

Food Insecurity and Blood Pressure in West Africans with Chronic Kidney Disease

Raghav Neupane^a, Runqi Zhao^a, Nicolas A. Dardet^a, Christiana O. Amira^f, Tolulope Adebile^{a,s}, Edward Kwakyi^b, Nanna Ripiye^c, Bolanle A. Omotoso^d, Yemi R. Raji^e, Manmak Mamven^c, Adaobi Solarin^h, Rotimi Braimoh^f, Theophilus Umezudikeⁱ, Tolulope Oluwadare^d, Ernestina Eduful^b, Bola Fatima Olokodeⁱ, Sebastian Ekenze^a, Chinwuba Ijoma^g, Amisu A. Mumuniⁱ, Fatiu Arogundade^d, Yvette C. Cozier^{j,k}, Lisa M. Quintiliani^l, Suzanne Juddⁿ, Babatunde L. Salako^e, Ifeoma Ulasi^g, Rulan S. Parekh^o, Rasheed Gbadegesin^p, Dwomoa Adu^b, Akinlolu Ojo^q, Cheryl A.M. Anderson^r, Sushrut S. Waikar^a, Titilayo O. Ilori^{a,m,*}

^a Division of Nephrology, Department of Medicine, Boston Medical Center, Boston University Chobanian and Avedisian School of Medicine, Boston, MA, USA

^b Department of Medicine and Therapeutics, University of Ghana Medical School, University of Ghana, Ghana

^c Department of Internal Medicine, University of Abuja, Nigeria

^d Department of Medical Pharmacology and Therapeutics, Department of Medicine, Obafemi Awolowo University, Ile-Ife, Nigeria

^e Department of Medicine, College of Medicine, University of Ibadan, Ibadan, Nigeria

^f Department of Medicine, College of Medicine, University of Lagos, Nigeria

^g University of Nigeria, Enugu, Nigeria

^h Department of Pediatrics, Lagos State University, Nigeria

ⁱ Department of Medicine, College of Medicine, Lagos State University, Nigeria

^j Slone Epidemiology Center, Boston University Chobanian and Avedisian School of Medicine, Boston, MA, USA

^k Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA

^l Department of Medicine, Tufts University School of Medicine, Boston, MA, USA

^m Department of Medicine, Boston Medical Center/Chobanian and Avedisian Boston University School of Medicine, Boston, MA, USA

ⁿ Department of Biostatistics, School of Public Health, The University of Alabama at Birmingham, Birmingham, AL, USA

^o Department of Medicine, Women's College Hospital, Hospital for Sick Children, and University of Toronto, Ontario, Canada

^p Department of Pediatrics and Department of Medicine, Duke University School of Medicine, North Carolina, USA

^q The University of Kansas Medical Center, Kansas, USA

^r Herbert Wertheim School of Public Health, University of California San Diego, San Diego, California, USA

^s Department of Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA

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ABSTRACT

Background/aims: Food insecurity, limited/uncertain access to adequate food, is a growing concern, especially in low- and middle-income countries, where it may exacerbate chronic kidney disease (CKD). Evidence on the relationship between food insecurity and blood pressure (BP) in West African CKD populations remains scarce. This study aimed to (1) assess food insecurity prevalence in West African CKD populations; (2) identify associated sociodemographic factors; and (3) examine its association with systolic BP (SBP) and diastolic BP (DBP). **Methods:** We conducted a cross-sectional analysis using data from the Diet, CKD, and Apolipoprotein L1 (DCA) Study and an ancillary study to the Human Heredity and Health in Africa (H3 Africa) Kidney Disease Research Network in Nigeria and Ghana. Food insecurity was assessed using a validated single-question survey, and BP was measured by trained study coordinators during in-person study visits after 5 min of seated rest using an automated device. We used the average of three blood pressure readings taken at the specific visit for the analyses. Prevalence estimates were calculated by region, and associations with BP were analyzed using mixed effects linear regression with clinical site as a random effect.

* Corresponding author. Division of Nephrology, Department of Medicine, Boston Medical Center, Boston University Chobanian and Avedisian School of Medicine, Boston, MA, USA.

E-mail address: tilori1@bu.edu (T.O. Ilori).

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Results: Among 617 CKD participants, 27% ($n = 169$) reported food insecurity. Prevalence was highest in South-East (67%) and South-West Nigeria (28%) compared to Central Nigeria (2%) and Greater Accra Region, Ghana (13%). Overall, food insecurity was not significantly associated with BP. However, stratified analysis showed that among females, food insecurity was associated with higher diastolic BP ($\beta = 4.86$, 95% CI: 0.92, 8.84, $p = 0.02$). **Conclusion:** Food insecurity was not directly associated with either SBP or DBP in the DCA participants; however, the elevated DBP among food-insecure females suggests potential indirect effects on disease progression.

