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Household food insecurity, sociodemographic and lifestyle risk factors associated with high blood pressure among women in farming communities in Ghana

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Abstract

Background Hypertension remains a primary contributor to avoidable mortality and impairment. This study aimed to examine the association between household food insecurity (HFI), another public health concern, and hypertension among women farmers in peri-urban and rural communities in Ghana.

Methods Self-reported hypertension status, blood pressure measurement, and HFI were assessed using data on 430 women from a cross-sectional survey. We examined the odds of hypertension in women experiencing different categories of food insecurity while controlling for other known factors.

Results Close to 74% ($n = 319$) of respondents belonged to households that were food-secure with 26% ($n = 111$) in food-insecure households. At the time of the survey, about a fifth of the participants (19%) reported to have ever been diagnosed with hypertension and 22% were living with high blood pressure (i.e., systolic: 140 mm Hg or higher and diastolic: 90 mm Hg or higher). Living in a rural community compared to a peri-urban community was associated with lower odds of living with high blood pressure. Older women were more likely than younger women to report having known hypertension and living with high blood pressure. Dangbe women were less likely to have high blood pressure than women from other ethnic groups. An increase in physical/morbidity activity was associated with a decreased likelihood of high blood pressure among food-insecure women.

Conclusions This study buttresses the importance of hypertension awareness among older women, particularly, in urbanizing communities, and the need to explore mediating factors through which ethnicity may influence living with high blood pressure.

Keywords Food insecurity, High blood pressure, Women, Non-communicable disease

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Introduction

A household is food secure when all people in that household at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life [1]. Food insecurity and non-communicable diseases (NCDs) are major developmental issues recognized by governments and policymakers globally, hence their inclusion in the Sustainable Development Goals (SDG) 2 and 3 respectively [2]. Although hunger, obesity, and other chronic diseases may coexist in many countries [3], there is frequently a functional divide when designing interventions to address these two public health concerns. Food insecurity and inadequate access to healthy foods have been linked to increased vulnerability to micronutrient deficiencies [4] and a higher probability of developing chronic diseases [5]. A 2017 report by the United States Agency for International Development (USAID) showed that while food insecurity was significantly associated with all 10 chronic diseases examined, income was associated with only 3 [6]. Given the observed significance of food insecurity on health outcomes, it is acknowledged as a critical target to address programs seeking to improve health-related social needs, reduce hospitalization and the lowering of health costs [7]. Food security is seen as a function of food availability, food access, stability, and biological utilization [8]. It is estimated that between 720 and 811 million people faced hunger in 2020, with sub-Saharan African (SSA) countries bearing the heaviest burden [9].

A parallel nutrition transition accompanies the demographic shift that has fuelled growth in not only urban but peri-urban communities in developing countries. The nutrition transition is characterized by changes in dietary practices such as increased consumption of processed foods and sugars, creating more obesogenic environments within the rural–urban gradient geographical space [10]. For example, results from the 2014 Ghana Demographic and Health Survey showed that the odds of having hypertension between rural and urban women were not significantly different after adjusting for other household and individual socio-demographic characteristics [11].

Alongside, the current interplay of the pandemic (COVID 19), obesity, and diet related NCDs have highlighted the importance of ensuring that everyone has access to inexpensive healthy diets. Though the prevalence of NCDs has been higher in urban centres compared to rural areas, this gap keeps narrowing [12]. Ironically, although small-holder rural women farmers are major contributors to food production in SSA countries like Ghana, they are often bedevilled by complex factors that make them more vulnerable to food insecurity. In Ghana, women contribute about 70% of agricultural production, processing, and marketing [13], however, existing gender inequalities remain strong, making women farmers more at risk of hunger, particularly when crisis strikes [14]. In this study, we ask if household food insecurity is associated with the incidence of hypertension among women in rural farming communities in the Eastern Region of Ghana. We also assessed the role of other household and individual characteristics associated with hypertension. But for few exceptions [11], research on hypertension in Ghana is skewed towards studies conducted predominantly among men or both men and women, and these studies have also not explored the link between household food insecurity and other lifestyle behaviours with hypertension. Improving our understanding of the relationship between food insecurity, lifestyle habits and hypertension is critical to inform strategic preventive intentions and functional and effective policy execution.

