



Food insecurity and associated health and social determinants among older adults in Ghana: Analysis of the WHO's study on global AGEing and adult health (SAGE), 2014–2015

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ABSTRACT

This study was conducted to assess the prevalence and factors associated with Food Insecurity (FI) and further quantify its association with unmet need for health services and health-related outcomes among older adults aged 50 years and above in Ghana. The Ghana Study on Global AGEing and Adult Health was used. Body Mass Index (BMI), depressive episodes, functional difficulties (FD), low Quality of Life (QoL), memory decline, and Unmet Needs of Health Services (UNHS) are the study outcomes. Ordinary Least Square, and Poisson regression analysis modified with Mahalanobis distance matching within propensity score caliper weights were employed. Stata 16.1 was used to perform analysis and a p-value < 0.05 was deemed significant. The prevalence of FI among older adults aged 50 years or older in Ghana was approximately 28 % (95 %CI = 24.5–31.7) and was strongly associated with lower educational attainment and social support. The prevalence ratio of depression, FD, low QoL and UNHS among older adults who experienced FI were; 3.43 (95 %CI = 2.25–5.21), 1.18 (95 %CI = 1.12–1.23), 2.01 (95 %CI = 1.54–2.62), and 1.46 (95 %CI = 1.01–2.11). Memory significantly decreased by 85 percentage points% among food insecure older adults [$a\beta$ (95 %CI) = $-0.85(-1.62--0.07)$]. Older adults with relatively higher educational attainment and social support are less likely to suffer FI and associated limited health and poor social well-being. In the national quest to achieve SDG 2, these health and social determinants of FI among older adults should be considered in the implementation of the national ageing policy to improve the health and well-being of older adults in Ghana.

1. Introduction

Food security is an important national health problem and an under-recognized social determinant of health which places a substantial burden on society through health care and social costs (Murthy, 2016). The United Nations indicates that 17.2 % of the world's population (about 1.3 billion) lacks regular access to nutritious and sufficient food (United Nations, 2019). In some developed countries the prevalence of household food insecurity is relatively high, ranging from 8 to 20 % of

the population (Pollard & Booth, 2019). The situation is very dire in Sub-Saharan Africa where the prevalence of moderate to severe food insecurity was 66.2 % in 2020 (Food and Agriculture Organization of the United Nations, et al., 2021). It is one of the top five challenges facing older adults in Sub-Saharan Africa, a region making gradual strides to improve access to healthcare and healthcare system responsiveness (Stewart Williams et al., 2020; Yamson et al., 2021). In Ghana, about 5 % of the population is food insecure and about 2 million are vulnerable to becoming food insecure (Darfour & Rosentrater, 2016). These

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significant differences in prevalence rates could be explained in the context of the methods and approaches used to estimate food insecurity. Again, the geographical location and population involved could also serve as a probable explanation.

Food insecurity has been associated with detrimental health outcomes across the lifespan. Increased risks of health conditions such as hypertension, heart disease, obesity, anaemia, as well as frailty due to lower nutrient intakes and psychological challenges including cognitive problems, aggression, depression, anxiety and functional difficulties have been associated with food insecurity (Drennen et al., 2019; Kursmark & Weitzman, 2009; Rose-Jacobs et al., 2008; Seligman et al., 2010). A more recent study reported that food insecurity was associated with higher odds of physical multimorbidity among older adults aged 50 years and above from six low-and middle-income countries, including Ghana (Smith et al., 2023). Although previous works have established factors associated with food insecurity, the health implications of not having access to sufficient, safe or nutritious food have not been extensively covered in the context of older adults in Ghana. As the world's population ages, it is anticipated that older adults will account for a sizeable share of the regional population by 2050 and Sub-Saharan Africa is expected to make the biggest gains with regard to life expectancy (Adamek et al., 2022; Stewart Williams et al., 2020). This study assesses the prevalence of food insecurity and its association with health outcomes amongst older adults in Ghana.

2. Methods

2.1. Study design

A nationally stratified cross-sectional study design with a multi-stage cluster sampling technique was used.

2.2. Study participants

Study On Global Ageing and Adult Health (SAGE) wave 2 involved older adults aged 50 years and above, and a smaller comparative sample of persons aged 18–49 years. SAGE wave 2 used the same study samples who were involved in wave 1. The Ghana SAGE wave 1 detailed methodological procedure has been published elsewhere (Biritwum et al., 2013) while the WHO SAGE study in general has been published by Chatterji et al (Chatterji, 2013).

In SAGE wave 2, a total sample of 4735 respondents were involved, however, the current study considered participants aged 50 years or more, accounting for 3575.

