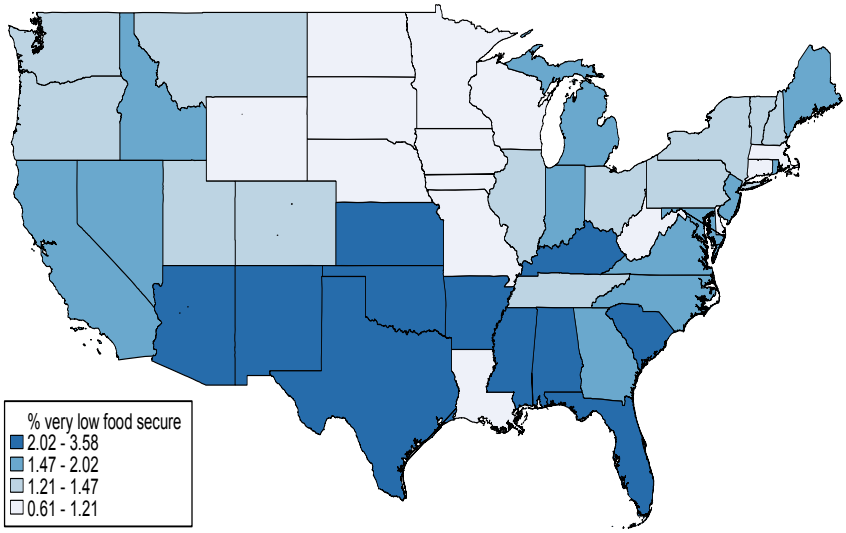


Figure 14: State Very Low Food Security Rates for Seniors, 2001-2005



appear to differ substantially across metropolitan and non-metropolitan households (with rates slightly higher among non-metropolitan households, with the possible exception of poor, marginally food insecure in Appendix Table 2). While Figures 12–14 indicate significant cross-state differences in food security, it appears that these differences affect metro and non-metro areas alike, suggesting that our multiple regression models below should control for permanent cross-state differences in food security status.

III. The Determinants of Senior Hunger

The summary statistics in Section II paint a portrait of food insecurity across a number of economic and demographic characteristics of senior households. In this section we take a step further by presenting results from food insecurity models for the full sample of elderly households simultaneously controlling for income, family structure, race, age, geography and other characteristics discussed here. The models help us determine which factors are associated with food insecurity, such as the effect of age on the probability of food insecurity holding income, race, and other factors constant, and thus we are able to estimate the probability that households with specific demographic profiles are food insecure. We use standard social science methods for models where the dependent variable takes only one of two values — 0 or 1 — by employing probit maximum likelihood. Formally, we estimate the following probit maximum likelihood model:

$$FS_{ij} = d_j + X_i p_j + v_{ij} \quad , \qquad (1)$$

where

FS_{ij} takes on a value of 1 if elder i suffers from food insecurity j,

j=*marginally food insecure, food insecure, or very low food secure;*

X_i is a vector of household demographic and economic factors;

d_j, p_j are unknown parameters to estimate;

v_{ij} is an error term.

In Table 5 (page 20) we present results from six separate variants of equation (1), three with controls for permanent state differences in columns (1)-(3) (i.e. an indicator variable for each of the 48 lower states) and three models without these so-called state fixed effects in columns (4)-(6). We focus our discussion on models with state fixed effects included. In interpreting the results it is important to recall how the dependent variables are constructed. Marginally food insecure takes a value of 1 if the household

Table 5. Estimated Marginal Effects for Food Insecurity Rates by Categories for Seniors

	Marginally Food Insecure	Food Insecure	Very Low Food Secure	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)	(4)	(5)	(6)
African American	0.070***	0.042***	0.008***	0.069***	0.038***	0.007***
	(0.006)	(0.004)	(0.002)	(0.006)	(0.004)	(0.001)
Other Race	0.033***	0.016***	0.004**	0.033***	0.015***	0.004**
	(0.008)	(0.005)	(0.002)	(0.008)	(0.005)	(0.002)
Hispanic	0.028***	0.014***	-0.001	0.031***	0.014***	-0.000
	(0.006)	(0.004)	(0.001)	(0.006)	(0.004)	(0.001)
High school	-0.030***	-0.012***	-0.003***	-0.031***	-0.012***	-0.003***
	(0.003)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)
Some College	-0.037***	-0.013***	-0.003***	-0.037***	-0.013***	-0.002***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
College	-0.059***	-0.024***	-0.005***	-0.059***	-0.025***	-0.005***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Married	-0.027***	-0.013***	-0.004**	-0.027***	-0.013***	-0.004**
	(0.006)	(0.004)	(0.001)	(0.006)	(0.004)	(0.002)
Widowed	0.006	0.004	0.001	0.006	0.005	0.002
	(0.006)	(0.003)	(0.001)	(0.006)	(0.003)	(0.001)
Divorced	0.021***	0.012***	0.003*	0.023***	0.013***	0.004**
	(0.007)	(0.004)	(0.002)	(0.007)	(0.004)	(0.002)
Age 65-69	-0.009***	-0.004**	-0.002**	-0.010***	-0.004**	-0.002**
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Age 70-74	-0.010***	-0.009***	-0.003***	-0.010***	-0.010***	-0.003***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Age 75-79	-0.020***	-0.013***	-0.004***	-0.021***	-0.014***	-0.004***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Age 80	-0.040***	-0.021***	-0.005***	-0.040***	-0.021***	-0.006***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
50-100% Poverty	-0.007	-0.006**	-0.002**	-0.009	-0.007**	-0.002**
	(0.006)	(0.003)	(0.001)	(0.006)	(0.003)	(0.001)
100-200% Poverty	-0.040***	-0.021***	-0.005***	-0.042***	-0.022***	-0.006***
	(0.005)	(0.002)	(0.001)	(0.005)	(0.002)	(0.001)
>200% Poverty	-0.149***	-0.069***	-0.019***	-0.152***	-0.071***	-0.020***
	(0.007)	(0.004)	(0.002)	(0.007)	(0.004)	(0.002)
Missing Income	-0.085***	-0.035***	-0.008***	-0.087***	-0.036***	-0.008***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Homeowner	-0.048***	-0.028***	-0.009***	-0.046***	-0.026***	-0.009***
	(0.004)	(0.003)	(0.001)	(0.004)	(0.003)	(0.001)
Non-metropolitan	0.002	0.000	-0.000	0.001	0.001	-0.000
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Employed	-0.055***	-0.024***	-0.007***	-0.055***	-0.024***	-0.007***
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Retired	-0.066***	-0.031***	-0.009***	-0.067***	-0.032***	-0.009***
	(0.004)	(0.003)	(0.001)	(0.004)	(0.003)	(0.001)
Grandchild	0.062***	0.029***	0.002**	0.063***	0.029***	0.002
	(0.007)	(0.005)	(0.001)	(0.008)	(0.005)	(0.002)
Lives Alone	-0.018***	-0.008***	-0.000	-0.018***	-0.008***	-0.000
	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
Female	-0.003	-0.004***	-0.001**	-0.003	-0.004***	-0.001**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
South	0.013	-0.003	0.002	0.008***	0.004*	0.002**
	(0.013)	(0.007)	(0.003)	(0.003)	(0.002)	(0.001)
West	0.026	0.015	0.006	0.012***	0.005**	0.002*
	(0.016)	(0.010)	(0.006)	(0.004)	(0.002)	(0.001)
Northeast	-0.014	-0.010	0.002	0.001	-0.003*	-0.000
	(0.011)	(0.006)	(0.004)	(0.003)	(0.002)	(0.001)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. N=50,330. State and year fixed effects are included in columns (1) through (3) and year fixed effects are included in columns (4) through (6).

answers affirmatively to one or more questions on the CFSM, and a value of 0 if the household is fully food secure. Food insecure takes a value of 1 if the household answers affirmatively to three or more questions, and a value of 0 if they answer yes on two or less. Very low food secure takes a value of 1 if the households answers affirmatively to six or more questions, and a value of 0 if they answer yes to five or fewer (respectively, eight and seven if there is a child present). This means that the reference groups in food insecure and very low food secure contain households that may or may not have a less severe form of food insecurity. To facilitate interpretation we present marginal effects rather than the direct coefficients on variables, meaning that the values reported in the ensuing tables refer to the effect of a one-unit change in the variable on the probability of being marginally food insecure, food insecure, and very low food secure, respectively. The variables in the models are all indicator variables and thus each grouping of characteristics has a reference category. That is, we omit white from the racial characteristics implying that the African-American and other race variables are interpreted relative to a white household. For the remaining groups the reference categories are high school dropouts, never-married household heads, heads age 60–64, households with income less than 50% of poverty, renters, residents of MSAs, the disabled and unemployed, households with no grandchild present, households with other members, male householders, and residents of the Midwest.

Among households experiencing any level of food insecurity in Table 5 (model 1), African American racial status increases the likelihood of food insecurity by 7.0 percentage points compared with white households; among other races the increase is 3.3 percentage points higher. The difference between non-Hispanic and Hispanic-headed households is 2.8 percentage points. Examining households experiencing very low food security (model 3), non-white racial status continues to be associated with a higher probability of food insecurity.[8] In this model ethnicity as measured by Hispanic status is no longer statistically significant; there is no evidence that hunger differs among Hispanics and non-Hispanics when we control for other household characteristics.

The probability of being food insecure or hungry significantly decreases as education increases; a high school graduate is 1.2 percentage points less likely to be food insecure compared to a high school dropout, which translates into about 20 percent lower odds of being food insecure from the baseline probability of 5.6 percent. This finding highlights the superiority of multiple regression over simple averages

8. We note that since the prevalence of food security is not the same across each of the categories, the coefficients are not directly comparable within columns (1) through (3) or within columns (4) through (6).

such as those reported in Table 4 which suggest that high school dropouts are 2-3 times more likely than high school graduates to be at-risk of hunger. The regression results in Table 5 show that after controlling for other intervening factors education is indeed an important protective factor of food security but at a much reduced level than the averages might intimate. Table 5 also shows that married seniors across all levels of food security are less likely to be food insecure than never-married seniors, and our analysis demonstrates that being divorced increases the probability of being marginally food insecure or low food insecure by a percentage point over being never married. The size of the marginal effects on married persons suggest that marriage offers protection against food insecurity on a scale comparable to a high school diploma, i.e. about a 20 percent reduced probability of being at risk of hunger.

The size of the marginal effects on married persons suggest that marriage offers protection against food insecurity on a scale comparable to a high school diploma, i.e. about a 20% reduced probability of being at risk of hunger.

Approximately 25 percent of the sample consists of households headed by persons 60-64 years old, and these households are more likely to experience any level of food insecurity than older seniors. For example, 65-69 year olds are 0.4 percentage points less likely to be food insecure, 70-74 year olds are 0.9 percentage points less likely, 75-79 year olds are 1.3 percentage points less likely, and seniors age 80 and older are 2.1 percentage points less likely to be food insecure compared to 60-64 year olds. That is, an 84 year old is over one-third less likely to be at-risk of hunger than a 64 year old on the baseline food insecurity rate of 5.6 percent. Conventional wisdom, and some community-level studies (Quandt, et al. 2001; Schoenberg 2000), suggests that food insecurity may increase with age. To our knowledge our study is the first to document the age gradient of food insecurity among seniors in a nationally representative sample.

An 84-year-old is over one-third less likely to be at-risk of hunger than a 64 year old on the baseline food insecurity rate of 5.6%.

At this juncture we do not fully understand the reasons for the declining age gradient, and believe it should be a research priority going forward, but there are a few factors that are consistent with our results. One possibility is that elderly nutrition programs such as Meals On Wheels have historically focused resources on the oldest old, and the programs have been effective in alleviating food insecurity and hunger among this older age cohort. Another possibility, as suggested by Schoenberg (2000), is that seniors have developed time-tested strategies to meet basic needs and thus are less likely to state that they are hungry.

There is also the possibility that emotional and physiological factors are at play in that seniors tend to suffer higher rates of depression; they often lack social interaction (especially relevant during the socially active time of eating); they suffer from declining sensory perception leading to the loss of enjoyment of food; and they have reduced physical and mental activity that lessens the need for caloric intake.[9] While the pathways are potentially many and varied, our results highlight a sizable population facing an unmet food need that is likely to grow significantly with the 'Baby Boom' generation entering their sixties.

Turning to other results in Table 5, we are unable to determine income for about one-quarter of the sample. We include these households in a separate category, and find that the effect size of income for this group falls between the values for those living between 100-200 percent of the poverty line and those living above 200 percent of the poverty line. When compared with households living below 50 percent of the poverty line (the reference category), seniors with higher incomes always have lower probabilities of being food insecure, with one exception. In columns (1) and (4), households living between 50 and 100 percent of the poverty line are not less likely to be marginally food insecure than those living below 50 percent of the poverty line. Households above 200 percent of the poverty line have nearly a 15 percentage point lower probability of being marginally food insecure than those living below 50 percent of the poverty line, a 7 percentage point lower probability of being food insecure, and a 2 percentage point lower probability of being very low food secure. As we would expect, the predicted probabilities that depict the relationship between income and food security for those living between 100-200 percent of the poverty line fall in between the values in the models for those living below the poverty line and those above 200 percent of the poverty line.

Home ownership is associated with a 5 percentage point lower probability of being marginally food insecure, and a 1 percentage point lower probability of being very low food secure. Metropolitan status does not affect food security once other household characteristics are taken into account. Employed and retired household heads are less likely to be food insecure than unemployed or disabled heads (the omitted groups); the effect is somewhat greater for those who are retired. Those living with a grandchild (with or without the child's parent present) are about 6 percentage points (or 50%) more likely to be marginally food insecure than those who do not, but looking at model 3, we see the probabilities are the same (the effect is no longer significant) when we examine only households that are very low food secure. Living

9. We are grateful to Nancy Schoenberg for suggesting these possible pathways underlying the declining age gradient.

alone is protective of being food insecure, but these individuals are no more or less likely to be hungry relative to persons living with other family or non-family members. Women, however, are less likely to be very low food secure, but the magnitude is negligible. Finally, there are no substantive differences in food security across broad regions of the country once we control for state-specific differences (those in the South and West households have higher probabilities of being food insecure without these controls). This suggests that permanent state policy or geographic barriers (such as difficulty getting to a store or limited availability of elderly nutrition services) in Southern and Western states may contribute to the greater probability of food insecurity among households in these regions.

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III. A. Differences in Food Insecurity by Poverty Status

We now turn to our results broken down by poverty status, where we replicate the models from columns (1) through (3) in Table 5 for those below the poverty line (Table 6), those between the line and twice the line (Table 7) and those whose incomes exceed two times the poverty line (Table 8).

As seen in Table 6 (page 25), among those living in poverty, being African American represents a 13 percentage point increase in the probability of being food insecure, a rate that is more than 50 percent higher than for a poor white household. Although poor persons of Hispanic descent are more likely to be marginally food insecure, they are also 2.5 percentage points less likely to be very low food secure. Even among the poor, the likelihood of experiencing food insecurity decreases with education – there is a nearly 10 percentage point difference between those who have completed college and those who have less than a high school education in the probability of being food insecure. Married persons are less likely suffer from hunger, while divorced persons are about 5 percentage points more likely to be food insecure. Controlling for other factors, shown in model 2 the percentage point difference between those who are over 80 and those aged 60-64 is 12 (poor, older seniors are 50 percent less likely to be food insecure than poor, younger seniors). Home ownership, being employed or retired, living without a grandchild, living alone, and living in the Northeast or South decrease the likelihood of a poor person being food insecure (but the

Table 6. Estimated Marginal Effects for Food Insecurity Rates for Seniors below 100% of the Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)
African American	0.151***	0.133***	0.035***
	(0.021)	(0.019)	(0.011)
Other Race	-0.004	-0.005	-0.009
	(0.035)	(0.028)	(0.014)
Hispanic	0.051*	0.017	-0.025***
	(0.027)	(0.021)	(0.008)
High School	-0.076***	-0.050***	-0.019***
	(0.016)	(0.012)	(0.007)
Some College	-0.071***	-0.032*	-0.006
	(0.022)	(0.017)	(0.010)
College	-0.150***	-0.099***	-0.029***
	(0.028)	(0.019)	(0.010)
Married	-0.043	-0.038	-0.026**
	(0.031)	(0.024)	(0.012)
Widowed	0.031	0.019	-0.005
	(0.029)	(0.023)	(0.012)
Divorced	0.098***	0.054**	0.022
	(0.031)	(0.026)	(0.015)
Age 65-69	-0.030	-0.015	-0.013*
	(0.022)	(0.016)	(0.008)
Age 70-74	-0.036	-0.040**	-0.012
	(0.023)	(0.017)	(0.009)
Age 75-79	-0.097***	-0.075***	-0.028***
	(0.023)	(0.016)	(0.008)
Age 80	-0.171***	-0.124***	-0.043***
	(0.021)	(0.015)	(0.008)
Homeowner	-0.103***	-0.086***	-0.046***
	(0.016)	(0.013)	(0.008)
Non-metropolitan	-0.013	0.001	0.009
	(0.017)	(0.014)	(0.008)
Employed	-0.195***	-0.115***	-0.039***
	(0.021)	(0.014)	(0.007)
Retired	-0.158***	-0.108***	-0.045***
	(0.019)	(0.015)	(0.009)
Grandchild	0.095***	0.069***	0.006
	(0.030)	(0.025)	(0.013)
Lives Alone	-0.085***	-0.048***	-0.012
	(0.020)	(0.016)	(0.009)
Female	-0.027*	-0.020	-0.015**
	(0.016)	(0.013)	(0.007)
South	-0.233***	-0.231***	-0.005
	(0.090)	(0.073)	(0.038)
West	0.022	0.021	-0.005
	(0.114)	(0.090)	(0.040)
Northeast	-0.161**	-0.205***	-0.043
	(0.078)	(0.046)	(0.029)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. N=5,221. State and year fixed effects are included.