Conceptualizing the association between food insecurity and non-communicable diseases

The above research questions under investigation are guided by Fig. 1, a conceptual framework explaining the mechanism/pathways through which household food insecurity may influence the individual's chronic disease status. While food insecurity is often a result of inequalities, particularly resources, it is also closely linked to biological processes in which diseases interact [15]. There are reported cases of food insecurity among women having a positive association with obesity, particularly among minority groups [16, 17]. Hypothesized mechanisms that lead to the association between food insecurity and chronic disease conditions include the fact that food insecure households consuming more unhealthy, inexpensive energy-dense foods and continued exposure to food-insecure conditions may alter the metabolic processes of individuals resulting to a positive energy balance [17, 18].

Lifestyle modifications such as the level of physical activity, dietary patterns, consumption of alcohol and smoking are known influencers of the incidence of high blood pressure [19, 20]. The current dietary recommendations for lowering blood pressure include consuming less salt, more potassium, losing weight, drinking alcohol in moderation, and adopting balanced, "heart-friendly" dietary patterns, including the well-known Dietary Approaches to Stop Hypertension (DASH) diet and improvement in dietary diversity [21]. Food insecurity is negatively correlated with measures of psychological well-being such as stress, and depression, as well as health behaviors like poor medication adherence [22]. These conditions are known to precipitate the onset of chronic conditions or exacerbate existing ones. Food

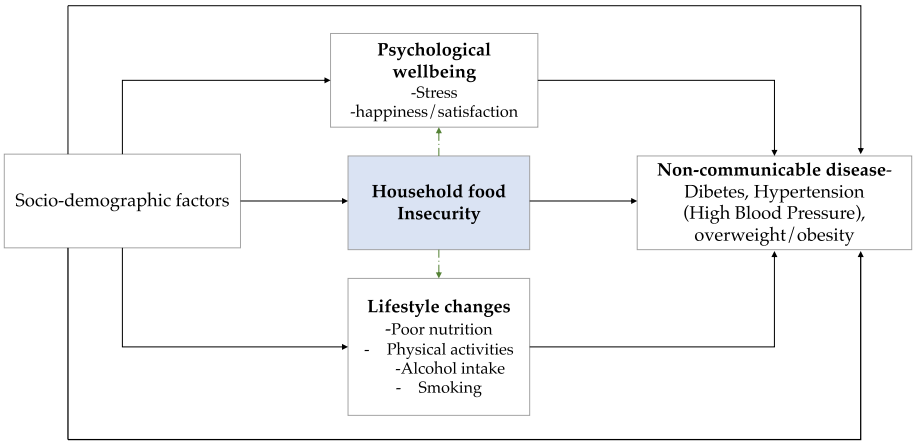

Fig. 1 Conceptual framework linking food insecurity to non-communicable disease

security could affect the lifestyle of individuals and affect socio-demographic and economic outcomes of households which can influence both the incidence and management of chronic conditions [23].

Methods

Study site and design

This was a cross-sectional study conducted in four communities in the Manya Krobo Districts with two being rural communities in the Upper Manya Krobo District (UMKD) and two peri-urban communities in the Lower Manya Krobo District (LMKD) in the Eastern region of Ghana. This study forms part of a larger study aimed at examining the interrelationships between women empowerment, household food insecurity, health, and nutritional status.

Ethical aspects

The Noguchi Memorial Institute for Medical Research Institutional Review Board of the University of Ghana approved the study's protocol (NMIMR: 020/19–20), and consent of each participant was sought before they were interviewed.

Sample size and data collection

Sample size for this study was based on determining the prevalence of hypertension among women in the Eastern region. The following formula was used

$n = \frac{Z^2P(1-P)}{d^2}$: where n = Sample size, Z = Z statistic for a level of confidence: Z = 1.96 for level of confidence of 95%, P = Expected prevalence or proportion: The prevalence of hypertension in an earlier study was 32.0% for women [24]. We assumed a hypertension prevalence rate of 50%. This gives a minimum required sample of 385. Finally, an additional 10% of the sample was added to account for missing data or non-responding respondents. Thus, the final target sample size was 435.

Using a 2-stage sampling procedure, in which 4 primary units (communities) were selected with probability proportional to size, and secondary units (women), women 18 years and above were selected using the random-walk method commonly used in EPI cluster surveys to identify participants. Women who were residing in the selected communities and were not pregnant by self-report were eligible to participate in the study. Interviews were conducted in the local dialect which is krobo and also some conducted in Twi or English if prefered by the respondent. Women with obvious impairment that interfered with anthropometric measurements and health conditions who required immediate hospital visit were exempted from the study.