2.3. Exposure variable

Food Insecurity (FI) was the main exposure variable considered in this study which was defined by SAGE using the following two questions; "In the last 12 months, how often did you ever eat less than you felt you should because there wasn't enough food?" and "In the last 12 months, were you ever hungry, but didn't eat because you couldn't afford enough food?" The above two questions were coded as; every month (1); almost every month (2); some months, but not every month (3); only in 1 or 2 months (4); and never (5). Those who answered 1–3 to both questions or 1 to either item were classified as extremely food insecure in prior SAGE studies (Koyanagi et al., 2019; Schrock et al., 2017; Smith et al., 2021). Those who did not meet the criteria for severe food insecurity but answered 2 through 4 for either question were coded as moderately food insecure and those who answered 5 to both items were categorized as food secure.

2.4. Dependent variable

The study considered six main outcomes as follow: Body Mass Index (BMI), depressive episode, functional difficulty (FD), Quality of Life

(QoL), memory decline, and Unmet Needs of Health Service (UNHS) among older adults in Ghana.

2.5. Depressive episode

Using the WHO International Classification of Diseases-10 categorization of mental and behavioural disorders for a severe depressive episode, the diagnostic approach for depressive disorder over the previous 12 months has been established (ICD code F32) (WHO, 2019). Based on the World Mental Health Survey version of the Composite International Diagnostic Interview depression score was generated (Virgili et al., 2013). If the participant answered "yes" in one of the following: during the last 12 months i) had a period lasting several days when feeling sad, empty or depressed; ii) had a period lasting several days when lost interest in most things usually enjoyed such as personal relationships, work or hobbies/recreation; iii) had a period lasting several days when feeling energy decreased or tired all the time. If any of these is "yes", SAGE wave 2 further used 15 standard questions to assess depression among those participants. Arokiasamy et al. proposed two algorithms for depressive episodes after generating the scores. To begin, two categories of independent variables were created from the depression index score, Category 1 and 2, respectively.

Depressive distress with symptoms, present virtually every day, most of the day; exhaustion or loss of energy; and loss of interest or pleasure in activities, including decreased sexual engagement, were the three domains in Category 1. Category 2 contained 7 domains with 12 items of depressive symptoms secondary to depressive distress; negative thought (frequently feeling hopeless, low self-esteem or lost confidence); cognitive difficulties (difficulties in concentration or slowdown in thinking); feeling anxious and worried most days; physical difficulty (slowing down in moving around or couldn't sit); sleep difficulty (problems falling asleep or problems waking up too early); loss of appetite; and suicidal ideas or attempts (tried to end life or wish dead).

Each item was scored as 1 "Yes" or 0 "No," and depressive illness was defined throughout 12 months if the score was 2-plus or 4-plus for categories 1 and 2, respectively (Arokiasamy et al., 2015).

2.6. Functional difficulties

SAGE Wave 2 asked participants, "In the last 30 days, how much difficulty did you have in ...; standing for a long period, household responsibilities, joining community activities, concentrating on doing something, walking for a long distance, washing the whole body, getting dressed, day to day work, carrying things, eating, getting up from lying, getting to and using the toilet, with control of your bowel or bladder functions, getting where you want to go, going out of home and emotional effect by health condition. The responses were coded None = 1, Mild = 2, Moderate = 3, Severe = 4, and Extreme/cannot do = 5. The responses were further re-coded by classifying none = 0 and mild-extreme/cannot do = 1. A composite variable was generated ranging from 0 to 16 where the scores were further re-grouped as 0 = None and 1–16 = Yes.

2.7. Quality of life

QoL was assessed by subjective measurements where participants were asked; *How would you rate your overall quality of life?* The question was coded as; 1 = Very Good, 2 = Good, 3 = Moderate, 4 = Bad, 5 = Very Bad, and 8 = don't know. The variable was reclassified as; 0 = good QoL (very good and good), and 1 = low QoL (moderate, bad, and very bad) while don't know was replaced as missing (1.5 %).

2.8. Cognitive impairment

Composite semantic and episodic memory impairments (verbal and delayed recall) were considered using neuropsychological assessment

processes. For semantic memory assessment, participants were assessed by adopting the verbal fluency method. The process assessed how participants were able to recall a series of animals within one minute. If respondents stopped before the minute was finished, they were urged to continue listing animals. In addition, if there was a 15-second period of silence, participants were urged to continue or repeat the fundamental instructions. Overall, participants named as many animals as they could within acceptable instructions. For verbal recall. Participants were instructed to repeat a set of words that included: Arm, Bed, Plane, Dog, Clock, Bike, Ear, Hammer, Chair, and Cat for verbal recall. The participants' three efforts were evaluated, and the right recall terms were recorded.

