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Varying Levels of Food Insecurity Associated with Clinically Relevant Depressive Symptoms in U.S. Adults Aged 60 Years and Over: Results from the 2005-2014 National Health and Nutrition Survey

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Abstract

Food insecurity refers to restricted or uncertain access to and ineffective utilization of nutritious and safe foods. Although food insecurity is linked to poorer physical health consequences among older adults, national estimates are not well known on food insecurity and depression. Using the 2005–2014 National Health and Nutrition Examination Survey, this study examines the associations between varying food insecurity levels and clinically relevant depressive symptoms (defined by PHQ-9 ≥ 10) among adults ≥ 60 years old ($n=7,969$). Rates of clinically relevant depressive symptoms in marginal, low, and very low food security were 12.3%, 16.3%, and 25.2%, respectively. Marginal, low, and very low food security were significantly associated with clinically relevant depressive symptoms: odds ratio (OR)=1.12 (95% confidence intervals [CI] 1.07–1.18), OR=1.07 (95% CI 1.03–1.12), and OR=1.24 (95% CI 1.16–1.32), respectively. Given the intersection of food insecurity and depression, geriatric health professionals should work to

improve health and nutrition programs for older adults at risk for or experiencing both public health concerns.

Keywords

Food insecurity; nutrition; NHANES; depression; older adults

Introduction

Approximately 12.7% of all U.S. households suffer from food insecurity,¹ defined as restricted or uncertain access to and ineffective utilization of nutritious and safe foods.² Food insecurity in the U.S. and other industrialized countries is commonly the result of insufficient financial resources for acquiring food,³ but it is also caused by unsafe handling or inappropriate food choices.⁴ With inadequate access to and misappropriate use of household food supplies, nutritional intake and dietary variation decreases among individuals and families.^{4,5} This alteration in diet quality often leads to the increased consumption of low-cost, energy-dense, nutrient-deficient foods that, over time, are linked to chronic diseases, including hypertension, hyperlipidemia, obesity, and diabetes.^{6–8} Prevalence of late-life food insecurity varies widely from 6.5% to 16%,^{3,9,10} with the highest rates between 70% and 93% for homebound older adults.^{11,12} Although food insecurity rates in older adults depends on the types of food security measures implemented and the older age group assessed,¹³ food-insecure older adults consistently report more severe health consequences to nutritional deficits compared to the general population.^{14–18}

Depression is one of the most common, prevalent and disabling health conditions among community-dwelling older adults^{19,20} and is linked to social isolation, loneliness, and all-cause mortality,^{21–23} which in turn is related to food security later in life.²⁴ Two studies, one with longitudinal datasets of the Health and Retirement Study (1996–2002) and the Asset and Health Dynamics Among the Oldest Old (1995–2002),²⁵ and one with the cross-sectional dataset of National Health and Nutrition Examination Survey (2007–2008),²⁶ demonstrated an association between food insecurity and depression among older adults. However, the research design and methods differed across these studies, with depression examined as both a predictor and outcome. Previous research has demonstrated the detrimental effects of nutritional inadequacies on mental health outcomes, such as the high rates of depression and anxiety among food-insecure children²⁷ and women.²⁸ Although increased attention has been given to mental health effects of food insecurity among children and younger adult women in particular, less is known about the intersection of nutritional deficiencies and mental health concerns among other potentially health-vulnerable groups such as older adults.

Given that there have only been two studies in the past several decades to use nationally representative datasets to investigate food insecurity and depression among older adults,^{25,26} exploring this under-examined, potential public health concern will better specify need in geriatric health and nutrition programs and establish priorities for social welfare policy and other federal funding sources. Additionally, due to the inconsistent operationalizations of

food insecurity among older adults,¹³ our study is unique in that we will investigate the varying degrees of food insecurity with a nationally validated, multi-dimensional food security measure of the *US Household Food Security Survey Module*.²⁹ The primary goal of the current study, therefore, is to evaluate the associations between the different food insecurity levels and clinically relevant depressive symptoms, as defined as moderate levels of self-reported depressive symptoms, among U.S. older adults from a population-based dataset. Given the higher rates of food insecurity in certain older adult subpopulations with higher mean age ranges,^{11,12} we also explore whether such associations are modified by specific age groups.