Measures

Household food insecurity

The primary independent variable was household food insecurity. This was determined by study respondents responding to the experience of household food insecurity episodes within the past 4 weeks/month. The Household Food Insecurity Access Scale (HFIAS*)* of the Food and Agriculture Organization (FAO)-Fanta and Nutrition Technical Assistance (FANTA) were used [25]. This instrument has been validated in the Ghanaian context. The HFIAS consists of 9 items specific to an experience of food insecurity. Respondents indicated whether their household had encountered the items mentioned due to a lack of food or resources to get/buy within the last one month. A score of 1 was given for responding "yes" to questions/items asked and 0 for responding "No". Individuals responding "Yes" were then asked to state the frequency of occurrence within the month. A score of 1 was given for the situation occurring rarely (once or twice in

the past four weeks), 2 for sometimes (three to ten times in the past four weeks), and 3 for often (more than ten times in the past month). A highest possible score of 27 was calculated representing the most food insecure household with a score of 0 representing households that were food secured [26].

The outcome variable of interest was living with hypertension or having elevated high blood pressure at the time of the survey.

High blood pressure

During the one-on-one interviews, respondents were asked if they had a known medical history of having been diagnosed with high blood pressure. Additionally, their blood pressure levels were checked using the average of three(3) repeated measurement with an Omron Automatic Upper Arm Blood Pressure Monitor (HEM- 7155-E) (Omron Healthcare, Kyoto, Japan). Study participants were asked to rest for about 5 min before having their blood pressure measured. Individuals with a systolic blood pressure of ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg were considered living with elevated blood pressure (25).

Body Mass Index (BMI)

For each respondent, the BMI was computed using the weight measurement in kilograms taken with an Omron Body Monitor (BF511) (Omron Healthcare, Kyoto, Japan) and height in meters. "BMI is defined as a person's weight in kilograms divided by the square of height in meters". In accordance with the World Health Organization's criteria for obesity, each woman, based on her recorded (actual) BMI, was classified under either, 'normal weight (BMI < 25)', 'overweight (BMI 25—< 30)' or 'obese (30 and above)' [27].

Dietary diversity

Women's dietary diversity was computed based on 14 food groups recommended by FAO guidelines for measuring household and individual dietary diversity. These food groups are grains, tubers, lentil, nuts, milk, offal, red meat, fish, eggs, dark-green vegetables, vitamin A rich vegetables, vitamin A rich fruits, other vegetables, and other fruits [28] Individual dietary diversity score were then recategorized as Low for scores between 0 to 4, medium for score between 5 and 9 and high for getting scores above 10.

Mobility/physical activity

A mobility score was generated from the number of times one visits urban centres, marketplaces, family, friends, and other community gatherings and how far away from home. An increase in scores means higher mobility. This measure served as a proxy for physical activity.

Socio-demographic characteristics

Socio-demographic variables that we controlled for included the age of the woman, marital status (never married, married, and ever married), level of education (no education, primary, secondary, and higher), religion, ethnicity (of Dangbe origin and Other ethnic groups), occupation, and household size and household wealth. Household wealth index was calculated by employing principal-component analysis to define asset-based survey specific wealth. Assets considered included wall clock, radio, television, phones, refrigerator,Electric generator/invertor(s) Washing machine Computer/tablet computer, Photo camera, Video deck/DVD/VCD, and Sewing machine.

Statistical analysis

Two separate Logit regression models were employed to analyse the effect of household food insecurity on (1) women who reported to have ever been diagnosed high blood pressure and (2) those whose systolic blood pressure of ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg. The generalized form of the model is presented below:

$$Hypertension_{ij} = \alpha + \beta_1 FdSc_j + \sum_i \beta_k X_{ij} + \varepsilon_{ij}$$

where, $hypertension_{ij}$ is the chronic disease status of respondent/women in household i; $FdSc_j$ represents the food insecurity situation for index for woman $i$in household j; X_{ij};, represents vector of characteristics for woman i in household j respectively;ε_{ij} signifies the randomly distributed error term; β_1 represents the coefficients of the regressors and α denotes the constant term or intercept. All analyses were performed using the Stata statistical software package version 18.0 (StataCorp, 2023). Statistical significance was set at the 5 % α - level (P< 0 05).

Results

Background characteristics

The final analytic sample consisted of 430 women. The highest percentage (44.4%) of the women were within the 18–39 age bracket. Approximately a third of the women (33.5%) had no formal education, 44.6% had completed primary school, while a little above a-fifth (21.9%) had secondary or higher education. More than half (56.1%) of the women were single.