Table 7. Estimated Marginal Effects for Food Insecurity Rates for Seniors between 100% and 200% of the Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)
African American	0.102***	0.075***	0.018***
	(0.017)	(0.013)	(0.006)
Other Race	0.055**	0.046***	0.013
	(0.025)	(0.018)	(0.009)
Hispanic	0.013	0.017	-0.008***
	(0.017)	(0.012)	(0.003)
Highschool	-0.062***	-0.019***	-0.007***
	(0.009)	(0.005)	(0.003)
Some College	-0.061***	-0.020***	-0.007**
	(0.010)	(0.006)	(0.003)
College	-0.069***	-0.016*	-0.010***
	(0.013)	(0.009)	(0.003)
Married	-0.031	0.003	0.001
	(0.020)	(0.013)	(0.006)
Widowed	0.021	0.028**	0.006
	(0.020)	(0.014)	(0.006)
Divorced	0.030	0.039**	0.008
	(0.022)	(0.018)	(0.008)
Age 65-69	-0.018	-0.012*	-0.001
	(0.012)	(0.007)	(0.003)
Age 70-74	-0.039***	-0.030***	-0.008***
	(0.012)	(0.006)	(0.003)
Age 75-79	-0.039***	-0.032***	-0.011***
	(0.012)	(0.006)	(0.003)
Age 80	-0.080***	-0.048***	-0.013***
	(0.011)	(0.006)	(0.003)
Homeowner	-0.081***	-0.058***	-0.017***
	(0.011)	(0.008)	(0.004)
Non-metropolitan	-0.008	-0.005	-0.004
	(0.009)	(0.006)	(0.003)
Employed	-0.106***	-0.049***	-0.016***
	(0.010)	(0.005)	(0.002)
Retired	-0.125***	-0.065***	-0.022***
	(0.014)	(0.010)	(0.005)
Grandchild	0.121***	0.075***	0.011
	(0.021)	(0.015)	(0.007)
Lives Alone	-0.035***	-0.015**	0.002
	(0.011)	(0.007)	(0.004)
Female	-0.007	-0.011**	-0.004
	(0.008)	(0.005)	(0.003)
South	0.063	-0.001	-0.002
	(0.053)	(0.034)	(0.015)
West	0.090	0.165***	0.008
	(0.056)	(0.060)	(0.019)
Northeast	0.050	0.049	0.005
	(0.048)	(0.041)	(0.016)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. N=10,390. State and year fixed effects are included.

Table 8. Estimated Marginal Effects for Food Insecurity Rates for Seniors above 200% of the Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)
African American	0.040***	0.018***	0.004*
	(0.007)	(0.005)	(0.002)
Other Race	0.029***	0.011**	0.004
	(0.009)	(0.005)	(0.003)
Hispanic	0.016**	0.006	0.002
	(0.007)	(0.004)	(0.002)
High School	-0.015***	-0.005***	-0.000
	(0.003)	(0.001)	(0.001)
Some College	-0.020***	-0.007***	-0.001
	(0.002)	(0.001)	(0.001)
College	-0.035***	-0.014***	-0.002***
	(0.002)	(0.001)	(0.001)
Married	-0.018**	-0.011**	-0.002
	(0.007)	(0.004)	(0.002)
Widowed	-0.001	-0.002	0.001
	(0.006)	(0.003)	(0.001)
Divorced	0.004	-0.000	0.000
	(0.007)	(0.003)	(0.001)
Age 65-69	-0.006**	-0.000	-0.001*
	(0.003)	(0.002)	(0.000)
Age 70-74	-0.005*	-0.002	-0.001
	(0.003)	(0.002)	(0.001)
Age 75-79	-0.009***	-0.004***	-0.001***
	(0.003)	(0.002)	(0.000)
Age 80	-0.016***	-0.006***	-0.002***
	(0.003)	(0.001)	(0.000)
Homeowner	-0.024***	-0.012***	-0.003**
	(0.005)	(0.003)	(0.001)
Non-metropolitan	0.006**	0.002	0.001
	(0.003)	(0.002)	(0.001)
Employed	-0.022***	-0.008***	-0.002***
	(0.003)	(0.002)	(0.001)
Retired	-0.026***	-0.012***	-0.003***
	(0.004)	(0.003)	(0.001)
Grandchild	0.035***	0.010**	0.001
	(0.009)	(0.005)	(0.002)
Lives Alone	-0.005	-0.001	0.000
	(0.003)	(0.002)	(0.001)
Female	-0.000	-0.000	-0.000
	(0.002)	(0.001)	(0.000)
South	0.008	-0.010	0.002
	(0.017)	(0.006)	(0.004)
West	0.033	0.006	0.002
	(0.021)	(0.008)	(0.004)
Northeast	-0.001	-0.010**	0.001
	(0.014)	(0.005)	(0.003)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. N=23,968. State and year fixed effects are included.

regional differences are zero for the very low food secure).

Tables 7 (page 26) and 8 (page 27) present similar findings among seniors between 100-200 percent of poverty and above 200 percent of poverty, respectively. The pattern of results are largely similar to those found in Table 6, except that widowers as well as divorced persons among the near poor in Table 7 both have higher odds of being food insecure, and among the non-poor in Table 8 there is no longer a difference in food security rates among those living alone versus with others.

III. B. Demographic Profiles of Hunger Risk

To understand the influence of key characteristics on food insecurity we look at hypothetical household demographic profiles and predict their probability of being food insecure. Again using data from 2001-2005 from the CPS, in Table 9 (page 29) we construct a "high-risk" group and a "low-risk" group of food insecure, and within each group we isolate the protective role of income. Based on the probit coefficients used in constructing the marginal effects found in Table 5, the high-risk group in Table 9 consists of a Hispanic African-American who is a high school dropout, is divorced, is living with a grandchild, is between the ages of 60 and 64, is renting, is living in the non-metro South, and is disabled or unemployed. This hypothetical household if living below one-half the poverty line is predicted to have a 95 percent chance of being marginally food insecure, an 88 percent chance of being food insecure, and a 47 percent chance of being hungry. These percentages are little changed when we include those with incomes between 50 and 100 percent of poverty, and indeed are quite stable even with incomes between the line and twice the poverty line, though the likelihood of hunger falls by one-fourth. Although few of the households in the CPS are characterized by this exact combination of demographic variables, the idea behind calculating these probabilities is to identify those groups most in need of senior nutrition services.

Significant improvements in the probability of food insecurity with or without hunger are realized for the hypothetical low-risk group of seniors. The low-risk group consists of a white college graduate who is married, not living with a grandchild, is age 80 or older, is a homeowner, who lives in a metro area in the Northeast, and is retired. This hypothetical household is 86 percent less likely to be at-risk of hunger or hungry even if household income is below 50 percent of the poverty line. This highlights the cumulative protective roles of marriage, higher education, age, race, and home ownership. The low-risk group is predicted to have no chance of being food insecure or very low food secure if family incomes exceed

Table 9. Predicted Probability of Food Insecurity for High Risk and Low-Risk Seniors (In Percent)

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)
High Risk Groups			
Below 50% of the Poverty Line	95	88	47
Below 100% of the Poverty Line	94	85	42
Between 100% and 200% of the Poverty Line	89	77	31
Above 200% of the Poverty Line	69	55	15
Low Risk Groups			
Below 50% of the Poverty Line	13	5	2
Below 100% of the Poverty Line	12	4	1
Between 100% and 200% of the Poverty Line	7	2	1
Above 200% of the Poverty Line	1	0	0

Notes: The predicted probabilities derive from estimates reported in Table 5. The high risk group is defined as someone who is African American, Hispanic, a non-high-school graduate, divorced, living with grandchild, age 60-64, renting, living in the South, living in a nonmetro area, and disabled or unemployed. The low risk group is defined as someone who is white, a college graduate, married, not living with grandchild, age 80 or older, homeowner, living in the Northeast, living in a metro area, and retired. The table includes both men and women and is pooled across 2001-2005.

Table 10. Predicted Probability of Being Food Insecure among Households Living Below 100% of the Poverty Line by Different Characteristics (In Percent)

African American, Non-Hispanic, High School Graduate, Never Married, Age 60-64, Renting, Employed, No Grandchild, Southern Nonmetro	36
African American, Non-Hispanic, High School Graduate, Married, Age 60-64, Homeowner, Employed, No Grandchild, Southern Nonmetro	21
White, Non-Hispanic, High School Graduate, Never Married, Age 60-64, Renting, Employed, No Grandchild, Southern Nonmetro	22
White, Non-Hispanic, High School Graduate, Married, Age 60-64, Homeowner, Employed, No Grandchild, Southern Nonmetro	11
African American, Non-Hispanic, High School Graduate, Never Married, Age 80, Renting, Retired, No Grandchild, Southern Nonmetro	23
African American, Non-Hispanic, High School Graduate, Married, Age 80, Homeowner, Retired, No Grandchild, Southern Nonmetro	12
White, Non-Hispanic, High School Graduate, Never Married, Age 80, Renting, Retired, No Grandchild, Southern Nonmetro	13
White, Non-Hispanic, High School Graduate, Married, Age 80, Homeowner, Retired, No Grandchild, Southern Nonmetro	6
Profiles for Disabled Widows Living Alone	
African American, Non-Hispanic, High School Dropout, Age 65-69, Renter, No Grandchild, Metro, Any Region	49
African American, Non-Hispanic, High School Graduate, Age 65-69, Homeowner, No Grandchild, Metro, Any Region	29
African American, Non-Hispanic, High School Graduate, Age 75-79, Homeowner, No Grandchild, Metro, Any Region	22
White, Non-Hispanic, High School Graduate, Age 75-79, Homeowner, No Grandchild, Metro, Any Region	16

twice the poverty line, compared to a 55 percent and 15 percent chance among the high-risk group.

Instead of changing all the demographics at once, in Table 10 we construct a hypothetical household with income below the poverty line and then selectively alter other, non-income characteristics of the household to examine more closely their role in predicting food insecurity or the likelihood of being at risk for hunger or hungry. We again use the probit coefficients underlying the marginal effects in Table 5 for these profiles.

In Table 10 (page 29) we begin with a poor African-American household whose head is a high school graduate that never married, is age 60–64, is renting, is employed, has no grandchild in the household, and lives in the non-metro South. The predicted probability of this household being food insecure is 36 percent. If we change the baseline family from being never-married to currently married, and from being a renter to a homeowner, the probability of food insecurity falls to 21 percent. If we take the baseline household and simply assume that the head is white and not African American the probability falls from 36 to 22 percent. In rows five through eight we manipulate age and employment status among our African American and white households. The African American household in the first row (never married and renting) is now at least 80 years old and retired in row five. The predicted probability of being food insecure for this poor household drops from 36 to 23 percent, highlighting how food security increases among the oldest old. When we change the region where this individual lives to the Northeast, the probability is 17 percent (not shown in the table). The African American household in the second row (married homeowner) when over 80 years old and retired experiences a 43 percent decrease in the probability of being food insecure (from 21 to 12 percent). Imposing the same age and retirement changes on the white households drops the probabilities for these seniors to 13 percent and 6 percent, respectively.

The analyses presented in this section demonstrate that although poverty is an important predictor of food insecurity, other characteristics including being white, married without grandchildren in the home, employed or retired, older, well-educated, and owning one's home can meaningfully buffer the effect of being poor and that these characteristics in combination can reduce the probability of experiencing low food security to almost zero.

In the bottom panel of Table 10 we highlight the vulnerable population of disabled widows living alone. If the widow is an African American age 65–69 with less than a high school diploma and who is renting in a metropolitan area then her predicted probability of being at-risk of hunger is 49 percent. If we assume that this same disabled widow graduated from high school and owns her home then this risk

of hunger plunges to 29 percent, again highlighting the importance of education and assets in alleviating food need. If the widow is ten years older and is a white non-Hispanic then the odds of hunger fall further still to 16 percent. In results not tabulated, we predicted the profiles for widowers instead of widows and the probabilities only increased by about one percentage points in each profile. Similar to the results for the age gradient, understanding why a large gap exists in food insecurity rates across whites and African Americans, even holding income and other factors constant, should be a future research priority.

In Section II of this report we presented tables showing the prevalence of low food security among various subgroups. The analyses presented in this section demonstrate that although poverty is an important predictor of food insecurity, other characteristics including being white, married without grandchildren in the home, employed or retired, older, well-educated, and owning one's home can meaningfully buffer the effect of being poor and that these characteristics in combination can reduce the probability of experiencing low food security to almost zero. Analyses presented in the next section examine the relationship between the severity of food insecurity and various health consequences.

IV. Health Consequences of Senior Hunger from the NHANES

In this section, we consider the impact of food insecurity on various health outcomes of seniors in the United States. We begin with a review of previous work on the relationship between food insecurity and health outcomes. We then turn to a description of the data we use for our analysis, the 1999-2002 National Health and Nutrition Examination Survey (NHANES) followed by the results of our analyses.

IV. A. Review of Previous Research

Low intakes of essential nutrients present a serious threat to the health of elderly persons in the United States. In national nutrition studies, the elderly have been found to have low intakes of energy, fiber, magnesium, antioxidants, and some other micronutrients (Berg and Cassells, 1992). For about 25 percent of elderly persons, these intakes are low enough to lead to an increased risk of nutrient deficiencies (Millen, 1999). These nutritional deficiencies can have serious consequences including diminished immune response, longer hospital stays, impairment in physical function, premature institutionalization, reduced activity levels, and higher risks of coronary heart disease (Chen et al., 2001; Chima et al., 1997;

Hendy et al., 1998; Herndon, 1995; Lesourd et al., 1998; Seiler and Stahelin, 1999; Sharkey et al., 2002). The effect of insufficient nutrient intakes is large enough that an estimated one-third to one-half of all health conditions in elderly persons may be related to low intakes (Ryan and Bower, 1989). These problems are more severe for the elderly than for the general population due, in part, to factors more common among the elderly including the use of multiple medications, and the incidence of oral health problems and chemosensory dysfunction (Ausman and Russell, 1999; Rolls, 1999; Schiffman, 1997) and to factors specific to the aging process (Campbell, et al., 1994; Roberts, et al., 1994; Rosenbloom and Whittington, 1993; Russel, 1992).

While there has been extensive work looking at nutrient-related deficiencies among the elderly and the consequences of those deficiencies, much less work has been done looking at the consequences of food insecurity among the elderly.[10] In other populations, food insecurity and hunger have been associated with a wide array of negative outcomes. For example, previous research, spanning numerous academic studies, has found that members of households suffering from food insecurity are more likely to incur compromised psychosocial functioning (Olson, 1999; Kleinman et al., 1998; Vozoris and Tarasuk, 2003), frequent stomachaches and headaches (Alaimo et al., 2001), obesity (Che and Chen, 2003; Adams et al., 2003; Townsend et al., 2001; Kaiser et al., 2004), depression (Che and Chen, 2003; Vozoris and Tarasuk, 2003; Heflin and Ziliak, Forthcoming), multiple chronic conditions (Che and Chen, 2003; Vozoris and Tarasuk, 2003), lower health outcomes across the SF-36 scales (Pheley et al., 2002; Stuff et al., 2004), increased odds of being hospitalized (Cook et al., 2004), higher levels of hyperactivity (Murphy et al., 1998), and greater propensities to have seen a psychologist (Alaimo et al., 2001).

