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The dynamic nature of poverty and food insecurity among older adults: Evidence from the Health and Retirement Study

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Abstract

This paper examines the dynamic of food insecurity for older adults over the past two decades and how it relates with different poverty measures, including the official poverty measure, Supplemental Poverty Measure, and Supplemental Poverty Measure enhanced with imputed rent. It further examines how age, birth cohort, and the Great Recession shape the relationship of food insecurity and poverty. The analysis uses data from the 2002 through 2018 Health and Retirement Study and assesses the risk of becoming food insecure as a function of various poverty measures across different age groups and birth cohorts before and following the Great Recession. The results show that compared with the official poverty measure, alternative poverty measures are stronger predictors of the onset of food insecurity. Beyond poverty, many factors, including demographic, economic, and health characteristics, also determine food insecurity. Moreover, there is no clear evidence that the impact of poverty on food insecurity declines at advanced ages or that the impact of the Great Recession on the onset of food insecurity has been smaller among the oldest older adults. Instead, more recent cohorts of older adults exhibit a greater discrepancy between food insecurity and poverty.

Executive Summary

While the prevalence of food insecurity has been somewhat lower among older Americans than in the general population, trends over the last two decades show a sharp increase in the prevalence and especially the number of older adults who are food insecure, with the latter more than doubling between 2001 and 2018 (Ziliak and Gundersen 2021). Given the rapid aging of the U.S. population, it is likely that the number of food insecure older Americans will continue to grow in the years to come and will constitute an ever larger share of food insecure Americans.

Although food insecurity is closely linked with poverty (Feeding America 2018), our knowledge on the nature and dynamic of this relationship, especially among older adults, remains limited. The majority of poor seniors are food secure, and most food insecure seniors have incomes above the official poverty line (Ziliak, Gundersen, and Haist 2008; Ziliak and Gundersen 2021). Over the past two decades, food insecurity among older adults increased by 45 percent (and very low food security more than doubled) (Ziliak and Gundersen 2021), while the official poverty rate for seniors remained almost unchanged and even marginally declined (Li and Dalaker 2019). Therefore, income poverty alone seems insufficient to account for such a complex phenomenon as food insecurity, especially as it pertains to older adults.

This paper examines the dynamic of food insecurity for older adults over the past two decades and how it relates with different poverty measures, including the official poverty measure (OPM), Supplemental Poverty Measure (SPM), and Supplemental Poverty Measure augmented with imputed rent (SPM-IR). It further examines how age, birth cohort, and the Great Recession shape the relationship of food insecurity and poverty. The analysis uses data from the 2002 through 2018 Health and Retirement Study and assesses the risk of becoming food insecure as a function of various poverty measures across different age groups and birth cohorts before and following the Great Recession, while controlling for a wide range of other demographic, economic, and health characteristics of adults aged 55 and older.

The results of the descriptive analysis show that the prevalence of food insecurity and poverty increased sharply, especially as measured by SPM and SPM-IR, during and immediately following the Great Recession. Unlike poverty, food insecurity increased in the years prior to the onset of the recession, while following the recession both food insecurity and poverty have been on a steady, albeit moderate, decline. Over the past two decades, the correlation between poverty and food insecurity as well as the correlation between different poverty measures for adults aged 55 and older has increased substantially. The results also show that while the prevalence of food insecurity among poor adults under age 80 increased between 2002 and 2018, it has either declined (as measured by OPM) or remained roughly constant (as measured by SPM and SPM-IR) for those aged 80 and older. Accounting for the trends in food insecurity among the nonpoor, this resulted in a sharp decline in the share of all food insecure adults 80 and older who are poor, whereas the share remained unchanged (using the OPM measure) or moderately increased (using the SPM and SPM-IR measures) for poor older adults younger than 80. These divergent age-related trends are consistent with the notion that population aging and an increase in the share of the oldest old adults could be associated with a weakening of the link between food insecurity and poverty.

Inferential results show that the alternative poverty measures, SPM and SPM-IR, are stronger predictors than OPM of the onset of food insecurity. While all poverty measures are significantly and strongly associated with the risk of food insecurity, a whole range of demographic, economic, and health factors, alongside period and cohort effects are also highly correlated with food insecurity. There is only limited evidence, however, that the impact of poverty on food insecurity declines at advanced old ages, and no evidence of age-related differences in the impact of poverty on long-term food insecurity. Similarly, results of the models of any food insecurity provide only limited support of the notion that the impact of economic shocks such as the Great Recession on the onset of food insecurity declines at the oldest ages, and there is no support for it in the models of long-term food insecurity. On the other hand, more recent cohorts of older adults clearly exhibit a greater discrepancy between food insecurity and poverty since they are much more likely to experience food insecurity than older generations after controlling for their poverty status and other personal characteristics.

Understanding the relationship between food insecurity and poverty is critical for policymakers, and this study makes an important contribution to advancing our knowledge on the dynamic aspect of the food insecurity-poverty relationship. The findings lend support to the notion that while poverty is a critical determinant of food insecurity among older adults, it is just one aspect of a more complex story that includes various demographic, socioeconomic, and health characteristics not traditionally captured by poverty measures, and is impacted by age, cohort, and period effects. These findings provide policymakers with information that facilitates a more accurate assessment of the extent to which poverty can be used as a proxy for food insecurity, the limitations of such an approach, and the sources of discrepancy between the two. Alongside information on the profile of older adults today and in the future, these insights can help assess what the likely extent of food insecurity may be in the years to come and, relatedly, how much food-related assistance older adults may need.

Introduction

Over 5 million older Americans are food insecure (Ziliak and Gundersen 2021). While the prevalence of food insecurity has been somewhat lower among older Americans than in the general population, trends over the last two decades show a sharp increase in the prevalence and especially the number of older adults who are food insecure, with the latter more than doubling between 2001 and 2018 (Ziliak and Gundersen 2021). Given the rapid aging of the U.S. population, it is likely that the number of food insecure older Americans will continue to grow in the years to come and will constitute an ever larger share of food insecure Americans. These older adults have lower nutrient intake, including proteins and essential vitamins and minerals, and suffer from worse physical and mental health relative to their food secure peers (Zilliak and Gundersen 2021). Many are forced to make trade-offs between buying food and paying for health care and other basic needs, such as housing, utilities, and clothing.

Although food insecurity is closely linked with poverty (Feeding America 2018), our knowledge on the nature and dynamic of this relationship, especially among older adults, remains limited. The majority of poor seniors are food secure, and most food insecure seniors have incomes above the official poverty line (Ziliak, Gundersen, and Haist 2008; Ziliak and Gundersen 2021). While this is true for the general population (U.S. Department of Agriculture 2021), the extent of this non-overlap between food insecurity and poverty is somewhat larger at older ages (Ziliak and Gundersen 2021). Moreover, after the sharp increase in food insecurity during the Great Recession, driven by seniors younger than age 80 and especially those younger than age 70, gains in food security have been much more moderate for older than younger adults (Ziliak and Gundersen 2021). In fact, over the past two decades, food insecurity among older adults increased by 45 percent (and very low food security more than doubled) (ibid), while the official poverty rate for seniors remained almost unchanged and even marginally declined (Li and Dalaker 2019). Therefore, income poverty alone seems insufficient to account for such a complex phenomenon as food insecurity, especially as it pertains to older adults.

With this in mind, this paper aims to address several related research questions, including: What has been the dynamic of food insecurity for older adults over the past two decades and how does it relate with different poverty measures?; What is the impact of different measures of poverty on the onset of food insecurity among older adults?; and, How does age shape the relationship of food insecurity and poverty?

Understanding these relationships is critical for policymakers. In the context of a rapidly aging population, an increasing number of older adults, even those not deemed poor, may be at risk of food insecurity, including persistent food insecurity. This may be exacerbated by cohort effects, such as cohort-specific preferences for independent living in old age, that further increase seniors' exposure to food insecurity, including nonpoor seniors. Moreover, the older population itself is aging and it is, therefore, important to understand whether advanced old-age adults follow similar or distinct patterns of the food insecurity-poverty relationship.

Background

A growing body of research has explored the determinants of food insecurity (Gundersen, Kreider, and Pepper 2011; Gundersen and Ziliak 2018). Low-income renters with severe housing cost burdens, where they must spend over half their income on housing-related costs, typically reduce their food expenditures by more than a third (Joint Center for Housing Studies 2015). Household composition also matters. Households with children face substantially higher rates of food insecurity than those without (Coleman-Jensen et al. 2021). Seniors living alone are also more likely to be food insecure than seniors living with others (Coleman-Jensen et al. 2021). Other factors associated with food insecurity include limited financial-management skills and lower levels of assets, savings, and access to credit, as well as housing-related challenges and low-wage, low-skill jobs (Gundersen and Garasky 2012; Fitzpatrick and Coleman-Jensen 2014). Rapid and unpredictable changes in income and expenses also increase the likelihood that households will be unable to meet their food needs and will struggle with food hardship (Bartfield and Collins 2017).

There is also a rich literature linking food insecurity with health status. Poor health, such as presence of chronic health conditions, can increase the risk of both temporary and persistent food insecurity (Hanson and Olson 2012). Households with at least one person with a disability have substantially higher rates of food insecurity than households in which no one has a disability (Brucker et al. 2015; Brucker and Coleman-Jensen 2017; Heflin, Altman, and Rodriguez 2019). This difference could be attributable to higher healthcare costs and limited financial resources that people with disabilities often experience relative to those without disabilities (e.g., Huang, Guo, and Kim 2010; Schwartz, Buliung, and Wilson 2019). For example, young adults with intellectual or developmental disabilities have significantly higher levels of food insecurity, even when controlling for poverty (Brucker and Nord 2016). The observed link between poor health and food insecurity appears to vary by the type and severity of health condition. Mental health conditions have larger impacts than physical conditions on rates of food insecurity (Maynard et al. 2018). Rates of food insecurity vary across ten major chronic diseases including hypertension/high blood pressure, diabetes, and chronic obstructive pulmonary disease (Gregory and Coleman-Jensen 2017).

A possible explanation for why there is not a stronger link between food insecurity and poverty is that current income does not accurately reflect families' ability to avoid food insecurity (Gundersen, Kreider, and Pepper 2011). Instead, long-run income, which averages income over multiple periods, and assets – in particular if readily accessible – may be better predictors of food insecurity (Gundersen and Gruber 2001; Loibl et al. 2022; Ribar and Hamrick 2003). Another explanation for this divergence may be the way poverty is measured. The official poverty measure (OPM) considers people poor if their resources fall below a threshold. Resources include various sources of before-tax cash income, and thresholds represent the approximate cost of a minimally adequate diet in 1963 multiplied by three to allow for other expenses (Orshansky 1963), adjusted for changes in the consumer price index (CPI) over time. Poverty thresholds vary by family size, composition, and whether the family head is age 65 or older.