Methods

Study Description

The National Health and Nutrition Examination Survey (NHANES) 2005–2014 data were fielded by the U.S. National Center for Health Statistics, a part of the Centers for Disease Control and Prevention, with surveys conducted annually since 1999. The NHANES is a cross-sectional survey representative of the civilian, noninstitutionalized population of the United States. The survey is a complex, multistage, stratified design, and oversamples minorities and older adults. Interviews and examinations were performed by trained staff with automated data collection. Questions were directed to the respondent or if necessary to their proxy. Other information on sampling, study design, and components are described at <http://www.cdc.gov/nchs/nhanes>. The protocol was exempt from research review because of the de-identified nature of the data.

Study Population

Data from the 2005–2014 National Health and Nutrition Examination Surveys were used to identify adults ≥60 years old (n=9,429). Of those sampled, we excluded participants with missing data, resulting in a final analytic sample of 7,969 participants.

Primary Variables

Food security was evaluated using the 10-item adult version of the *US Household Food Security Survey Module*.²⁹ This version is a reliable and valid survey developed by the USDA to measure self-report of food insecurity over the past 12 months.³⁰ Items measure how frequently a person went without food, or consumed a reduced amount of food not due to choice.³¹ The responses were used to classify participants into four categories of food security: full food security (no affirmative response), marginal food security (1–2 affirmative responses), low food security (3–5 affirmative responses), and very low food security (6–10 affirmative responses). Depressive symptoms were evaluated using the *Patient Health Questionnaire* (PHQ-9).^{32,33} The PHQ-9 is a 9-item screening instrument that asks about the frequency of symptoms of depression over the past 2 weeks. Total PHQ-9 score ranges from 0 to 27 and based on past research, we classified clinically relevant depressive symptoms as a cut-off score of ≥10.³⁴

Sociodemographic and Health Covariates

Sociodemographic and health characteristics were selected based on past literature on potential moderating and mediating factors for food insecurity among older adults.^{24,35} Interviewers ascertained a participant's gender, birthdate, race/ethnicity status, educational attainment, income, and Supplemental Nutrition Assistance Program (SNAP) participation by self-report through the initial screening questionnaire. Age in years was a continuous variable and also categorized into the following groups: 60–69, 70–79, and 80 years or older as performed in our previous analyses. Race/ethnicity was classified as non-Hispanic white, non-Hispanic black, Hispanic-American, or other. Educational attainment was dichotomized by high school education status.

Smoking status was identified by responses to: “Do you now smoke cigarettes?” Participants who answered “some days” or “every day” were classified as current smokers. Diagnosis of diabetes mellitus, hypertension, or arthritis were determined if a participant responded with a “yes” to: “Have you ever been told by a doctor or health professional that you have [condition]?” Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared. Weight was measured on an electronic digital scale calibrated in kilograms. Height was measured with a stadiometer in meters. We then defined obesity as a BMI $\geq 30\text{kg/m}^2$.

Statistical Analyses

All data were combined using standard NHANES analytical procedures. Mobile Examination Center sample weights and the appropriate home-examined sample design variables (strata, primary sampling unit) were used in the analysis to account for the complex survey design (including oversampling) and survey nonresponse, and were post-stratified to obtain nationally representative estimates of the U.S. civilian non-institutionalized population using the R package *survey* ().³⁶ Sociodemographic and health characteristics were analyzed using descriptive statistics such as means, frequencies, and percentages for the total sample, food security levels, and depression groups. For between-group analyses, statistical testing was performed using t-tests with an α -level of <0.05 denoting statistical significance. Unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated using six different multiple logistic regression models for clinically relevant depressive symptoms outcome by marginal, low, and very low food security. For food security categories, full food security was the reference group. The first model was unadjusted (Model 1); the second included age and sex (Model 2); the third included Model 2 covariates and race/ethnicity, education, marital status, and SNAP participation (Model 3); the fourth included Model 3 covariates and income-to-poverty ratio and smoking status (Model 4); the fifth included Model 4 covariates and obesity, hypertension, and diabetes (Model 5); and the sixth included Model 5 covariates and arthritis (Model 6). Odds ratios with a 95% CI not including the value of one were considered statistically significant. Statistical analyses were conducted using R, Version 3.3.2.³⁶ To examine the post-hoc stability of findings and determine whether the regression analyses varied on the basis of age group, we re-estimated the fully adjusted models for each of the three groups of participants from the age categories of 60–69, 70–79, and 80+ years.