Although some of the findings for the general population will carry over to seniors, the impact of hunger may be quite different for seniors as they are more likely to be in poor health than non-seniors. This makes research specific to seniors especially important. There has, however, been much more limited research on the effect of food insecurity on the nutrient intake and health of seniors. Lee and Frongillo (2001) found that food insufficient seniors have lower intakes of a variety of nutrients and lower skinfold thickness and are more likely to be in fair or poor health than food sufficient seniors.[11] In comparison to

10. While food insecurity is related to nutrient deficiencies (e.g., Kendall et al., 1996; Dixon et al., 2001) there is not an exact correspondence. Moreover, data sets with information on nutrient intakes are much less prevalent than data sets with information on food insecurity.
11. This food sufficiency question asks respondents to describe their food intake in terms of the following: Which of these statements best describe the food eaten in your household in the last month? Respondents have four choices: enough of the kinds of food we want to eat; enough but not always the kinds of food we want to eat; sometimes not enough to eat; or often not enough to eat. Those households reporting that they sometimes or often do not get enough to eat are considered food insufficient.

seniors without financial difficulties obtaining food, Klesges et al. (2001) found that seniors with difficulties obtaining food had higher levels of depression, poorer quality of life, and lower levels of physical performance. As food insecurity worsened, Holben et al. (2006) found that general functioning, bodily pain, general health, vitality, and mental health all declined among seniors. Kim and Frongillo (2007) found a positive relationship between food insecurity and obesity among seniors. Finally, Bhattacharya et al. (2004) found that some measures of food insecurity were related to nutrient intakes, even after controlling for other risk factors such as poverty status. Collectively, this work has yielded many important insights and serves as a guide for future work. However, this research may be somewhat limiting; in some cases the samples sizes were quite small (Holben et al., 2006), in others the samples were for only limited areas (Klesges et al., 2001), and in others the full set of food insecurity questions were not used (Bhattacharya et al., 2004; Lee and Frongillo, 2001; Kim and Frongillo, 2007).

IV. B. Data from NHANES

For the analyses in this section, we use data from the 1999-2002 NHANES. The NHANES, conducted by the National Center for Health Statistics, Centers for Disease Control (NCHS/CDC), is a program of studies designed to assess the health and nutritional status of adults and children in the United States through interviews and focused physical examinations. The survey now examines a nationally representative sample of about 5,000 persons each year, about half of whom are adults. The interview includes demographic, socioeconomic, dietary, and health-related questions and health assessments consisting of medical and dental examinations, physiological measurements and laboratory tests. Vulnerable groups, including persons over 60, are oversampled in the NHANES to produce more reliable statistics. We use weights constructed by NHANES that are applicable for samples pooled across years.

For the analyses here, we use data from the following subset of NHANES modules: demographics, food security, occupation, health insurance, body measures, diabetes, hospital utilization, physical functioning, total nutrients, and current health. Of particular importance to the analyses here is, of course, the presence of the full CFSM on the food security module.

We use the following sets of variables. For nutrient intakes we consider variables measuring energy intake, protein, vitamin A, vitamin C, thiamin, riboflavin, vitamin B6, calcium, phosphorous, magnesium, and iron. These are all based on individual's self-reports of their food consumption for two full days.

Table 11. Health Outcomes by Food Insecurity Status for Seniors, Full Sample

	Food Secure	Marginally Food Secure	Low Food Security	Very Low Food Secure
	(1)	(2)	(3)	(4)
Nutrient intakes				
Energy Intake	1791.40	1534.77*	1565.71*	1385.88*
Protein	69.54	62.44*	62.68*	55.64*
Vitamin A	858.84	721.85	646.99*	661.08
Vitamin C	100.22	79.42*	70.63*	68.33*
Thiamin	1.50	1.31*	1.25*	1.17*
Riboflavin	1.95	1.66*	1.69*	1.44*
Vitamin B6	1.76	1.52*	1.57	1.28*
Calcium	742.36	588.18*	616.20*	566.56*
Phosphorous	1145.93	981.08*	986.69*	872.59*
Magnesium	267.30	231.06*	218.33*	209.29*
Iron	14.78	12.69*	13.52	11.89*
Measures of body size				
BMI	28.18	30.90*	29.31	27.06
Arm circumference	32.24	33.96*	32.95	31.22
Tricep skinfold	19.22	21.86*	19.40	17.41*
Subscapular skinfold	19.49	22.11*	21.09	19.76
Diabetic	0.14	0.26*	0.21	0.24
Self-Reports of General Health				
Excellent	0.16	0.09	0.04*	0.06*
Excellent or very good	0.44	0.16*	0.19*	0.20*
Excellent, very good, or good	0.77	0.51*	0.36*	0.54*
Suffers from depression	0.02	0.06	0.11*	0.11
ADL limitations	0.62	0.76*	0.84*	0.88*

Notes: Food secure is defined as 0 affirmative responses in the Core Food Security Module; marginally food insecure is defined as 1-2 affirmative responses; low food secure is defined as 3-7 affirmative responses for a household with children, 3-5 for a household without children; very low food secure is defined as 8 or more affirmative responses for a household with children, 6 or more for a household without children. * Different from column (1), $p \leq 0.05$.

We examine body measurement including body mass index (the BMI is based on the weight and height of individuals), arm circumference, tricep skinfold, and subscapular skinfold. Body measurements are performed by trained surveyors for the NHANES. The final set of variables is based on individuals' self-reports – diabetes, self-reports of general health (excellent, very good, good, fair, or poor), depression, diabetes, and ADL limitations.

IV. C. Descriptive Associations Between Food Insecurity and Health Outcomes

We now turn to our results for the variables listed above. We begin with the full sample of all

individuals. The results for each variable are displayed in Table 11 (page 34) and are broken into four mutually exclusive categories – food secure, marginally food secure, low food secure, and very low food secure. For this full sample, the proportions of individuals in each category are 92 percent, 4 percent, 3 percent and 2 percent, respectively. (For more information on the sample, see Appendix Table 11.)

Intakes are lower for each nutrient for comparisons between the three food insecurity categories versus the food secure category. And, in almost all cases, these differences are statistically significant. The differences are particularly stark for some comparisons. For example, the energy intakes of very low food secure individuals are 29.3 percent lower than food secure individuals; vitamin C intakes are 46.7 percent lower; and vitamin B6 intakes are 27.3 percent lower.

Based on previous research for other portions of the population, the expected relationship between food insecurity and body size is ambiguous. For example, Alaimo et al. (2001), Gundersen et al. (2007), Kaiser et al. (2002), and Martin and Ferris (2007) find no relationship between food insecurity and obesity; Jimenez-Cruz et al. (2003), Matheson et al. (2002), and Rose and Bodor (2006) find an inverse relationship; and Casey et al. (2001), Casey et al. (2006), Dubois et al. (2006), and Jyoti et al. (2005) find a positive relationship. Among seniors, we find no difference between low food secure and food secure individuals and very low food secure and food secure individuals. However, marginally food insecure individuals have statistically significantly higher BMIs than food secure individuals – 30.9 versus 28.2.

We also examine a more comprehensive set of measures of body size. Consistent with the results for BMI, marginally food secure individuals have wider arm circumferences (34.0 cm versus 32.2 cm), higher tricep skinfolds (21.9 mm versus 19.2 mm), and higher subscapular skinfold (22.1 mm versus 19.5 mm). The only manifestation of lower body size due to food insecurity is with respect to tricep skinfold where very low food secure individuals have a value of 17.4 versus 19.2 for food secure individuals. Diabetes is more common among the marginally food insecure in comparison to the food secure; a result which may be due to the higher body sizes in this category.

We finish with a consideration of health outcomes which may not be as directly related to food insecurity and, moreover, where the causality may go in the opposite direction. In terms of self-reports of general health, individuals experiencing food insecurity are worse-off, especially when one considers comparisons of excellent or very good health versus the other three categories and comparisons of excellent, very good, or good health versus the other two categories. With respect to the former, 44 percent of

Table 12. Health Outcomes by Food Insecurity Status for Seniors, Households with Incomes below 200 Percent of the Poverty Line

	Food Secure	Marginally Food Insecure	Low Food Security	Very Low Food Secure
	(1)	(2)	(3)	(4)
Nutrient intakes				
Energy Intake	1657.02	1458.81 *	1465.06 *	1414.51
Protein	62.87	60.96	60.25	57.82
Vitamin A	802.62	731.87	604.08 *	648.87
Vitamin C	86.23	73.83	65.76 *	74.79
Thiamin	1.38	1.23	1.20	1.22
Riboflavin	1.76	1.65	1.62	1.44 *
Vitamin B6	1.54	1.47	1.46	1.36
Calcium	678.55	582.67 *	633.68	576.43
Phosphorous	1046.51	954.39	943.17	900.97
Magnesium	240.29	214.26	201.60 *	216.01
Iron	13.39	12.16	11.74	12.43
Measures of body size				
BMI	27.89	31.87 *	28.52	27.21
Arm circumference	31.75	34.49 *	32.25	31.26
Tricep skinfold	19.04	23.36 *	18.91	17.27
Subscapular skinfold	19.04	22.96 *	19.19	18.89
Diabetic	0.18	0.28	0.24	0.26
Self-Reports of General Health				
Excellent	0.10	0.05 *	0.05	0.06
Excellent or very good	0.32	0.11 *	0.13 *	0.18 *
Excellent, very good, or good	0.65	0.46 *	0.32 *	0.51
Suffers from depression	0.03	0.07	0.12 *	0.07
ADL limitations	0.70	0.76	0.81 *	0.86 *

Notes: Food secure is defined as 0 affirmative responses in the Core Food Security Module; marginally food insecure is defined as 1-2 affirmative responses; low food secure is defined as 3-7 affirmative responses for a household with children, 3-5 for a household without children; very low food secure is defined as 8 or more affirmative responses for a household with children, 6 or more for a household without children. * Different from column (1), $p \leq 0.05$.

food secure individuals report excellent or very good health versus 16 percent of marginally food secure individuals, 19 percent of low food secure individuals, and 20 percent of very low food secure individuals. ADL limitations are remarkably different between the categories – the highest proportion is for very low food security group (88 percent) which is 42 percent higher than for the food secure group.

In Table 12 (page 36) we replicate the analyses in Table 11, using a sample of households with incomes less than 200 percent of the poverty line. Consistent with the results from the previous section, food insecurity is more common among households in this sample – 82.6 percent are food secure, 7.3 percent are marginally food secure, 5.7 percent are low food secure, and 4.5 percent are very low food secure.

The differences between the food insecurity categories are generally more muted once we restrict the sample by income. For example, the intakes of protein, thiamin, vitamin B6, phosphorous, and iron are not statistically significant among the food insecurity categories and diabetes is no longer more prevalent for the marginally food insecure in comparison to the food secure. However, the results for measures of body size and for ADL limitations still hold in the restricted sample.

IV. D. The Effect of Food Insecurity on Health Outcomes

We now turn to our analysis of the effect of food insecurity on health outcomes when we control for other factors which may also influence these health outcomes. Formally, we estimate the following probit maximum likelihood model:

$$OUT_{ij} = q_i + \mathrm{r}_i H_i + Z_i l_i + u_{ij}, \qquad (2)$$

where

OUT_{ij} takes on a value of 1 if elder i suffers from a poor health condition j;

H_i takes on a value of 1 if the elder is suffering from food insecurity (defined below), 0 otherwise;

Z_i is a vector of household demographic and economic factors similar to those used in the CPS analyses of food insecurity;

u_{ij} is an error term.

For our measures of food insecurity we return to the non-mutually exclusive and summative categories of marginally food insecure, food insecure, and very low food secure as defined in Table 1 and implemented in the regressions models from the CPS. We concentrate on the results for the marginally food insecure versus fully food secure insofar as these are the results for which the effects of food insecurity on

Table 13: Effect of marginal food insecurity and other variables on various nutrient intake outcomes

	Energy	Protein	Vitamin A	Vitamin C	Thiamin	Riboflavin
	(1)	(2)	(3)	(4)	(5)	(6)
Marginally food insecure	-143.416	-3.817	-174.808	-14.158	-0.149	-0.141
	(43.385)**	(1.891)*	(85.174)*	(5.997)*	(0.046)**	(0.063)*
Not married or widowed	41.133	1.562	109.797	4.745	0.004	0.119
	(42.314)	(1.845)	(83.072)	(5.849)	(0.045)	(0.062)
Widowed	59.938	1.670	1.622	-1.090	0.031	0.091
	(37.551)	(1.637)	(73.720)	(5.190)	(0.040)	(0.055)
Income/Poverty line	29.641	1.530	22.489	5.574	0.032	0.054
	(11.190)**	(0.488)**	(21.969)	(1.547)**	(0.012)**	(0.016)**
Female	-459.577	-19.492	-109.336	-6.903	-0.356	-0.448
	(29.403)**	(1.282)**	(57.725)	(4.064)	(0.031)**	(0.043)**
Black	-255.097	-7.149	186.839	7.653	-0.237	-0.528
	(41.720)**	(1.819)**	(81.905)*	(5.766)	(0.045)**	(0.061)**
Hispanic	-102.157	-1.932	182.743	18.453	-0.125	-0.213
	(39.285)**	(1.712)	(77.125)*	(5.430)**	(0.042)**	(0.057)**
Other	-313.911	-7.072	-167.727	17.914	-0.059	-0.548
	(98.264)**	(4.283)	(192.912)	(13.582)	(0.105)	(0.143)**
High school graduate	122.107	3.627	261.604	21.999	0.110	0.192
	(33.361)**	(1.454)*	(65.494)**	(4.611)**	(0.036)**	(0.049)**
Employed	-134.140	-6.471	-113.659	-7.112	-0.110	-0.297
	(118.766)	(5.177)	(233.162)	(16.416)	(0.127)	(0.173)
Out of Labor Force	-233.006	-8.548	21.881	-7.605	-0.181	-0.308
	(116.829)*	(5.093)	(229.361)	(16.148)	(0.125)	(0.170)
Age	-11.853	-0.506	3.204	0.137	0.000	-0.002
	(2.092)**	(0.091)**	(4.107)	(0.289)	(0.002)	(0.003)
Constant	2,925.274	116.932	410.373	68.821	1.716	2.393
	(191.596)**	(8.352)**	(376.145)	(26.482)**	(0.205)**	(0.279)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Table 14: Effect of marginal food insecurity and other variables on various nutrient intake outcomes

	Vitamin B6	Calcium	Phosphorous	Magnesium	Iron
	(1)	(2)	(3)	(4)	(5)
Marginally food insecure	-0.134	-60.732	-92.199	-24.371	-1.311
	(0.065)*	(27.561)*	(30.872)**	(7.853)**	(0.524)*
Not married or widowed	0.069	49.796	40.004	11.028	-0.119
	(0.064)	(26.881)	(30.110)	(7.659)	(0.511)
Widowed	0.056	-5.617	11.963	-0.273	0.431
	(0.056)	(23.855)	(26.721)	(6.797)	(0.454)
Income/Poverty line	0.079	14.665	21.923	7.957	0.378
	(0.017)**	(7.109)*	(7.963)**	(2.025)**	(0.135)**
Female	-0.426	-120.323	-284.433	-59.227	-3.515
	(0.044)**	(18.679)**	(20.923)**	(5.322)**	(0.355)**
Black	-0.212	-268.105	-259.220	-56.025	-2.542
	(0.063)**	(26.503)**	(29.687)**	(7.551)**	(0.504)**
Hispanic	-0.003	-49.848	-38.238	-4.327	-0.781
	(0.059)	(24.956)*	(27.955)	(7.111)	(0.475)
Other	-0.100	-221.852	-221.141	-22.701	-0.957
	(0.148)	(62.423)**	(69.923)**	(17.786)	(1.187)
High school graduate	0.211	45.361	76.283	23.463	1.337
	(0.050)**	(21.193)*	(23.739)**	(6.038)**	(0.403)**
Employed	-0.203	-33.777	-101.056	-22.703	-2.832
	(0.178)	(75.447)	(84.512)	(21.497)	(1.435)*
Out of Labor Force	-0.217	-78.308	-132.509	-32.012	-3.433
	(0.176)	(74.217)	(83.134)	(21.146)	(1.412)*
Age	0.004	0.672	-4.895	-0.938	0.008
	(0.003)	(1.329)	(1.489)**	(0.379)*	(0.025)
Constant	1.534	778.655	1,675.223	358.867	17.584
	(0.288)**	(121.714)**	(136.337)**	(34.679)**	(2.315)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Table 15: Effect of marginal food insecurity and other variables on body measures

	BMI	Arm circumference	Tricep skinfold	Subscapular skinfold
	(1)	(2)	(3)	(4)
Marginally food insecure	0.223	0.245	0.350	0.194
	(0.332)	(0.261)	(0.409)	(0.477)
Not married or widowed	-1.204	-1.062	-1.233	-1.626
	(0.318)**	(0.250)**	(0.395)**	(0.453)**
Widowed	-0.422	-0.256	-0.942	-0.478
	(0.290)	(0.226)	(0.357)**	(0.405)
Income/Poverty line	-0.131	-0.004	0.100	0.016
	(0.085)	(0.067)	(0.105)	(0.120)
Female	1.013	-0.280	8.951	1.467
	(0.224)**	(0.176)	(0.278)**	(0.318)**
Black	1.306	1.418	0.478	1.856
	(0.317)**	(0.250)**	(0.400)	(0.481)**
Hispanic	-0.134	-0.632	-1.012	0.713
	(0.300)	(0.235)**	(0.371)**	(0.423)
Other	-3.048	-2.401	-3.157	-0.025
	(0.738)**	(0.584)**	(0.914)**	(1.078)
High school graduate	0.071	0.053	0.399	0.460
	(0.256)	(0.200)	(0.317)	(0.368)
Employed	0.221	0.390	1.814	0.593
	(0.881)	(0.703)	(1.108)	(1.264)
Out of Labor Force	0.226	0.445	2.049	0.194
	(0.867)	(0.692)	(1.091)	(1.244)
Age	-0.160	-0.189	-0.192	-0.243
	(0.016)**	(0.013)**	(0.020)**	(0.023)**
Constant	39.347	45.480	26.041	35.487
	(1.452)**	(1.141)**	(1.801)**	(2.060)**

Notes: Number of observations is 2544, 2633, 2489, and 2185. * significant at 5% level; ** significant at 1% level.