Most researchers agree that the OPM does not paint an accurate picture of modern-day economic resources and spending needs. Family resources have changed considerably since 1963, especially as the government has increasingly focused on providing noncash benefits (such as benefits from the Supplemental Nutrition Assistance Program (SNAP) and housing assistance) and refundable tax credits (such as the earned income tax credit) to assist low-income families, and the OPM no longer accounts for all sources of income, taxes, and nondiscretionary expenses (Citro and Michael 1995). Some argue that a poverty measure should also account for the value of owner-occupied housing and the potential income from financial assets (Wimer and Manfield 2015; Wolff, Zacharias, and Kum 2007). Others point out that the thresholds (or equivalence scales) which define minimal needs standards in the OPM no longer reflect current spending patterns because they fail to capture the growth since 1963 in housing, health, and other costs relative to food costs. For example, people today spend closer to one-tenth of their income on food rather than one-third (U.S. Department of Labor 2021).

These criticisms especially pertain to the older adult population because their resources, needs, and health expenses differ most dramatically from the assumptions reflected in the OPM. Health in particular may be a reason why the OPM does not account more accurately for the prevalence of food insecurity and why many food insecure adults come from moderate-income households. People with disabilities and in poor health more generally need higher incomes to cover their basic needs that may include medicines, treatments, adaptive equipment, and other expenses not incurred by healthy individuals. Coleman-Jensen and Nord (2013) find that 13 percent of households that included an adult not in the labor force because of a disability had incomes that were at least three times the Federal poverty line but were also considered food insecure.

Butrica, Murphy, and Zedlewski (2010) show that the official poverty rate of adults age 65 and older in 2003 was 6.5 percent, but as high as 12.3 percent depending on how poverty was measured. Their finding suggests that a different poverty measure, such as Supplemental Poverty Measure (SPM), might align better with food insecurity rates. Accounting for older adults' medical expenses, for example, would likely plunge a number of seniors into poverty who are food insecure, but not officially poor. However, the official and any alternative poverty measure are based on a limited number of factors related to current resources and/or needs (i.e., economic hardship) and are only as good as the data they are based upon. Bee and Mitchell (2017) find higher incomes and lower poverty rates among older adults in administrative data than they do in survey data—mostly due to the underreporting of retirement income. Accounting for this income would move a number of seniors from poverty who are food secure, but thought to be poor. Notwithstanding this data-related issue, SPM and other alternative measures of poverty (e.g., consumption-based poverty) are based on a broader set of factors than those used for the OPM calculation, suggesting that they might capture better the prevalence of food insecurity.

Finally, and importantly, food insecurity may be impacted by factors other than economic hardship—something that would weaken the link between food insecurity and poverty. Those who are food insecure might live in areas with little or no access to healthy and affordable food, also known as food deserts (Schartz, Buliung, and Wilson 2019). Butrica, Mudrazija, and

Schwabish (2022) find that counties with high rates of people with disabilities experience limited availability of and accessibility to food establishments and that many of these same counties also have high rates of food insecurity. It may also be the case that some health conditions directly affect food security. Certain health conditions, for example, can suppress people's appetites, cause them to forget to eat, or make meal preparation difficult or impossible. A scoping review by Schwartz, Buliung, and Wilson (2019) finds an increased risk of food insecurity among people with disabilities, but especially those with mental health disabilities. Maynard et al. (2018) finds that most of the 39 articles in their meta-analysis of the literature showed associations between depression and food insecurity. Gregory and Coleman-Jensen (2017) find that rates of food insecurity vary across ten major chronic diseases including hypertension/high blood pressure, diabetes, and chronic obstructive pulmonary disease (see also Tarasuk et al. 2013). Given that food insecurity measurement tools are primarily based on economic access, people impacted by these types of food insecurity are not likely to be recognized as food insecure in the data other than to the extent that their conditions may also impact their economic wellbeing.

In the context of our research questions and utilizing insights from the reviewed empirical literature, we propose a set of research hypotheses that we will assess in our analysis, including:

1. Population aging and an increase in the share of the oldest old will increase the discrepancy between food insecurity and poverty trends.
2. Alternative poverty measures are more predictive of the onset of food insecurity than OPM.
3. Regardless of the poverty measure, there are many other factors that determine the risk of food insecurity onset.
4. The magnitude of the relationship between food insecurity and different poverty measures among older adults declines with age.
5. The impact of economic shocks such as the Great Recession, declines with age among older adults.

Also, since food insecurity among older adults has been trending up in recent years, while poverty—measured by OPM and SPM alike—has remained roughly constant (Fox 2018), it is possible that the observed increased discrepancy reflects cohort effects. For example, newer cohorts of older adults may have higher preference and (expectation) of living independently in old age, which decreases the availability of potential family or non-family helpers who can assist older adults with basic activities of daily living, including eating, and limits their ability to rely on the economies of scale to sustain their financial wellbeing in old age. Such generational differences in lifestyle choices are not captured by any poverty measure. With this in mind, we posit an additional research hypothesis:

6. Newer cohorts exhibit greater discrepancy between food insecurity and measures of poverty.

Data and Methods

Data

Data for this analysis come from the Health and Retirement Study (HRS). The HRS is a nationally representative biennial longitudinal survey of Americans over the age of 50 that began in 1992. The HRS includes detailed information on older adults and their family members, including their income, assets, poverty, and most importantly their food security. Questions about food insecurity in the HRS have been consistently asked since 1996. The survey asks respondents whether, since the prior wave (or in the past two years if this is their first interview), they always had enough money to buy the food they needed.

The Current Population Survey (CPS) is used to produce official poverty rates. Using information collected from 18 questions in the Core Food Security Module, the CPS is also used to produce official statistics of food insecurity. Although the food insecurity questions in the HRS are less detailed than those in the CPS, the HRS has many advantages over the CPS for this analysis. First, the HRS is focused on older adults. Second, it includes detailed self-reported information on assets and out-of-pocket medical expenses in addition to information on income. Third, while the CPS has been shown to understate income—particularly retirement income (Bee and Mitchell 2017), the HRS survey instruments capture very detailed retirement income information (Chen, Munnell, and Sanzenbacher 2018), making it more comparable to the income reported in administrative data sources. Lastly, the panel survey design of the HRS allows us to track respondents' food insecurity over time. Thus, the HRS is the best suited survey to examine the dynamics of the food insecurity-poverty relationship among seniors.

Our analysis uses data from the 2002 through 2018 HRS waves.[1] We focus on respondents age 55 and older. We exclude nursing home residents and those who missed a full interview in any wave, had zero weights, or had missing information on food security.[2] This results in a sample of 28,596 respondents. For the survival analyses, we restrict our sample to respondents who were interviewed in at least two waves, who were not food insecure at their first interview, and who had non-missing information for all model covariates. This leaves 22,446 respondents representing 90,739 person-years.[3]

Variables

[1] Although the HRS is currently available through 2018, the weights are not yet available. Therefore, we use the 2016 weights for both the 2016 and 2018 data.

[2] About 1 percent of the sample has missing information on food insecurity. Socioeconomic and health profiles of the respondents with missing information on food insecurity appear more favorable than for those who reported that they are food insecure, but less favorable than for those who reported that they are food secure.

[3] For the analysis of long-term food insecurity, defined as two or more consecutive waves of food insecurity, as a function of long-term poverty, defined as two or more consecutive waves of poverty, the sample varies by poverty measure because the reference category (i.e., nonpoor) excludes persons who report being poor at a single wave (or in multiple nonconsecutive waves).

Our outcome of interest is an indicator of whether the respondent has enough money to buy food.[4] We consider how food insecurity relates to poverty using three different poverty measures, including the OPM, SPM, and SPM enhanced with information on imputed rent. The OPM is readily available in the HRS data. It includes family cash income from earnings and pensions, non means-tested transfers such as Social Security, means-tested transfers such as Supplemental Security Income (SSI), interest, dividends, rental income, and transfers from outside the household.[5] The OPM thresholds assume that a single person age 65 or older requires about 92 percent as much income as a person under age 65 ($12,413 compared with $13,465 in 2020), a young couple requires 29 percent more than a young single person ($17,331 compared with $13,465), and an aged couple requires 26 percent more than an older single adult ($15,644 compared with $12,413) and 16 percent more than a younger single adult ($15,644 compared with $13,465).

Unlike the OPM, the SPM is not available in the HRS and needs to be constructed. It includes the same resources as those in the OPM, adds realized capital gains and losses, IRA distributions, and noncash benefits (e.g., SNAP benefits, also known as food stamps), and deducts income and payroll taxes[6] and out-of-pocket medical expenses.[7] We account for these differences to calculate the income used to determine SPM poverty level. The SPM thresholds include spending for a household (i.e., reference) unit with two children on food, clothing, shelter, and utilities and a modest adjustment for other needs, based on five-year average values from the CEX (Short and Garner 2012).[8] The thresholds vary by size and composition of family units, but with no differential for persons over age 65. They also vary by whether the household rents, owns with a mortgage, or owns without a mortgage.[9] In general, the thresholds are lowest for homeowners without a mortgage and highest for homeowners with a mortgage.

[4] Although the HRS has information on the receipt of SNAP benefits (or food stamps) and free or subsidized food such as Meals on Wheels, we do not use it to approximate food insecurity since program benefits might help some individuals and households afford the food they need to avoid food insecurity. Second, participation in home-delivered meal programs may be motivated by mobility issues rather than insufficient resources to afford food. Finally, program rules and priorities, such as income eligibility criteria for SNAP and targeting of meal programs to lower-income individuals, would likely result in a stronger relationship between food insecurity and poverty by design.

[5] For a full description of how the U.S. Census Bureau constructs OPM, see https://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html.

[6] For each respondent, we estimate their taxes for each state using the NBER's TAXSIM model and then assign them average taxes over all states.

[7] The SPM also accounts for benefits from the Low Income Home Energy Assistance Program (LIHEAP); Special Supplemental Nutrition Program for Women, Infants, and Children; and National School Lunch Program, and deducts work expenses. Because these are not available in the HRS, we do not account for these in our SPM poverty rate. However, this should not meaningfully impact our poverty estimates since the programs are small in size and, except for LIHEAP, not generally utilized by older adults (Wimer and Manfield 2015).

[8] This differs from the NAS panel's recommendation for basing the thresholds on the spending of a reference family of two adults and two children (U.S. Census Bureau 2010).

