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Psychosocial mechanisms largely mediate the path between food insecurity and depressive symptoms in later life



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ABSTRACT

Food insecurity (FI) is highly prevalent and can lead to depression. This study 1) examines the association of FI with depression symptoms (DS) among older adults in Ghana, 2) explores the degree to which psychosocial factors mediate the FI-DS link, and 3) investigates the effect modification of the association by age and sex differences. Data from adults aged ≥ 50 years in the AgeHeaPsyWel-HeaSeeB Study were analyzed. DS (cutoff of ≥ 9) was assessed using the CES-D-10 scale. Continuous score and categorical FI were measured with hunger and skipped breakfast items due to insufficient food or resources. Multivariable regression and bootstrapping analyses were used to evaluate the hypothesized associations. The sample included 1201 individuals ($M_{age}=66.1[11.9]$; $F = 63.3\%$). Moderate ($OR=1.75$, $95\%CI=1.22-2.51$) and severe FI ($OR=4.69$, $95\%CI=2.58-8.55$) (vs no FI) were associated with DS, while a unit increase in FI was associated with 1.67 ($95\%CI=1.39-2.01$) times higher odds for DS. The association was much stronger in males than in females and in those aged 50–69 years than in those aged ≥ 70 . Anxiety (mediated percentage 41%), loneliness (30%), hopelessness (8%), and social isolation (4%) mediated the FI-DS association. Higher FI levels are positively associated with DS. Addressing FI and the identified psychosocial mediators may reduce DS in food-insecure older adults in low-income countries, pending future longitudinal conclusions.

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Introduction

Depression is often characterized by persistent sadness, hopelessness, and a lack of interest or pleasure in once-enjoyable activities.¹ Depression is now a leading cause of disability, a contributor to the global burden of disease, and an absence from work.^{1,2} A systematic review and meta-analysis found the global prevalence of depression at 35.1% ($95\%CI=30.2-40.4\%$) among older adults³; higher estimates are reported in sub-Saharan Africa (SSA).⁴

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The high prevalence of depression in old age is concerning as it is notably associated with multiple detrimental health outcomes, including increased suicide risks,⁵ dementia,⁶ hospitalization and healthcare costs, and indirect costs related to sickness absence and working disability,⁷ loss of independence,⁸ and early death.⁹ For example, older adults with depression (vs. those without) are 40 % more likely to die prematurely.¹⁰ Crucially, the burden of depression is much more severe in SSA amid the current rapid aging and poor socioeconomic and environmental conditions, with limited access to mental health and social care resources.⁴ In this regard, identifying the social determinants of depression among older adults and its early detection are essential clinical practices to guide interventions to improve mental health in later life.

Research increasingly recognizes food insecurity (FI) as a common old-age social determinant of health closely linked to depression.^{11–13} FI represents a limited or uncertain ability to acquire nutritionally adequate and safe foods in a socially acceptable manner.^{14,15} As a modifiable factor, FI is remarkably frequent in older adults¹³ and is an important psychosocial stressor that may contribute to the onset and progression of depression. Some studies have also observed marked sex differences in FI and depression.¹⁵ For example, estimates show that females are more likely to experience food shortages and malnutrition-related mental disorders, including depression, than males.^{15,16} A meta-analysis found that severe FI was significantly associated with 2.43 (95 % CI=1.65–3.57) times higher odds for depression among older adults.¹⁷ Moreover, longitudinal data from U.S. adults found that FI was associated with an increased likelihood of depression.¹⁸ A study among 31,464 Indian older adults found that a higher prevalence of FI was associated with increased odds of depressive symptoms.¹⁹ Several biological and psychological mechanisms may underlie the FI-depression association. Poor nutritional intake may alter the hypothalamic-pituitary-adrenal (HPA) axis and increase the discharge of inflammatory cytokines, such as IL-1 β and IL-6.²⁰ Moreover, uncertainty and increased feelings of shame about securing a nutritious and culturally appropriate meal may trigger psychosocial changes, including anxiety, hopelessness, loneliness, sleep problems, and social withdrawal, which in turn may lead to psychological distress and depression. Indeed, research is needed to examine the potential psychosocial factors that mediate the association between FI and depressive symptoms in older adults.

However, most research evaluating the association between FI and depressive symptoms originate from high-income and Asian countries,^{21,22} leaving a significant knowledge gap, especially in low- and middle-income countries (LMICs). Thus, research on the association between FI and depressive symptoms is highly limited among older adults in SSA, where the pathophysiology of depression, socioeconomic status, and cultural and aging dynamics remain distinct.^{4,17,23} The generalizability of Western-based findings may be invalid in the SSA context. Importantly, studies investigating the psychosocial mechanisms underlying the association between FI and depressive symptoms in old age are poorly characterized and largely unknown. Understanding these crucial dynamics may aid interventions to address FI and depressive symptoms in older populations, particularly in LMICs.

Therefore, the current study investigated the association between FI and depressive symptoms among older adults in Ghana and explored potential mechanisms underlying this association. We hypothesized that FI would be positively associated with depressive symptoms, and that this association would be mediated by psychosocial factors.

Methods

Survey

The study employs a large, nationally representative sample of older adults from Ghana as part of the AgeHeaPsyWel-HeaSeeB

Study. This is a representative, questionnaire-based study examining demographics, socioeconomic factors, and health-related issues in Ghana between 2016 and 2018.²³ The participants were randomly selected using a multistage stratified cluster sampling technique from community-dwelling adults aged ≥ 50 years in Ghana. Age 50 or higher was selected as the United Nations considers adults aged 50 or older in conceptualizing older adults in the SSA context, given that life expectancy in the region is generally lower than 60 years. The selection phases included regional, sub-regional, rural-urban demarcation, community-level selection, and participant selection. The documentation of the study design, sample selection processes, participants' characteristics, and variable measurement is extensively described in the literature.^{24,25} This overall analytic sample comprised 1201 community-dwelling older adults.