Table 16: Marginal effects of marginal food insecurity and other variables on various nutrient intake outcomes

	Diabetic	Excellent	Excellent or very good	Excellent, very good, or good	Depression	ADL limitations
	(1)	(2)	(3)	(4)	(5)	(6)
Marginally food insecure	0.019	-0.019	-0.116	-0.134	0.022	0.141
	(0.022)	(0.020)	(0.029)**	(0.030)**	(0.011)	(0.025)**
Not married or widowed	-0.037	0.008	0.011	-0.024	-0.001	0.005
	(0.019)	(0.020)	(0.030)	(0.027)	(0.008)	(0.028)
Widowed	0.019	0.014	0.004	0.021	0.005	-0.013
	(0.020)	(0.018)	(0.026)	(0.024)	(0.008)	(0.026)
Income/Poverty line	-0.028	0.020	0.042	0.045	-0.003	-0.023
	(0.006)**	(0.005)**	(0.007)**	(0.008)**	(0.002)	(0.007)**
Female	-0.026	-0.028	-0.010	0.008	0.014	0.114
	(0.018)	(0.010)**	(0.018)	(0.021)	(0.007)*	(0.019)**
Black	0.083	-0.034	-0.121	-0.072	0.024	-0.017
	(0.028)**	(0.013)**	(0.022)**	(0.030)*	(0.010)*	(0.028)
Hispanic	0.060	-0.034	-0.111	-0.122	0.018	-0.057
	(0.025)*	(0.013)*	(0.023)**	(0.028)**	(0.008)*	(0.027)*
Other	0.102	-0.024	-0.103	0.063	-0.009	0.010
	(0.067)	(0.032)	(0.054)	(0.065)	(0.013)	(0.063)
High school graduate	-0.016	0.041	0.115	0.131	0.006	-0.011
	(0.020)	(0.013)**	(0.021)**	(0.022)**	(0.005)	(0.022)
Employed	0.103	0.036	0.034	-0.066	-0.035	-0.127
	(0.106)	(0.045)	(0.075)	(0.103)	(.)	(0.082)
Out of Labor Force	0.132	-0.018	-0.084	-0.182	-0.029	0.011
	(0.058)*	(0.040)	(0.076)	(0.081)*	(0.027)	(0.075)
Age	-0.004	0.000	0.002	0.001	-0.000	0.008
	(0.001)**	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)**

Notes: Number of observations is 2751. * significant at 5% level; ** significant at 1% level.

health outcomes are the strongest. These results can be found in Tables 13 through 16. The results for the other food insecurity comparisons can be found in Appendix Tables 12 through 19.

Starting with Tables 13 and 14 (page 38), after controlling for other factors, marginal food insecurity has a statistically significant negative effect on the intakes of energy, protein, vitamin A, vitamin C, thiamin, riboflavin, vitamin B6, calcium, phosphorous, magnesium, and iron. Thus, the bivariate relationships found in Table 11 still hold, even after controlling for other factors known to affect health. The Appendix Tables show that these results are robust across many of these same outcomes for those at-risk of hunger and those experiencing hunger.

However, unlike nutrient intakes, as seen in Table 15 (page 39) marginal food insecurity has no statistically significant effect on measures of body size. Marginal food insecurity does have a negative effect on whether a senior reports being in "excellent or very good" health or in "excellent, very good, or good" health. Similarly, marginal food insecurity has a negative effect on a senior's probability of depression and ADL limitations. Unlike for nutrient intakes, the causality is not as clear with these relationships. For example, someone suffering from ADL limitations may be less able to get to the store to purchase food in comparison with someone who is readily able to perform such daily functions as bathing, eating, and dressing.

IV. E Social Isolation and Food Insecurity

There has been some research regarding the potential influence of social support on the food security status of seniors in community-level studies (Ahluwalia et al., 1998; Greder and Brotherson, 2002; Gundersen et al., 2003; Quandt et al., 2001; Schoenberg, 2000), but we are not aware of similar research in national samples. We might expect social support to be especially important for the food security status of seniors because of possible social isolation from children living far away, loss of interaction with former co-workers due to retirement, and the loss of a spouse or other family members and friends. In addition, social support is likely important for those seniors experiencing significant health limitations.

To examine the effect of social support on food insecurity we estimate models akin to those estimated in Tables 5 through 8. Here we use two variables in the NHANES not available in the CPS – whether someone has access to emotional support from family and friends and whether someone has access to financial support if needed. The marginal effects of emotional and financial support on food

Table 17. Estimated Marginal Effects of Social Isolation on Food Insecurity Among Senior Americans in the NHANES

	Marginally Food Insecure	Food Insecure	Very Low Food Secure	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	All Incomes			Incomes below 200% of the Poverty Line		
	(1)	(2)	(3)	(4)	(5)	(6)
Access to emotional support	-0.067	-0.030	-0.013	-0.123	-0.094	-0.045
	(0.026)**	(0.016)*	(0.008)*	(0.047)**	(0.039)**	(0.024)*
Access to financial support	-0.062	-0.034	-0.013	-0.151	-0.080	-0.045
	(0.017)**	(0.011)**	(0.006)**	(0.034)**	(0.027)**	(0.017)**
Observations	2684	2684	2684	1341	1341	1341

Notes: Standard errors in parentheses. ** p<0.01, * p<0.05. N= 2684 for columns (1) through (3). N=1341 for columns (4) through (6).

insecurity from the probit model are found in Table 17 (page 41).[12] In columns (1) through (3), the results are for a sample with all income levels and, in columns (4) through (6), they are for a sample with incomes below 200% of the poverty line.

The effects of access to financial and emotional support are statistically significant across all of the food insecurity measures. These effects are also large. Thus, social isolation has an effect size on the likelihood of being at-risk of hunger that is of comparable magnitude to living in poverty.

As seen in Table 17, the effects of access to financial and emotional support are statistically significant across all of the food insecurity measures. These effects are also large. For sake of comparison, consider the reduction in the probability of marginal food insecurity if a household's income declined from twice the poverty line to the poverty line. This would lead to a 5.7 percentage point increase for all income levels and a 21.1 percentage point increase for the sample below 200% of the poverty line. If a loss of emotional support occurred, this would lead to a 6.7 percentage point increase in the probability of marginal food insecurity for the full sample and 12.3 percentage point increase for the low-income sample. Similarly, the loss of financial support would lead to increases of 6.2 and 15.1 percentage points. Thus, social isolation has an effect size on the likelihood of being at-risk of hunger that is of comparable magnitude to living in poverty.

V. Food Insecurity and Wealth, Health, Food Expenditures in the PSID

A limitation of the CPS is that it collects no information either on the asset position of families or the family's food expenditures aside from whether or not they own their home or whether they receive

12. The results from the other variables are suppressed in the table. Unlike the CPS, due to confidentiality reasons, state identifiers are not included in the publicly available NHANES and so state fixed effects are not included in these models.

food stamps (along with the dollar value of food stamps). We might believe that wealth offers a protective buffer against hunger over and above income because families can use savings and other forms of wealth to cover necessities such as food in the event of a negative shock to income or health. Related, a direct economic consequence of food insecurity is the potential for reduced spending on food, though the causal pathway may be reversed in that reduced food spending may lead to higher food insecurity. To examine the effect of assets on food insecurity, and the effect of food insecurity on food spending, we turn to the oldest longitudinal social science dataset in the United States—The University of Michigan's Panel Study of Income Dynamics (PSID).

The PSID has followed a core set of 5000 families since 1968 plus newly formed households as members of the original core have split off into new, independent units. Just under 3000 of the original sample were part of the Survey Research Center (SRC) random sample of the U.S. population, and the remaining families were part of the Survey of Economic Opportunity (SEO) over-sample of low-income and African-American families. Because of changes in survey design in the mid 1990s many families in the SEO were dropped, and because the CFSM is not collected until 1999, we restrict our analysis to those families in the random SRC sample of the PSID. Beginning in 1997 the survey went from annual data collection to every other year. Thus, our sample in this section draws from the 1999, 2001, and 2003 survey years of the PSID (the CSFM was not collected in 2005), and is restricted to households with a head or wife (if both spouses are present) between the age of 60 and 101. As with the CPS, we only include families residing in the contiguous 48 states in our sample.

Beginning in 1984 the PSID asked detailed questions on the asset holdings of families, including liquid and illiquid forms of wealth, repeating this survey during the years in which the CFSM was administered. A module including weekly expenditures on food, including food eaten in the home, food eaten out, and food delivered as well as the dollar value of food stamps is also administered during these years. Analyses examining the effect of wealth on food insecurity, and examining the effect of food insecurity on food expenditures are conducted at the household level. Like we did with the CPS, samples from each survey year are pooled to increase sample size for key outcomes and characteristics, and excluding households with unknown income and wealth, the pooled sample across the three years includes 2,228 senior households. Because households are surveyed over all survey years (unless the household is non-responding) we report robust standard errors clustering on non-unique households.

Starting in 1999, and repeated in 2001 and 2003, the PSID asked a series of questions on physical health status including a module on ADL difficulties. For the 2003 survey year the PSID added a mental health instrument and a series of questions that identify difficulties completing independent tasks including shopping, preparing meals, handling money, and other activities. Using these health modules, we examine the robustness of the NHANES results on physical and mental health in addition to daily functioning in the context of food security. For theses analyses, we use data on household heads, male and female. Wives are not included in this sample in order to exclude any effect of sharing a household. Heads can reappear in all survey years, and models using pooled samples from 1999, 2001 and 2003 report robust standard errors clustering on non-unique individuals. Excluding individuals younger than 60, the pooled sample includes 2,787 heads between the ages of 60 and 101 with complete information on health outcomes.

V. A. Wealth and Food Insecurity

Table 17 presents the rates and distribution of food insecurity by liquid wealth and net worth among seniors in the PSID. Liquid wealth contains assets such as the value of checking and savings accounts, stocks, bonds, IRAs, CDs, and the like. Net worth add to liquid wealth the value of real estate, the value of business or farm, the value of pension funds, the value of vehicles owned, and subtracts away the value of any outstanding debt including credit card debt. Reflecting the fact that the PSID sample is considerably different than the CPS sample because of its longitudinal design the table reveals that considerably fewer families are food insecure in the PSID, ranging from 5.25 percent that are marginally food insecure to 0.45 percent that are very low food secure. The numbers for marginal food insecurity are more similar to the NHANES, albeit there are more low food secure and very low food secure households in the NHANES. The PSID is known to be among the highest quality data sources for income and wealth, though no validation studies have been conducted comparing the CFSM across datasets. Our hunch is that even though the SRC subsample in the PSID is a random sample of families, the fact that the elderly in the survey continue to participate year after year suggests that seniors in the PSID are likely to be a more stable and wealthy population than in both the CPS and NHANES.

The top panel of Table 18 (page 44) is akin to Table 4 and answers questions such as "among those with liquid wealth less than $5,000, what fraction are food insecure?" Here we see that about 16 percent of households with less than $5,000 in liquid wealth are marginally food insecure, 6 percent are food in-

Table 18. Rates and Distribution of Food Insecurity by Income and Wealth Levels in the PSID

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Rates of Food Insecurity			
Full Sample	5.25	1.84	0.45
Liquid Wealth Categories			
Liquid Wealth below $5,000	15.92	6.26	1.61
Liquid Wealth between $5,000-25,000	4.35	1.45	0.29
Liquid Wealth between $25,000-$50,000	2.80	0.00	0.00
Liquid Wealth between $50,000-$100,000	0.69	0.00	0.00
Liquid Wealth above $100,000	0.64	0.13	0.00
Net Worth Categories			
Net Worth below $5,000	23.24	7.75	1.41
Net Worth between $5,000-25,000	14.17	6.30	3.15
Net Worth between $25,000-$50,000	14.29	8.27	1.50
Net Worth between $50,000-$100,000	8.46	2.20	0.74
Net Worth above $100,000	1.48	0.26	0.00
Distribution of Food Insecurity Rates			
Liquid Wealth Categories			
Liquid Wealth below $5,000	76.07	85.37	90.00
Liquid Wealth between $5,000-25,000	12.82	12.20	10.00
Liquid Wealth between $25,000-$50,000	5.13	0.00	0.00
Liquid Wealth between $50,000-$100,000	1.71	0.00	0.00
Liquid Wealth above $100,000	4.27	2.44	0.00
Net Worth Categories			
Net Worth below $5,000	28.21	26.83	20.00
Net Worth between $5,000-25,000	15.38	19.51	40.00
Net Worth between $25,000-$50,000	16.24	26.83	20.00
Net Worth between $50,000-$100,000	19.66	14.63	20.00
Net Worth above $100,000	19.66	9.76	0.00

secure, and just under 2 percent are very low food secure (the remaining 76 percent are food secure). The comparable percentages for the group with net worth under $5,000 is 23, 7.75, and 1.4 percent. Indeed, the top panel of Table 18 reveals considerable variation in rates of food insecurity across the distribution net worth, at least for those with net worth less than $100,000. The bottom panel of Table 18 is akin to Table 3 and asks questions such as "among those food insecure, what fraction have liquid wealth or net worth less than $5,000?" Within each of the three food insecurity categories at least three-fourths of families have liquid wealth less than $5,000, and 90 percent have liquid wealth under $25,000. These are very low levels of liquidity in the retirement years. Once again, however, we see greater dispersion across the net worth categories where nearly 20 percent of the marginally food insecure and 10 percent of the food insecure have net worth exceeding $100,000.[13]

In Tables 19–21 (page 45-46) we replicate the analyses in Table 5 from the CPS on the determinants of food insecurity, now using the PSID and including the set of liquid wealth or net worth indicators.

13. Net worth exceeding $100,000 is the mode in this sample as just over 80 percent of households with heads or wives over age 60 have net worth in excess on $100,000.

Table 19. Estimated Marginal Effects of Income and Wealth on Marginal Food Insecurity for Senior Households in the PSID

	(1)	(2)	(3)
50-100% Poverty	0.003	-0.002	-0.007
	(0.024)	(0.015)	(0.014)
100-200% Poverty	-0.012	-0.009	-0.008
	(0.017)	(0.013)	(0.014)
>200% Poverty	-0.070	-0.032	-0.038
	(0.042)	(0.027)	(0.029)
Liquid Wealth $5-25,000		-0.018**	
		(0.005)	
Liquid Wealth $25-50,000		-0.021**	
		(0.006)	
Liquid Wealth $50-100,000		-0.031**	
		(0.006)	
Liquid Wealth >$100,000		-0.048**	
		(0.009)	
Net Worth $5-25,000			-0.019*
			(0.006)
Net Worth $25-50,000			-0.022*
			(0.006)
Net Worth $50-100,000			-0.028**
			(0.006)
Net Worth >$100,000			-0.164**
			(0.044)

Notes: All models control for characteristics (not shown above) presented in models 4-6, Table 5. Standard errors in parentheses. ** p<0.01, * p<0.05. N= 2487

Table 20. Estimated Marginal Effects of Income and Wealth on Food Insecurity for Senior Households in the PSID

	(1)	(2)	(3)
50-100% Poverty	-.002	-.002	-.002
	(.004)	(.003)	(.002)
100-200% Poverty	-.005	-.004	-.003
	(.004)	(.003)	(.002)
>200% Poverty	-.045	-.031	-.022
	(.028)	(.021)	(.015)
Liquid Wealth $5-25,000		-.001	
		(.002)	
Liquid Wealth $25-50,000		+	
Liquid Wealth $50-100,000		+	
Liquid Wealth >$100,000		-.008*	
		(.003)	
Net Worth $5-25,000			-.003
			(.002)
Net Worth $25-50,000			-.003
			(.002)
Net Worth $50-100,000			-.005*
			(.002)
Net Worth >$100,000			-.057*
			(.026)

Notes: All models control for characteristics (not shown above) presented in models 4-6, Table 5. Standard errors in parentheses. ** p<0.01, * p<0.05. N= 2228. + No Food Insecure households hold liquid wealth between $25,000-$100,000.