The respondent belonged to a household with a mean (mean SD) household size of 4.80 (1.9). About 94.9% of

the women belong to the Ga-dangbe ethnic group. A higher percentage (66.5%) of the women were resident in the Upper Manya Krobo district compared to 35.4% in the Lower Manya Krobo District.

Close to three-quarters (74%, $n = 319$) of respondents belonged to households that were food secure with a little above a quarter (26%, $n = 111$) in food insecure households. At the time of the survey, about a-fifth (19%) reported to have ever been diagnosed with hypertension and a little above a-fifth (22%) were living with high blood pressure (i.e., systolic: 140 mm Hg or higher and diastolic: 90 mm Hg or higher).

Figure 2 shows the food groups that women had consumed during the past 24 h prior to the interview. Fish and tubers were the most consumed food group (92% and 80.9% respectively) while Offal (16.7%) and vitamin A-rich vegetables (16.7%) were consumed by the least proportion of respondents.

Significantly, greater proportions of women belonging to food insecure households consumed eggs, milk, vitamin A rich vegetables, nuts, red meat, vitamin A rich fruits, and offal compared to their counterparts in food secure households (43 vs. 30, 34 vs. 23, 23 vs. 14, 49 vs. 30, 50 vs. 29, 31 vs. 14, and 28 vs. 13 respectively).

The mean dietary diversity score was significantly higher for women from food insecure household compared to those from food secure households (mean ± SD; 6 ± 4 vs. 5 ± 2, $p < 0.001$). There was no significant difference between the mobility/physical activity score of women in food insecure household (28 ± 14) and those in food secure households (28 ± 11). About 27% of the women consumed alcohol. Approximately a higher proportion of women in food insecure households consumed alcohol compared to those in food secure households (41% vs. 22%; $p = < 0.001$).

Household food insecurity and women's hypertension status

Table 1 presents Logit estimates of the relationship between household food insecurity and other covariates with women's hypertension status for individuals who have known history of high blood pressure (HBP) and individuals with measured high blood pressure during survey. Food insecurity was not a predictor of both known history of hypertension and elevated high blood pressure during time of survey. Variables controlled for included household wealth, age of participant, body mass index, educational status, marital status, DASH

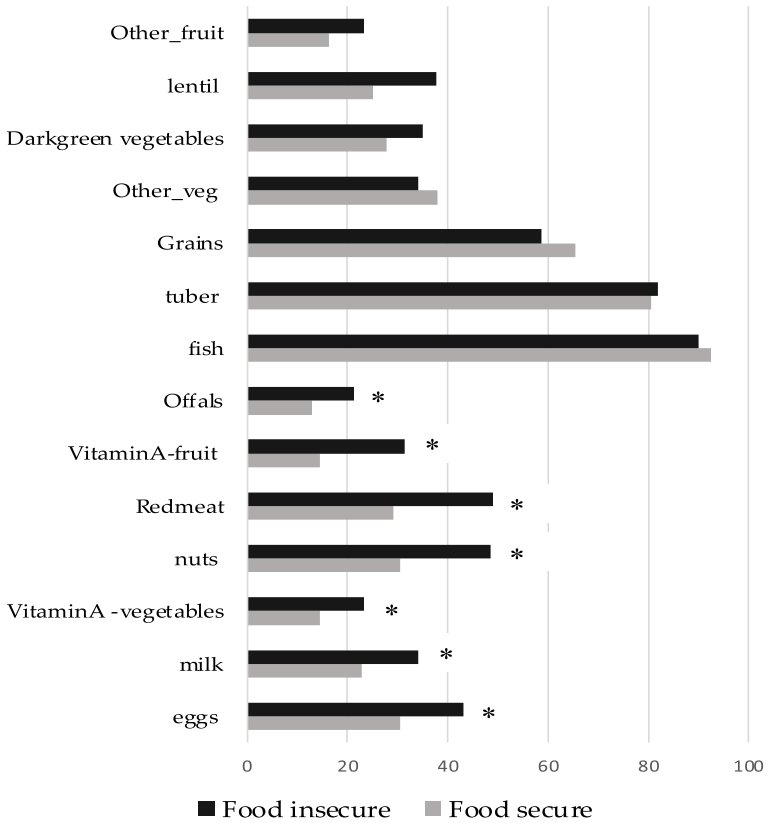

Fig. 2 The percentage of women consuming from food groups by their household food security status