Face-to-face interviews were conducted by trained staff using a standard questionnaire. Questionnaires were translated into local dialects using the World Health Organization's standard procedure. Thus, we first translated the research instruments from English into the local Asante Twi dialect (the dominant dialect in the study areas) and then back-translated them from Asante Twi into English with the assistance of experts. This was done to ensure accuracy in the meanings of each item on the questionnaire.

Ethics approval was obtained from the Committee on Human Research, Publications & Ethics (CHRPE), School of Medical Sciences, Kwame Nkrumah University of Science and Technology, and Komfo Anokye Teaching Hospital, Ghana (Ref: CHRPE/AP/507/16). Written informed consent was obtained from all participants.

Measures

Depressive symptoms

DS was defined and assessed using the Center for Epidemiological Studies Depression Scale (CES-D).²⁶ The scale with of 10 items inquiring about participants' feelings and behaviors over the past seven days. The items were scored on a four-point scale: 0=rarely (<1 day), 1=some or a little of the time (1–2 days), 2=occasionally or a moderate amount of time (3–4 days); and 3=most or all of the time (5–7 days). The items were summed to produce a score (0–30), with higher scores indicating greater depression severity. The Cronbach's alpha of the CES-D-10 was 0.861 in this study. We dichotomized the variable, using a cutoff score >9 to differentiate between the absence and presence of depressive symptoms.²⁷ Previous research has shown the effectiveness of the CES-D-10 in older African populations.²⁸

Food insecurity (FI)

FI was assessed using items related to dietary inadequacy, including hunger and breakfast skipping. Respondents were asked, "During the past 30 days, how often did you go hungry because there was not enough food in your home?" and "During the past 30 days, how often did you skip breakfast because there was not enough food and you had no resources to obtain one?" Each item had a 5-point response option: 1 = never, 2 = rarely, 3 = sometimes, 4 = most of the time, and 5 = always. The items were adapted from the US Household Food Security Survey Module and the National Health and Nutrition Examination Survey Food Security module²⁹ and used in WHO SAGE studies.³⁰ An overall score (range: 2–10) was calculated, with higher scores indicating greater FI. We used the following algorithm to categorize the FI variable: respondents who answered 3–5 to both questions, or 5 to either item, were classified as severely food insecure. Those who did not meet the criteria for severe FI but answered 3 or 4 on either question were coded as moderately food insecure. Those who answered 1 through 2 for both items were categorized as no FI.

Potential mediators

The potential psychosocial mediating factors in the FI-depressive symptoms association (anxiety, loneliness, sleep problems, social isolation, and restlessness) were based on previous literature suggesting that they could be the consequence of FI and subsequently lead to depression.^{31,32} Anxiety was assessed with the Generalized Anxiety Disorder Scale (GAD-7) with good psychometric properties.^{33,34} Using a four-point scale (1=not at all to 4=nearly every day), a total score ranged from 7–28, with higher scores depicting higher anxiety levels (Cronbach's alpha =0.90 in this study). Sleep problems were assessed using 2 items from the last 30 days regarding the extent of the problem respondents experienced with sleeping, including difficulty falling asleep, waking up frequently during the night, or waking up too early in the morning. These were scored on a 5-point scale from none=1 to extreme = 5. An overall score (2–10) was created; higher scores reflected more sleep problems³⁵ (Cronbach's alpha of 0.83 in this study). Loneliness was assessed with the UCLA three-item loneliness scale: 'How often do you feel you lack companionship, left out, and isolated?' on a 3-point scale from 1=hardly ever/never to 3=often or always (range: 3–9).³⁶ Higher scores reflected greater loneliness (Cronbach's alpha=0.81 in this study). Restlessness was assessed using a single item with four-level responses: 1=never to 4=always based on the question "Over the past 30 days, would you say you are restless".³⁷ The scale ranged from 1 to 4, with higher scores indicating higher levels of restlessness. Social isolation was assessed with six items: being unmarried/living alone, having no family/friends contact, having no social participation, having nobody assisting in seeking healthcare, having nobody to share concerns, and having no emotional bond with others.³⁸ An overall score ranged from 0 to 6, with higher scores indicating greater social isolation (Cronbach's alpha = 0.89).

Other variables

The control variables were selected based on previous literature.^{6,31} These included age (years), sex (male/female), residential status (rural/urban), employment status (unemployed/employed), level of education (never/primary/secondary/tertiary), and net monthly income (in Cedis). The lifestyle factors included alcohol consumption (no/yes) and physical activity, which was assessed by the International Physical Activity Questionnaire (metabolic equivalent task – the sum of days performing walking, moderate, and vigorous activity)³⁹ and classified as low (<600 MET per week) or high (≥600 MET per week) based on conventional cut-offs.⁴⁰ Health-related variables included pain interference (continuous 0–4 points) based on the Medical Outcomes Study Short Form-36 (MOS SF-36) scale.³⁷ Data on chronic physical conditions, including eight conditions (hypertension, diabetes, respiratory diseases, cancers, stroke, chronic kidney diseases, asthma, and arthritis), were obtained using the item, "Have you been diagnosed by a doctor with any of the following conditions?" categorized as absent = 0 or present = 1. Functional limitations were evaluated with self-reported difficulties in conducting seven activities concerning activities of daily living (ADL) and instrumental ADL (IADL) using the Medical Outcomes Study Short Form-36 (MOS SF-36) Scale.³⁷ Each item was scaled on a 4-point scale, ranging from "not limited at all" (1) to "much limited" (4). We dichotomized the score into two categories: not limited (0) or limited (1).

Statistical analysis

Descriptive statistics were calculated to summarize the sample characteristics; categorical and continuous variables were reported as frequencies with percentages and means with standard deviations (SDs), respectively. Differences in sample characteristics by

depression status (no/yes) were evaluated using Student's *t*-tests for continuous variables and χ^2 tests for categorical variables.