Table 21. Estimated Marginal Effects of Income and Wealth on Very Low Food Security for Senior Households in the PSID

	(1)	(2)	(3)
50-100% Poverty	-0.001	-0.001	-0.000
	(0.000)	(0.000)	(0.000)
100-200% Poverty	-0.00	-0.001	-0.000
	(0.001)	(0.001)	(0.000)
>200% Poverty	-0.007	-0.008	-0.003
	(0.006)	(0.006)	(0.002)
Liquid Wealth $5-25,000		-0.000	
		(0.001)	
Liquid Wealth $25-50,000		+	
Liquid Wealth $50-100,000		+	
Liquid Wealth >$100,000		+	
Net Worth $5-25,000			0.008
			(0.008)
Net Worth $25-50,000			0.002
			(0.002)
Net Worth $50-100,000			0.001
			(0.002)
Net Worth >$100,000			+

Notes: All models control for characteristics (not shown above) presented in models 4-6, Table 5. Standard errors in parentheses. ** p<0.01, * p<0.05. N=2228. + No Very Low Food Insecure Households hold liquid wealth above $25,000 or have net worth above $100,000.

The models control for the same set of variables as in Table 5, but we suppress these other coefficients for ease of presentation. Because of the comparatively small samples in the PSID, we do not control for state fixed effects and thus the results are more akin to columns (4)–(6) in Table 5. Tables 19–21 reveal a strong and statistically significant protective role of both liquid and illiquid assets on household food insecurity.[14] High incomes reduce the probability of food insecurity, but having access to assets has a robust and statistically significant effect in reducing food insecurity. This suggests that access to a stock of wealth insures against the hardship associated with food insecurity.

High incomes reduce the probability of food insecurity, but having access to assets has a robust and statistically significant effect in reducing food insecurity. This suggests that access to a stock of wealth insures against the hardship associated with food insecurity.

14. The coefficients on the income variables are statistically significant in the probit models, but the marginal effects lose statistical significance because of the small samples.

V. B Food Spending and Food Insecurity

Having established that wealth affects food insecurity, in this section we turn the tables to examine whether food insecurity affects food spending by the household. The PSID has collected information on food expenditures over the length of the sample, gathering information on the amount of money spent on food eaten at home, on food eaten away from home, on food delivered, and on the dollar value of food stamps. Most of these questions refer to the amount of money spent on an average week. We sum the food categories to arrive at total spending and convert these weekly amounts to annual amounts to be consistent with the CFSM reference to food security over the year. Because food spending varies by family size and composition we deflate total food spending by the USDA Thrifty Food Plan Need Standard for a given family size, converting the measure in terms of adult equivalent units. To examine the potential positive role of delivered food and food stamps on the security of total household food expenditures, we also construct a measure of food spending to needs that omits the contributions of food stamps and delivered meals.

In Table 22 (below) we present estimates of the effect of food insecurity on food spending relative to needs both without additional control variables and with these variables. The additional controls are the same as used in earlier analyses and include variables relating to race, age, education, employment status,

Table 22. The Effects of Food Insecurity on Food Expenditures in the PSID

	Total Food Spending Relative to Needs	Food Spending Relative to Needs Excluding Food Stamps and Delivered Food
Marginal Food Insecurity with no additional controls	–0.599 (0.103)**	–0.639 (0.108)**
Marginal Food Insecurity with additional controls	–0.110 (0.093)	–0.128 (0.094)
Food Insecurity with no additional controls	–0.413 (0.184)*	–0.478 (0.193)*
Food Insecurity with additional controls	0.123 (0.169)	0.084 (0.172)
Very Low Food Secure with no additional controls	–0.883 (0.433)*	–0.950 (0.449)*
Very Low Food Secure with additional controls	–0.155 (0.361)	–0.199 (0.371)

Notes: Robust standard errors in parentheses. * significant at 5% level.; ** significant at 1% level. Number of observations is 2228. The models with additional controls include variables relating to the race, age, education, employment status, region of country, gender, family structure, and year effects.

region of country, gender, family structure, and year effects. The simple bivariate relationships between each measure of food insecurity and food expenditures (for both categorizations of spending) are large, negative, and statistically different from zero. On average a marginally food insecure family spends about 60 percent less on food relative to needs, and a family that is very low food secure spends 88 percent less. The second column indicates average spending among the food insecure is lower by about 7 percent when we exclude food stamps and delivered food. (These results are roughly consistent with those in Nord et al., 2006.) However, once we control for other variables that determine food spending we still find a negative relationship but one that is no longer statistically significant. The lack of significance of between food insecurity and food expenditures is perhaps surprising but is consistent with previous work on the connection between food expenditures and food insecurity (Gundersen and Ribar, 2005). One possible explanation for the lack of significance is the timing of the two questions. While the food insecurity question refers to the entire previous year, the food expenditure question asks for the average expenditures over the previous year. Given that many spells of food insecurity are episodic rather than chronic, someone may have average expenditures that are high enough to maintain food security in most periods but, over some time period of the previous year, these expenditures fell.

V. C Health and Food Insecurity

The NHANES is considered to be among the best datasets collected on the health of the U.S. population, but we take advantage of the health modules in the PSID to examine the robustness of the NHANES results in this subsection. We also conduct this exercise as a validation check on the quality of the food security and health data in the PSID. That is, finding results on health outcomes that agree with those found in Section IV will lend credibility both to the NHANES estimates and to data quality in the PSID.

In Table 23 (page 49) we report the effects of marginal food insecurity on BMI, and indicators of excellent health, excellent or very good health, excellent, very good, or good health, diabetes, depression, ADL and IADL limitations, and the number of weeks spent in the hospital during the last year. The BMI and hospitalization models are from Ordinary Least Squares regression, while the remaining models are based on probit maximum likelihood methods. Although we control for the same set of covariates as in the NHANES health models, for parsimony we report the marginal effect of marginal food insecurity (us-

Table 23. Marginal Effect of Marginal Food Insecurity on Various Health Outcomes of Seniors in the PSID

BMI	1.560
	(0.557)*
Excellent Health	–0.052
	(0.021)*
Excellent or Very Good Health	–0.081
	(0.049)
Excellent, Very Good, or Good Health	–0.117
	(0.054)*
Diabetes	0.129
	(0.048)*
Depression	0.195
	(0.077)*
ADL Limitations	0.133
	(0.049)*
IADL Limitations	0.211
	(0.080)*
Weeks Hospitalized	0.203
	(0.080)*

Notes: Robust standard errors in parentheses. * significant at 5% level.

ing the inclusive categorization capturing any form of food insecurity) on the respective health outcome. Table 23 makes clear that even after controlling for income, education, race, age, gender, and other demographics, food insecure individuals have higher BMI scores (about 1.5 points higher, or about 5 percent), are less likely to report being in good health, are more likely to suffer from diabetes, depression, some form of limitation on daily living, and to be hospitalized. These results broadly corroborate those from the NHANES, and indeed are somewhat stronger in that we find significant harmful effects of food insecurity on BMI and diabetes not identified in our analyses using the NHANES.

VI. The Future of Hunger in 2025

To project the future of senior hunger in America, we employ a technique that uses current information about persons who will be seniors in the future. In making these projections, we rely on information about the determinants of hunger that we identified in Section III. Within our framework, we again utilize a data set that contains a large number of observations, is nationally representative, is readily available on a consistent basis, has a full set of economic and demographic variables, and has the information to calculate who is at risk of suffering from hunger. The data set most suited for this task is the CPS, the data set used in Sections II and III. Because the CPS is cross-sectional (i.e. it does not follow the same set of individuals over successive years), we look at the impact of economic and demographic conditions by

age cohorts rather than by age.

Our framework can be summarized in the following three steps. Because our ultimate goal is to predict the risk of hunger that a 40 to 60 year old in 2005 will face in the year 2025, we first need to examine the relationship between food insecurity for 60 to 80 year olds in 2005 against key economic and demographic factors of this group twenty years ago when they were ages 40 to 60.[15] Thus, in step one we computed the averages of our three measures of food insecurity from the pooled 2001–2005 CPS at each age ranging from 60 to 80, yielding 21 age-specific averages for each of the three insecurity measures.[16] Informed by our analyses of the determinants of food insecurity we then identified a parsimonious group of seven economic and demographic variables affecting hunger– whether someone is a homeowner, whether a person is in a poor household, the gender of an individual, the age of an individual, whether a person lives alone, the race of an individual, and whether the person graduated from high school. We constructed the age-specific average of each of these seven variables from the pooled 1981–1985 CPS for 40 to 60 year olds. This leads to the following regression model:

$$\begin{aligned} H_{a,j} = a_{0,j} + a_{1,j}OWN_{a-20} + a_{2,j}POOR_{a-20} + a_{3,j}FEMALE_{a-20} + a_{4,j}AGE_{a-20} + \\ a_{5,j}ALONE_{a-20} + a_{6,j}WHITE_{a-20} + a_{7,j}HSGRAD_{a-20} + e_{a,j} \end{aligned} \quad (3)$$

where

$H_{a,j}$ is the average fraction of households at each age a = 60,…,80 suffering from food insecurity of type j, j = marginal food insecurity, food insecurity, or very low food security;

OWN is the fraction of households in each age 40 to 60 owning their home;

POOR is the fraction of households living in poverty at each age 40 to 60;

FEMALE is the fraction of women in the population at each age 40 to 60;

AGE is the age of the group ranging from 40 to 60;

ALONE is the fraction of household heads living alone at each age 40 to 60;

WHITE is the fraction of household heads that are white;

HSGRAD is the fraction of household heads who graduated from high school.

In step two of our procedure the estimates of the effects of our seven economic and demographic

15. To ensure confidentiality, currently the CPS assigns everyone 80 and over the age of "80". In the future, as the number of older elders increases, this value may increase.
16. We pool across the years in order to minimize the potential role of measurement error that is more prevalent in year-by-year estimates of food insecurity by age group.

variables from equation (3) are used to predict food insecurity in 2025 for persons age 60 to 80. This is accomplished by multiplying each coefficient $\hat{a}_1, \hat{a}_2, \hat{a}_3, \hat{a}_4, \hat{a}_5, \hat{a}_6, \hat{a}_7$ by the respective values of the economic and demographic factors for each age from 40 to 60 years old. Specifically the prediction equation is

$$\hat{H}_{a,j}^{2025} = \hat{a}_{0,j} + \hat{a}_{1,j} OWN_{a-20}^{2005} + \hat{a}_{2j} POOR_{a-20}^{2005} + \hat{a}_{3,j} FEMALE_{a-20}^{2005} + \hat{a}_{4,j} AGE_{a-20}^{2005} + \hat{a}_{5,j} ALONE_{a-20}^{2005} + \hat{a}_{6,j} WHITE_{a-20}^{2005} + \hat{a}_{7,j} HSGRAD_{a-20}^{2005} \quad (4)$$

where the left hand side of equation (4) is the predicted value of food insecurity type *j* for 60 to 80 year olds in 2025, which is a function of the coefficients and the averages of the demographics from the pooled 2001-2005 CPS.

The third and final step in this framework is to weight these age-specific predicted values from equation (4) based on the U.S. Census Bureau's population share that each age is projected to take in 2025 and then to sum across the 21 age groups. That is,

$$\hat{H}_j^{2025} = \sum_{a=60}^{80} b_a \hat{H}_{a,j}^{2025} \quad (5)$$

where the projected share of the 60–80 year old population for each age group between 60 and 80 in 2025. We obtain the population projections from the U.S. Census Bureau and these can be found in Appendix Table 20.[17]

Our initial attempts to implement equations (3)–(5) were met with mixed success. Further analysis revealed high collinearity between the variable AGE and the variables WHITE and HSGRAD; that is, those most likely to live into their 70s are white persons with at least a high school diploma. We thus pursued two alternatives. In our baseline specification we dropped both WHITE and HSGRAD from equations (3) and (4) and instead estimated

$$H_{a,j} = a_{0,j} + a_{1,j} OWN_{a-20} + a_{2,j} POOR_{a-20} + a_{3,j} FEMALE_{a-20} + a_{4,j} AGE_{a-20} + a_{5,j} ALONE_{a-20} + e_{a,j} \quad (3")$$

and

17. The data are found at http://www.census.gov/population/www/projections/projectionsagesex.html. For the age 80 group we sum up the projected population for those older than 80 years of age.

$$\hat{H}_{a,j}^{2025} = \hat{a}_{0,j} + \hat{a}_{1,j} OWN_{a-20}^{2005} + \hat{a}_{2,j} POOR_{a-20}^{2005} + \hat{a}_{3,j} FEMALE_{a-20}^{2005} + \hat{a}_{4,j} AGE_{a-20}^{2005} + \hat{a}_{5,j} ALONE_{a-20}^{2005} \quad (4")$$

In the second alternative we instead estimated equation (3) in first differences, i.e. by subtracting the values for someone of age 80 from the corresponding values of a 79 year old, the values for someone of age 79 from the corresponding 78 year old, and so on. Rewriting the model in this way yields

$$\Delta H_{a,j} = a_{1,j} \Delta OWN_{a-20} + a_{2,j} \Delta POOR_{a-20} + a_{3,j} \Delta FEMALE_{a-20} + a_{4,j} \Delta AGE_{a-20} + a_{5,j} \Delta ALONE_{a-20} + a_{6,j} \Delta WHITE_{a-20} + a_{7,j} \Delta HSGRAD_{a-20} + \Delta e_{a,j} \quad (6)$$

where Δ is known as the first-difference operator such that $\Delta H_{a,j} \equiv H_{a,j} - H_{a-1,j}$ and the remaining variables are similarly defined.[18] In this case equation (4) is implemented as

$$\hat{H}_{a,j}^{2025} = \hat{a}_1 \Delta OWN_{a-20}^{2005} + \hat{a}_2 \Delta POOR_{a-20}^{2005} + \hat{a}_3 \Delta FEMALE_{a-20}^{2005} + \hat{a}_4 \Delta AGE_{a-20}^{2005} + \hat{a}_5 \Delta ALONE_{a-20}^{2005} + \hat{a}_6 \Delta WHITE_{a-20}^{2005} + \hat{a}_7 \Delta HSGRAD_{a-20}^{2005} + H_{a-1,j}^{2005} \quad (7)$$

For both of these modifications the third step of equation (5) remains the same.

The results from estimating equations (3") and (6) are found in Appendix Table 21, and the corresponding projections from equation (5) for each model are recorded in Table 24. The top panel of Table 24 is based on levels predictions from equation (4") and the bottom panel is based on first-difference predictions from equation (7). The table contains projections of both the fraction and number of seniors expected to be marginally food insecure, food insecure, or very low food secure. Because the projections are based on estimated parameters we also present the lower and upper bounds of the 95 percent confidence interval in square brackets.

Our baseline projection from the levels model is that there will be 9.5 million seniors experiencing marginal food insecurity in 2025, which amounts to 11.25 percent of the senior population. The 95 percent confidence interval ranges from 7.5 percent to 14.9 percent, or from 6.4 million seniors to almost 13 million. For the two more severe measures of hunger risk, the levels projections are as follows: for food insecurity, 3.9 million seniors (4.6 percent), and for very low food security, 1.0 million seniors (1.2 per-

18. Because the variable AGE increases by one year for each observation in equation (3) this becomes the model's constant term in equation (6). In language common to time-series analyses, equation (3) assumes that the variables are "trend stationary" while equation (6) assumes that they are "difference stationary." Given the cointegration between age and high school graduation, the difference stationary model of equation (6) is likely more robust.