In all three attempts, a total score was generated by summing all correct responses (maximum of 30 correct answers). For delayed recall, participants were asked to recollect the 10 initial words (Arm, Bed, Plane, Dog, Clock, Bike, Ear, Hammer, Chair, and Cat) over the previous 10 min, and the right words were recorded (maximum correct score of 10). Episodic memory was scored by adding verbal and delayed recall to have a maximum correct score of 40 points. An overall memory decline was assessed by adding SM and EM scores where a low score indicates memory decline.

2.9. Unmet needs of health service

A subjective unmet need for healthcare services (UNHS) was assessed when participants were asked "The last time you needed health care; did you get health care?" The responses were "Yes" and "No" where No indicates UNHS. Participants needed care for; pain in joints, generalized pain, communicable, acute conditions, high blood pressure, injuries, maternal concerns, diabetes, stroke, surgery, sleep, occupational, nutritional health. The main cause of UNHS was affordability and transportation.

Body Mass Index

Using the formula; BMI = $\frac{\text{Weight (kg)}}{[\text{Height(m)}]^2}$. The raw scores were used (Biritwum et al., 2005).

Independent variables

Covariate variables considered in this study were; sex differential, age group (50–59, 60–69, 70–79, 80+), educational level (none, primary, Senior High School, tertiary), marital status (never married, married, separated/divorced, widowed), religion (none, Christian, Islam, Primal indigenous), place of residence (urban versus rural), currently working (no, yes), regional disparity (the then 10 administrative regions in Ghana), currently smoking (no, yes), alcohol use (no, yes), Waist Hip Ratio (low, moderate, high).

2.10. Data analysis

Bivariate descriptive statistics with a Rao-Scott chi-square test of an independent association and multivariate data analysis were carried out. Due to the complex nature of the SAGE data, the Rao-Scott χ^2 was employed to account for the SAGE design by correcting the usual Pearson chi-squared statistic. Factors associated with FI were assessed by employing four statistical models independently; Poisson, Logistic, Probit, and Ordered Logistic regression models. The Poisson regression was the main model the authors adopted. The other three statistical models were sensitivity analysis.

Associated factors were used for matching purposes to eliminate bias in the estimate. Rubin and colleagues have established that bias estimations are reduced by matching the linear propensity score (Rubin & Thomas, 2000). In this study, the 1:1 Mahalanobis distance matching within the propensity score calliper was adopted to obtain a credible counterfactual estimate of the study outcome. Variables including, region, religion, marital status and educational level were selected as the matching variables because they were associated with FI. The

association between FI and; BMI, depression, FD, and low QoL was quantified after pre-processing the data with Mahalanobis weights. The study employed robust Ordinary Least Square regression, and Poisson regression analysis separately. Ordinary Least Square was applied to BMI and memory decline outcomes due to the variable nature (continuous and discrete respectively) and were normally distributed. Poisson regression was applied to binary outcomes to assess the prevalence ratio rather odd ratio. In all the models, a specification link test for errors was performed with hatsq showing p-values > 0.05. All analysis was performed using Stata 16.1 and p-value < 0.050 was deemed significant.

3. Results

The prevalence of food insecurity (FI) among older adults aged 50 years or older in Ghana was approximately 28 % (95 %CI = 24.5–31.7) and was relatively higher among the lower older adults (those aged 50–59 years) which accounted for 36 %. Bivariate analysis from the Rao-Scott chi test of independence showed that educational level, marital status, religion, place of residence, and region of residence were significantly associated with FI status (p-value < 0.05) (Table 1).

Inferential analyses showed that factors such as lower educational level, never-married older adults, participants who had no religious affiliation, and regional disparity were strongly associated with FI (Appendix Table 1).

In testing for common support assumptions to improve the precision of estimates, the analysis clearly showed an overlap of the propensity scores matching of food insecurity among participants and those without. This means the common support assumptions were achieved as presented in Fig. 1.

Adopting 1:1 Mahalanobis distance matching within propensity caliper as presented in Fig. 2 showed a significant reduction in the standardized bias estimate of significant factors associated with FI to 0 % after matching (Fig. 2).

Association between Food insecurity and Body Mass Index, depression, functional difficulty, low quality and memory disorder among older adults in Ghana.

Analysis of all the indicators showed strong evidence that food insecure older adults had lower BMI and memory (23.9 kg/m² and 24.3 respectively), a higher proportion of depression, functional difficulty, and low QoL (9.4 %, 84.4 %, and 10.5 % respectively (Table 2).

The association between FI and health outcomes controlling for Mahalanobis distance matching within the propensity calliper is presented in Table 3. Analysis found evidence of strong association between FI and depression, FD, low QoL, and cognitive impairment. The prevalence ratio of depression, FD, low QoL, and unmet needs of health service among older adults who experience FI were; 3.43(95 %CI = 2.25–5.21), 1.18(95 %CI = 1.12–1.23), 2.01(95 %CI = 1.54–2.62), and 1.46(95 %CI = 1.01–2.11). These were all statistically significant. Furthermore, memory disorder significantly decreased by 85 % among food insecure older adults compared with their food secure counterparts [$a\beta$ (95 %CI) = -0.85(-1.62- -0.07)] (Table 3).