[9] Additionally, they vary by geographic location to account for differences in the housing cost across state and metropolitan areas. Our analysis, however, does not vary the SPM thresholds by geography.

Additionally, we construct an alternative poverty measure that augments the SPM with information on the value of imputed rent (SPM-IR). We calculate imputed rental income as the annual rate of return (i.e., bond yield) on home equity less property taxes paid.

In the inferential analysis, we also control for various demographic, socioeconomic, and health characteristics of respondents. Demographic controls include relationship status (married or partnered, divorced or separated, widowed, and never married), sex, and race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and Asian/Native American/other). Socioeconomic controls include educational attainment (less than high school degree, high school degree or GED, some college, and college degree or above), work status indicator, and indicator of homeownership. Health controls include self-rated health status (excellent or very good, good, and fair or poor), and indicators of self-reported health conditions, including presence of a mental health condition,[10] being overweight, having any activity of daily living (ADL) limitation,[11] having any instrumental activity of daily living (IADL) limitation,[12] or having ever been diagnosed with a memory disease. Additionally, to account for the possible impact of the Great Recession, we create an indicator that distinguishes the period following the recession (i.e., including survey wave 2010 and later) from the period preceding it.[13] In a supplementary analysis, we also control for cohorts based on birth years with the reference category being 1923 and earlier, and the remaining categories including 1924-1930, 1931-1941, 1942-1947, 1948-1953, 1954-1959, and 1960-1965 (corresponding to the Assets and Health Dynamics, Children of Depression Age, original HRS, War Baby, Early Baby Boomer, Mid Baby Boomer, and Late Baby Boomer cohorts of the HRS survey, respectively).

Methods

We begin by describing the relationship between food insecurity and poverty in our sample. First, we examine trends in and the correlation of food insecurity and different measures of poverty since the early 2000s. Next, we show how the cumulative risk of becoming food insecure increases over time for those who are poor using different measures of poverty. We then examine trends in food insecurity over time by poverty status (using OPM, SPM, and SPM-IR) and age (greater or less than age 70, and greater or less than age 80).

Then we turn to the inferential analyses of the dynamics of the relationship between food insecurity and poverty. We estimate a series of continuous-time multivariate hazard models to examine the factors related to older adults becoming food insecure. We use the semi-parametric Cox proportional hazards model, which is commonly used in analyzing multivariate survival data. In the Cox model, we specify a continuous-time cause-specific hazard rate (i.e., a subdistribution hazard rate, $h_r(t)$) that represents the instantaneous probability of an event (E)

[10] Mental health conditions include: feeling depressed, happy, lonely, sad, everything being an effort, could not get going, sleeping restlessly, and enjoyed life. The reference period is the week prior to the interview.
[11] ADL limitations include: bathing/showering, dressing, eating, getting in/out of a bed, and walking across a room.
[12] IADL limitations include: using a telephone, managing money, taking medications, shopping for groceries, and preparing hot meals.
[13] Although the recession officially lasted between December 2007 and June 2009, its full impact on the variables of interest in this study would be observed in the 2010 wave of the HRS.

such as the onset of food insecurity (f) occurring in an interval of time [t, Δt], given that the event has not previously occurred:

$$h_r(t) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} \Pr[t \leq T < t + \Delta t, E = f \mid T \geq t]$$

Age is our analytic unit of time. Our models include respondents ages 55 and older who participated in at least two consecutive survey waves and are food secure and thus have the potential to become food insecure. To examine the extent to which poverty (and other predictors) may vary with age, we estimate models that include time (i.e., age) varying covariates with cutoffs at age 70 and, alternatively, at age 80. This allows us to estimate whether the direction and magnitude of the association between all model covariates, including different measures of poverty, and the onset of food insecurity changes at advanced old ages.

For each measure of poverty, we fit a series of four model specifications. The first model includes only demographic control variables, the second one includes demographic and economic control variables, the third one includes demographic and health control variables, and the fourth model includes the full set of control variables. We estimate this set of models twice—once without any constraints on the duration of food insecurity and poverty and again for long-term food insecurity and poverty, where long-term is defined as a minimum of two consecutive waves of being food insecure and poor.[14] In a supplemental analysis, we also control for birth cohort to examine whether the risk of the onset of food insecurity differs significantly across generations accounting for poverty status and other individual characteristics.[15] We report hazard ratios, which are exponentiated coefficients: a hazard ratio greater than one indicates an increasing risk of becoming food insecure for a change in the independent variable at any event time, whereas a hazard ratio less than one indicates a decreasing risk. We report only selected coefficients in the main report and the full set of covariates across all model specifications in the Appendix.

Results

Descriptive Results

Between 2002 and 2018, the prevalence of both food insecurity and poverty increased for adults aged 55 and older (Figure 1). There are, however, several distinct periods. First, between 2002 and 2008, poverty remained constant as measured by OPM and even declined as measured by

[14] All these analyses were repeated using the set of household-level economic and health control variables, that is, accounting for the work status, educational attainment, and the health profile of both respondent and spouse/partner rather than respondent only. However, the results for the key predictors of interest were not substantively different and therefore these analyses are not included in the paper.

[15] Accordingly, this analysis requires a minimum of three consecutive observations of the same individual since someone who enters the risk set as food secure would have to be present in at least two subsequent waves to determine whether she/he experienced the onset of long-term food insecurity. Since the cohort born 1960-1965 (i.e., late baby boomer cohort) only joined the HRS sample in 2016 and our most recent survey wave was completed in 2018, this cohort is not a part of the analysis of the impact of long-term poverty on long-term food insecurity.

SPM and especially the alternative measure of poverty, SPM-IR, whereas food insecurity increased moderately. During and in the immediate aftermath of the Great Recession, as reflected in the 2010-2012 periods, both food insecurity and poverty increased considerably. Between 2008 and 2012, food insecurity increased by 2.8 percentage points, whereas poverty increased by 2.3, 3.1, and 4.2 percentage points for OPM, SPM, and SPM-IR, respectively. Since then, there has been a moderate decline in food insecurity and poverty prevalence (regardless of the measure), but the levels remain elevated compared with the pre-recession period.

The correlation between food insecurity and different measures of poverty is overall low. However, it increased markedly during and immediately following the Great Recession, especially as measured by SPM and SPM-IR, and has remained elevated since (Figure 2, left). The correlation between various poverty measures also increased throughout the observation period (Figure 2, right).

Given the observed association between food insecurity and poverty, we expect poor individuals to have a higher risk of food insecurity than nonpoor individuals. In Figure 3, we show the magnitude of this difference for our full sample using different measures of poverty. The results show that the cumulative risk of food insecurity is higher the more stringent the definition of poverty, with just over a half of OPM poor individuals expected to become food insecure by the end of the observation period, followed by 45 percent of SPM-IR poor, and 41 percent of SPM poor individuals. Importantly, nonpoor individuals also have a non-trivial risk of becoming food insecure. Within six or seven waves of observing nonpoor individuals, their risk of becoming food insecure rivals that experienced by their poor peers in the short-term—that is, the first wave we start observing them.

Until now, our analyses have treated those aged 55 and older as a monolith. In Table 1, we relax this implicit assumption and disaggregate the trends in food insecurity by age for nonpoor and poor individuals. We find that food insecurity increased over the observed period and especially during and following the Great Recession for poor and nonpoor individuals alike, regardless of the poverty measure. Within age groups, however, there are some notable differences. Food insecurity increased for poor people aged 55-69 and those aged 70 and older, but not for those aged 80 and older. In fact, poor people aged 80 and older experienced a decline in food insecurity as measured by OPM and little change as measured by SPM and SPM-IR. This suggests that the oldest old adults follow a different pattern of the food insecurity-poverty relationship than other adults aged 55 and older. Roughly a third of the food insecure population is also poor, with the share being somewhat higher among younger old than oldest old adults and higher using SPM and SPM-IR than OPM. Indeed, among food insecure adults aged 80 and older, only about a fifth were OPM poor and a quarter SPM-IR poor in 2018. Much of the age-related divergence in these trends seems to have occurred following the Great Recession as there is no evidence of such distinct age patterns in earlier years.

Finally, in Table 2 we describe the characteristics of our analytic sample by age groups and test the differences in means between those aged 55-69 and those aged 70 and older, as well as between those aged 55-79 and those aged 80 and older. While adults aged 70 and older are less likely than adults aged 55-69 to be poor when measured using OPM and SPM-IR, there is no

difference in SPM poverty rates. Compared with adults aged 55-79, those aged 80 and older have a significantly higher prevalence of poverty regardless of the poverty measure, with a particularly large difference in poverty rates as measured with the SPM.

The demographic profile varies in expected ways between younger and older subsamples regardless of the age cutoff point. More advanced age adults (i.e., those aged 70 and older or 80 and older) are more likely to be widowed, female, and non-Hispanic white than younger adults (i.e., those aged 55-69 or 55-79, respectively). On average, more advanced age adults have lower educational attainment, are much less likely to still be working, and are less likely to own a home than their younger peers. Their health profile is worse across a range of subjective and objective indicators of physical and mental health. The only exception is the share of people who are overweight, which is substantially and statistically significantly lower at older ages.

Inferential Results

In Table 3, we present the key results from the hazard models of food insecurity. First, all measures of poverty across all model specifications are strongly significantly predictive of the onset of food insecurity. The magnitude of the relationship, however, declines as we control for more personal characteristics and is consistently lower using OPM than the two alternative poverty measures. For example, in the model with age 70 and older varying covariates (Panel A), the hazard of food insecurity in the baseline specification is 2.69 times higher for the OPM poor, 2.95 times higher for the SPM poor, and 3.09 times higher for the SPM-IR poor than for the nonpoor. Once all personal characteristics are accounted for, the hazard of food insecurity remains significantly higher, but the magnitude declines to 1.69, 2.02, and 2.00 for each of the three poverty measures, respectively.[16] While the impact of poverty on the onset of food insecurity for those aged 70 and older is attenuated in the baseline model specifications (reducing the previously reported hazard of food insecurity by 18-23 percent across the three poverty measures),[17] this effect disappears as we add more controls for personal characteristics. However, the indicator of the post-Great Recession period for those aged 70 and older suggests a consistently lower hazard by about 21-27 percent relative to adults aged 55-69.

The second set of models, which increase the age cutoff to 80 for the age-varying component of the model (Panel B), paints a slightly different picture. The impact of poverty on food insecurity remains significant with somewhat larger estimated coefficients. For those aged 80 and older, the impact is attenuated by 36-42 percent in the baseline models and remains at least marginally significant in all but the full model specification using SPM and SPM-IR poverty measures (and in the baseline specification using the OPM poverty measure). While the indicator of the post-Great Recession period in the baseline model suggests a lower hazard of food insecurity for those aged 80 and older relative to those aged 55-79, its magnitude is smaller

[16] By default, these coefficients refer to adults aged 55-69, but are also applicable to adults 70 and older when corresponding time-varying covariates are not statistically significant. When they are statistically significant, however, the non-time-varying coefficients have to be adjusted accordingly to reflect the accurate estimates for those aged 70 and older.