Table 24. Projections of Senior Hunger in the Year 2025

	Levels Model Predictions Controlling for Homeownership, Poverty Status, Female, Age, Living Alone	
	Percent (%)	Number (millions)
Marginally Food Insecure	11.25 [7.53, 14.98]	9.53 [6.38, 12.70]
Food Insecure	4.56 [3.32, 5.80]	3.86 [2.81, 4.91]
Very Low Food Secure	1.20 [0.87, 1.54]	1.02 [0.73, 1.30]

	First-Difference Model Predictions Controlling for Homeownership, Poverty Status, Female, Age, Living Alone	
	Percent (%)	Number (millions)
Marginally Food Insecure	11.55 [7.61, 15.48]	9.77 [6.44, 13.10]
Food Insecure	5.51 [3.49, 7.52]	4.66 [2.96, 6.37]
Very Low Food Secure	1.71 [1.06, 2.36]	1.45 [0.90, 1.99]

Note: The numbers in square brackets are the lower bound and upper bound of the 95 percent confidence interval around our point estimates.

cent). The bottom panel of Table 24 shows that the baseline projections are quite robust to the addition of race and education, and the use of the more complicated techniques in equations (6) and (7). In this case we project 9.8 million, 4.7 million, and 1.5 million seniors to be marginally food insecure, food insecure, and very low food secure, respectively.

The projected numbers of seniors who will experience each type of food insecurity in 2025 are about 75 percent, 50 percent, and 33 percent higher, respectively, than our current estimates in Table 2. As a fraction of the senior population, though, these projected numbers are remarkably stable compared to current data. We believe that a couple of countervailing forces are at work—the growth in the fraction of high school graduates between the mid 1980s and mid 2000s is pulling down our estimates while at the same time the growth of the non-white population over the same period is pushing the estimates upward. Such stability is not without precedent in key social indicators; witness the remarkable stickiness of the U.S. poverty rate over the past two decades.

Making projections twenty years into the future is a useful exercise but one that should be accompanied with some caveats. The strength of our methodology here is its transparency relative to potentially much more complicated (general equilibrium) models of the economy, but its main drawback is the assumption of constant cohort effects over time that yields a stable relationship between current year predic-

tions of food insecurity and future projections. For example, our projections implicitly assume that older persons in 2025 will have lower food insecurity rates than younger persons, consistent with what we find in comparisons in 2001-2005. However, these lower food insecurity rates may reflect a cohort effect for younger seniors rather than an age effect. In other words, it could be that those born after 1935 are more likely to be food insecure at later ages than those born before 1935. One possibility is that the current generation of older seniors developed effective coping strategies in light of their first hand experiences with major economic and social changes from the Great Depression and World War II and thus are less likely to report food insecurity. Given that current 40 to 60 year olds have not faced social dislocations on a similar scale, and thus have had less need to develop coping strategies for food need, they may be more likely to report food insecurity when they reach the ages of 60 to 80 in 2025. In other work, Gundersen and Ziliak (forthcoming) find that this cohort effect occurs with respect to food stamp participation. Likewise, unforeseen negative economic events could lead to higher rates of poverty in coming decades, and thus lead to higher risk of hunger by 2025. These contingencies mean that our projections may be too low.

The projected numbers of seniors who will experience each type of food insecurity in 2025 are about 75 percent, 50 percent, and 33 percent higher, respectively, than our current estimates in Table 2.

Alternatively, our projections may be too high. For example, if strong economic growth in the future reduces poverty substantially it is possible our estimates of food insecurity will be too high. Moreover, we recognize the profound influence that elderly nutrition programs such as Meals On Wheels have on alleviating senior hunger in America. As the MOWAAF expands its programs and builds on the research in this proposal, this will surely lead to further reductions in hunger. Thus, if these efforts come to fruition, our estimates here would overstate the extent of food insecurity among seniors in the future.

VII. Conclusion

This report represents the first comprehensive effort to describe the face of senior hunger in America, identify the determinants and health consequences of senior hunger, and make projections of future hunger among seniors. Using data from the 2001-2005 Current Population Survey (CPS), a nationally representative survey of over 50,000 households per year, we examined the characteristics of persons aged 60 and over who are at-risk of hunger and those who are suffering from hunger. In 2005 (the last year of our study), over 5 million seniors--11.4% of all seniors—experienced some form of food insecurity (i.e.,

are marginally food insecure). Of these, about 2.5 million are at-risk of hunger (i.e. are food insecure), and about 750,000 actually experienced hunger (i.e., very low food security) due to financial constraints.

These aggregate measures of food insecurity do not portray, however, the diversity in experiences of food insecurity among seniors. Among seniors, those with limited incomes, under age 70, African-Americans, Hispanics, never-married individuals, renters, and persons living in the South are all more likely to be at-risk of hunger. At the same time the risk of hunger extends up into the income and wealth distributions. For example, over 50 percent of all seniors who are at-risk of hunger have incomes above the poverty line, and nearly one-fourth have net worth exceeding $50,000. Likewise, hunger risk is present in all demographic groups. For example, even though African Americans are over represented amongst the food insecure, over two-thirds of seniors at-risk of hunger are white.

Descriptive statistics about hunger among seniors is an important first step to enhancing the efforts of MOWAAF and others as they seek to improve the status of seniors in America. In this report we went one step forward to examine, controlling for other factors, what determines why some seniors are food insecure and others are not. To do so, we first used data from the 2001-2005 CPS. We found that after controlling for other relevant factors in the senior population, seniors are more likely to be at-risk of hunger if they are ages 60 to 64, poor, African-American or Hispanic, a high school dropout, divorced or separated, living with a grandchild, or a renter. Perhaps the most surprising result in this part of our analysis is the declining age gradient in food insecurity among the senior population. For example, our results suggest that an 84 year old is over one-third less likely to be at-risk of hunger than a 64 year old on the baseline food insecurity rate of 5.6 percent. While the pathways underlying this age gradient are potentially many and varied, our results highlight a sizable population facing an unmet food need that is likely to grow significantly with the 'Baby Boom' generation entering their sixties.

We also considered two additional determinants of food insecurity, one relating to social isolation and the other to wealth. Using data from the 1999-2002 National Health and Nutrition Examination Survey (NHANES) we found that, after controlling for other factors, seniors without access to emotional and financial support are substantially more likely to suffer from hunger. Data from the 1999–2003 Panel Study of Income Dynamics suggested that the household's asset position shelters the family from the risk of hunger—having net worth in excess of $100,000 reduces the probability of being marginally food insecure by nearly 6 percentage points, or nearly two-thirds.

The efforts of MOWAAF to alleviate the extent of senior hunger in America and address its consequences would be relevant even if there were no negative health consequences associated with food insecurity; that seniors are experiencing hunger is reason enough. Unfortunately, senior hunger is associated with a number of negative health consequences. Using data from the 1999-2002 NHANES, we examined the health consequences of hunger for Americans over the age of 60. After controlling for other risk factors for poor health we find that seniors at-risk of hunger are significantly more likely to be in poor or fair health, more likely to have limitations in activities of daily living (ADL), more likely to suffer from depression, and more likely to have lower intakes of energy and major vitamins.

MOWAAF has made the alleviation of senior hunger a centerpiece of its numerous efforts to help Americans. To see the potential importance of these future efforts, using data from multiple years of the Current Population Survey and projections of the age-composition of senior Americans from the U.S. Census Bureau, we made projections of the extent of hunger in the year 2025. The relevancy of MOWAAF will be present far into the future. In 2025, we estimate that 9.5 million senior Americans will experience some form of food insecurity, almost double the number in 2005. In addition, in 2025, an estimated 3.9 million senior Americans will be at-risk of hunger and over 1 million senior Americans will suffer from hunger.

This report represents an important contribution to our understanding of senior hunger in America. Much work remains to be done, however, in efforts to ensure that no senior be at risk of going without food. We identify two key areas for future research. First, we need to be kept up-to-date on the extent of senior hunger along with the determinants and consequences of senior hunger. If the population of seniors was relatively static, such research would not be as relevant. But this is not the case – the population of seniors is changing rapidly, both in size and composition. Thus, we would anticipate that issues of senior hunger will change as well. In response, we recommend an annual updating of this report. Such a report would allow MOWAAF to identify the implications of these rapid changes among seniors. Second, we found some striking, and heretofore undocumented, results that the probability of food insecurity declines along the age gradient, that it rises significantly for those seniors living with a grandchild, and that it rises significantly for those socially isolated. Further research into the causal mechanisms of these processes is merited in order for MOWAAF, ENP, the Food Stamp Program, and related organizations to better target food-related services.

Appendix

Appendix Table 1: Questions on the Core Food Security Module

Food Insecurity Question	Asked of Households without Children	Asked of Households without Children
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?	x	x
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?	x	x
3. "We couldn't afford to eat balanced meals." Was that **often, sometimes**, or never true for you in the last 12 months?	x	x
4. "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?	x	
5. 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)	x	x
6. "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?	x	
7. 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)	x	x
8. (If yes to Question 5) How often did this happen—**almost every month, some months but not every month**, or in only 1 or 2 months?	x	x
9. "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?	x	
10. In the last 12 months, were you ever hungry, but didn't eat, because you couldn't afford enough food? (**Yes**/No)	x	x
11. In the last 12 months, did you lose weight because you didn't have enough money for food? (**Yes**/No)	x	x
12. 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)	x	
13. 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)	x	x
14. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (**Yes**/No)	x	
15. (If yes to Question 13) How often did this happen—**almost every month, some months but not every month**, or in only 1 or 2 months?	x	x
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)	x	
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?	x	
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)	x	

Notes: Responses in bold indicate an "affirmative" response.

Appendix Table 2. Food Insecurity Rates for Seniors below Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	38.86	21.91	8.15
Year			
2001	39.85	20.87	6.58
2002	35.19	21.97	9.25
2003	38.55	22.24	8.38
2004	40.40	22.25	8.70
2005	40.65	22.44	7.89
Racial Categories			
White	35.28	18.48	6.71
African American	52.74	35.78	13.83
Other	3.84	15.56	6.03
Hispanic Status			
Hispanic	46.74	24.27	6.91
Non-Hispanic	37.46	21.49	8.37
Marital Status			
Married	37.11	19.49	5.98
Widowed	35.35	19.41	6.57
Divorced or Separated	47.96	29.76	13.74
Never Married	52.19	33.57	17.96
Homeownership Status			
Homeowner	33.80	17.72	5.35
Renter	46.21	28.01	12.21
Metropolitan Location			
Non-Metro	35.79	21.68	8.07
Metro	40.16	22.01	8.18
Region			
Northeast	34.66	17.82	6.62
Midwest	33.38	17.85	5.65
South	41.93	25.32	9.49
West	41.01	21.67	8.87
Age			
Less than 70	47.53	29.15	11.33
Between 70 and 80	37.05	19.77	7.19
More than 80	26.82	12.79	4.16
Employment Status			
Employed	30.75	15.95	5.39
Unemployed	57.39	41.86	12.92
Retired	33.20	17.40	5.99
Disabled	57.75	36.42	15.37
Food Stamp			
Recipient	64.29	39.16	15.86
Non Recipient	32.77	17.79	6.30
Grandchild or Parent Present			
No Grandchild and Parent Present	37.18	20.55	7.72
Grandchild and Parent Present	64.65	43.33	17.30
Grandchild Present	50.68	34.01	10.70
Gender			
Female	37.84	20.88	7.38
Male	40.81	23.88	9.61
Living Arrangement			
Living Alone	35.75	20.72	8.49
Not Living Alone	41.89	23.08	7.81
Education			
Less than High School	43.56	25.22	9.35
High School only	33.18	17.56	6.39
Some College	36.09	21.55	8.82
College Degree more	25.35	11.29	3.53

Appendix Table 3. Food Insecurity Rates for Seniors between 100 and 200 Percent of the Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	19.93	8.91	2.42
Year			
2001	16.39	7.58	1.40
2002	19.72	9.46	2.02
2003	20.73	9.64	2.75
2004	22.98	8.82	2.62
2005	20.04	9.14	3.41
Racial Categories			
White	17.97	7.46	1.98
African American	33.66	18.95	5.76
Other	27.58	14.90	3.57
Hispanic Status			
Hispanic	25.06	12.49	1.82
Non-Hispanic	19.42	8.56	2.49
Marital Status			
Married	18.50	8.49	2.02
Widowed	19.94	8.17	2.31
Divorced or Separated	24.01	12.36	4.25
Never Married	37.58	19.23	5.95
Homeownership Status			
Homeowner	17.98	7.41	1.95
Renter	27.33	14.60	4.22
Metropolitan Location			
Non-Metro	18.72	8.08	1.81
Metro	20.41	9.24	2.67
Region			
Northeast	20.11	9.45	2.45
Midwest	16.92	6.64	2.10
South	21.31	9.86	2.89
West	21.08	9.59	1.92
Age			
Less than 70	24.25	12.53	3.43
Between 70 and 80	18.90	7.57	1.91
More than 80	14.99	5.54	1.72
Employment Status			
Employed	19.10	9.16	1.58
Unemployed	35.43	19.73	7.97
Retired	17.66	7.21	1.97
Disabled	37.20	20.75	6.61
Food Stamp			
Recipient	51.55	31.32	10.52
Non Recipient	18.70	8.04	2.11
Grandchild or Parent Present			
No Grandchild and Parent Present	18.63	7.99	2.27
Grandchild and Parent Present	37.35	20.48	5.24
Grandchild Present	35.60	23.83	2.96
Gender			
Female	19.80	8.36	2.25
Male	20.14	9.77	2.69
Living Arrangement			
Living Alone	18.80	7.88	2.71
Not Living Alone	20.55	9.47	2.27
Education			
Less than High School	25.68	11.59	3.10
High School only	16.81	7.38	2.05
Some College	16.91	7.48	2.27
College Degree more	16.03	7.72	1.48

Appendix Table 4. Food Insecurity Rates for Seniors above 200 Percent of the Poverty Line

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	3.90	1.57	0.35
Year			
2001	3.22	1.02	0.25
2002	3.40	1.27	0.28
2003	3.69	1.55	0.27
2004	3.96	1.70	0.37
2005	5.09	2.19	0.57
Racial Categories			
White	3.51	1.37	0.30
African American	8.83	4.17	0.94
Other	6.03	2.27	0.72
Hispanic Status			
Hispanic	9.36	4.06	0.91
Non-Hispanic	3.66	1.45	0.33
Marital Status			
Married	3.25	1.10	0.17
Widowed	4.99	2.35	0.83
Divorced or Separated	6.00	3.03	0.70
Never Married	7.98	2.84	0.93
Homeownership Status			
Homeowner	3.55	1.34	0.28
Renter	7.90	4.15	1.20
Metropolitan Location			
Non-Metro	3.99	1.42	0.36
Metro	3.88	1.60	0.35
Region			
Northeast	3.43	1.32	0.22
Midwest	4.03	1.75	0.41
South	4.06	1.53	0.33
West	3.92	1.65	0.46
Age			
Less than 70	4.22	1.80	0.39
Between 70 and 80	3.67	1.29	0.32
More than 80	3.13	1.24	0.27
Employment Status			
Employed	3.68	1.69	0.36
Unemployed	14.62	3.93	0.78
Retired	3.49	1.23	0.27
Disabled	8.75	4.45	1.25
Food Stamp			
Recipient	56.29	36.88	2.67
Non Recipient	3.73	1.45	0.35
Grandchild or Parent Present			
No Grandchild and Parent Present	3.64	1.49	0.33
Grandchild and Parent Present	7.59	2.05	0.72
Grandchild Present	11.95	2.12	0
Gender			
Female	4.35	1.81	0.45
Male	3.44	1.31	0.26
Living Arrangement			
Living Alone	4.27	2.14	0.73
Not Living Alone	3.82	1.43	0.27
Education			
Less than High School	8.16	3.42	0.54
High School only	4.58	1.92	0.44
Some College	3.66	1.50	0.40
College Degree more	1.58	0.45	0.14

Appendix Table 5. Food Insecurity Rates for African American Seniors

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	27.72	16.83	5.46
Year			
2001	27.86	17.05	3.88
2002	26.76	17.45	6.18
2003	25.83	15.84	5.11
2004	29.21	15.97	5.42
2005	28.99	18.03	6.69
Income Categories			
Below 50% of the Poverty Line	66.29	50.52	22.06
Between 50% and 100% of the Poverty Line	49.15	31.87	11.65
Between 100% and 200% of the Poverty Line	33.66	18.95	5.76
Above 200% of the Poverty Line	8.83	4.17	0.94
Missing Income	21.84	12.56	3.03
Hispanic Status			
Hispanic	29.24	17.19	6.66
Non-Hispanic	27.70	16.82	5.54
Marital Status			
Married	20.69	12.07	2.76
Widowed	33.92	20.67	6.64
Divorced or Separated	31.83	20.88	9.04
Never Married	35.70	22.92	8.71
Homeownership Status			
Homeowner	22.85	13.28	3.32
Renter	40.78	26.63	11.20
Metropolitan Location			
Non-Metro	38.75	25.92	5.44
Metro	25.73	15.20	5.60
Region			
Northeast	25.74	13.70	5.94
Midwest	25.04	15.78	4.93
South	30.35	19.13	5.71
West	21.76	12.05	3.89
Age			
Less than 70	27.14	17.16	5.66
Between 70 and 80	28.27	16.72	5.09
More than 80	28.52	15.95	5.62
Employment Status			
Employed	16.67	10.17	1.78
Unemployed	43.74	24.28	11.19
Retired	25.81	14.62	4.73
Disabled	45.52	31.59	11.71
Food Stamp			
Recipient	68.34	49.87	21.16
Non Recipient	23.79	13.64	3.94
Grandchild or Parent Present			
No Grandchild and Parent Present	26.51	15.84	5.21
Grandchild and Parent Present	28.35	21.58	6.91
Grandchild Present	42.47	31.29	8.36
Gender			
Female	30.07	17.91	5.74
Male	24.20	15.23	5.04
Living Arrangement			
Living Alone	32.58	20.01	8.08
Not Living Alone	25.48	15.37	4.26
Education			
Less than High School	37.17	23.77	7.87
High School only	25.19	14.31	4.28
Some College	18.81	11.27	3.34
College Degree more	11.19	5.14	2.57