4. Discussion

This study sought to assess the prevalence and factors associated with food insecurity (FI) among older adults in Ghana and further quantify its association with health-related outcomes and unmet needs for health services. FI was found to be prevalent among one-third of the older adult population with evidence of association with lower level of education, never married, religious affiliation and regional disparity. Similarly, health and social factors such as depressive episodes, FD, cognitive impairment, low QoL as well as unmet health needs were significantly associated with FI. Experience of food insecurity (FI) is very stressful among older adults and may result in feelings of powerlessness and estrangement, as well as possible shame (Polsky & Gilmour, 2020). The prevalence of FI recorded among older adults in this study is

Table 1
Prevalence of food insecurity by socio-demographic characteristics among older adults in Ghana, Study on Global Ageing and Adult Health Wave 2 from 2014 to 2015.

Variable	Total	Food insecurity		Rao-Scott Test
	Weighted %	Weighted % No	Weighted % Yes	
Overall		72.0 (68.3–75.5)	28.0 (24.5–31.7)	0.73
Sex				
Male	46.5	34	12.5	
Female	53.5	38	15.5	
Age group				0.94
50–59	49.4	36.2	13.2	
60–69	26.8	19.1	7.7	
70–79	15.5	11.1	4.4	
80+	8.3	5.6	2.7	
Educational level				11.94***
None	42.2	26.9	15.3	
Primary	28.1	20.8	7.3	
Senior High School	25.8	20.7	5.1	
Tertiary	3.9	3.6	0.3	
Marital status				2.85*
Never married	3.5	2	1.5	
Married	61.8	44.9	16.9	
Separated/ Divorced	11.5	8.4	3.1	
Widowed	23.2	16.8	6.5	
Religion				8.96***
None	3.5	1.5	2	
Christian	72.8	55.1	17.7	
Islam	18.5	12.8	5.7	
Primal indigenous	5.3	2.7	2.6	
Place of residence				9.95***
Urban	48.5	37.9	10.7	
Rural	51.5	34.2	17.3	
Currently working				0.95
No	32.3	22.7	9.6	
Yes	67.7	49.3	18.4	
Region				12.76***
Ashanti	18	15.2	2.8	
Brong Ahafo	8.9	7.3	1.6	
Central	9.2	7.7	1.5	
Eastern	12.8	6.5	6.3	
Greater Accra Accra	14.5	12.2	2.2	
Northern	8.4	6.8	1.7	
Upper East	5	1.7	3.3	
Upper West	3.2	0.6	2.6	
Volta	10.7	6.7	4	
Western	9.2	7.2	2	
Currently smoking				1.53
No	95.2	69	26.3	
Yes	4.8	3.1	1.7	
Alcohol use				1.24
No	77.2	56.2	21	
Yes	22.8	15.9	6.9	
Waist-Hip-Ratio				0.54
Low	23.8	17	6.9	
Moderate	30.3	21.5	8.8	
High	40.4	29.8	10.7	
Missing	5.4	3.8	1.6	

NOTE: All percentages were weighted cell percentages. WHR = Waist-Hip-Ratio. P-value Notation: *p-value < 0.05, and p-value***<0.001.

worrisome. By 2050, this population is projected to account for 14.1 percent of the total population (Mba, 2010). This prevalence rate is over two times compared with a similar study conducted in low-middle-income countries which found a pooled FI prevalence of 11.7 % among older adults (Smith et al., 2021). Even though this current prevalence of FI is relatively high, it is lower compared with a similar study conducted in South Africa. The study found approximately 32 % FI among older adults aged 50 years and older (Koyanagi et al., 2019). Both scholars used similar datasets, however, the Wave 1 dataset was used in these analyses.

4.1. Food insecurity associated with health and social wellbeing of older adults in Ghana

Based on a diverse range of data sets and empirical approaches, a compelling picture of FI is linked to unfavourable health outcomes among older adults by many scholars (Gkiouras et al., 2020; Jackson et al., 2019; Koyanagi et al., 2019; Leung et al., 2020; Petersen et al., 2019; Polsky & Gilmour, 2020; Silverman et al., 2015; Smith et al., 2021). In all these previous studies, older adults who experienced food insecurity had worse health and social outcomes.