[17] For example, the hazard of food insecurity is 2.69 times higher for the OPM poor aged 55-69 and 2.21 times higher (2.69*.82) for the OPM poor aged 70 and older.

than in the Panel A models and it does not reach statistical significance at the conventional levels of significance. The full set of covariates across all models shows that demographic, economic, and health characteristics significantly impact the hazard of becoming food insecure even after accounting for poverty and the period impact of the Great Recession (results available in the Appendix Tables A1 and A2).

In Table 4, we repeat the above analysis, but limit it to the onset of long-term food insecurity as a function of long-term poverty—that is, the onset of two or more consecutive waves of food insecurity as a function of two or more consecutive waves of poverty.[18] The results across both sets of models show a much larger positive effect of poverty on food insecurity. They also suggest that the impact of long-term poverty on long-term food insecurity is not attenuated at older ages, as it was for any poverty and food insecurity and, if anything, may be amplified, especially for adults aged 80 and older under the SPM-IR. There is also no evidence across any model specification that the risk of the onset of long-term food insecurity differs following the Great Recession or that the impact of the post-Great Recession period on the hazard of long-term food insecurity is attenuated for advanced old-age adults.

Supplemental Analysis: Cohort Effects

In the supplemental analysis, we explore possible cohort differences in the risk of food insecurity. The results for the hazard of food insecurity, both any and long-term, show that younger cohorts have an increasingly higher risk of food insecurity even controlling for their personal characteristics (Table 5). The impact of poverty on food insecurity remains similar as in the models not controlling for cohort effects. The only difference is with the post-Great Recession indicator, which suggests a substantially lower risk of falling into food insecurity following the Great Recession regardless of the age of older adults. In contrast, the models that do not control for cohort effects suggest that the attenuating impact of the post-recession period on food insecurity is concentrated among those aged 70 and older.

Unlike the risk of experiencing any food insecurity, there is no cohort gradient in the risk of becoming long-term food insecure (Table 6). Importantly, estimates of the impact of poverty and the post-Great Recession period on long-term food insecurity across all models is consistent in direction, significance, and magnitude with estimates from models that do not control for cohort effects.

Discussion

In this paper, we set out to examine the dynamic of food insecurity for older adults over the past two decades and its relationship with different poverty measures, including OPM, SPM, and SPM-IR, as well as the impact of different measures of poverty on the onset of food insecurity among older adults. Furthermore, we aimed to assess whether and how age shapes the relationship between food insecurity and poverty. The results of the descriptive analysis show that the prevalence of food insecurity and poverty increased sharply, especially as measured by

[18] The full set of results that includes all covariates is available in the Appendix tables B1 and B2.

SPM and SPM-IR, during and immediately following the Great Recession. Unlike poverty, food insecurity increased in the years prior to the onset of the recession, while following the recession both food insecurity and poverty have been on a steady, albeit moderate, decline. Over the past two decades, the correlation between poverty and food insecurity as well as the correlation between different poverty measures for adults aged 55 and older has increased substantially. The results also show that while the prevalence of food insecurity among poor adults under age 80 increased between 2002 and 2018, it has either declined (as measured by OPM) or remained roughly constant (as measured by SPM and SPM-IR) for those aged 80 and older. Taking into account the increase in food insecurity among nonpoor, this resulted in a sharp decline in the share of all food insecure adults 80 and older who are poor, whereas the share remained unchanged (using the OPM measure) or moderately increased (using the SPM and SPM-IR measures) for poor older adults younger than 80. These divergent age-related trends are consistent with the notion that population aging and an increase in the share of the oldest old adults could be associated with a weakening of the link between food insecurity and poverty, lending partial support to our first hypothesis.

Inferential results provide clear support for the second research hypothesis given that the alternative poverty measures, SPM and SPM-IR, are stronger predictors than OPM of the onset of food insecurity. While all poverty measures are significantly and strongly associated with the risk of food insecurity, a whole range of demographic, economic, and health factors, alongside period and cohort effects are also highly correlated with food insecurity, thereby lending support to our third hypothesis that many factors beyond poverty determine food insecurity. However, we find only limited support that the impact of poverty on food insecurity is smaller at advanced old ages, and no evidence of age-related differences in the impact of poverty on long-term food insecurity. Therefore, our fourth research hypothesis is mostly unsupported. The fifth hypothesis, which conjectures that the impact of economic shocks such as the Great Recession on the onset of food insecurity declines at the oldest ages, finds mixed support in our models of any food insecurity and no support in our models of long-term food insecurity. Finally, in our supplemental analysis examining the impact of cohort effects on food insecurity, we find support for our final hypothesis that more recent cohorts of older adults exhibit greater discrepancy between food insecurity and poverty since controlling for their poverty status (alongside other personal characteristics), they are much more likely to experience food insecurity than older generations. However, this relationship does not extend to the association of long-term poverty and food insecurity, which suggests that the nature of the link of persistent food insecurity and persistent poverty has not changed across generations.

While in this paper we undertook a comprehensive analysis of the link between food insecurity and different measures of poverty over time, there are additional areas the research could explore to gain further insight into the nature of this relationship. For example, in our preliminary analysis of the role of place-based characteristics, such as local unemployment and housing costs (results not shown), we find no evidence for its substantial impact on our key topic of interest—that is, the food insecurity-poverty relationship. However, expanding the set of place-based characteristics to capture the institutional context for support of poor and/or food insecure older adults (e.g., presence of charities and other not-for-profit entities aimed at

providing food and other supports to those in need) and including them in the model specifications presented in this paper may help us gain further insight. Furthermore, there is scope for expanding the research into the possible impact of various (financial and nonfinancial) supports exchanged between older adults and their (non-coresident) family and friends, which may conceivably moderate the impact of poverty on food insecurity. Finally, given that various personal characteristics may contribute to determining not only food insecurity but also poverty, future research might build on our analytic approach and fit a more complex structural equation model to account for the indirect impact of personal characteristics on food insecurity through their impact on poverty.

Conclusion

Understanding the relationship between food insecurity and poverty is critical for policymakers. In the context of a rapidly aging population, an increasing number of older adults, even those not deemed poor, may be at risk of food insecurity, including persistent food insecurity. Notwithstanding any limitations, the current study makes an important contribution to advancing our knowledge on the dynamic aspect of the food insecurity-poverty relationship. It assesses this link using multiple measures of poverty and accounts explicitly for possible differences in the impact by age (and cohort), while also accounting for the possible impact of the Great Recession. The findings lend support to the notion that while poverty is a critical determinant of food insecurity among older adults, it is just one aspect of a more complex story that includes various demographic, socioeconomic, and health characteristics not traditionally captured by poverty measures, and is impacted by age, cohort, and period effects. While much work remains to understand fully the nature of food insecurity and even the full extent of its link with poverty, policymakers may benefit from the information in this study as it allows them to assess more accurately the extent to which poverty can be used as a proxy for food insecurity, as well as the limitations of such an approach and the sources of discrepancy between the two. Alongside information on the profile of older adults today and in the future, these insights can help assess what the likely extent of food insecurity may be in the years to come and, relatedly, how much food-related assistance older adults may need.

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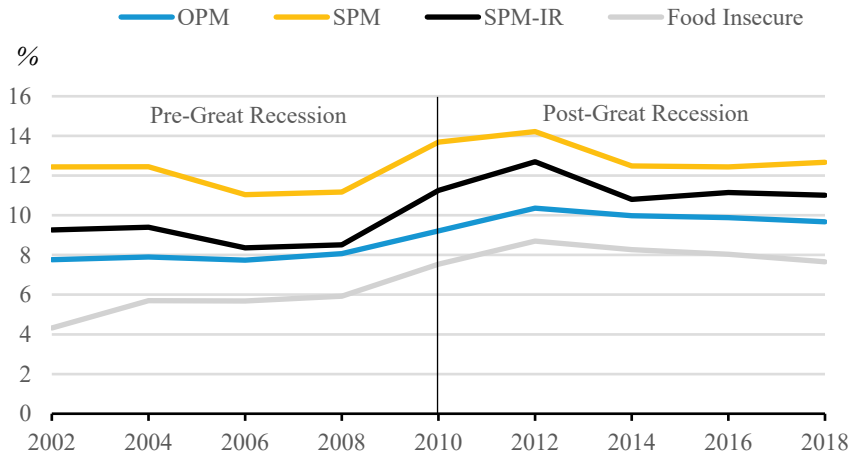
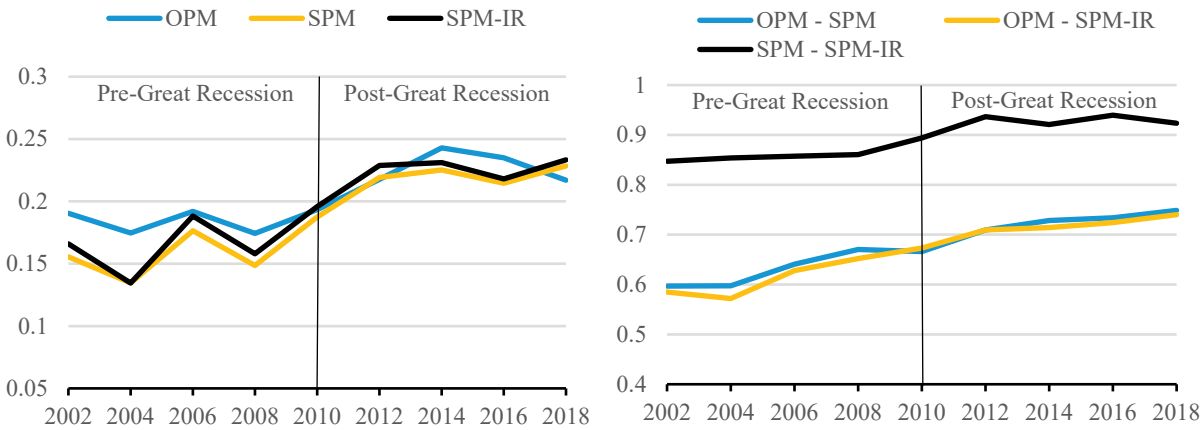
Figures

Figure 1. Rates of poverty and food insecurity for adults aged 55 and older, by year



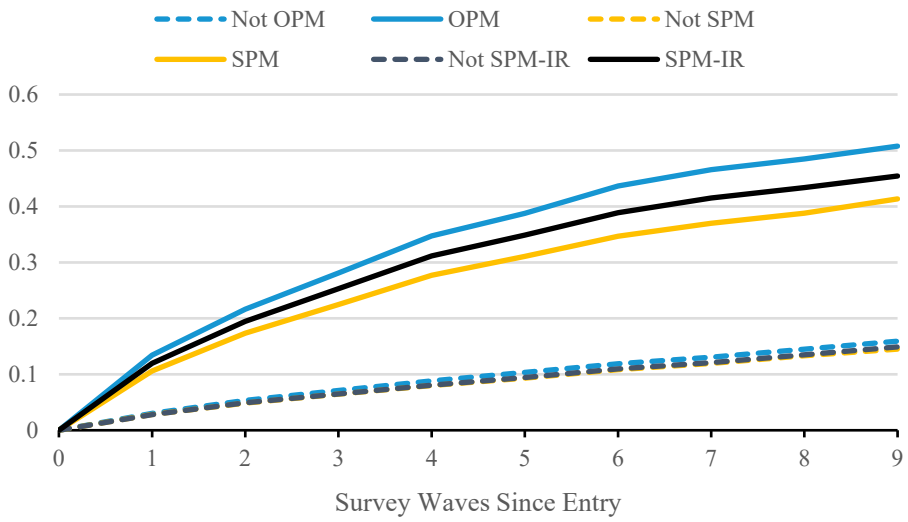
Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent.
Source: Health and Retirement Study (2002-2018).