Appendix Table 6. Food Insecurity Rates for Hispanic Seniors

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	24.36	12.98	3.05
Year			
2001	27.12	14.45	2.37
2002	25.35	13.48	3.55
2003	23.53	14.31	2.68
2004	28.44	14.44	5.34
2005	18.03	8.69	1.45
Income Categories			
Below 50% of the Poverty Line	45.92	20.66	8.29
Between 50% and 100% of the Poverty Line	46.92	25.06	6.60
Between 100% and 200% of the Poverty Line	25.06	12.49	1.82
Above 200% of the Poverty Line	9.36	4.06	0.91
Missing Income	18.76	13.18	3.24
Racial Categories			
White	24.09	12.66	2.99
African American	29.24	17.19	6.62
Other	31.97	24.25	1.62
Marital Status			
Married	20.14	10.34	2.49
Widowed	28.00	15.24	2.48
Divorced or Separated	28.24	16.19	4.34
Never Married	44.89	26.67	11.39
Homeownership Status			
Homeowner	18.31	9.21	1.61
Renter	39.97	22.70	6.77
Metropolitan Location			
Non-Metro	21.03	13.61	3.83
Metro	24.70	12.91	2.97
Region			
Northeast	23.39	13.29	3.17
Midwest	17.03	8.72	1.29
South	23.58	12.52	2.60
West	27.00	14.15	3.87
Age			
Less than 70	23.96	13.24	3.22
Between 70 and 80	24.70	13.10	3.09
More than 80	25.26	11.52	2.18
Employment Status			
Employed	15.13	7.80	1.24
Unemployed	46.43	32.26	4.00
Retired	22.16	11.53	2.34
Disabled	41.56	22.84	7.44
Food Stamp			
Recipient	60.66	34.31	9.76
Non Recipient	20.99	11.00	2.43
Grandchild or Parent Present			
College Degree more	10.08	6.22	2.92

Appendix Table 7. Food Insecurity Rates for Seniors Receiving Food Stamps

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	62.68	38.94	15.12
Year			
2001	64.00	35.82	10.51
2002	60.78	39.49	16.92
2003	60.81	41.42	16.01
2004	62.74	36.61	16.02
2005	63.63	40.68	15.42
Income Categories			
Below 50% of the Poverty Line	69.95	44.53	18.58
Between 50% and 100% of the Poverty Line	62.89	37.84	15.18
Between 100% and 200% of the Poverty Line	51.55	31.32	10.52
Above 200% of the Poverty Line	56.29	36.88	2.67
Missing Income	82.52	57.32	27.75
Racial Categories			
White	60.33	34.91	12.79
African American	68.34	49.87	21.16
Other	66.17	37.27	16.02
Hispanic Status			
Hispanic	60.66	39.93	9.77
Non-Hispanic	63.12	34.31	16.28
Marital Status			
Married	61.08	38.71	13.55
Widowed	59.23	36.34	12.92
Divorced or Separated	66.90	40.18	17.43
Never Married	72.94	50.11	25.43
Homeownership Status			
Homeowner	58.14	34.20	11.42
Renter	66.16	42.81	18.14
Metropolitan Location			
Non-Metro	63.11	40.69	16.95
Metro	62.53	38.33	14.49
Region			
Northeast	56.88	33.68	12.20
Midwest	57.10	37.20	11.19
South	66.03	42.65	17.68
West	68.49	36.13	16.77
Age			
Less than 70	67.09	46.00	19.26
Between 70 and 80	59.75	34.17	11.20
More than 80	54.42	25.94	10.22
Employment Status			
Employed	58.49	37.67	7.99
Unemployed	91.79	76.59	6.44
Retired	55.83	32.78	11.09
Disabled	73.07	47.44	22.93
Grandchild or Parent Present			
No Grandchild and Parent Present	61.61	38.19	15.67
Grandchild and Parent Present	57.65	29.16	7.05
Grandchild Present	73.63	57.43	18.02
Gender			
Female	61.61	38.09	14.62
Male	64.98	40.76	16.21
Living Arrangement			
Living Alone	59.98	36.07	15.87
Not Living Alone	67.80	41.19	14.55
Education			
Less than High School	64.97	40.58	15.80
High School only	57.48	34.73	11.87
Some College	65.72	41.64	22.34
College Degree more	58.14	37.60	11.29

Appendix Table 8. Food Insecurity Rates for Never-Married Seniors

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	27.41	15.99	7.13
Year			
2001	30.80	10.36	5.61
2002	28.16	13.89	7.91
2003	26.51	17.49	9.68
2004	25.29	16.43	4.81
2005	25.94	22.31	7.67
Income Categories			
Below 50% of the Poverty Line	48.35	28.70	12.81
Between 50% and 100% of the Poverty Line	53.33	35.01	19.49
Between 100% and 200% of the Poverty Line	37.58	19.23	5.95
Above 200% of the Poverty Line	7.98	2.84	0.93
Missing Income	13.15	8.21	2.50
Racial Categories			
White	23.27	12.82	6.75
African American	36.70	22.91	8.71
Other	17.66	9.72	1.08
Hispanic Status			
Hispanic	44.89	26.67	11.73
Non-Hispanic	23.39	13.53	6.07
Homeownership Status			
Homeowner	18.73	8.18	3.12
Renter	36.51	24.18	11.34
Metropolitan Location			
Non-Metro	28.61	18.84	8.93
Metro	27.18	15.44	6.79
Region			
Northeast	21.99	10.63	5.29
Midwest	20.78	13.70	7.16
South	34.12	20.44	8.12
West	26.31	16.63	8.07
Age			
Less than 70	27.56	15.67	7.43
Between 70 and 80	27.70	18.70	6.48
More than 80	24.55	7.25	6.79
Employment Status			
Employed	13.04	6.77	2.76
Unemployed	19.88	11.69	11.69
Retired	26.87	15.43	5.98
Disabled	47.32	29.26	15.14
Food Stamp			
Recipient	72.94	50.11	25.43.
Non Recipient	20.03	10.46	4.16
Grandchild or Parent Present			
No Grandchild and Parent Present	25.87	15.00	6.95
Grandchild and Parent Present	28.55	17.02	7.35
Grandchild Present	78.67	50.93	16.71
Gender			
Female	33.89	18.43	7.71
Male	19.26	12.91	6.40
Living Arrangement			
Living Alone	26.06	15.78	8.03
Not Living Alone	29.21	16.27	5.92
Education			
Less than High School	40.40	22.57	9.52
High School only	27.28	18.40	8.93
Some College	17.75	8.30	2.90
College Degree more	2.74	1.86	1.85

Appendix Table 9. Food Insecurity Rates for Seniors in Households with Grandchildren but no Parents

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	30.34	19.13	3.92
Year			
2001	30.30	19.32	2.86
2002	32.00	19.51	7.49
2003	26.04	15.52	1.34
2004	31.15	22.76	3.80
2005	32.16	18.35	3.42
Income Categories			
Below 50% of the Poverty Line	54.46	39.34	4.28
Between 50% and 100% of the Poverty Line	49.64	32.55	12.46
Between 100% and 200% of the Poverty Line	35.60	23.83	2.96
Above 200% of the Poverty Line	11.95	2.12	0.00
Missing Income	23.38	16.83	2.26
Racial Categories			
White	26.23	14.51	2.07
African American	42.47	31.30	8.36
Other	19.70	19.70	8.00
Hispanic Status			
Hispanic	52.85	39.11	2.22
Non-Hispanic	28.16	17.20	4.09
Marital Status			
Married	22.69	12.02	1.12
Widowed	29.41	19.72	3.69
Divorced or Separated	47.85	34.15	12.00
Never Married	78.67	50.93	16.71
Homeownership Status			
Homeowner	25.23	12.84	2.49
Renter	50.03	43.36	9.48
Metropolitan Location			
Non-Metro	27.96	15.27	3.15
Metro	31.11	20.03	4.18
Region			
Northeast	41.23	25.81	3.28
Midwest	21.03	11.92	1.33
South	36.05	23.72	6.26
West	17.89	10.34	1.35
Age			
Less than 70	35.37	22.36	4.61
Between 70 and 80	25.19	14.01	3.21
More than 80	20.70	17.59	2.66
Employment Status			
Employed	25.75	15.54	4.16
Unemployed	54.78	33.02	0.00
Retired	25.56	15.36	3.33
Disabled	49.85	34.98	6.25
Food Stamp			
Recipient	73.64	57.43	18.02
Non Recipient	24.45	13.92	2.01
Gender			
Female	35.47	24.43	5.06
Male	21.53	10.01	1.98
Education			
Less than High School	42.84	30.04	6.14
High School only	23.54	13.03	1.93
Some College	25.84	14.72	4.56
College Degree more	9.61	2.61	0.00

Appendix Table 10. Food Insecurity Rates for Seniors in Households with Grandchildren and Parents

	Marginally Food Insecure	Food Insecure	Very Low Food Secure
Full Sample	20.04	10.28	3.14
Year			
2001	17.96	8.13	2.99
2002	20.27	7.63	0.37
2003	19.42	12.94	5.63
2004	23.77	12.84	3.30
2005	18.92	10.13	3.55
Income Categories			
Below 50% of the Poverty Line	66.93	55.88	17.78
Between 50% and 100% of the Poverty Line	64.05	40.04	17.18
Between 100% and 200% of the Poverty Line	37.35	20.48	5.24
Above 200% of the Poverty Line	7.59	2.05	0.72
Missing Income	10.99	4.12	0.26
Racial Categories			
White	21.04	9.69	2.75
African American	28.35	21.57	6.91
Other	11.01	5.52	2.26
Hispanic Status			
Hispanic	31.87	17.94	3.83
Non-Hispanic	16.96	8.30	2.96
Marital Status			
Married	18.20	10.44	3.18
Widowed	19.33	9.20	2.73
Divorced or Separated	24.37	12.46	3.92
Never Married	28.55	17.01	7.35
Homeownership Status			
Homeowner	16.30	7.63	2.60
Renter	38.13	23.19	5.26
Metropolitan Location			
Non-Metro	26.43	11.53	5.17
Metro	19.31	10.53	2.91
Region			
Northeast	13.36	6.12	1.00
Midwest	22.18	11.62	3.46
South	24.21	11.19	3.69
West	19.18	10.84	3.89
Age			
Less than 70	20.99	13.45	3.74
Between 70 and 80	18.98	8.12	2.57
More than 80	20.38	9.35	3.22
Employment Status			
Employed	18.41	10.97	1.17
Unemployed	69.58	45.12	10.51
Retired	18.12	8.28	2.70
Disabled	28.15	18.21	6.22
Food Stamp			
Recipient	57.65	29.16	7.04
Non Recipient	17.38	8.95	2.86
Gender			
Female	19.01	9.28	2.52
Male	22.94	13.16	4.91
Education			
Less than High School	24.75	12.41	3.72
High School only	17.77	10.28	3.26
Some College	14.12	5.56	2.91
College Degree more	11.36	4.62	0.00

Appendix Table 11. Descriptive Statistics from NHANES

	Full Sample	Income under 200 percent
Food insecurity status		
Fully food secure	92	83
Marginally food secure	4	7
Low food secure	3	6
Very low food secure	2	4
Income as a proportion of the poverty line		
Below the poverty line	11	32
Between 100 and 200 percent of the poverty line	24	68
Above 200 percent of the poverty line	64	-
Marital status		
Married	63	43
Divorced or never married	13	20
Widowed	23	35
Female	55	62
Race/ethnicity		
White, non-Hispanic	80	70
Non-Hispanic African American	9	12
Hispanic	8	15
Other	3	3
High school graduate	68	49
Employment status		
Employed	22	12
Unemployed	1	1
Out of labor force	76	88
Age	71	73

Appendix Table 12: Effect of food insecurity and other variables on various nutrient intake outcomes

	Energy	Protein	Vitamin A	Vitamin C	Thiamin	Riboflavin
	(1)	(2)	(3)	(4)	(5)	(6)
Food insecure	-158.677	-5.373	-250.442	-11.793	-0.155	-0.186
	(51.526)**	(2.245)*	(101.092)*	(7.124)	(0.055)**	(0.075)*
Not married or widowed	43.516	1.642	113.522	4.925	0.006	0.121
	(42.332)	(1.844)	(83.054)	(5.853)	(0.045)	(0.062)*
Widowed	57.434	1.595	-1.856	-1.308	0.028	0.088
	(37.561)	(1.636)	(73.693)	(5.193)	(0.040)	(0.055)
Income/Poverty line	31.945	1.552	23.346	5.934	0.034	0.055
	(11.087)**	(0.483)**	(21.752)	(1.533)**	(0.012)**	(0.016)**
Female	-460.846	-19.530	-111.077	-7.014	-0.357	-0.449
	(29.411)**	(1.281)**	(57.703)	(4.066)	(0.031)**	(0.043)**
Black	-255.291	-7.126	188.006	7.538	-0.237	-0.528
	(41.732)**	(1.818)**	(81.877)*	(5.770)	(0.045)**	(0.061)**
Hispanic	-105.766	-1.866	186.364	17.553	-0.130	-0.213
	(39.181)**	(1.707)	(76.871)*	(5.417)**	(0.042)**	(0.057)**
Other	-310.326	-6.951	-162.066	18.180	-0.056	-0.543
	(98.297)**	(4.282)	(192.855)	(13.590)	(0.105)	(0.143)**
High school graduate	123.086	3.608	260.557	22.247	0.111	0.192
	(33.360)**	(1.453)*	(65.451)**	(4.612)**	(0.036)**	(0.048)**
Employed	-132.886	-6.447	-112.603	-6.956	-0.109	-0.296
	(118.796)	(5.175)	(233.073)	(16.424)	(0.127)	(0.173)
Out of Labor Force	-232.050	-8.502	24.048	-7.579	-0.180	-0.306
	(116.864)*	(5.091)	(229.281)	(16.157)	(0.125)	(0.170)
Age	-11.669	-0.504	3.259	0.167	0.000	-0.002
	(2.089)**	(0.091)**	(4.098)	(0.289)	(0.002)	(0.003)
Constant	2,900.645	116.688	400.790	65.002	1.687	2.380
	(190.951)**	(8.319)**	(374.636)	(26.400)*	(0.204)**	(0.277)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Appendix Table 13:Effect of food insecurity and other variables on various nutrient intake outcomes

	VitaminB6	Calcium	Phosphorous	Magnesium	Iron
	(1)	(2)	(3)	(4)	(5)
Food insecure	-0.130	-57.963	-106.600	-25.924	-1.318
	(0.077)	(32.734)	(36.659)**	(9.327)**	(0.623)*
Not married or widowed	0.070	50.672	41.602	11.418	-0.099
	(0.064)	(26.894)	(30.117)	(7.663)	(0.511)
Widowed	0.054	-6.608	10.319	-0.691	0.409
	(0.056)	(23.862)	(26.723)	(6.799)	(0.454)
Income/Poverty line	0.082	15.957	23.248	8.384	0.404
	(0.017)**	(7.044)*	(7.888)**	(2.007)**	(0.134)**
Female	-0.427	-120.829	-285.264	-59.439	-3.527
	(0.044)**	(18.685)**	(20.925)**	(5.324)**	(0.355)**
Black	-0.213	-268.414	-259.232	-56.084	-2.547
	(0.063)**	(26.512)**	(29.690)**	(7.554)**	(0.504)**
Hispanic	-0.009	-52.674	-39.913	-5.087	-0.833
	(0.059)	(24.892)*	(27.875)	(7.092)	(0.473)
Other	-0.097	-220.542	-218.732	-22.115	-0.927
	(0.148)	(62.448)**	(69.934)**	(17.794)	(1.188)
High school graduate	0.212	46.137	76.731	23.670	1.351
	(0.050)**	(21.193)*	(23.734)**	(6.039)**	(0.403)**
Employed	-0.201	-33.169	-100.288	-22.482	-2.820
	(0.179)	(75.471)	(84.518)	(21.504)	(1.435)*
Out of Labor Force	-0.216	-78.066	-131.814	-31.868	-3.427
	(0.176)	(74.243)	(83.143)	(21.154)	(1.412)*
Age	0.004	0.777	-4.791	-0.904	0.010
	(0.003)	(1.327)	(1.486)**	(0.378)*	(0.025)
Constant	1.504	764.918	1,661.034	354.308	17.312
	(0.287)**	(121.310)**	(135.852)**	(34.566)**	(2.307)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Appendix Table 14:Effect of food insecurity and other variables on various nutrient intake outcomes

	BMI	Arm circumfrence	Tricep skinfold	Subscapular skinfold
	(1)	(2)	(3)	(4)
Food insecure	-0.180	-0.079	-0.354	-0.481
	(0.392)	(0.308)	(0.480)	(0.561)
Not married or widowed	-1.204	-1.064	-1.230	-1.626
	(0.318)**	(0.250)**	(0.395)**	(0.453)**
Widowed	-0.421	-0.255	-0.945	-0.477
	(0.290)	(0.226)	(0.357)**	(0.405)
Income/Poverty line	-0.150	-0.020	0.067	-0.009
	(0.084)	(0.066)	(0.104)	(0.119)
Female	1.013	-0.279	8.953	1.468
	(0.224)**	(0.176)	(0.278)**	(0.317)**
Black	1.315	1.428	0.502	1.874
	(0.317)**	(0.250)**	(0.400)	(0.481)**
Hispanic	-0.069	-0.578	-0.902	0.814
	(0.300)	(0.235)*	(0.370)*	(0.422)
Other	-3.044	-2.395	-3.140	0.011
	(0.738)**	(0.584)**	(0.914)**	(1.078)
High school graduate	0.052	0.038	0.371	0.428
	(0.256)	(0.200)	(0.317)	(0.368)
Employed	0.215	0.385	1.803	0.598
	(0.881)	(0.703)	(1.108)	(1.264)
Out of Labor Force	0.233	0.450	2.060	0.216
	(0.867)	(0.692)	(1.091)	(1.244)
Age	-0.162	-0.190	-0.195	-0.246
	(0.016)**	(0.012)**	(0.020)**	(0.023)**
Constant	39.540	45.649	26.386	35.753
	(1.448)**	(1.138)**	(1.794)**	(2.053)**

Notes: Number of observations is 2544, 2633, 2489, and 2185. * significant at 5% level; ** significant at 1% level.