Table 1 Logit models on the association between household food insecurity and High Blood Pressure (HBP) among women in rural farming community in Ghana

Blood Pressure				
Variables	**Known Hypertensive**		**High Blood Pressure[b]**	
	Coeff	**(RSE)**	**Coeff**	**(RSE)**
Household				
Food security (Ref: Food secured)				
Food insecure	− 0.51	(0.35)	− 0.14	(0.34)
Location (Ref: Upper Manya *(peri-urban)*				
Lower Manya (*rural*)	0.12	(0.33)	− 0.86	(0.39)**
Household wealth (ref: low)				
Medium	0.07	(0.36)	− 0.39	(0.39)
High	0.43	(0.85)	− 0.75	(0.49)
Women				
Age in years (ref: 18–39)				
40–49	0.85*	(0.43)	1.63***	(0.41)
50 and above	2.28***	(0.40)	2.30***	(0.37)
Education (ref: None)				
Primary	0.28	(0.40)	0.08	(0.32)
Secondary and above	− 0.02	(0.44)	− 0.08	(0.45)
Marital Status (Ref: Single)				
Married	− 0.19	(0.67)	0.40	(0.31)
Ethnicity (Ref: Other)				
Dangbe	− 0.13	(0.67)	− 1.29**	(0.55)
Dietary diversity score (ref: Low)				
Medium	0.49*	(0.29)	0.08	(0.32)
High	0.41	(0.50)	− 0.47	(0.49)
Mobility score	0.00	(0.01)	− 0.02*	(0.01)
Consumes alcohol (Ref: Yes)				
Does not consumed	− 0.29	(0.34)	0.10	(0.32)
Body Mass Index (Ref: Normal)				
Overweight/Obese	0.19	(0.88)	0.17	(0.28)
Observations	430		364	

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ [b]Normal systolic: less than 140 mm Hg diastolic: less than 89 mm Hg, High Blood Pressure (hypertension) systolic: 140 mm Hg or higher diastolic: 90 mm Hg or higher

dietary recommendation score and the ethnic group of the woman.

Compared to women who are between 18- 39 years, those who were 50 years and above were more likely to be known hypertensives (Coeff, SE: [(2.28, (0.40); $p <$ 0.01). Conversely, compared with women within the age bracket 18- 39 years, women aged 40- 49 and those above 50 years were more likely to be living with high blood pressure ((1.63, (0.41); $p <$ 0.001 and 2.30, (0.37); $p <$ 0.001, respectively). Women living in rural communities in the Lower Manya Krobo district compared with their counterparts (peri-urban communities) in Upper Manya Krobo are less likely to have high blood pressure (− 0.86, (0.39), $p < 0.05$). Compared with their counterparts of the other ethnicity, Dangbe women were less likely to have high blood pressure than having a normal blood pressure (− 1.28 (0.56); $p < 0.05$.).

Discussion

This study sought to examine the relationship between household food insecurity (HFI) and hypertension among women farmers in peri-urban and rural communities in the Eastern region. The prevalence of HFI reported in this study (26%) was higher than the national prevalence (18%) reported for rural households [29]. This result confirms that although rural farming households grow and sell majority of food consumed in the country, they are confronted by significant levels of food insecurity and malnutrition [30]. Close to a-fifth of respondents reported living with hypertension and survey results showed that a little above a-fifth were living with high blood pressure. This is consistent with other studies in rural communities in Ghana that have reported the prevalence of hypertension to be between 19 to 24% [31–34]. The Global plan for the Prevention and Control of NCDs by the WHO recommends a global target of reducing existing prevalence of elevated blood pressure to 25% between 2010 and 2025 and the provision of cost-effective interventions to reduce associated burden of at both population and individual levels [35]. Although the prevalence of high blood pressure (both known and measured) among study respondents is below the targeted level, current prevalence which is just a little below recommended levels call for continuous public health education for lifestyle modifications recommended for the reduction of the burden of hypertension. The observed association of higher alcohol consumption among food insecure households is consistent with other studies [36, 37]. Given that food insecurity could cause anxiety and stress, alcohol can be used to cope with stress [38], additionally, with the limited income among food insecure households, may lead to the consumption of cheap alcohol to fill empty calories or provide a temporary escape for some women.