Figure 2. Correlation of food insecurity with poverty measures (left figure) and correlation between poverty measures (right figure) for adults aged 55 and older, by year



Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. We report Pearson's correlation coefficients.
Source: Health and Retirement Study (2002-2018).

Figure 3. Cumulative hazard of food insecurity among adults aged 55 and older, by whether they also experience poverty spells



Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Not OPM, Not SPM, and Not SPM-IR refers to those not defined as poor according to the three measures of poverty, respectively.
Source: Health and Retirement Study (2002-2018).

Tables

Table 1. Food insecurity (FI) among nonpoor and poor individuals and poverty rate among FI population for adults aged 55 and older, by poverty measure, age group and year

	OPM								
	55-69			70 and older			80 and older		
	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor
2002	3.7	21.0	34.3	2.5	11.8	25.6	2.4	12.2	31.1
2004	5.0	22.3	28.9	3.7	14.2	22.6	3.8	11.7	22.2
2006	5.1	24.7	30.0	3.2	13.7	24.6	2.4	9.3	23.3
2008	5.6	22.8	27.6	3.2	13.7	25.1	2.4	9.9	26.7
2010	7.5	27.2	28.2	3.2	15.9	30.9	2.9	10.4	27.3
2012	8.1	32.2	33.4	4.0	14.0	25.5	3.0	9.1	25.6
2014	7.3	32.8	35.6	3.8	17.4	29.1	2.5	11.0	34.3
2016	7.1	32.0	35.6	3.7	14.7	25.2	2.6	9.7	29.1
2018	7.1	28.9	33.5	3.6	15.9	26.2	3.3	8.2	19.8

	SPM								
	55-69			70 and older			80 and older		
	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor
2002	3.6	16.7	38.5	2.5	7.6	32.2	2.3	7.4	39.3
2004	5.0	17.5	32.1	3.7	9.0	27.0	3.8	7.9	28.7
2006	5.0	21.1	33.2	2.9	11.4	34.6	2.3	6.3	30.6
2008	5.5	18.7	30.1	3.2	10.6	29.0	2.4	7.2	29.0
2010	6.9	24.7	36.2	3.2	11.4	36.2	2.8	8.0	35.1
2012	7.5	29.5	40.6	3.8	12.1	32.5	2.6	9.0	40.0
2014	7.1	29.8	38.9	3.8	13.7	31.3	2.4	9.2	39.4
2016	7.1	27.6	37.2	3.4	13.9	33.1	2.5	8.7	35.5
2018	6.6	27.6	40.0	3.2	14.8	35.5	3.0	8.3	31.2

	SPM-IR								
	55-69			70 and older			80 and older		
	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor	% Nonpoor FI	% Poor FI	% FI Poor
2002	3.7	18.8	34.7	2.6	8.8	25.1	2.4	8.8	32.7
2004	5.2	19.2	27.9	4.0	9.2	19.5	4.0	8.1	20.7
2006	5.1	23.8	30.2	3.1	13.5	27.9	2.5	6.4	21.1
2008	5.6	21.0	27.3	3.4	12.1	22.5	2.6	8.0	20.9
2010	7.1	26.6	33.2	3.3	13.0	31.6	3.0	8.7	27.8
2012	7.6	30.9	39.1	3.8	13.4	30.1	2.8	9.6	34.3
2014	7.3	30.8	36.5	3.9	15.8	27.9	2.5	10.6	34.0
2016	7.3	28.5	35.1	3.5	15.3	31.2	2.5	10.0	33.5
2018	6.7	28.8	38.1	3.4	16.2	30.2	3.1	8.9	25.7

Notes: OPM – official poverty measure, SPM – supplemental poverty measure. SPM-IR - supplemental poverty measure with imputed rent.
Source: Health and Retirement Study (2002-2018).

Table 2. Profile of analytic sample, by age groups

	55-69	70 and older		55-79	80 and older	
OPM poor	0.071	0.060	***	0.065	0.076	***
SPM poor	0.099	0.101		0.094	0.130	***
SPM-IR poor	0.083	0.075	**	0.077	0.094	***
Relationship status						
Married/partnered	0.726	0.561	***	0.700	0.420	***
Divorced/separated	0.147	0.090	***	0.134	0.061	***
Widowed	0.067	0.314	***	0.112	0.488	***
Never married	0.061	0.035	***	0.054	0.030	***
Female	0.527	0.571	***	0.534	0.610	***
Race and ethnicity						
Non-Hispanic white	0.808	0.860	***	0.819	0.890	***
Non-Hispanic black	0.086	0.065	***	0.082	0.051	***
Hispanic	0.074	0.056	***	0.071	0.045	***
Asian/Native American/Other	0.032	0.019	***	0.029	0.014	***
Educational attainment						
Less than high school degree	0.094	0.178	***	0.114	0.209	***
High school degree/GED	0.304	0.375	***	0.326	0.374	***
Some college	0.276	0.214	***	0.258	0.208	***
College degree or above	0.326	0.233	***	0.302	0.209	***
Working	0.559	0.144	***	0.446	0.059	***
Homeowner	0.860	0.813	***	0.858	0.741	***
Self-rated health						
Excellent/very good	0.494	0.381	***	0.466	0.339	***
Good	0.313	0.355	***	0.325	0.360	***
Fair/poor	0.193	0.264	***	0.209	0.300	***
Any mental health condition	0.254	0.302	***	0.259	0.352	***
Overweight	0.364	0.249	***	0.344	0.162	***
Any ADL limitation	0.045	0.088	***	0.050	0.134	***
Any IADL limitation	0.025	0.069	***	0.029	0.122	***
Memory disease	0.011	0.031	***	0.014	0.048	***

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent; significance tests relative to 55-69 age group for 70 and older age group and 55-79 age group for 80 and older age group; *** $p<0.001$; ** $p<0.01$.
Source: Health and Retirement Study (2004-2018).

Table 3. Hazard ratios for becoming food insecure

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Panel A - Models with age 70 and older varying covariates												
Poverty indicator	2.69***	1.84***	2.00***	1.69***	2.95***	2.21***	2.27***	2.02***	3.09***	2.21***	2.32***	2.00***
Post-Great Recession period	0.97	1.02	1.05	1.07	0.97	1.00	1.04	1.05	0.95	1.00	1.02	1.04
Age varying covariates												
Poverty*Age 70+	0.82+	1.01	1.00	1.04	0.77*	0.91	0.91	0.94	0.77*	0.93	0.92	0.97
Post-Great Recession*Age 70+	0.77**	0.78**	0.73***	0.76**	0.78**	0.79**	0.74***	0.77**	0.78**	0.79**	0.74***	0.76**
Panel B - Models with age 80 and older varying covariates												
Poverty indicator	2.67***	1.89***	2.06***	1.75***	2.87***	2.22***	2.29***	2.04***	3.04***	2.24***	2.37***	2.04***
Post-Great Recession period	0.91*	0.96	0.96	0.99	0.90*	0.94	0.96	0.98	0.88*	0.94	0.94	0.97
Age varying covariates												
Poverty*Age 80+	0.63**	0.78	0.77	0.82	0.64**	0.75+	0.76+	0.79	0.58**	0.73+	0.70*	0.76
Post-Great Recession*Age 80+	0.93	0.92	0.89	0.90	0.93	0.93	0.89	0.91	0.94	0.93	0.90	0.91

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Model 1 specification includes controls for relationship status, sex, and race and ethnicity. Model 2 adds socio-economic controls (educational attainment, indicators for working and homeownership) to baseline specification. Model 3 adds health controls (self-rated health, and indicators for having any mental health condition, being overweight, having any activities of daily living limitation, having any instrumental activity of daily living limitation, and being diagnosed with memory disease) to baseline specification. Model 4 includes all covariates. N = 90,739. *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table 4. Hazard ratios for becoming long-term food insecure

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Panel A - Models with age 70 and older varying covariates												
Poverty indicator	4.60***	2.60***	2.91***	2.30***	4.91***	3.26***	3.03***	2.69***	4.67***	2.84***	2.83***	2.36***
Post-Great Recession period	0.87	0.94	0.90	0.93	0.93	0.98	0.95	0.98	0.93	1.01	0.97	1.01
Age varying covariates												
Poverty*Age 70+	1.11	1.41	1.40	1.44	1.31	1.50	1.72+	1.63+	1.09	1.37	1.43	1.46
Post-Great Recession*Age 70+	0.84	0.85	0.86	0.88	0.92	0.95	0.93	0.97	0.83	0.83	0.83	0.85
Panel B - Models with age 80 and older varying covariates												
Poverty indicator	4.74***	2.74***	3.09***	2.43***	5.09***	3.43***	3.31***	2.90***	4.61***	2.86***	2.92***	2.42***
Post-Great Recession period	0.83+	0.90	0.86	0.90	0.91	0.98	0.94	0.97	0.89	0.97	0.93	0.97
Age varying covariates												
Poverty*Age 80+	0.83	1.04	1.23	1.20	1.48	1.72	2.05	1.96	1.90	2.68*	2.72*	3.04*
Post-Great Recession*Age 80+	1.11	1.14	1.14	1.19	0.92	0.93	1.01	1.04	0.93	0.93	1.01	1.02