We used hierarchical multivariable logistic regression to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between FI (a three-level categorical exposure variable) and depression as the outcome. In an additional analysis, we considered continuous FI scores to examine whether the association was influenced by extreme scores. Three specific models were procured. Model I included only the exposure variable without the covariates. Model II included Model I and adjusted for demographic traits (age, sex, residential status, level of education, employment status, and income level). Finally, Model III included Model II and further adjusted for lifestyle and health-related elements (alcohol consumption, physical activity, number of chronic physical conditions, functional limitations, sleep problems, loneliness, social isolation, pain interference, anxiety, and hopelessness). Possible interactions between FI and age/sex were examined by introducing multiplicative interaction terms (sex × FI and age × FI) into Model III. Obtaining significant interactions, age (50–69 vs ≥70 years) and sex (male vs female) stratified analyses were then performed. We calculated the variance inflation factor (VIF) value for each independent variable. The highest VIF value was 1.28, indicating no multicollinearity.⁴¹

We estimated the extent to which psychological factors (anxiety, sleep, loneliness, hopelessness, and social isolation) mediate the association between FI and depressive symptoms using PROCESS Macro.⁴² Bootstrapping with 95 % CIs decomposed the total effect into direct and indirect effects and was set at 5000 samples.⁴² The mediation effect was considered statistically significant if the 95 % confidence interval (CI) of the indirect effect did not include zero. We estimated the proportion of the main association mediated by each mediator variable. We fully adjusted the mediation model for potential confounders and mediators to obtain each mediator's relative/independent effect. The statistical analyses were conducted using SPSS v.25 (IBM, Armonk, NY, USA) software, and the statistically significant level was set at $p < 0.05$.

Results

The analytic sample consisted of 1201 adults aged 50 years or older. We stratified the sample by DS status (no vs. yes), as shown in Table 1a (SD) age was 66.14 (11.85), and 63.3 % were females. Most participants lived in urban areas (55.0 %), and half had not attended school (50.0 %) or had only completed a primary level of education (36.1 %). Over one in two were unemployed (55.6%) and had low incomes (74.7%). While a smaller proportion of participants consumed alcohol (31.5%), the majority (63.3%) met the recommendation for physical activity. Regarding health variables, 53.0 % had chronic conditions, and 36.1 % were functionally limited. The prevalence of depressive symptoms was 29.5 %. The prevalence of FI severity was none (47.5 %), moderate (44.0 %), and severe (8.5 %) (Fig. 1).

Older age, females, the unemployed, those with low incomes, lower education, and the physically inactive were significantly more likely to be depressed ($P < 0.05$). Similarly, health and psychosocial factors (anxiety, chronic conditions, functional limitations, sleep problems, pain, restlessness, loneliness, social isolation) significantly increased with depressive symptoms ($P < 0.05$) (Table 1). FI was much higher among those who were depressed than those who were not depressed (Fig. 1). For example, in the overall sample, the prevalence of severe FI was 18.1 % among those with depressive symptoms and 4.5 % among those without depressive symptoms ($p < 0.05$), respectively.

Table 2 presents the results for the association between FI and depressive symptoms. After adjusting for all potential confounders, multivariable logistic regression estimates indicated that, compared with no FI, moderate (OR=1.75, 95% CI=1.22–2.51) and severe FI