Results

As demonstrated in Table 1, the study participant characteristics of our analytic sample includes 4,672 women and 3,297 men aged 60 years and older with prevalence rates of marginal, low, and very low food security of n=601 (7.5%), n=491 (6.2%), and n=318 (4.0%), respectively.

The average rates of clinically relevant depressive symptoms in marginal, low, and very low food security categories were 12.3% (range: 8.3% to 15.3%), 16.3% (range: 2.9% to 21.1%), and 25.2% (range: 25.2% to 28%), which is shown in Table 2. Within the low food security group, prevalence rates of clinically relevant depressive symptoms were significantly different between age groups of 60–69, 70–79, and 80–89 years (21.1% to 10.5% to 2.9%, respectively). However, there were no significant differences between the other food security categories with respect to prevalence rates of clinically relevant depressive symptoms.

As presented in Table 3, marginal, low, and very low food security in the unadjusted model and Model 2 were significantly associated with clinically relevant depressive symptoms as the outcome (ORs: 1.07–1.24; 95% CIs: 1.03–1.32). Very low food security level was significantly associated with clinically relevant depressive symptoms in Models 3 to 5 (ORs: 1.15–1.18; 95% CIs: 1.10–1.27). Marginal food security was also associated with clinically relevant depressive symptoms in Models 3 to 5 (ORs: 1.07–1.08; 95% CIs: 1.01–1.13). In the final model, very low food security level remained significantly associated with clinically relevant depressive symptoms (OR: 1.14; 95% CI: 1.07–1.22). Finally, marginal food security was associated with clinically relevant depressive symptoms in Model 6 (OR: 1.06; 95% CI: 1.01–1.12).

The results from the post hoc tests are displayed in Table 4. In the fully adjusted models, participants ages 60–69 and 80+ years independently reported levels of very low food security that were significantly associated with clinically relevant depressive symptoms (ORs: 1.13–1.27; CIs: 1.01–1.60). Participants from ages 60–69 years reported levels of low food security that was associated with clinically relevant depressive symptoms (OR: 1.10; CI: 1.02–1.19). The remaining age groups did not report levels of food security that were significantly associated with clinically relevant depressive symptoms.

Discussion

Our results suggest that food insecurity—marginal, low, and very low levels of food security—were significantly associated with reports of clinically relevant depressive symptoms in U.S. older adults. Across all ages of older adults, a secondary finding is that the prevalence of reporting clinically relevant depressive symptoms is high among participants reporting varying degrees of food insecurity. Such nutritional inadequacies and mental health concerns among this health-vulnerable group of older adults might indicate the need to simultaneously address, screen for, and monitor risks of food insecurity and clinically relevant depressive symptoms within geriatric health and nutrition programs.

The prevalence rates of food-insecure older adults with clinically relevant depressive symptoms (12.3%, 16.3% and 25.2% for marginal, low, and very low food security,