Depression as a mental disorder has been found to have a bidirectional impact. In this current study, the prevalence of depressive episodes among food insecure participants was approximately over 3-fold compared with food secure participants. Food availability, affordability, and culturally accepted methods of obtaining food have been linked to mental health illnesses as a multidimensional notion (Kolovos et al., 2020). In these circumstances, if an individual is not able to provide sufficient food for him/herself and/or family, the occurrence of mental disorders like stress, anxiety, and depression are inevitable; this might explain the significant impact of food insecurity on depression as demonstrated in our analysis.

The prevalence of functional limitations among older adults who experience food insecurity was approximately 20 % and was significantly higher relative to food secure older adults. This conforms with previous studies which established that FI was associated with an increased risk of mobility limitations (Bishop & Wang, 2018). This finding could be a bidirectional effect, in that, individuals with FI are likely to have a chronic disease or poor health status, which could translate into difficulties in daily activities.

In addition, food insecurity was associated with quality of life (QoL) of older adults. The prevalence of poor QoL among older adults who experience FI was over 2-fold compared with their food secure counterparts. The reduction of QoL has been associated with certain population groups and persons with chronic diseases e.g. among pregnant women (Moafi et al., 2018) and patients with cancer (Gany et al., 2015). Quality of life as a dimension of good health is an economic situation where an individual is exposed to social and institutional support, and quality of the natural environment (Diener & Tay, 2015), and these indicators directly and positively associated FI (Coleman-Jensen et al., 2014).

It has been observed that FI is linked to cognitive impairment across all age groups (Tan et al., 2020). This is in agreement with our analysis, that older adults with food insecurity had significant memory decline (estimated 85 % decline). Cognitive impairment occurs naturally with ageing however FI has been considered as one of the predisposing factors (Na et al., 2020). In the United States, Tan and colleagues also found that FI was associated with low cognitive function among persons living with Human Immunodeficiency Syndrome (Tan et al., 2020).

Healthcare service demands that are met are extremely important, especially for adults who live with other health issues (Yamson et al., 2021). We found that food insecure older adults were approximately 50 % likely to experience the unmet need for health service mainly because they could not afford it. Thus, the underlying factor that promotes FI directly influences the ability to access and afford the cost of medication for treatment. This observation conforms to findings of a significant

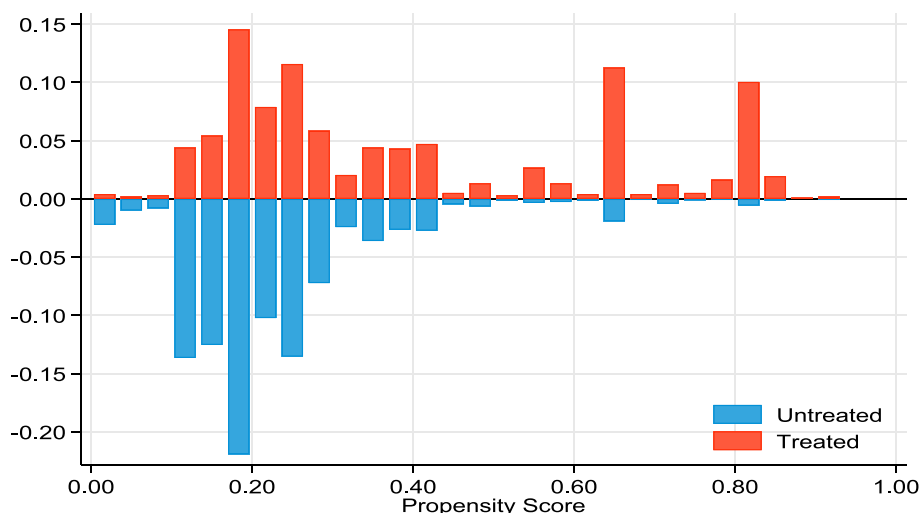


Fig. 1. Propensity score matching assessing common support assumption for food insecurity. Evidence from the Study on Global Ageing and Adult Health Wave 2 from 2014 to 2015.

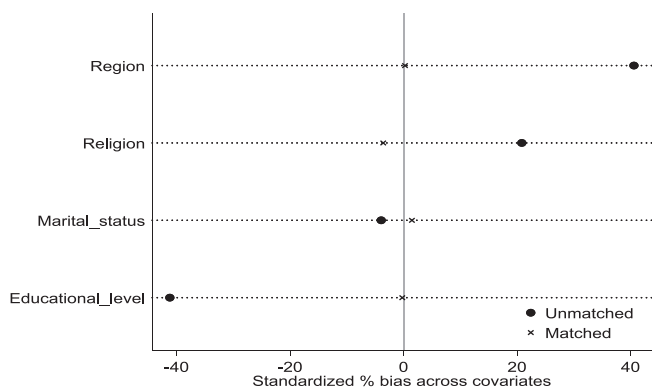


Fig. 2. Mahalanobis distance matching within propensity caliper (1:1) showing standardize percentage bias across significant covariates associated with food insecurity. Evidence from the Study on Global Ageing and Adult Health Wave 2 from 2014 to 2015.

association between low food security and unmet needs for dental care (Wiener et al., 2018).