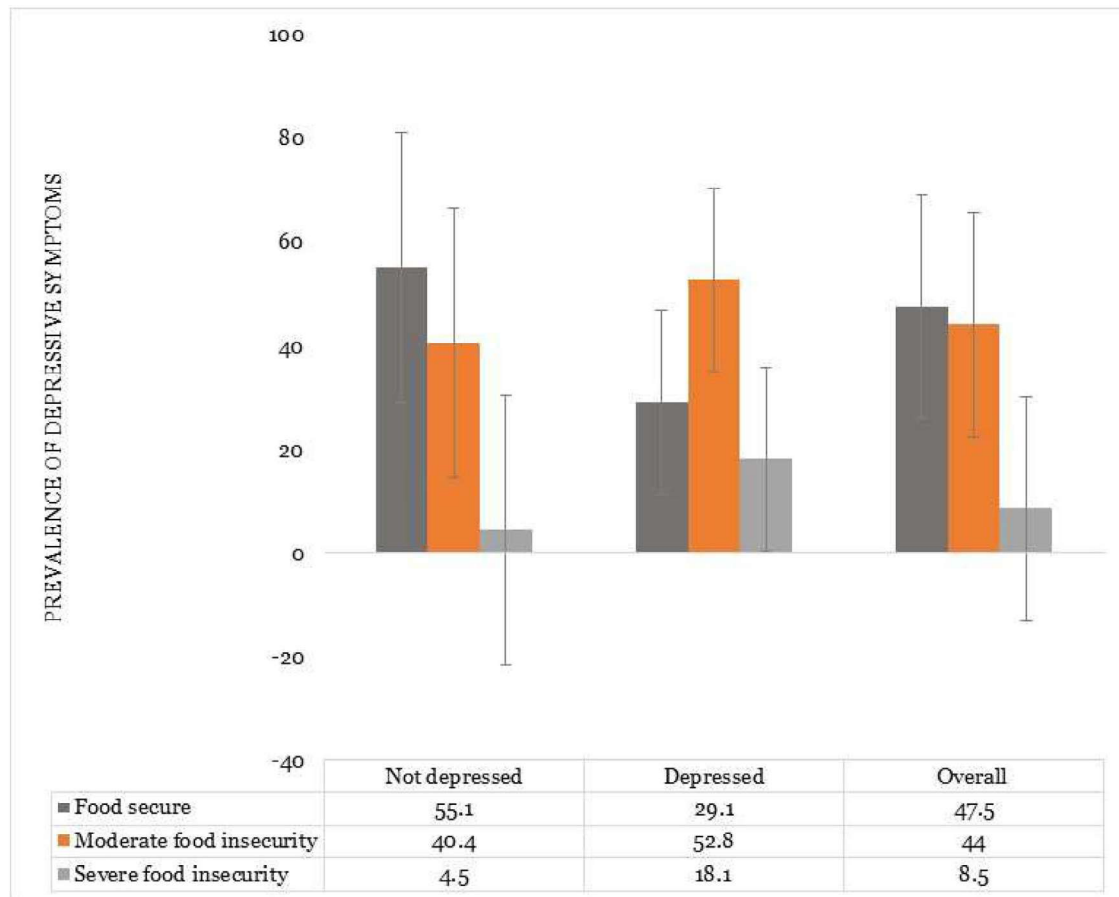


Fig. 1. Prevalence of probable depression by food insecurity. The error bars represent the 95 % confidence interval with significant association ($\chi^2 [2, N = 1201] = 103.9; p < 0.001$).

(OR=4.69, 95 % CI=2.58–8.55) were significantly associated with a higher odds of depressive symptoms in the overall sample. Similarly, a unit increase in FI was associated with a 1.67-fold (95 %CI=1.39–2.01) higher odds for depressive symptoms. After identifying significant interactions between age/sex and FI on depressive symptoms at the $p < 0.05$ threshold (Supplementary Table 1), we performed age- and sex-specific analyses. The association between FI and depressive symptoms was more pronounced in males (OR=1.92, 95 %CI=1.37–2.67) than females (OR=1.60, 95 %CI=1.27–2.01) and in those aged 50–69 years (OR=1.89, 95 %CI=1.49–2.41) than those in ≥ 70 (OR=1.64, 95 %CI=1.19–2.26). We obtained similar estimates for the categorical FI measures (Table 3).

Mediation analysis in Table 3 revealed that anxiety (41.1 %), loneliness (29.8 %), hopelessness (7.7 %), and social isolation (4.2 %) significantly explained a modest proportion of the FI-depressive symptoms association (total indirect effect was approximately 83.0 %).

Discussion

Using a representative sample of older adults, this populationbased study examined the association between FI and depressive symptoms, assessing both categorical and continuous dimensions of FI. It further explored the interactive roles of age and sex with FI on depression and the mediating role of psychosocial factors in the FI-depressive symptoms association. In the overall sample, regressions found that moderate and severe FI (vs. no FI) were independently associated with two times and five times more likely for depressive symptoms, respectively. A unit increase in FI was associated with a

1.67 (95 %CI=1.39–2.01) likelihood for depressive symptoms. We found significant interactions between age/sex and FI on depressive symptoms, such that the association between FI and depressive symptoms was stronger in males (than females) and among those aged 50–69 years (vs those in ≥ 70 years). Moreover, anxiety, loneliness, hopelessness, and social isolation mediated a substantial amount (approximately 83.0 %) of the FI-depressive symptoms association. This is one of the few studies in LMICs to examine the link between FI and depressive symptoms in old age¹⁷, and the first to explore the interactive effects of age and sex and the mediating roles of psychosocial factors in this association. The current study extends prior work by providing important insights into the FI-depressive symptoms discourse.

The finding that FI is associated with higher odds of depression is consistent with prior work, particularly from high-income countries and advanced LMICs.^{17,43,44} Specifically, FI has been related to an increased risk of testing positive for depression.⁴⁵ Additionally, older adults with very low food security had significantly greater odds of expressing depression than food-secure adults.⁴⁶ Building on previous studies, our findings suggest a positive association between FI and depression among aging adults in the LMIC context, where data on this important relationship are lacking. This research also provides insight into the effect modification by age and sex and the potential psychosocial mediator in the FI-depressive symptoms association.

Our analysis identified several psychosocial mechanisms that may explain the observed association between FI and depressive symptoms. Specifically, anxiety mediated 41 % of the association. Previous studies indicate that FI may generate chronic stress and changes in mood, such as sadness, worry, stress, and anger.^{47,48} These

Table 1
Overall characteristics of the study sample by depressive symptoms status (N = 1201).

Variable	Total		Depressive symptoms				F/ χ^2 p-value
	N/M	(%/SD)	No		Yes		
			n/M	(%/SD)	n/M	(%/SD)	
Number	1201	100	847	(70.5)	354	(29.5)	-
Age (in years)	66.14	11.85	65.5	(11.7)	67.7	(12.2)	.003
Age group							
50–69 years	770	(64.1)	564	(66.6)	206	(58.2)	.006
≥70 years	431	(35.9)	283	(33.4)	148	(41.8)	
Sex (%)							
Male	441	(36.7)	339	(40.0)	102	(28.8)	<0.001
Female	760	(63.3)	508	(60.0)	252	(71.2)	
Residential status (%)							
Rural	540	(45.0)	376	(44.4)	164	(46.3)	.539
Urban	661	(55.0)	471	(55.6)	190	(53.7)	
Level of education (%)							
Never	601	(50.0)	384	(45.3)	217	(61.3)	<0.001
Primary	434	(36.1)	332	(39.2)	102	(28.8)	
Secondary	104	(8.7)	76	(9.0)	28	(7.9)	
Tertiary	62	(5.2)	55	(6.5)	7	(2.0)	
Employment status							
Not employed	667	(55.6)	416	(49.2)	251	(70.9)	<0.001
Employed	533	(44.4)	430	(50.8)	103	(29.1)	
Income level							
Low	780	(74.7)	538	(71.4)	242	(83.2)	<0.001
High	264	(25.3)	215	(28.6)	49	(16.8)	
Current alcohol consumption							
No	823	(68.5)	573	(67.7)	250	(70.6)	.312
Yes	378	(31.5)	274	(32.3)	104	(29.4)	
Physical activity							
<600 MET per week	441	(36.7)	269	(31.8)	172	(48.6)	<0.001
≥600 MET per week	760	(63.3)	578	(68.2)	182	(51.4)	
Chronic physical conditions							
No	564	(47.0)	427	(50.4)	137	(38.7)	<0.001
Yes	637	(53.0)	420	(49.6)	217	(61.3)	
Functional limitations							
Not limited	767	(63.9)	611	(72.1)	156	(44.1)	<0.001
Limited	434	(36.1)	236	(27.9)	198	(55.9)	
Pain interference	3.04	(1.26)	2.82	(1.21)	3.51	(1.23)	<0.001
Anxiety	1.94	(0.78)	1.67	(0.58)	2.58	(0.82)	<0.001
Sleep problems	2.59	(1.31)	2.45	(1.28)	2.92	(1.33)	<0.001
Loneliness	1.76	(0.82)	1.48	(0.62)	2.43	(0.856)	<0.001
Social isolation	1.80	(1.46)	1.54	(1.33)	2.43	(1.57)	<0.001
Hopelessness	1.641	(0.79)	1.41	(0.62)	2.21	(0.88)	<0.001