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Model 1 specification includes controls for relationship status, sex, and race and ethnicity. Model 2 adds socio-economic controls (educational attainment, indicators for working and homeownership) to baseline specification. Model 3 adds health controls (self-rated health, and indicators for having any mental health condition, being overweight, having any activities of daily living limitation, having any instrumental activity of daily living limitation, and being diagnosed with memory disease) to baseline specification. Model 4 includes all covariates. Long-term food insecurity defined as two or more repeated waves of reporting not having enough money for food. Model samples vary across the three groups of model specifications as they exclude those who are below poverty line at one wave only. N = 90,235 (for OPM poverty models), 87,293 (for SPM poverty models), and 89,218 (for SPM and imputed rent poverty models). *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table 5. Hazard ratios for becoming food insecure, controlling for cohort effects

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socioeconomic)	Model 3 (health)	Model 4 (full)
Panel A - Models with age 70 and older varying covariates												
Poverty indicator	2.69***	1.82***	1.99***	1.67***	2.97***	2.20***	2.27***	2.01***	3.11***	2.20***	2.32***	1.99***
Post-Great Recession period	0.66***	0.67***	0.71***	0.71***	0.64***	0.65***	0.70***	0.70***	0.64***	0.65***	0.69***	0.69***
Cohort (ref. 1923 and earlier)												
1924-1930	1.31*	1.32*	1.31*	1.31*	1.33*	1.34*	1.32*	1.33*	1.33*	1.34*	1.32*	1.33*
1931-1941	1.42*	1.47*	1.44*	1.47*	1.46*	1.50*	1.47*	1.49*	1.46*	1.50*	1.46*	1.49*
1942-1947	1.67*	1.85**	1.70**	1.83**	1.74**	1.91**	1.76**	1.88**	1.74**	1.91**	1.75**	1.87**
1948-1953	2.71***	3.13***	2.74***	2.98***	2.84***	3.21***	2.83***	3.04***	2.82***	3.20***	2.82***	3.04***
1954-1959	2.91***	3.34***	3.02***	3.20***	3.10***	3.47***	3.14***	3.28***	3.07***	3.46***	3.10***	3.27***
1960-1965	4.86***	5.66***	4.98***	5.38***	5.32***	5.95***	5.28***	5.58***	5.20***	5.90***	5.22***	5.56***
Age varying covariates												
Poverty*Age 70+	0.82	1.02	1.00	1.06	0.77*	0.92	0.92	0.95	0.78*	0.95	0.93	0.98
Post-Great Recession*Age 70+	1.01	1.03	0.96	0.98	1.02	1.05	0.97	0.99	1.02	1.04	0.96	0.99
Panel B - Models with age 80 and older varying covariates												
Poverty indicator	2.67***	1.88***	2.06***	1.73***	2.89***	2.21***	2.29***	2.03***	3.05***	2.23***	2.36***	2.03***
Post-Great Recession period	0.65***	0.67***	0.69***	0.70***	0.64***	0.66***	0.68***	0.69***	0.63***	0.65***	0.67***	0.69***
Cohort (ref. 1923 and earlier)												
1924-1930	1.16	1.15	1.16	1.14	1.18	1.17	1.17	1.15	1.18	1.17	1.17	1.15
1931-1941	1.27	1.30	1.28	1.29	1.30	1.33	1.32	1.32	1.29	1.32	1.31	1.31
1942-1947	1.50+	1.66*	1.54*	1.63*	1.59*	1.72*	1.61*	1.69*	1.56*	1.70*	1.59*	1.68*
1948-1953	2.44***	2.78***	2.49***	2.67***	2.57***	2.86***	2.59***	2.74***	2.53***	2.83***	2.55***	2.72***
1954-1959	2.63***	2.98***	2.74***	2.87***	2.80***	3.09***	2.86***	2.96***	2.75***	3.07***	2.82***	2.94***
1960-1965	4.38***	5.04***	4.53***	4.83***	4.80***	5.30***	4.84***	5.04***	4.67***	5.23***	4.75***	5.00***
Age varying covariates												
Poverty*Age 80+	0.63**	0.80	0.78	0.84	0.64**	0.76+	0.76+	0.80	0.59**	0.74+	0.70*	0.77
Post-Great Recession*Age 80+	1.15	1.16	1.10	1.13	1.15	1.17	1.10	1.13	1.16	1.18	1.11	1.14

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Model 1 specification includes controls for relationship status, sex, and race and ethnicity. Model 2 adds socio-economic controls (educational attainment, indicators for working and homeownership) to baseline specification. Model 3 adds health controls (self-rated health, and indicators for having any mental health condition, being overweight, having any activities of daily living limitation, having any instrumental activity of daily living limitation, and being diagnosed with memory disease) to baseline specification. Model 4 includes all covariates. N = 90,739. *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table 6. Hazard ratios for becoming long-term food insecure, controlling for cohort effects

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Panel A - Models with age 70 and older varying covariates												
Poverty indicator	4.40***	2.50***	2.81***	2.22***	4.72***	3.14***	2.93***	2.60***	4.49***	2.74***	2.73***	2.28***
Post-Great Recession period	0.94	0.94	0.97	0.97	0.93	0.94	0.96	0.96	0.92	0.93	0.96	0.96
Cohort (ref. 1923 and earlier)												
1924-1930	2.41*	2.39*	2.29*	2.26*	1.80	1.79	1.76	1.74	1.83	1.81	1.77	1.75
1931-1941	1.89	1.94	1.86	1.87	1.48	1.53	1.47	1.49	1.36	1.39	1.32	1.33
1942-1947	1.80	2.03	1.73	1.89	1.53	1.69	1.47	1.57	1.37	1.50	1.30	1.39
1948-1953	2.03	2.42+	1.98	2.19	1.93	2.25	1.88	2.03	1.74	2.03	1.67	1.83
1954-1959	1.37	1.67	1.34	1.48	1.15	1.35	1.13	1.22	1.12	1.33	1.09	1.19
Age varying covariates												
Poverty*Age 70+	1.13	1.45	1.42	1.48	1.35	1.56	1.77+	1.70+	1.12	1.42	1.47	1.51
Post-Great Recession*Age 70+	0.78	0.82	0.79	0.82	0.91	0.97	0.93	0.97	0.87	0.91	0.89	0.92
Panel B - Models with age 80 and older varying covariates												
Poverty indicator	4.56***	2.65***	2.99***	2.36***	4.93***	3.34***	3.22***	2.82***	4.44***	2.77***	2.83***	2.35***
Post-Great Recession period	0.89	0.90	0.92	0.93	0.93	0.94	0.95	0.96	0.90	0.92	0.94	0.95
Cohort (ref. 1923 and earlier)												
1924-1930	2.42+	2.32+	2.42+	2.32+	2.18	2.07	2.11	2.02	1.94	1.85	1.91	1.82
1931-1941	1.74	1.77	1.88	1.85	1.83	1.87	1.87	1.86	1.43	1.45	1.48	1.46
1942-1947	1.65	1.84	1.74	1.86	1.86	2.03	1.85	1.96	1.42	1.56	1.45	1.52
1948-1953	1.91	2.23	2.03	2.20	2.34	2.69	2.34	2.51	1.82	2.12	1.86	2.00
1954-1959	1.31	1.57	1.39	1.51	1.40	1.62	1.41	1.51	1.17	1.39	1.21	1.30
Age varying covariates												
Poverty*Age 80+	0.83	1.05	1.25	1.23	1.52	1.78	2.11	2.02	1.91	2.70*	2.75*	3.07*
Post-Great Recession*Age 80+	0.80	0.86	0.79	0.86	0.67	0.71	0.74	0.78	0.77	0.81	0.82	0.86

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Model 1 specification includes controls for relationship status, sex, and race and ethnicity. Model 2 adds socio-economic controls (educational attainment, indicators for working and homeownership) to baseline specification. Model 3 adds health controls (self-rated health, and indicators for having any mental health condition, being overweight, having any activities of daily living limitation, having any instrumental activity of daily living limitation, and being diagnosed with memory disease) to baseline specification. Model 4 includes all covariates. N = 90,235 (for OPM poverty models), 87,293 (for SPM poverty models), and 89,218 (for SPM and imputed rent poverty models). *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Appendix Tables

Table A1. Hazard ratios for becoming food insecure, age 70 and older varying covariates

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Poverty indicator	2.69***	1.84***	2.00***	1.69***	2.95***	2.21***	2.27***	2.02***	3.09***	2.21***	2.32***	2.00***
Post-Great Recession period	0.97	1.02	1.05	1.07	0.97	1.00	1.04	1.05	0.95	1.00	1.02	1.04
Relationship status (ref. Married/partnered)												
Divorced/separated	1.80***	1.50***	1.58***	1.37***	1.81***	1.49***	1.58***	1.36***	1.81***	1.51***	1.58***	1.38***
Widowed	1.65***	1.38***	1.46***	1.31**	1.63***	1.36***	1.44***	1.29**	1.63***	1.37***	1.44***	1.30**
Never married	1.34*	1.11	1.20	1.04	1.35*	1.09	1.19	1.02	1.35*	1.11	1.20	1.04
Female	1.04	1.02	1.01	1.00	1.04	1.02	1.01	1.00	1.05	1.02	1.01	1.01
Race and ethnicity (ref. Non-Hispanic white)												
Non-Hispanic black	1.83***	1.47***	1.62***	1.42***	1.79***	1.44***	1.60***	1.39***	1.77***	1.44***	1.58***	1.39***
Hispanic	1.87***	1.42***	1.51***	1.30**	1.79***	1.36***	1.46***	1.26**	1.78***	1.37***	1.47***	1.27**
Asian/Native American/Other	1.87***	1.70***	1.54**	1.47**	1.82***	1.68***	1.53**	1.46**	1.81***	1.68***	1.53**	1.47**
Educational attainment (ref. Less than high school degree)												
High school degree/GED		0.79**		0.90		0.81**		0.92		0.81**		0.91
Some college		0.64***		0.76**		0.66***		0.78**		0.66***		0.77**
College degree or above		0.53***		0.71**		0.55***		0.73**		0.55***		0.72**
Working		0.68***		0.89		0.70***		0.91		0.69***		0.90
Homeowner		0.51***		0.58***		0.51***		0.58***		0.53***		0.60***
Self-rated health (ref. Excellent/very good)												
Good			1.44***	1.38***			1.42***	1.37***			1.42***	1.37***
Fair/poor			2.16***	1.91***			2.07***	1.85***			2.08***	1.86***
Any mental health condition			1.81***	1.73***			1.81***	1.73***			1.80***	1.73***
Overweight			1.09	1.09			1.10+	1.10+			1.10	1.10
Any ADL limitation			1.43***	1.34**			1.43***	1.34**			1.42***	1.33**
Any IADL limitation			1.12	1.10			1.10	1.07			1.10	1.08
Memory disease			1.45*	1.41*			1.51**	1.47*			1.49*	1.45*
Age varying covariates												
Poverty*Age 70+	0.82+	1.01	1.00	1.04	0.77*	0.91	0.91	0.94	0.77*	0.93	0.92	0.97
Post-Great Recession*Age 70+	0.77**	0.78**	0.73***	0.76**	0.78**	0.79**	0.74***	0.77**	0.78**	0.79**	0.74***	0.76**