4.2. Strengths and limitations

Using a nationally representative sample of older adults in Ghana is a strength of this study. The SAGE study as a cross-sectional design does not allow for causal inferences between food insecurity and the study outcomes. To address this limitation, the study adopted a sensitivity analysis approach by employing a matching procedure that addresses

unbiased estimation of the effect of FI on the study outcomes, hence the causal path analysis depicts a clear counterfactual effect. Food insecurity is closely related to poverty and civil war as established. The current analysis did not include the Household data. Gundersen and colleagues suggested that, even though poverty is closely related to FI, it is not limited to individuals or household with poor wealth index; it can also affect persons living above the poverty level (Gundersen et al., 2011). Additionally, using FI tools like the US Household Food Security Survey Module, National Health and Nutrition Examination Survey Food Security module (Petersen et al., 2019), or Household Food Insecurity Access Scale for Measurement of Food Access (Coleman-Jensen et al., 2014) and amongst others could have been the more subjective measurement of FI and could have improved the results. Self-report measures as used in this study are also vulnerable to recall bias which may affect the findings. However, the method adopted to estimate FI in this study has been adopted by other scholars using a similar study with the same study design (Koyanagi et al., 2019; Smith et al., 2021). In addition, other confounding variables mediating between FI and the study outcomes including chronic health conditions were not assessed in this study.

5. Conclusion

Older adults with relatively higher educational attainment and social support are less likely to suffer food insecurity and associated limited health and social well-being. Food insecurity was associated with depression, functional difficulty, Low QoL, cognitive impairment and unmet needs for health services. In the national quest to achieve SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), these health and social determinants of food

Table 2

Mean and percentage distribution of Body Mass Index, depression, functional difficulty, low quality, memory decline, and unmet needs for health services by the status of food insecurity among older adults in Ghana, Study on Global Ageing and Adult Health Wave 2 from 2014 to 2015.

Food insecurity	Health outcome indicators					Unmet needs
	BMI	Depression	FD	Low QoL	Memory	
	μ[95 %CI]	%[95 %CI]	%[95 %CI]	%[95 %CI]	μ[95 %CI]	
No	25.9[25.1–26.9]	4.7[3.8–5.7]	60.0[55.8–63.9]	6.6[5.6–7.9]	25.3[24.7–25.8]	4.4[3.3–5.8]
Yes	23.9[21.4–28.5]	9.4[6.9–12.6]	84.4[80.0–88.0]	10.5[8.2–13.4]	24.3[23.6–24.9]	6.6[4.4–9.9]
P-value	4.99*	10.09***	41.84***	5.56**	5.66**	4.08*

NOTE: Abbreviations; BMI = Body Mass Index, FD = Functional Difficulty, QoL = Quality of Life. P-value Notation. *p-value < 0.05, ** p-value < 0.01 and *** p-value < 0.001.

The analysis controlled for study sampling weights, primary sampling unit and stratification

Table 3

Association between food insecurity and body mass index, depression, functional difficulty, low quality of life, memory assessment and unmet need for healthcare services among older adults in Ghana, Study on Global Ageing and Adult Health Wave 2 from 2014 to 2015.