M – Mean score; SD – standard deviation.
The p-value is based on either the χ^2 test or the one-way ANOVA test.

Table 2
Association between FI and depressive symptoms estimated by multivariable logistic regression models.

Pain severity	Model I		Model II		Model III	
	OR	95 %CI	OR	95 %CI	OR	95 %CI
Continuous estimates						
A unit increase in FI	2.07	(1.79–2.38)***	2.04	(1.73–2.40)***	1.67	(1.39–2.01)***
Categorical estimates						
No FI	1.00		1.00		1.00	
Moderate FI	2.48	(1.88–3.27)***	2.19	(1.60–3.01)***	1.75	(1.22–2.51)**
Severe FI	5.64	(4.85–10.03)***	5.40	(5.02–9.06)***	4.69	(2.58–8.55)***
Confounders	√		√		√	

Note: OR – odds ratio; CI – confidence interval; FI – food insecurity; √ – potential confounders.

Model I is an unadjusted model.

Model II is adjusted for age, sex, residential status, level of education, employment status, and income level.

Model III included Model II and further adjusted for alcohol consumption, physical activity, #chronic physical conditions, functional limitations, sleep problems, loneliness, social isolation, pain interference, anxiety, and hopelessness.

***p < 0.001; **p < 0.005; *p < 0.05.

physiological stress responses may trigger anxiety symptoms and emotional instability, which may heighten the vulnerability of older adults to depression.⁴⁹ Second, hopelessness mediated approximately 8% of the association between FI and depression. Indeed,

uncertainty about the availability and accessibility to food can foster a sense of despair, hopelessness, and lack of control over life circumstances.⁵⁰ Again, the food insecure are more likely to feel hopeless and worthless via increased levels of stigma,⁵¹ which, in turn, may

Table 3

Sex and age-wise analysis of the association between FI and depressive symptoms estimated by multivariable logistic regression models.

	Sex				Age group			
	Male		Female		50–69 years		≥70 years	
	OR	95 %CI	OR	95 %CI	OR	95 %CI	OR	95 %CI
Pain severity								
Continuous estimate								
A unit increase in FI	1.92	(1.37–2.67)***	1.601	(1.27–2.01)***	1.894	(1.49–2.41)	1.64	(1.19–2.26)**
Categorical estimate								
No FI	1.00		1.00		1.00		1.00	
Moderate FI	1.91	(0.99–3.69)	1.72	(1.20–2.68)*	2.73	(1.69–4.42)***	1.22	(1.15–2.29)*
Severe FI	6.04	(2.47–20.10)***	3.91	(1.87–8.19)***	5.98	(2.71–13.20)***	4.79	(1.76–13.02)**
Potential confounders	✓		✓		✓		✓	

Note: OR – odds ratio; CI – confidence interval; FI – food insecurity; ✓ – potential confounders.

Models were adjusted for age, sex, residential status, level of education, employment status, income level, alcohol consumption, physical activity, #chronic physical conditions, functional limitations, sleep problems, loneliness, social isolation, pain, anxiety, and hopelessness.

***p < 0.001; **p < 0.005; *p < 0.05.

Table 4

Mediators in the association between FI and depressive symptoms (outcome).

Mediators	Total effect		Direct effect		Indirect effect		% Mediated
	B	(95 % CI)	B	(95 % CI)	B	(95 % CI)	
Anxiety	.285	(0.241, 0.330)	.047	(0.008, 0.085)	.117	(0.091, 0.145)	41.1
Loneliness	.285	(0.241, 0.330)	.047	(0.008, 0.085)	.085	(0.061, 0.110)	29.8
Hopelessness	.285	(0.241, 0.330)	.047	(0.008, 0.085)	.022	(0.005, 0.038)	7.7
Social isolation	.285	(0.241, 0.330)	.047	(0.008, 0.085)	.012	(0.004, 0.021)	4.2
Sleep problems	.285	(0.241, 0.330)	.047	(0.008, 0.085)	.003	(–0.008, 0.014)	NA

Note: B – Unstandardized regression coefficients; FI – food insecurity.

Models were adjusted for age, sex, residential status, level of education, employment status, income level, alcohol consumption, physical activity, #chronic physical conditions, functional limitations, sleep problems, loneliness, social isolation, pain, anxiety, and hopelessness.