Relationship status (ref. Married/partnered)												
Divorced/separated*Age 70+	0.70**	0.80+	0.77+	0.86	0.72*	0.82	0.80+	0.88	0.72*	0.82	0.80+	0.89
Widowed* Age 70+	0.72**	0.79+	0.77*	0.82+	0.74*	0.81+	0.79*	0.84	0.74*	0.82+	0.80+	0.84
Never married*Age 70+	0.87	1.00	0.96	1.07	0.91	1.05	1.02	1.13	0.91	1.05	1.01	1.13
Female*Age 70+	0.99	1.01	1.00	1.01	0.99	1.00	1.01	1.01	0.98	1.00	1.00	1.01
Race and ethnicity (ref. Non-Hispanic white)												
Non-Hispanic black*Age 70+	1.39**	1.53***	1.44***	1.52***	1.43***	1.58***	1.49***	1.56***	1.46***	1.59***	1.51***	1.57***
Hispanic*Age 70+	1.28+	1.34*	1.39*	1.37*	1.37*	1.42*	1.47**	1.44*	1.38*	1.42*	1.48**	1.44*
Other*Age 70+	1.12	1.23	1.35	1.41	1.15	1.24	1.36	1.41	1.17	1.25	1.37	1.42
Educational attainment (ref. Less than high school degree)												
High school degree/GED* Age 70+		0.89		0.84		0.88		0.83		0.87		0.83
Some college*Age 70+		0.84		0.78+		0.83		0.77+		0.82		0.76+
College degree or above*Age 70+		0.99		0.84		0.98		0.84		0.96		0.83
Working*Age 70+		1.32*		1.10		1.31*		1.10		1.32*		1.10
Homeowner*Age 70+		1.62***		1.49***		1.59***		1.46***		1.62***		1.49***
Self-rated health (ref. Excellent/very good)												
Good*Age 70+			0.82	0.84			0.83	0.84			0.82	0.84
Fair/poor*Age 70+			0.68**	0.73*			0.70**	0.74*			0.69**	0.73*
Any mental health condition*Age 70+			0.75**	0.76**			0.74**	0.75**			0.75**	0.75**
Overweight*Age 70+			1.09	1.07			1.08	1.07			1.08	1.07
Any ADL limitation*Age 70+			0.75+	0.80			0.76+	0.80			0.75+	0.80
Any IADL limitation*Age 70+			0.99	0.97			1.01	0.99			1.01	0.98
Memory disease*Age 70+			0.85	0.87			0.81	0.83			0.83	0.85

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. N = 90,739. *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table A2. Hazard ratios for becoming food insecure, age 80 and older varying covariates

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Poverty indicator	2.67***	1.89***	2.06***	1.75***	2.87***	2.22***	2.29***	2.04***	3.04***	2.24***	2.37***	2.04***
Post Great Recession period	0.91*	0.96	0.96	0.99	0.90*	0.94	0.96	0.98	0.88*	0.94	0.94	0.97
Relationship status (ref. Married/partnered)												
Divorced/separated	1.71***	1.45***	1.54***	1.35***	1.73***	1.45***	1.55***	1.34***	1.73***	1.47***	1.55***	1.36***
Widowed	1.58***	1.34***	1.41***	1.26***	1.57***	1.33***	1.40***	1.25***	1.58***	1.35***	1.40***	1.26***
Never married	1.31*	1.10	1.20+	1.05	1.33**	1.09	1.20+	1.04	1.33**	1.11	1.21+	1.06
Female	1.03	1.01	1.00	0.99	1.03	1.01	1.00	1.00	1.04	1.02	1.01	1.00
Race and ethnicity (ref. Non-Hispanic white)												
Non-Hispanic black	1.92***	1.58***	1.71***	1.52***	1.90***	1.55***	1.70***	1.49***	1.87***	1.55***	1.68***	1.49***
Hispanic	1.95***	1.49***	1.60***	1.36***	1.88***	1.44***	1.56***	1.33***	1.88***	1.45***	1.56***	1.34***
Asian/Native American/Other	1.87***	1.74***	1.60***	1.54***	1.83***	1.72***	1.58***	1.53***	1.83***	1.72***	1.58***	1.53***
Educational attainment (ref. Less than high school degree)												
High school degree/GED		0.78***		0.88*		0.79***		0.89+		0.79***		0.88+
Some college		0.62***		0.73***		0.64***		0.75***		0.63***		0.74***
College degree or above		0.52***		0.68***		0.54***		0.70***		0.54***		0.69***
Working		0.70***		0.88*		0.72***		0.90+		0.71***		0.89+
Homeowner		0.54***		0.60***		0.54***		0.60***		0.57***		0.62***
Self-rated health (ref. Excellent/very good)												
Good			1.41***	1.35***			1.39***	1.33***			1.39***	1.33***
Fair/poor			2.02***	1.79***			1.95***	1.75***			1.95***	1.75***
Any mental health condition			1.71***	1.64***			1.70***	1.63***			1.70***	1.63***
Overweight			1.11*	1.11*			1.12*	1.11*			1.11*	1.11*
Any ADL limitation			1.35***	1.27**			1.35***	1.27**			1.34***	1.27**
Any IADL limitation			1.16	1.13			1.14	1.11			1.14	1.11
Memory disease			1.33*	1.31*			1.37*	1.34*			1.36*	1.34*
Age varying covariates												
Poverty*Age 80+	0.63**	0.78	0.77	0.82	0.64**	0.75+	0.76+	0.79	0.58**	0.73+	0.70*	0.76
Post-Great Recession*Age 80+	0.93	0.92	0.89	0.90	0.93	0.93	0.89	0.91	0.94	0.93	0.90	0.91
Relationship status (ref. Married/partnered)												

Divorced/separated*Age 80+	0.60*	0.74	0.65+	0.78	0.61*	0.76	0.67+	0.80	0.61*	0.76	0.67+	0.80
Widowed* Age 80+	0.56***	0.65**	0.62***	0.69**	0.58***	0.67**	0.63**	0.70*	0.57***	0.67**	0.63**	0.70*
Never married*Age 80+	0.90	1.13	0.97	1.18	0.93	1.17	1.02	1.22	0.92	1.16	1.00	1.21
Female*Age 80+	1.02	1.08	1.05	1.10	1.01	1.07	1.04	1.09	1.01	1.07	1.04	1.09
Race and ethnicity (ref. Non-Hispanic white)												
Non-Hispanic black*Age 80+	1.60**	1.71**	1.67**	1.70**	1.62**	1.73***	1.69***	1.72***	1.68***	1.76***	1.75***	1.75***
Hispanic*Age 80+	1.31	1.40+	1.41+	1.40+	1.38+	1.48+	1.47*	1.47+	1.41+	1.48+	1.50*	1.47+
Other*Age 80+	1.42	1.54	1.70	1.76	1.47	1.56	1.74	1.79	1.51	1.59	1.77	1.81
Educational attainment (ref. Less than high school degree)												
High school degree/GED* Age 80+		0.82		0.76+		0.83		0.77+		0.81		0.76+
Some college*Age 80+		0.85		0.76		0.85		0.77		0.84		0.75
College degree or above*Age 80+		1.04		0.88		1.04		0.88		1.03		0.87
Working*Age 80+		1.81*		1.56+		1.80*		1.55+		1.80*		1.55+
Homeowner*Age 80+		2.07***		1.91***		2.05***		1.90***		2.06***		1.90***
Self-rated health (ref. Excellent/very good)												
Good*Age 80+			0.74+	0.78			0.75+	0.78			0.75+	0.78
Fair/poor*Age 80+			0.64**	0.70*			0.65**	0.72*			0.65**	0.71*
Any mental health condition*Age 80+			0.78*	0.79+			0.77*	0.79+			0.78*	0.79+
Overweight*Age 80+			1.05	1.03			1.04	1.02			1.04	1.02
Any ADL limitation*Age 80+			0.87	0.93			0.86	0.92			0.87	0.92
Any IADL limitation*Age 80+			0.76	0.77			0.77	0.78			0.78	0.78
Memory disease*Age 80+			1.07	1.10			1.02	1.05			1.04	1.07

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. N = 90,739. *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table B1. Hazard ratios for becoming long-term food insecure, age 70 and older varying covariates