Variable	BMI	Depression	FD	Low QoL	Memory	Unmet needs
	OLS	Poisson	Poisson	Poisson	OLS	Poisson
	aβ[95 %CI]	aPR[95 %CI]	aPR[95 %CI]	aPR[95 %CI]	aβ[95 %CI]	aPR[95 %CI]
Food insecurity						
No	ref	Ref	ref	Ref	ref	ref
Yes	-0.50[-4.33-3.32]	3.43[2.25-5.21]***	1.18[1.12-1.23]***	2.01[1.54-2.62]***	-0.85[-1.62-0.07]*	1.46[1.01-2.11]*
Sex						
Female						
Male	-0.68[-4.14-2.77]	0.36[0.22-0.57]***	1.03[0.97-1.09]	2.08[1.52-2.84]***	2.69[1.86-3.53]***	0.23[0.13-0.39]***
Age						
80+	ref	Ref	ref	Ref	ref	ref
50-59	4.66[2.35-6.97]***	0.29[0.17-0.48]***	0.83[0.77-0.89]***	0.33[0.21-0.51]***	6.40[5.30-7.49]***	1.07[0.44-2.58]
60-69	3.51[1.92-5.09]***	0.33[0.19-0.58]***	0.85[0.79-0.91]***	0.53[0.36-0.78]***	5.33[4.33-6.33]***	2.80[1.19-6.58]*
70-79	3.66[0.81-6.51]*	0.58[0.34-0.97]*	0.96[0.89-1.02]	0.89[0.65-1.24]	2.96[1.98-3.93]***	2.73[1.16-6.41]*
Place of residence						
Urban	ref	Ref	ref	Ref	ref	ref
Rural	-1.88[-4.28-0.52]	1.18[0.77-1.82]	0.99[0.94-1.05]	1.16[0.86-1.57]	-0.78[-1.60-0.04]	0.43[0.30-0.63]***
Currently working						
Yes	ref	Ref	ref	Ref	ref	ref
No	0.94[-0.70-2.57]	2.00[1.31-3.06]***	1.08[1.03-1.14]**	1.89[1.40-2.55]***	-0.09[-0.86-0.67]	0.59[0.36-0.94]*
Currently smoking						
No	ref	Ref	ref	Ref	ref	ref
Yes	-1.98[-6.45-2.48]	1.32[0.57-3.04]	0.92[0.82-1.03]	1.63[1.02-2.59]***	0.88[-1.57-3.34]	1.70[0.87-3.30]
Alcohol use						
No	ref	Ref	ref	Ref	ref	ref
Yes	-0.04[-3.77-3.68]	1.41[0.85-2.35]	1.06[0.99-1.12]	0.91[0.65-1.27]	0.17[-0.78-1.13]	2.53[1.61-3.99]***
WHR						
High	ref	Ref	ref	Ref	ref	ref
Low	-0.86[-3.62-1.91]	1.79[1.12-2.87]*	0.89[0.82-0.96]**	0.47[0.31-0.69]***	1.16[0.15-2.18]*	2.56[1.46-4.49]***
Moderate	-2.40[-4.39-0.41]*	1.16[0.71-1.88]	0.93[0.87-0.98]**	0.44[0.32-0.62]***	0.02[-0.89-0.94]	1.71[1.06-2.78]*

NOTE: Abbreviation; BMI = Body Mass Index, FD = Functional difficulty, QoL = Quality of Life, aPR = adjusted Prevalence Ratio from Poisson regression, aβ = adjusted coefficient estimates from Ordinary Least Square regression, WHR = Waist-Hip-Ratio. ref denotes the reference category used for inferences. P-value Notation: *p-value < 0.05, ** p-value < 0.01 and *** p-value < 0.001.

The analysis controlled for Mahalanobis distance matching within propensity calliper (1:1 matching on covariates).

insecurity among older adults should be considered in the implementation of the national ageing policy to improve the health and wellbeing of older adults in Ghana.

Author contributions

JT and AEY conceptualized the study and sought approval for access to the SAGE wave 2 data. JT and AEY undertook the statistical analysis. GE-F, JT and AEY drafted the initial manuscript. KM, AOY, EO SMS, and MYN read and provided intellectual content revisions and suggestions for clarity and precision. All authors read and approved the final review manuscript.

CRedit authorship contribution statement

John Tetteh: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **George Ekem-Ferguson:** Writing – review & editing, Writing – original draft, Methodology. **Keziah Malm:** Writing – review & editing, Writing – original draft. **Ohenewa Anita Yawson:** Writing – review & editing, Writing – original draft. **Elom Otchi:** Writing – review & editing, Writing – original draft. **Swithin M. Swaray:** Writing – review & editing, Writing – original draft, Methodology. **Michael Yao Ntumu:** Writing – review & editing, Writing – original draft, Methodology. **Alfred Edwin Yawson:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization.

Appendix

Table 1: Regression analysis showing factors associated with food insecurity among older adults in Ghana, Study on Global Ageing and Adult

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Ethical requirements

SAGE wave 2 study was approved by World Health Organization’s Ethical Review Board with reference number RPC149 and also, the Ethical and Protocol Review Committee, College of Health Sciences, University of Ghana, Accra, Ghana. Written informed consent was obtained from all study participants. Informed consent was obtained from all participants involved.

Health Wave 2 from 2014 to 2015.