Current analysis suggests no significant association between household food insecurity with both known status of being hypertensive and blood pressure measures. Examination of the association between HFI and hypertension is premised not only on the fact that HFI is associated with stress but it is also linked with the increased likelihood of consumption of calorically dense foods and high salty diets which provide favourable conditions for the onset of high blood pressure [39]. This notwithstanding, the observed no association between HFI and hypertension is consistent with

conclusion drawn from a systematic review and meta-analysis on the relationship between HFI and hypertension [40]. As suggested by same (Beltran et al.), such results call for more robust analysis into the relationship between HFI and hypertension possibly with longitudinal data unlike the cross-sectional datasets that have been predominately used. Although there exists plausible bio-social reasons to suggest a link between HFI and blood pressure, the incidence of elevated blood pressure could be a result of a complex array of medical, social, and genetic conditions individuals are predisposed to. Thus, the effect of HFI may be either masked or enhanced by other factors. In this study we controlled for the dietary diversity (DDS) based on a 24-h recall. The results indicate that DDS did not predict blood pressure as observed in other studies such as Déré et al. 2016 [41].

Our results do show an increase in hypertension risk among women in peri-urban communities compared to rural communities. This reveals that despite the narrowing gap in prevalence of hypertension with regards to urbanization, that divide still exists in some settings. Despite the communities in both districts being predominantly agrarian, a gradual shift to urbanization (i.e., from rural to peri-urban) could be associated with an increase in obesogenic parameters such as increased access to processed foods and decrease in physical activity and others known to fuel the incidence of chronic conditions such as hypertension and obesity [42].

Hypertension was found to be associated with increasing age ($\geq$ 45 yrs) in women, as have been reported in literature [43]. Hypertension, like other chronic conditions among the elderly could lead to significant disability and activities of daily living and do require proper care and continuous management. With increasing age, women are prone to hormonal changes as menopause sets in coupled with weight changes, fat deposition, increasing lipid levels, structural changes in the arteries and presence of chronic and low-grade inflammation [43]. Thus, awareness of these facts could guide lifestyle modification that could mitigate negative health consequences. Generally, chronic diseases are more common as populations age. Considering the continuous increase in life-expectancy in Ghana (from 61 years in 2010 to 64 year in 2020), continuous improvement in the provision of adequate care for the elderly is needed [44].

In this study, women of the Dangbe origin were more likely to have high blood pressure than their counterparts from other ethnic groups. While some studies have highlighted statistically significant racial/ethnic disparities among patients with hypertension with respect to dietary factors, specifically Healthy Eating Index 2015 [45], others have reported ethnic differences in relation to hypertension because of socio-demographic variability [46].

There will be a need for further research to explore different pathways to explain the effect of ethnicity on hypertension in these communities. There is growing evidence of a genetic predisposition to hypertension, particularly among individuals of African origin in countries such as the United States [47], which may give credence to any biogenetic investigation.

The current study acknowledges some limitations. Firstly, the cross-sectional nature of the inquiry may not capture fully the effect of food insecurity on blood pressure outcomes. Thus, a longitudinal or panel data would better explain the association between HFI and hypertension, hence recommended for further studies. Also, although there may be concerns about recall bias with respect to women recalling their experiences of food insecurity and whether they correctly recognized if they have ever been diagnosed with hypertension, the methodology used in this study has been validated and used in similar studies investigating the association between dietary intake and non-communicable conditions [48, 49]. Another limitation is the fact that the study did not purposefully isolate multiple-working women from purely agricultural women. Notwithstanding these limitations, the study has several strengths. Examining both known diagnosed hypertension status and blood pressure measurement at the time of the survey among population subgroups that are rarely examined was complimentary. Additionally, the use of HFIAS as a measure of household food insecurity is highly commended as it was developed to address the complexity of food security issues. This measure has been validated in several developing country settings.

Authors' contributions

AKC and IAK designed the study. AKC and RTO performed the data analysis. AKC wrote the first draft of this manuscript. IAK and RTO contributed significantly to the writing of the manuscript. All authors approved this final version of the paper.

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The research procedures adhered to the ethical principles outlined in the Declaration of Helsinki throughout all stages of the study. Ethical clearance for this

study was granted by the Noguchi Memorial Institute for Medical Research Institutional Review Board of the University of Ghana (study's protocol, NMIMR: 020/19–20). Prior to participation, the study's purpose was clearly communicated to all participants, and written informed consent was obtained from agreeing respondents. Confidentiality was rigorously maintained throughout the research process, and all collected data were securely stored.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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