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Poverty indicator	4.60***	2.60***	2.91***	2.30***	4.91***	3.26***	3.03***	2.69***	4.67***	2.84***	2.83***	2.36***
Post Great Recession period	0.87	0.94	0.90	0.93	0.93	0.98	0.95	0.98	0.93	1.01	0.97	1.01
Relationship status (ref. Married/partnered)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Divorced/separated	2.87***	2.24***	2.43***	2.02***	3.33***	2.57***	2.79***	2.30***	3.30***	2.57***	2.74***	2.29***
Widowed	2.94***	2.22***	2.39***	2.00***	3.17***	2.37***	2.59***	2.16***	3.18***	2.37***	2.59***	2.16***
Never married	2.14**	1.65*	1.90**	1.53+	2.31***	1.77*	1.96**	1.60+	2.28***	1.76*	1.93**	1.60*
Female	1.09	1.09	1.03	1.04	1.17	1.17	1.08	1.10	1.15	1.15	1.08	1.09
Race and ethnicity (ref. Non-Hispanic white)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-Hispanic black	2.71***	1.92***	2.11***	1.70***	2.58***	1.89***	2.03***	1.70***	2.63***	1.94***	2.10***	1.76***
Hispanic	2.30***	1.43+	1.77**	1.35	2.10***	1.40+	1.59*	1.32	2.09***	1.39+	1.57*	1.29
Asian/Native American/Other	2.44**	1.98*	1.85*	1.66+	2.49**	2.15**	1.88*	1.77*	2.50**	2.14**	1.88*	1.77*
Educational attainment (ref. Less than high school degree)		1.00		1.00		1.00		1.00		1.00		1.00
High school degree/GED		0.58***		0.69*		0.73+		0.89		0.73+		0.89
Some college		0.48***		0.61**		0.62**		0.80		0.57**		0.74+
College degree or above		0.29***		0.44***		0.34***		0.52**		0.31***		0.48**
Working		0.54***		0.77+		0.56***		0.82		0.54***		0.79
Homeowner		0.41***		0.48***		0.43***		0.51***		0.43***		0.51***
Self-rated health (ref. Excellent/very good)			1.00	1.00			1.00	1.00			1.00	1.00
Good			1.86***	1.70**			1.83**	1.68**			1.78**	1.63**
Fair/poor			2.60***	2.04***			2.74***	2.22***			2.81***	2.23***
Any mental health condition			2.38***	2.21***			2.29***	2.15***			2.32***	2.17***
Overweight			1.29*	1.29*			1.42**	1.40**			1.37**	1.36**
Any ADL limitation			1.81**	1.61*			1.65*	1.50*			1.56*	1.42+
Any IADL limitation			1.60*	1.45+			1.60*	1.51+			1.57*	1.47+
Memory disease			0.19**	0.19**			0.36+	0.36+			0.56	0.55
Age varying covariates												
Poverty*Age 70+	1.11	1.41	1.40	1.44	1.31	1.50	1.72+	1.63+	1.09	1.37	1.43	1.46
Post-Great Recession*Age 70+	0.84	0.85	0.86	0.88	0.92	0.95	0.93	0.97	0.83	0.83	0.83	0.85
Relationship status (ref. Married/partnered)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Divorced/separated*Age 70+	0.62	0.71	0.69	0.76	0.66	0.78	0.73	0.84	0.72	0.85	0.80	0.91
Widowed* Age 70+	0.62+	0.69	0.67+	0.72	0.68	0.77	0.72	0.79	0.64+	0.74	0.69	0.76
Never married*Age 70+	0.56	0.66	0.60	0.70	0.85	1.03	0.95	1.11	1.06	1.28	1.19	1.39
Female*Age 70+	1.02	1.01	1.02	1.01	0.89	0.87	0.90	0.88	0.95	0.93	0.95	0.93
Race and ethnicity (ref. Non-Hispanic white)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-Hispanic black*Age 70+	2.03**	2.35***	2.19**	2.40***	2.00**	2.19**	2.19**	2.27***	1.93**	2.17**	2.09**	2.22**
Hispanic*Age 70+	1.62	1.73+	1.53	1.54	1.67	1.62	1.59	1.46	1.69+	1.73+	1.64	1.58
Other*Age 70+	1.08	1.31	1.39	1.52	1.50	1.71	1.85	1.91	1.14	1.35	1.47	1.58
Educational attainment (ref. Less than high school degree)		1.00		1.00		1.00		1.00		1.00		1.00
High school degree/GED* Age 70+		1.00		0.97		0.75		0.71		0.87		0.83
Some college*Age 70+		0.87		0.84		0.66		0.64		0.79		0.76
College degree or above*Age 70+		1.20		1.10		0.98		0.88		1.10		0.98
Working*Age 70+		1.12		0.98		0.99		0.84		1.00		0.85
Homeowner*Age 70+		1.65*		1.52+		1.75*		1.60+		1.77*		1.63+
Self-rated health (ref. Excellent/very good)			1.00	1.00			1.00	1.00			1.00	1.00
Good*Age 70+			0.67	0.71			0.77	0.81			0.73	0.77
Fair/poor*Age 70+			0.88	1.00			0.95	1.04			0.84	0.94
Any mental health condition*Age 70+			0.77	0.78			0.81	0.81			0.81	0.82
Overweight*Age 70+			1.30	1.27			1.13	1.12			1.13	1.12
Any ADL limitation*Age 70+			0.78	0.86			0.68	0.74			0.73	0.81
Any IADL limitation*Age 70+			0.56+	0.56			0.62	0.60			0.66	0.65
Memory disease*Age 70+			4.96*	4.84*			3.12+	3.11+			2.06	2.08

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Long-term food insecurity defined as two or more repeated waves of reporting not having enough money for food. Model samples vary across the three groups of model specifications as they exclude those who are below poverty line at one wave only. N = 90,235 (for OPM poverty models), 87,293 (for SPM poverty models), and 89,218 (for SPM and imputed rent poverty models). *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018).

Table B2. Hazard ratios for becoming long-term food insecure, age 80 and older varying covariates

	OPM				SPM				SPM-IR			
	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)	Model 1 (baseline)	Model 2 (socio-economic)	Model 3 (health)	Model 4 (full)
Poverty indicator	4.74***	2.74***	3.09***	2.43***	5.09***	3.43***	3.31***	2.90***	4.61***	2.86***	2.92***	2.42***
Post Great Recession period	0.83+	0.90	0.86	0.90	0.91	0.98	0.94	0.97	0.89	0.97	0.93	0.97
Relationship status (ref. Married/partnered)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Divorced/separated	2.75***	2.18***	2.36***	1.97***	3.24***	2.54***	2.74***	2.29***	3.25***	2.57***	2.74***	2.30***
Widowed	2.77***	2.12***	2.27***	1.92***	3.04***	2.32***	2.49***	2.11***	2.97***	2.26***	2.43***	2.05***
Never married	2.02**	1.59*	1.81**	1.48+	2.27***	1.77*	1.95**	1.62*	2.35***	1.84**	2.01**	1.69*
Female	1.10	1.10	1.03	1.03	1.15	1.14	1.06	1.07	1.14	1.13	1.06	1.07
Race and ethnicity (ref. Non-Hispanic white)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-Hispanic black	2.99***	2.18***	2.37***	1.94***	2.82***	2.10***	2.26***	1.90***	2.87***	2.15***	2.32***	1.95***
Hispanic	2.42***	1.53*	1.84***	1.40*	2.20***	1.45*	1.66**	1.34+	2.20***	1.46*	1.64**	1.33+
Asian/Native American/Other	2.51***	2.10**	1.95*	1.76*	2.67***	2.37***	2.08**	1.96**	2.57***	2.26**	2.00**	1.89**
Educational attainment (ref. Less than high school degree)		1.00		1.00		1.00		1.00		1.00		1.00
High school degree/GED		0.58***		0.69**		0.68**		0.82		0.71*		0.85
Some college		0.49***		0.62**		0.59***		0.75+		0.56***		0.71*
College degree or above		0.31***		0.45***		0.33***		0.50**		0.32***		0.48***
Working		0.54***		0.76*		0.56***		0.81		0.54***		0.77+
Homeowner		0.43***		0.50***		0.46***		0.53***		0.46***		0.53***
Self-rated health (ref. Excellent/very good)			1.00	1.00			1.00	1.00			1.00	1.00
Good			1.74***	1.60**			1.77***	1.64**			1.71**	1.57**
Fair/poor			2.58***	2.06***			2.72***	2.24***			2.72***	2.20***
Any mental health condition			2.25***	2.10***			2.20***	2.07***			2.23***	2.09***
Overweight			1.38**	1.37**			1.48***	1.46***			1.43***	1.42***
Any ADL limitation			1.79***	1.62**			1.59**	1.46*			1.54*	1.41*
Any IADL limitation			1.46*	1.33			1.50*	1.41+			1.51*	1.41+
Memory disease			0.27**	0.27**			0.45*	0.44*			0.59	0.57
Age varying covariates												
Poverty*Age 80+	0.83	1.04	1.23	1.20	1.48	1.72	2.05	1.96	1.90	2.68*	2.72*	3.04*
Post-Great Recession*Age 80+	1.11	1.14	1.14	1.19	0.92	0.93	1.01	1.04	0.93	0.93	1.01	1.02
Relationship status (ref. Married/partnered)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Divorced/separated*Age 80+	0.34	0.43	0.37	0.46	0.20+	0.29	0.22+	0.30	0.24+	0.36	0.27+	0.38
Widowed* Age 80+	0.41**	0.48*	0.46*	0.51*	0.34**	0.43*	0.41**	0.47*	0.36**	0.46*	0.43*	0.50*
Never married*Age 80+	0.46	0.57	0.43	0.50	0.40	0.58	0.43	0.57	0.35	0.52	0.39	0.53
Female*Age 80+	0.87	0.95	0.92	1.00	0.89	0.96	0.98	1.06	0.95	1.00	1.03	1.08
Race and ethnicity (ref. Non-Hispanic white)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-Hispanic black*Age 80+	2.72*	2.96*	3.12**	3.15**	3.52**	3.86**	3.95**	3.97**	3.29**	3.64**	3.68**	3.75**
Hispanic*Age 80+	2.46+	2.62+	2.53+	2.43	3.56*	3.93*	3.47*	3.35*	3.48**	3.94*	3.52*	3.50*
Other*Age 80+	0.71	0.96	0.94	1.20	1.00	1.24	1.29	1.56	0.92	1.14	1.24	1.51
Educational attainment (ref. Less than high school degree)		1.00		1.00		1.00		1.00		1.00		1.00
High school degree/GED* Age 80+		1.07		0.98		0.92		0.79		0.96		0.85
Some college*Age 80+		0.20*		0.17*		0.34		0.29+		0.52		0.45
College degree or above*Age 80+		0.83		0.67		0.73		0.56		0.79		0.62
Working*Age 80+		3.73**		3.31*		2.28		2.04		2.47		2.13
Homeowner*Age 80+		2.44*		2.15*		3.64**		3.19**		3.84**		3.35**
Self-rated health (ref. Excellent/very good)			1.00	1.00			1.00	1.00			1.00	1.00
Good*Age 80+			0.69	0.76			0.52	0.57			0.57	0.62
Fair/poor*Age 80+			0.68	0.82			0.80	0.95			0.77	0.93
Any mental health condition*Age 80+			0.93	0.98			0.78	0.81			0.83	0.87
Overweight*Age 80+			0.68	0.68			0.60	0.60			0.60	0.59
Any ADL limitation*Age 80+			0.48	0.55			0.36+	0.41+			0.40+	0.44
Any IADL limitation*Age 80+			0.56	0.57			0.46	0.46			0.41	0.42
Memory disease*Age 80+			5.32*	5.37**			4.10*	3.91*			3.51*	3.35+

Notes: OPM – official poverty measure, SPM – supplemental poverty measure, SPM-IR – supplemental poverty measure with imputed rent. Long-term food insecurity defined as two or more repeated waves of reporting not having enough money for food. Model samples vary across the three groups of model specifications as they exclude those who are below poverty line at one wave only. N = 90,235 (for OPM poverty models), 87,293 (for SPM poverty models), and 89,218 (for SPM and imputed rent poverty models). *** p<0.001; ** p<0.01; * p<0.05; + p<0.1.
Source: Health and Retirement Study (2004-2018)