Variable	Main model	Sensitivity analysis		
	Poisson	Logistic	Probit	Ordered Logistic
	aPR[95 %CI]	aOR[95 %CI]	aβ[95 %CI]	aOR[95 %CI]
Sex				
Female	Ref	ref	ref	Ref
Male	1.03[0.85–1.25]	1.05[0.76–1.46]	0.03[–0.16–0.21]	1.03[0.75–1.43]
Age				
80+	Ref	ref	ref	Ref
50–59	1.08[0.88–1.33]	1.17[0.81–1.70]	0.09[–0.12–0.31]	1.23[0.85–1.78]
60–69	1.13[0.91–1.41]	1.25[0.84–1.86]	0.14[–0.09–0.36]	1.30[0.88–1.93]
70–79	1.03[0.87–1.24]	1.07[0.78–1.47]	0.04[–0.14–0.22]	1.11[0.82–1.50]
Education				
Tertiary	Ref	ref	ref	Ref
None	4.58[1.72–12.19]***	7.73[2.33–25.62]***	1.09[0.51–1.67]***	8.28[2.66–25.72]***
Primary	3.64[1.37–1.41]**	5.21[1.62–16.82]**	0.86[0.30–1.41]***	5.46[1.80–16.56]***
Senior High School	2.88[1.13–7.30]*	3.69[1.21–11.23]*	0.66[0.14–1.18]**	3.86[1.36–10.94]**
Marital Status				
Married	Ref	ref	ref	Ref
Never married	1.33[1.01–1.75]*	1.73[1.02–2.93]*	0.32[0.00–0.64]*	1.64[1.00–2.68]*
Separated/divorced	1.18[0.94–1.47]	1.31[0.92–1.85]	0.15[–0.04–0.35]	1.32[0.93–1.87]
Widowed	1.00[0.84–1.19]	1.00[0.74–1.34]	0.01[–0.16–0.18]	0.93[0.70–1.24]
Religion				
Christian				
None	1.66[1.26–2.19]***	2.92[1.59–5.37]***	0.63[0.26–1.01]***	3.34[1.80–6.31]***
Islam	1.13[0.82–1.56]	1.22[0.69–2.17]	0.12[–0.19–0.43]	1.13[0.67]
Primary indigenous	0.99[0.73–1.33]	0.95[0.49–1.82]	–0.02[–0.38–0.34]	0.77[0.42–1.42]
Place of residence				
Urban	Ref	ref	ref	Ref
Rural	1.03[0.79–1.35]	1.06[0.69–1.63]	0.04[–0.20–0.28]	1.03[0.65–1.63]
Currently working				
Yes	Ref	ref	ref	Ref
No	1.01[0.85–1.20]	1.01[0.75–1.37]	0.01[–0.16–0.18]	1.02[0.76–1.38]
Region				
Ashanti	Ref	ref	ref	Ref
Brong Ahafo	1.12[0.58–2.16]	1.14[0.51–2.54]	0.08[–0.36–0.53]	1.04[0.49–2.18]
Central	1.00[0.62–1.62]	0.98[0.54–1.77]	–0.01[–0.34–0.32]	0.94[0.52–1.69]
Eastern	3.06[1.95–4.81]***	5.29[2.35–11.91]***	0.99[0.49–1.48]***	6.36[2.60–15.56]***
Greater Accra Accra	1.11[0.64–1.94]	1.17[0.59–2.32]	0.09[–0.28–0.45]	1.11[0.55–2.23]
Northern	1.04[0.58–1.88]	0.96[0.43–2.14]	–0.03[–0.47–0.42]	1.00[0.46–2.18]
Upper East	3.53[2.47–5.05]***	8.23[4.37–15.48]***	1.27[0.89–1.65]***	11.75[5.91–23.34]***
Upper West	4.55[3.25–6.39]***	21.70[9.31–50.59]***	1.84[1.36–2.32]***	9.17[5.45–15.43]***
Volta	2.28[1.49–3.49]***	3.05[1.60–5.79]***	0.66[0.28–1.04]***	3.07[1.56–6.03]***
Western	1.41[0.98–2.01]	1.52[0.96–2.40]	0.24[–0.01–0.50]	1.44[0.92–2.27]
Currently smoking				
No	Ref	ref	ref	Ref
Yes	1.05[0.79–1.39]	1.18[0.70–2.00]	0.09[–0.21–0.40]	1.14[0.68–1.89]
Alcohol use				
No	Ref	ref	ref	Ref
Yes	1.09[0.90–1.32]	1.17[0.84–1.61]	0.10[–0.08–0.28]	1.15[0.83–1.61]
Waist-Hip-Ratio				
High	Ref	ref	ref	Ref
Low	1.05[0.84–1.31]	1.08[0.74–1.57]	0.05[–0.16–0.27]	1.05[0.72–1.53]
Moderate	1.06[0.89–1.25]	1.10[0.83–1.45]	0.05[–0.11–0.22]	1.05[0.81–1.37]

NOTE: Abbreviation; aPR = adjusted Prevalence Ratio from Poisson regression, aOR = adjusted Odd Ratio from Logistic and Ordered Logistic regression, aβ = adjusted coefficient estimates from Ordinary Least Square regression. ref denotes the reference category used for inferences. P-value Notation: *p-value < 0.05, ** p-value < 0.01 and *** p-value < 0.001.

The analysis controlled for study sampling weights, primary sampling unit and stratification.

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