respectively) were higher than individuals with full food security (5.4%). The latter, in fact, approximates national, community-dwelling older adult depression rate estimates of 5%.¹⁹ There may be multi-dimensional health factors that influence the patterns and associations between food insecurity and clinically relevant depressive symptoms, which might be difficult to disentangle without further examination of additional variables and the use of longitudinal data. However, there is the possibility of common psychosocial mechanisms. For instance, social isolation and loneliness following retirement or bereavement can diminish the opportunities for and pleasures of eating in social settings,¹⁵ which might explain associations between greater depressive symptoms and food insecurity in older adults.^{21,22,24} It is also possible that episodic experiences with food insecurity may be linked to acute or chronic stress in older adults, which may lead to the onset of depression.³⁷ An alternative explanation might be that older adults with clinically relevant depressive symptoms may perceive food insecurity due to issues with food deprivation caused by anhedonia, poor appetite, or a lack of attention to food intake. Finally, older adults with clinically relevant depressive symptoms may experience cognitive or somatic functional limitations, which can interfere with the ability to manage food budgets or engage in grocery shopping, meal planning, food preparation, or food safety practices.

Very low and marginal levels of food security were significantly associated with clinically relevant depressive symptoms, even after controlling for sociodemographic and health characteristics including age, sex, race/ethnicity, education, marital status, SNAP participation, income-to-poverty ratio, smoking status, obesity, hypertension, diabetes, and arthritis. These findings are similar to other studies indicating associations between food insecurity and greater depressive symptoms among all age groups^{38,39} and nationally representative samples of older adults from the NHANES 2007–2008, Health and Retirement Study 1996–2002, and the Asset and Health Dynamics Among the Oldest Old 1995–2002 datasets.^{25,26} This is also consistent with research suggesting the opposite effect of high diet quality being associated with reduced symptoms of depression among older adults.⁴⁰ However, in Models 3–5, low food security was no longer associated with clinically relevant depressive symptoms. One possible explanation for the lack of significance is that the size of the low food security subsample was smaller than the marginal food security subsample, which may have limited statistical power and reduced the ability to ascertain associations. Given the study's findings on the significantly higher prevalence of clinically relevant depressive symptoms among adults ages 60–69 years reporting low food security, one other explanation might be that this association is most pronounced in the subsample of younger older adults, also interfering with the ability to ascertain associations in the total sample.

We deliberately performed post hoc tests to examine the stability of findings and determine whether the results varied on the basis of age group. Our findings showed that the two groups of adults ages 60–69 and 80+ years independently reported levels of very low food security that were significantly associated with clinically relevant depressive symptoms, albeit the odds ratios were very similar for ages 60–69 and 70–79 years. Results also indicated a significant and fully adjusted association between low food security and clinically relevant depressive symptoms is present in younger older adults of ages 60–69 but not the other older age groups. One possible reason might be that this finding suggests that

other sociodemographic and health characteristics may be equally or more important than low levels of food security to the increased likelihood of clinically relevant depressive symptoms in older and oldest adult age groups. For instance, chronic disease and functional disability are linked to food security in older adults, which may be other contributing factors for depression.⁴¹ The association between arthritis and depression in adults 65+ years is also well-documented,⁴² and the co-occurrence of such biomedical and psychosocial factors in aging adults often interact and negatively influence one another to worsen symptoms of both disorders.⁴³

To our knowledge, this is one of only three studies to investigate varying levels of food insecurity among older adults with clinically relevant depressive symptoms.^{25,26} We do acknowledge several limitations when interpreting our findings. First, we used cross-sectional data, limiting our ability to draw conclusions about the causality or direction of associations. Because the current study was a secondary data analysis, our dataset was restricted to the variables selected for the original study. We were limited to self-reported assessments of food insecurity and depressive symptoms. The majority of the measures on sociodemographic and health characteristics were also self-report, which may be subject to reporting and measurement bias. Receipt of senior nutrition program use, food bank services, pharmacological treatments for depression (e.g., antidepressant use), or non-pharmacological interventions for depression (e.g., therapy services) were also not assessed. Survey weights were used with analyses to reduce sampling bias, yet some biases likely remain due to the nature of sampling within difficult-to-reach older populations (e.g., persons with recurrent depression with significant functional impairment). Finally, this study did not address other mental health factors potentially associated with food insecurity. Future research should investigate mental health factors such as anxiety, anger, trauma, or psychosis, or related socio-environmental factors including social support or employment status.