Confidence intervals and standard errors are based on 5000 bootstrap samples and a 95 % bias correction. The empirical 95 % confidence interval does not overlap with zero.

lead to psychological distress and depression.⁵² Third, loneliness explained about 30 % of the FI–depressive symptoms link, while social isolation explained the association to a lesser extent. Studies have suggested that FI can increase feelings of social abandonment, disconnection from others, and withdrawal from social networks, leading to isolation and loneliness.^{53,54} For example, individuals unable to participate in communal meals or social food-related activities may feel excluded and lonely due to a lack of opportunities for meaningful social engagements.⁵⁵ FI also leads to feelings of inferiority, reduces self-worth, and increases social withdrawal.⁵⁶ These circumstances may increase social isolation and loneliness through reduced access to vital social support systems. Loneliness and isolation, in turn, are well-established risk factors for depression in old age.⁵⁷ In addition, FI is known to activate the hypothalamic-pituitary-adrenal (HPA) axis, releasing stress hormones like cortisol.⁵⁸ Chronic activation of the HPA axis contributes to dysregulation of the body's stress-response system, impairing brain function and emotional regulation.⁵⁹ Elevated cortisol levels may shrink the hippocampus and disrupt prefrontal cortex activity, both of which are critical for mood regulation, thereby increasing the risk of depression in older adults.⁶⁰ Similarly, FI is associated with the release of pro-inflammatory cytokines, such as IL-6 and TNF- α , which have been implicated in the pathophysiology of depression.⁶¹ These inflammatory markers disrupt neurotransmitter function and brain signaling pathways, which in turn may lead to depression.⁶² Finally, nutritional deprivation via FI may reduce energy levels and physical capacity, which in turn may increase depressive symptoms among older adults.¹⁴ Another potential mediating factor is physical multimorbidity. People with FI may be vulnerable to physical multimorbidity, which, in turn, may increase the odds of impaired mental health.²¹

Our analysis found important sex- and age-wise differences in the association between FI and depressive symptoms. Among men and

those aged 50–69 years, FI exposure was more highly related to depression than women and those in the ≥ 70 -year group. Men may face greater psychological stress due to societal expectations as providers,⁶² while middle-aged adults often bear economic and social responsibilities that exacerbate vulnerability to FI. Conversely, older adults may benefit from community support systems, and women, despite higher FI risk as hypothesized by the male–female health-survival paradox, may rely on social networks and coping mechanisms that buffer depressive effects.⁶¹

Our findings have several implications for Ghana's public health, clinical care, and policy intervention' First, healthcare providers should incorporate mental health and FI screenings into routine care, providing tailored interventions to address anxiety, loneliness, and hopelessness linked to FI. Second, community-based programs fostering social interaction and psychological support can mitigate depressive symptoms, particularly among food-insecure men and middle-aged adults. Third, educational initiatives on affordable healthy eating can empower individuals to make better nutritional choices. Finally, policy efforts should strengthen safety nets, such as livelihood empowerment against poverty (LEAP) (a module of the cash transfer program in Ghana)⁶² and invest in local agriculture to enhance food availability and reduce FI-related vulnerabilities among older populations.

Limitations

The study has some limitations that should be acknowledged. First, the use of self-reported measures of FI and depressive symptoms could introduce recall and social desirability biases, which may lead to under- or over-estimation of the associations observed. Second, the cross-sectional design limits the ability to establish causality between FI and depressive symptoms, as the direction of the

relationship cannot be determined. Third, although psychosomatic mediators such as anxiety and loneliness were examined, the study did not account for other potential mediating or moderating factors, including cultural norms, social support systems, or economic policies, which might influence the findings. Finally, the study relies on subjective assessments rather than objective measures of FI and mental health, which could enhance the robustness of future research. Future studies should employ longitudinal designs and objective indicators to validate these findings and explore additional contextual factors.

Conclusions

In this large population-based cross-sectional study of older adults in Ghana, we found that FI was positively associated with an increased odds of depressive symptoms. While this the association between FI and depressive symptoms was pronounced in men and those aged 50–69 years, psychosocial mechanisms (anxiety, loneliness, hopelessness, and social isolation) potentially mediated the association. Interventions aimed at reducing FI through social safety nets and programs such as cash transfers and pensions should be prioritized. Strengthening and expanding pro-poor programs such as the LEAP could help alleviate the financial strain of older adults and reduce FI-induced mental disorders.

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Declaration of competing interest

The authors declare no conflict of interest in the publication of this paper

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Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.gerinurse.2026.103802](https://doi.org/10.1016/j.gerinurse.2026.103802).