Appendix Table 15: Effect of food insecurity and other variables on various nutrient intake outcomes

	Diabetic	Excellent	Excellent or very good	Excellent, very good, or good	depression	ADL limitations
	(1)	(2)	(3)	(4)	(5)	(6)
Food insecure	-0.019	-0.032	-0.094	-0.137	0.011	0.150
	(0.023)	(0.023)	(0.035)**	(0.036)**	(0.011)	(0.029)**
Not married or widowed	-0.037	0.008	0.012	-0.021	-0.001	0.003
	(0.020)	(0.020)	(0.029)	(0.027)	(0.008)	(0.028)
Widowed	0.019	0.014	0.004	0.019	0.006	-0.012
	(0.021)	(0.018)	(0.025)	(0.024)	(0.008)	(0.026)
Income/Poverty line	-0.030	0.020	0.045	0.048	-0.004	-0.026
	(0.006)**	(0.005)**	(0.007)**	(0.007)**	(0.002)	(0.007)**
Female	-0.026	-0.028	-0.010	0.007	0.014	0.116
	(0.019)	(0.010)**	(0.018)	(0.021)	(0.007)	(0.018)**
Black	0.084	-0.034	-0.122	-0.072	0.024	-0.016
	(0.029)**	(0.013)**	(0.022)**	(0.030)*	(0.012)*	(0.028)
Hispanic	0.067	-0.033	-0.118	-0.127	0.021	-0.052
	(0.026)**	(0.013)*	(0.022)**	(0.028)**	(0.009)*	(0.027)
Other	0.104	-0.023	-0.106	0.064	-0.009	0.013
	(0.068)	(0.032)	(0.052)*	(0.066)	(0.015)	(0.063)
High school graduate	-0.017	0.041	0.117	0.132	0.006	-0.012
	(0.020)	(0.013)**	(0.021)**	(0.022)**	(0.006)	(0.022)
Employed	0.102	0.036	0.035	-0.064	-0.036	-0.130
	(0.107)	(0.045)	(0.074)	(0.103)	(.)	(0.082)
Out of Labor Force	0.133	-0.017	-0.085	-0.181	-0.029	0.008
	(0.060)*	(0.040)	(0.075)	(0.083)*	(0.030)	(0.074)
Age	-0.005	0.000	0.002	0.002	-0.000	0.007
	(0.001)**	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)**

Notes: Number of observations is 2751. * significant at 5% level; ** significant at 1% level.

Appendix Table 16:Effect of food insecurity with hunger and other variables on various nutrient intake outcomes

	Energy	Protein	Vitamin A	Vitamin C	Thiamin	Riboflavin
	(1)	(2)	(3)	(4)	(5)	(6)
Food insecure hunger	-216.125	-10.073	-225.903	-13.841	-0.181	-0.332
	(79.344)**	(3.453)**	(155.729)	(10.968)	(0.085)*	(0.115)**
Not married or widowed	49.252	1.938	118.299	5.269	0.011	0.131
	(42.445)	(1.847)	(83.306)	(5.867)	(0.045)	(0.062)*
Widowed	59.305	1.667	0.732	-1.176	0.030	0.091
	(37.575)	(1.635)	(73.747)	(5.194)	(0.040)	(0.055)
Income/Poverty line	34.637	1.609	29.055	6.162	0.037	0.057
	(10.996)**	(0.479)**	(21.582)	(1.520)**	(0.012)**	(0.016)**
Female	-462.649	-19.621	-112.672	-7.124	-0.359	-0.452
	(29.435)**	(1.281)**	(57.772)	(4.069)	(0.031)**	(0.043)**
Black	-255.602	-7.090	185.599	7.478	-0.238	-0.527
	(41.750)**	(1.817)**	(81.943)*	(5.771)	(0.045)**	(0.061)**
Hispanic	-117.534	-2.130	162.169	16.570	-0.143	-0.223
	(38.714)**	(1.685)	(75.985)*	(5.352)**	(0.041)**	(0.056)**
Other	-309.443	-6.864	-163.057	18.200	-0.055	-0.541
	(98.343)**	(4.280)	(193.017)	(13.594)	(0.105)	(0.143)**
High school graduate	128.760	3.793	269.809	22.675	0.117	0.199
	(33.312)**	(1.450)**	(65.382)**	(4.605)**	(0.036)**	(0.048)**
Employed	-134.016	-6.516	-113.084	-7.015	-0.109	-0.298
	(118.846)	(5.173)	(233.258)	(16.428)	(0.127)	(0.173)
Out of Labor Force	-232.584	-8.492	22.003	-7.642	-0.181	-0.306
	(116.909)*	(5.088)	(229.457)	(16.161)	(0.125)	(0.170)
Age	-11.342	-0.495	3.851	0.193	0.001	-0.001
	(2.085)**	(0.091)**	(4.092)	(0.288)	(0.002)	(0.003)
Constant	2,863.335	115.674	331.480	62.028	1.648	2.343
	(190.266)**	(8.281)**	(373.434)	(26.301)*	(0.203)**	(0.276)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Appendix Table 17:Effect of food insecurity with hunger and other variables on various nutrient intake outcomes

	VitaminB6	Calcium	Phosphorous	Magnesium	Iron
	(1)	(2)	(3)	(4)	(5)
Food insecure hunger	-0.278	-76.664	-170.044	-25.700	-1.862
	(0.119)*	(50.395)	(56.421)**	(14.370)	(0.958)
Not married or widowed	0.079	52.683	46.377	11.998	-0.049
	(0.064)	(26.959)	(30.182)	(7.687)	(0.513)
Widowed	0.056	-5.932	11.654	-0.416	0.425
	(0.056)	(23.865)	(26.719)	(6.805)	(0.454)
Income/Poverty line	0.083	16.969	24.741	8.946	0.426
	(0.017)**	(6.984)*	(7.819)**	(1.991)**	(0.133)**
Female	-0.430	-121.462	-286.745	-59.629	-3.542
	(0.044)**	(18.695)**	(20.931)**	(5.331)**	(0.356)**
Black	-0.212	-268.566	-259.027	-56.295	-2.548
	(0.063)**	(26.517)**	(29.688)**	(7.561)**	(0.504)**
Hispanic	-0.014	-57.084	-46.605	-7.479	-0.928
	(0.058)	(24.589)*	(27.529)	(7.011)	(0.468)*
Other	-0.095	-220.267	-217.625	-22.170	-0.918
	(0.148)	(62.462)**	(69.930)**	(17.810)	(1.188)
High school graduate	0.217	48.216	80.480	24.622	1.398
	(0.050)**	(21.158)*	(23.688)**	(6.033)**	(0.402)**
Employed	-0.203	-33.556	-101.329	-22.558	-2.830
	(0.178)	(75.484)	(84.510)	(21.523)	(1.436)*
Out of Labor Force	-0.216	-78.284	-131.913	-32.055	-3.430
	(0.176)	(74.254)	(83.133)	(21.173)	(1.412)*
Age	0.005	0.898	-4.588	-0.844	0.013
	(0.003)	(1.324)	(1.482)**	(0.378)*	(0.025)
Constant	1.483	751.082	1,638.217	347.343	17.008
	(0.286)**	(120.847)**	(135.296)**	(34.458)**	(2.298)**

Notes: Number of observations is 2626. * significant at 5% level; ** significant at 1% level.

Appendix Table 18:Effect of food insecurity with hunger and other variables on various nutrient intake outcomes

	BMI	Arm circumfrence	Tricep skinfold	Subscapular skinfold
	(1)	(2)	(3)	(4)
Food insecure hunger	-0.144	-0.271	-0.114	-0.396
	(0.617)	(0.476)	(0.732)	(0.863)
Not married or widowed	-1.201	-1.055	-1.231	-1.619
	(0.319)**	(0.251)**	(0.396)**	(0.454)**
Widowed	-0.420	-0.254	-0.941	-0.479
	(0.290)	(0.226)	(0.357)**	(0.405)
Income/Poverty line	-0.145	-0.020	0.079	0.001
	(0.083)	(0.066)	(0.103)	(0.118)
Female	1.012	-0.281	8.953	1.466
	(0.224)**	(0.176)	(0.278)**	(0.318)**
Black	1.313	1.430	0.494	1.869
	(0.317)**	(0.250)**	(0.400)	(0.481)**
Hispanic	-0.087	-0.575	-0.945	0.768
	(0.296)	(0.232)*	(0.366)**	(0.417)
Other	-3.044	-2.392	-3.150	-0.007
	(0.738)**	(0.584)**	(0.914)**	(1.078)
High school graduate	0.059	0.040	0.383	0.449
	(0.256)	(0.200)	(0.316)	(0.367)
Employed	0.215	0.384	1.805	0.586
	(0.881)	(0.703)	(1.108)	(1.264)
Out of Labor Force	0.231	0.452	2.054	0.201
	(0.867)	(0.692)	(1.091)	(1.244)
Age	-0.161	-0.190	-0.194	-0.244
	(0.016)**	(0.012)**	(0.020)**	(0.023)**
Constant	39.487	45.644	26.259	35.631
	(1.442)**	(1.133)**	(1.786)**	(2.046)**

Notes: Number of observations is 2544, 2633, 2489, and 2185. * significant at 5% level; ** significant at 1% level.

Appendix Table 19: Effect of food insecurity with hunger and other variables on various nutrient intake outcomes

	Diabetic	Excellent	Excellent or very good	Excellent, very good, or good	depression	ADL limitations
	(1)	(2)	(3)	(4)	(5)	(6)
Food insecure hunger	0.001	0.024	-0.074	-0.020	0.008	0.142
	(0.038)	(0.044)	(0.056)	(0.050)	(0.017)	(0.045)**
Not married or widowed	-0.037	0.008	0.013	-0.022	-0.001	-0.001
	(0.019)	(0.020)	(0.029)	(0.028)	(0.008)	(0.028)
Widowed	0.019	0.014	0.004	0.020	0.006	-0.013
	(0.021)	(0.017)	(0.025)	(0.024)	(0.008)	(0.026)
Income/Poverty line	-0.030	0.021	0.047	0.052	-0.005	-0.029
	(0.006)**	(0.005)**	(0.007)**	(0.007)**	(0.002)*	(0.007)**
Female	-0.026	-0.028	-0.010	0.007	0.014	0.116
	(0.018)	(0.009)**	(0.018)	(0.021)	(0.008)	(0.018)**
Black	0.083	-0.035	-0.123	-0.076	0.024	-0.015
	(0.028)**	(0.012)**	(0.021)**	(0.030)*	(0.012)*	(0.028)
Hispanic	0.064	-0.037	-0.125	-0.146	0.022	-0.038
	(0.025)*	(0.012)**	(0.021)**	(0.028)**	(0.010)*	(0.026)
Other	0.103	-0.025	-0.109	0.059	-0.009	0.014
	(0.067)	(0.030)	(0.052)*	(0.068)	(0.016)	(0.062)
High school graduate	-0.017	0.042	0.121	0.136	0.005	-0.018
	(0.020)	(0.012)**	(0.021)**	(0.022)**	(0.006)	(0.022)
Employed	0.102	0.037	0.037	-0.063	-0.036	-0.128
	(0.106)	(0.044)	(0.073)	(0.104)	(.)	(0.081)
Out of Labor Force	0.133	-0.019	-0.085	-0.183	-0.029	0.010
	(0.059)*	(0.039)	(0.074)	(0.085)*	(0.031)	(0.073)
Age	-0.005	0.000	0.003	0.002	-0.000	0.007
	(0.001)**	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)**

Notes: Number of observations is 2751. * significant at 5% level; ** significant at 1% level.

Appendix Table 20: Projections of Senior Population Sizes by Ages in 2025

Ages	Number (millions)	Proportions (as share of senior population)
60	4.2	5.0
61	4.3	5.0
62	4.2	5.0
63	4.2	5.0
64	4.2	5.0
65	4.2	5.0
66	4.0	4.7
67	4.0	4.7
68	3.8	4.5
69	3.7	4.3
70	3.6	4.2
71	3.4	4.0
72	3.2	3.8
73	3.0	3.6
74	2.9	3.4
75	2.8	3.3
76	2.6	3.1
77	2.5	3.0
78	2.4	2.9
79	1.9	2.3
80 and higher	15.5	18.4

Notes: These projections are taken from the U.S. Census Bureau (http://www.census.gov/population/www/projections/projectionsagesex.html)

Appendix Table 21: Estimates of the Effect of Various Averaged Factors on Food Insecurity

	Levels Models Based on Equation (3") of the text		
	Marginally Food Insecure	Food Insecure	Very Low Food Secure
	(1)	(2)	(3)
Homeowner	0.779	0.269	0.062
	(0.211)**	(0.190)	(0.159)
Below poverty line	0.676	0.408	0.242
	(0.237)*	(0.195)*	(0.118)*
Female	-0.310	0.290	0.075
	(0.276)	(0.288)	(0.135)
Age	-0.005	-0.003	-0.001
	(0.001)**	(0.001)*	(0.001)
Lives Alone	0.159	-0.085	-0.037
	(0.131)	(0.134)	(0.064)
Constant	-0.200	-0.206	-0.051
	(0.140)	(0.142)	(0.095)
	First Difference Models Based on Equation (6) of the text		
Homeowner	0.582	0.460	0.050
	(0.218)**	(0.220)*	(0.151)
Below poverty line	0.275	0.376	0.333
	(0.516)	(0.298)	(0.158)*
Female	-0.259	–0.056	0.089
	(0.419)	(0.258)	(0.139)
Lives Alone	-0.075	-0.214	-0.071
	(0.286)	(0.168)	(0.110)
White	–0.397	-0.306	-0.106
	(0.421)	(0.256)	(0.194)
High School Graduate	0.217	-0.449	-0.038
	(0.217)	(0.136)**	(0.100)
Constant	-0.005	-0.007	-0.001
	(0.003)	(0.003)*	(0.002)

Notes: Heteroskedasticity robust standard errors in parentheses for the levels models and Newey-West standard errors with one lag for the first difference models. The independent variables are averages for each age between 40 and 60 taken from the 1982-1986 Current Population Survey (CPS). (These represent values from the 1981-1985 calendar years.) The dependent variables are averages for each age between 60 and 80 taken from the 2001-2005 CPS (2001-2005 calendar years).
* significant at 5% level; ** significant at 1% level.

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