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Take Away Points

- Varying levels of food insecurity was highly prevalent among older adults with clinically relevant depressive symptoms in this study. The average rates of clinically relevant depressive symptoms in participants with marginal, low, and very low food security were 12.3%, 16.3%, and 25.2%.
- The strong link between these two health concerns in later life may be considered a larger-scale public health challenge for geriatric health providers, researchers, and policy makers than either problem alone.
- Geriatric health professionals should consider simultaneously addressing, screening for, and monitoring risks of food insecurity and clinically relevant depressive symptoms among older adults within health and nutrition programs.
- Given the speculation on causes and influences such as social isolation or psychological distress on the association between food insecurity and clinically relevant depressive symptoms, geriatric health providers should initially focus on improving recruitment, screening, treatments, and referral services for health and nutrition programs among food-insecure older adults with clinically relevant depressive symptoms, instead of prevention efforts.
- Geriatric health professionals should also request and advocate for federal funds and charitable donations toward the continuation and improvement of senior nutrition programs. Existing nutrition assistance programs, such as Meals on Wheels, might consider enhancing mental health and nutritional health assessments, support services, cross-agency collaborations, and outreach among food-insecure older adults with clinically relevant depressive symptoms.

Table 1:
Study Participant Characteristics by Food Security Levels Among Older Adults

	Full	Marginal	Low	Very low	p-value
n	6559 (82.3)	601 (7.5)	491 (6.2)	318 (4.0)	
Age n (%)					<0.001
60–69	3088 (87.1)	353 (5.5)	310 (4.2)	223 (3.2)	
70–79	2151 (89.4)	182 (5.3)	141 (3.6)	73 (1.7)	
80+	1320 (93.4)	66 (3.7)	40 (1.8)	22 (1.1)	
Gender n (%)					<0.001
Male	3297 (83.8)	272 (6.9)	209 (5.3)	156 (4.0)	
Female	3262 (80.8)	329 (8.2)	282 (7.0)	162 (4.0)	
Race n (%)					<0.001
Non-Hispanic White	3844 (92.2)	208 (4.1)	119 (2.2)	87 (1.5)	
Non-Hispanic Black	1265 (75.7)	176 (10.7)	129 (7.9)	97 (5.7)	
Hispanic	1070 (67.1)	179 (11.5)	216 (13.8)	122 (7.6)	
Other	380 (85.4)	38 (6.3)	27 (4.6)	12 (3.7)	
Marital Status n (%)					<0.001
Single	274 (84.0)	36 (6.6)	35 (5.8)	25 (3.6)	
Widowed, divorced, or separated	2253 (82.3)	280 (7.8)	236 (5.6)	173 (4.3)	
Married or living with partner	4028 (92.4)	285 (3.7)	220 (2.5)	119 (1.4)	
Smoking Status n (%)					<0.001
Never smoker	3208 (90.2)	265 (4.5)	222 (3.3)	139 (2.0)	
Former smoker	2660 (90.2)	220 (4.8)	171 (3.2)	91 (1.8)	
Current smoker	686 (77.7)	115 (9.6)	98 (6.5)	88 (6.2)	
Education n (%)					<0.001
<=12th grade	1766 (76.5)	279 (9.4)	270 (8.6)	181 (5.5)	
High school graduate/GED	1615 (88.9)	137 (5.2)	116 (3.6)	63 (2.3)	
Some college or Associate's degree	1663 (90.1)	143 (5.2)	86 (2.8)	62 (1.9)	
College graduate or above	1507 (97.1)	41 (1.8)	19 (0.6)	11 (0.5)	
Body Mass Index n (%)					<0.001
<18.5	81 (85.0)	7 (6.4)	14 (6.8)	5 (1.8)	
18.5–24.9	1648 (90.9)	121 (4.2)	97 (3.0)	62 (1.9)	
25–29.9	2382 (90.3)	213 (5.1)	142 (2.5)	110 (2.1)	
>=30	2336 (86.2)	247 (5.9)	230 (5.0)	132 (2.9)	
Hypertension n (%)	3955 (87.5)	375 (5.3)	333 (4.2)	223 (3.0)	<0.001
Diabetes n (%)	1391 (82.8)	180 (7.8)	134 (5.0)	105 (4.4)	<0.001
Arthritis n (%)	3244 (87.4)	325 (5.7)	263 (4.2)	177 (2.7)	0.001
SNAP* n (%)	457 (51.4)	176 (18.9)	177 (17.0)	131 (12.7)	<0.001
IPR[§] mean (95% CI)	3.2 (3.1–3.3)	1.7 (1.5–1.8)	1.5 (1.3–1.6)	1.24 (1.1–1.4)	