References

1. Yan R, Liu X, Xue R, Duan X, Li L, He X, et al. Association between internet exclusion and depressive symptoms among older adults: panel data analysis of five longitudinal cohort studies. *eClinicalMed [Internet]*. 2024 Sep 1;75. [cited 2024 Dec 10] Available from: [https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370\(24\)00346-8/fulltext](https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(24)00346-8/fulltext).
2. Collaborators G. 2019 MD. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global burden of disease study 2019. *Lancet Psychiatry*. 2022;9(2):137–150.
3. Cai H, Jin Y, Liu R, Zhang Q, Su Z, Ungvari GS, et al. Global prevalence of depression in older adults: a systematic review and meta-analysis of epidemiological surveys. *Asian J Psychiatry*. 2023;80:103417.
4. Gbadamosi IT, Henneh IT, Aluko OM, Yawson EO, Fokoua AR, Koomson A, et al. Depression in Sub-Saharan Africa. *IBRO Neurosci Rep*. 2022 Jun 1;12:309–322.
5. Patel V, Chisholm D, Parikh R, Charlson FJ, Degenhardt L, Dua T, et al. Addressing the burden of mental, neurological, and substance use disorders: key messages from disease control priorities. *Lancet*. 2016;387(10028):1672–1685.
6. Leung CW, Insolera NE, Wolfson JA, McEvoy CT, Ryan LH, Friedman EM, et al. Food insecurity and dementia risk in U.S. Older adults: evidence from the 2013–2021 panel study of income dynamics. *J Gerontol B*. 2024 Nov 1;79(11):gbae153.
7. Buczak-Stec EW, Löbner M, Stein J, Stark A, Kaduszkiewicz H, Werle J, et al. Depressive symptoms and healthcare utilization in late life. Longitudinal evidence from the AgeMooDe study. *Front Med [Internet]*. 2022 Jul 22;9. [cited 2024 Dec 10] Available from: <https://www.frontiersin.org/journal/article/10.3389/fmed.2022.924309/full>.
8. Hajek A, Kretzler B, Gyasi RM, König HH. Community centers for older adults and psychosocial factors: evidence from the German ageing survey. *Int J Geriatr Psychiatry*. 2023;38(3):e5901.
9. Walker ER, McGee RE, Druss BG. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. *JAMA Psychiatry*. 2015 Apr 1;72(4):334–341.
10. Organization WH. Mental health of older adults [Fact sheet]. *World Health Organ Media Cent*. 2017.
11. Fang D, Thomsen MR, Nayga RM. The association between food insecurity and mental health during the COVID-19 pandemic. *BMC Public Health*. 2021 Mar 29;21(1):607.
12. Kim Y, Park A, Kim K. Food insecurity and depressive symptoms of older adults living alone in South Korea. *Ageing Soc*. 2019 Sep;39(9):2042–2058.
13. Mesbah SF, Sulaiman N, Mohd Shariff Z, Ibrahim Z. Does food insecurity contribute towards depression? A cross-sectional study among the urban elderly in Malaysia. *Int J Env Res Public Health*. 2020 Jan;17(9):3118.
14. Gyasi RM, Aikins E, Hajek A, Opoku-Ware J, Osei BA, Kwabena-Adade J, et al. Cross-sectional association of food insecurity with loneliness in older adults: the role of sex, age, and psychosomatic factors. *J Nutr Health Aging*. 2024 Sep 1;28(9):100328.
15. Fao I. *The State of Food Security and Nutrition in the World 2021 [Internet]*. FAO; 2021. [cited 2024 Apr 27] Available from: <https://openknowledge.fao.org/handle/20.500.14283/cb4474en>.
16. Sheikomar O, Sahyoun N. Characteristics of food insecure older adults by gender in the League of Arab States (P04-082-19). *Curr Dev Nutr [Internet]*. 2019 Jun 1;3. [cited 2024 Apr 27] Available from: [https://cdn.nutrition.org/article/S2475-2991\(23\)15949-X/fulltext](https://cdn.nutrition.org/article/S2475-2991(23)15949-X/fulltext).
17. Smith L, Il Shin J, McDermott D, Jacob L, Barnett Y, López-Sánchez GF, et al. Association between food insecurity and depression among older adults from low- and middle-income countries. *Depress Anxiety*. 2021;38(4):439–446.
18. Bergmans RS, Wegryn-Jones R. Examining associations of food insecurity with major depression among older adults in the wake of the Great Recession. *Soc Sci Med*. 2020 Aug 1;258:113033.
19. T M, Sulaiman KM, Drishti D, Srivastava S. Food insecurity and associated depression among older adults in India: evidence from a population-based study. *BMJ Open*. 2022 Apr 1;12(4):e052718.
20. Piątkowska-Chmiel I, Krawiec P, Ziętara KJ, Pawłowski P, Samardakiewicz M, Pac-Kożuchowska E, et al. The impact of chronic stress related to COVID-19 on eating behaviors and the risk of obesity in children and adolescents. *Nutrients*. 2024 Jan;16(1):54.
21. Bigand TL, Dietz J, Gubitz HN, Wilson M. Chronic pain and depressive symptoms are related to food insecurity among urban food bank users. *J Public Health*. 2021 Sep 1;43(3):573–580.
22. Gyasi RM, Yebo-Julius EB, Nketiah JOM, Bavemba J, Adevor BS, Ankaopong JB, et al. More movement, less bodily pain? Findings from a large, representative multi-district aging study in Ghana. *J Am Med Dir Assoc*. 2024 Sep 1;25(9):105153.
23. Gyasi RM. Ageing, health and health-seeking behaviour in Ghana. *Lingnan Theses Diss [Internet]*. 2018 Sep 7. Available from: <https://commons.in.edu.hk/otd/41>.
24. Gyasi RM, Phillips DR, Amoah PA. Multidimensional social support and Health services utilization among noninstitutionalized older persons in Ghana. *J Aging Health*. 2020 Mar 1;32(3–4):227–239.
25. Gyasi RM, Phillips DR. Gender, self-rated health and functional decline among community-dwelling older adults. *Arch Gerontol Geriatr*. 2018 Jul 1;77:174–183.

26. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977 Jun 1;1(3):385–401.
27. Miller WC, Anton HA, Townson AF. Measurement properties of the CESD scale among individuals with spinal cord injury. *Spinal Cord*. 2008 Apr;46(4):287–292.
28. Baron EC, Davies T, Lund C. Validation of the 10-item centre for epidemiological studies depression scale (CES-D-10) in Zulu, Xhosa and Afrikaans populations in South Africa. *BMC Psychiatry*. 2017 Jan 9;17(1):6.
29. Leung CW, Zhou MS. Household food insecurity and the association with cumulative biological risk among lower-income adults: results from the National Health and Nutrition Examination Surveys 2007–2010. *Nutrients*. 2020 May;12(5):1517.
30. Schrock JM, McClure HH, Snodgrass JJ, Liebert MA, Charlton KE, Arokiasamy P, et al. Food insecurity partially mediates associations between social disadvantage and body composition among older adults in india: results from the study on global AGEing and adult health (SAGE). *Am J Hum Biol*. 2017;29(6):e23033.
31. Pengpid S, Peltzer K. Food insecurity and health outcomes among community-dwelling middle-aged and older adults in India. *Sci Rep*. 2023 Jan 20;13(1):1136.
32. Selvamani Y, Elgar F. Food insecurity and its association with health and well-being in middle-aged and older adults in India. *J Epidemiol Community Health*. 2023 Apr 1;77(4):252–257.
33. Rutter LA, Brown TA. Psychometric properties of the generalized Anxiety disorder scale-7 (GAD-7) in outpatients with anxiety and mood disorders. *J Psychopathol Behav Assess*. 2017 Mar 1;39(1):140–146.
34. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006 May 22;166(10):1092–1097.
35. Senaratna CV, Perret JL, Matheson MC, Lodge CJ, Lowe AJ, Cassim R, et al. Validity of the Berlin questionnaire in detecting obstructive sleep apnea: a systematic review and meta-analysis. *Sleep Med Rev*. 2017 Dec 1;36:116–124.
36. Hughes ME, Waite LJ, Hawkey LC, Cacioppo JT. A short scale for measuring loneliness in large surveys: results from two population-based studies. *Res Aging*. 2004 Nov 1;26(6):655–672.
37. Ware JE, Kosinski MA, Keller SD. SF-36 physical and mental health summary scales: a user's manual. *Health Inst N Engl Med Cent*. 1995.
38. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol*. 1979 Feb 1;109(2):186–204.
39. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381–1395.
40. Gyasi RM, Yebo-Julius EB, Nketiah JOM, Bavemba J, Adevor BS, Ankapong JB, et al. More movement, less bodily pain? Findings from a large, representative multi-district aging study in Ghana. *J Am Med Dir Assoc*. 2024 Sep 1;25(9):105153.
41. O'brien RM. A caution regarding rules of thumb for variance inflation factors. *Qual Quant*. 2007 Oct 1;41(5):673–690.
42. Hayes AF. *Introduction To Mediation, Moderation, And Conditional Process Analysis: A Regression-Based Approach*. Guilford publications; 2017.
43. Pourmotabbed A, Moradi S, Babaei A, Ghavami A, Mohammadi H, Jalili C, et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020 Jul;23(10):1778–1790.
44. Wolfson JA, Garcia T, Leung CW. Food insecurity is associated with depression, Anxiety, and stress: evidence from the early days of the COVID-19 pandemic in the United States. *Health Equity*. 2021 Dec;5(1):64–71.
45. Arenas DJ, Thomas A, Wang J, DeLisser HM. A systematic review and meta-analysis of depression, Anxiety, and sleep disorders in US adults with food insecurity. *J Gen Intern Med*. 2019 Dec 1;34(12):2874–2882.
46. Reeder N, Tolar-Peterson T, Bailey RH, Cheng WH, Evans MW. Food insecurity and depression among US adults: NHANES 2005–2016. *Nutrients*. 2022 Jan;14(15):3081.
47. Gianaros PJ, Wager TD. Brain-body pathways linking psychological stress and physical health. *Curr Dir Psychol Sci*. 2015 Aug 1;24(4):313–321.
48. Heidari M, Khodadadi Jokar Y, Madani S, Shahi S, Shahi MS, Goli M. Influence of food type on Human psychological–Behavioral responses and crime reduction. *Nutrients*. 2023 Jan;15(17):3715.
49. Uri R. [Master's Thesis]. The University of North Carolina at Charlotte; 2021.
50. Gyasi RM, Quansah N, Boateng PA, Akomeah E, Yakubu AF, Ahiabli PA, et al. Meeting the WHO physical activity guidelines is associated with lower odds of depression in older adults: potential psychosomatic mechanisms. *Am J Geriatr Psychiatry*. 2024 Sep 1;32(9):1105–1118.
51. Myers CA. Food insecurity and psychological distress: a review of the recent literature. *Curr Nutr Rep*. 2020 Jun 1;9(2):107–118.
52. Vuillier L, May L, Greville-Harris M, Surman R, Moseley RL. The impact of the COVID-19 pandemic on individuals with eating disorders: the role of emotion regulation and exploration of online treatment experiences. *J Eat Disord*. 2021;9(1):10. 12.
53. Björnwall A, Mattsson Sydner Y, Koochek A, Neuman N. Eating alone or together among community-living older people—a scoping review. *Int J Env Res Public Health*. 2021 Jan;18(7):3495.
54. Graham R, Hodgetts D, Stolte O, Chamberlain K. Hiding in plain sight: experiences of food insecurity and rationing in New Zealand. *Food Cult Soc*. 2018 May 27;21(3):384–401.
55. Erzen E, Çikrikci Ö. The effect of loneliness on depression: a meta-analysis. *Int J Soc Psychiatry*. 2018 Aug 1;64(5):427–435.
56. Chiu DT, Parker JE, Wiley CR, Epel ES, Laraia BA, Leung CW, et al. Food insecurity, poor diet, and metabolic measures: the roles of stress and cortisol. *Appetite*. 2024 Jun 1;197:107294.
57. Herman JP, Nawreen N, Smail MA, Cotella EM. Brain mechanisms of HPA axis regulation: neurocircuitry and feedback in context Richard Kvetnansky lecture. *Stress*. 2020 Nov 1;23(6):617–632.
58. Chaput JP, St-Onge MP. Increased food intake by insufficient sleep in humans: are we jumping the gun on the hormonal explanation? *Front Endocrinol*. 2014. <https://www.frontiersin.org/journals/endocrinology/articles/10.3389/fendo.2014.00116/full>.
59. Fellows E. [Master's Thesis]. University of Toronto (Canada); 2024.
60. Stiawa M, Müller-Stierlin A, Staiger T, Kilian R, Becker T, Gündel H, et al. Mental health professionals view about the impact of male gender for the treatment of men with depression - a qualitative study. *BMC Psychiatry*. 2020 Jun 3;20(1):276.
61. Burris M, Kihlstrom L, Arce KS, Prendergast K, Dobbins J, McGrath E, et al. Food insecurity, loneliness, and social support among older adults. *J Hunger Env Nutr*. 2021 Jan 2;16(1):29–44.
62. Gyasi RM, Asamoah E, Gyasi-Boadu N, Zornu O, Asiki G, Phillips DR. Food insecurity and sleep quality among older adults: findings from a population-based study in Ghana. *Maturitas*. 2022 Mar;157:27–33. <https://doi.org/10.1016/j.maturitas.2021.10.011>.