Note. Means ± CIs are presented for continuous variables, counts for categorical variables. All percentages are weighted and account for complex survey design (including oversampling), survey non-response, and post-stratification

* SNAP – Supplemental Nutrition Assistance Program

[§]IRP – Income-to-Poverty Ratio

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Table 2:

Co-occurring Food Security Levels and Clinically Relevant Depressive Symptoms Among Older Adults by All Ages and Specific Age Groups

	All Ages	60–69 [†]	70–79 [†]	80+ [†]	p-value
Depression, n (%)	586 (7.4)	359 (62.2)	157 (24.8)	70 (13.0)	
Food Security, n (%)					
Full	352 (5.4)	191 (54.3)	106 (30.1)	55 (15.6)	0.176
Marginal	74 (12.3)	51 (15.3)	17 (6.9)	6 (8.3)	0.058
Low	80 (16.3)	61 (21.1)	17 (10.5)	2 (2.9)	0.004
Very low	80 (25.2)	56 (25.2)	17 (28.0)	7 (26.4)	0.933

Note. Depression=Clinically Relevant Depressive Symptoms with PHQ-9 score ≥ 10. Prevalence rates are presented as counts (weighted prevalence).

[†] Depression rates between food security levels within the age group were significant (p-value <0.001)

Table 3:
Main Effects of Food Security Levels on Clinically Relevant Depressive Symptoms Outcome Among Older Adults

Food Security Level	Odds Ratio (95% CI)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Full	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Marginal	1.12 (1.07–1.18)	1.12 (1.06–1.17)	1.08 (1.03–1.13)	1.07 (1.02–1.13)	1.07 (1.01–1.12)	1.06 (1.01–1.12)
Low	1.07 (1.03–1.12)	1.07 (1.03–1.11)	1.04 (1.00–1.09)	1.04 (1.00–1.09)	1.04 (0.99–1.09)	1.04 (0.99–1.08)
Very low	1.24 (1.16–1.32)	1.23 (1.15–1.31)	1.18 (1.1–1.27)	1.17 (1.09–1.26)	1.15 (1.07–1.23)	1.14 (1.07–1.22)

Note. Clinically Relevant Depressive Symptoms=PHQ-9 score 10.

Model 1: Unadjusted

Model 2: Model 1, as well as age and sex

Model 3: Model 2 covariates, as well as race/ethnicity, education level, marital status, and SNAP participation

Model 4: Model 3 covariates, as well as income-to-poverty ratio and smoking status

Model 5: Model 4 covariates, as well as obesity, hypertension, and diabetes

Model 6: Model 5 covariates, as well as arthritis

Table 4:

Main Effects of Food Security Levels on Clinically Relevant Depressive Symptoms Outcome Among Older Adults by Specific Age Groups

Food Security OR (95%CI)	60–69	70–79	80+
Full	1 (Ref)	1 (Ref)	1 (Ref)
Marginal	1.06 (0.99–1.13)	1.01 (0.95–1.07)	1.01 (0.93–1.09)
Low	1.10 (1.02–1.19)	1.01 (0.97–1.06)	0.93 (0.88–0.99)
Very low	1.13 (1.03–1.24)	1.14 (0.99–1.32)	1.27 (1.01–1.60)

Note. Clinically Relevant Depressive Symptoms=PHQ-9 score ≥ 10. Models are adjusted for gender, race/ethnicity, education, smoking status, SNAP participation, income-to-poverty ratio, obesity, hypertension, diabetes, and arthritis