1. Introduction

Food insecurity is defined as a household-level economic or social condition characterized by limited or uncertain access to sufficient and nutritious food.¹ It is a significant public health challenge that affects over 2 billion people globally.² In 2023, the prevalence of food insecurity was 58% in Africa compared to 29% worldwide, 28% in Latin America and the Caribbean, 25% in Asia, and 9% in North America and Europe. The disproportionately higher prevalence in Africa may be due to poverty, conflicts, climate variability, and systemic inequities.³ Within the continent, food insecurity is especially severe in Middle Africa (78%), East Africa (69%), and Western Africa (66%), compared to a lower prevalence of 25% in Southern Africa.⁴

The impact of food insecurity extends beyond undernutrition and hunger, as it may affect the development of chronic diseases.^{5,6} Hypertension, a key risk factor for both Chronic Kidney Disease (CKD) and cardiovascular disease, is closely linked to diet and nutrition.^{6,7} In high-income countries like the United States, multiple studies have shown that food insecurity is associated with elevated systolic blood pressure (SBP) and diastolic blood pressure (DBP).^{8–11} Data from the National Health and Nutrition Examination Survey (NHANES) showed that individuals experiencing high food insecurity had a 20.3% prevalence of CKD compared to 15.7% prevalence among those without food insecurity.⁵ Additional studies have shown that food insecurity contributes to faster CKD progression, poorer disease management,^{7,12} and increased cardiovascular risk.^{3,8,10,11,13–16} Because hypertension is a major modifiable risk factor for CKD progression, understanding the relationship between food insecurity and blood pressure may provide insight into potential pathways linking social determinants of health to kidney disease outcomes.

There are clear mechanisms underlying the effect of food insecurity on hypertension and CKD. Food insecurity often forces patients to prioritize inexpensive, calorie-dense but nutrient-poor foods, resulting in poor adherence to dietary patterns critical for controlling blood pressure (BP)¹⁷ and managing CKD.¹⁸ This inadequate nutrient intake, combined with inconsistent access to food, exacerbates inflammation, oxidative stress, and disease progression, ultimately increasing the risk of end-stage kidney disease and cardiovascular complications.¹⁹

Despite these insights, there is limited evidence on how food insecurity among individuals with CKD affects BP and albuminuria in African populations. While both CKD and hypertension are highly prevalent across the continent, few studies have examined the prevalence of food insecurity in this population, particularly in West Africa. Even less is known about how food insecurity may influence SBP and DBP, as well as the factors associated with it, among patients with kidney disease. These gaps leave critical uncertainties in understanding the impact of food insecurity on kidney health and cardiovascular risk in this region.

The purpose of this study was to investigate the association between food insecurity and BP among individuals with CKD in West Africa. We aimed to (1) assess the prevalence of food insecurity in West African CKD populations; (2) identify sociodemographic and clinical characteristics associated with food insecurity; and (3) investigate the association between food insecurity and SBP and DBP in this at-risk population.

2. Methods

2.1. Materials and methods

2.1.1. Study design

The Diet, CKD, and Apolipoprotein L1 (APOL1) study (DCA) is an ancillary study to the Human Hereditary and Health in Africa (H3Africa) Kidney Disease study, a prospective cohort study involving participants with CKD in sub-Saharan Africa.^{20,21} Between 2020 and 2021, the DCA recruited participants from the H3Africa cohort from seven sites in Nigeria and Ghana. The study sites included the University of Ghana, the University of Ibadan, the University of Nigeria, Ituku-Ozalla, the University of Abuja, the University of Lagos, Lagos State University, and Obafemi Awolowo University. This study is a secondary analysis of previously collected baseline data from the H3Africa Study and newly collected data from year 1 of the DCA study (2 Jan 2022 – 30 Dec 2022). Although the parent DCA study continues follow-up through year 5, only data collected up to year 1 are included in this manuscript. This study used cross-sectional data from the DCA cohort to examine the relationship between food insecurity and BP.

2.1.2. Study population

Participants in the DCA Study were recruited from the H3Africa Kidney Disease cohort. All eligible participants who were enrolled in the H3Africa Kidney Disease study and were willing and able to complete the required 24-h urine collection and 24-h dietary recall were included. Inclusion and exclusion criteria for the parent H3Africa Kidney Disease study have been previously described.²⁰ The inclusion criteria for the H3Africa study included: (1) age >15 years, (2) there were two groups of patients: the first group included individuals with CKD with an estimated glomerular filtration rate (eGFR) of 20–59 mL/min per 1.73 m², based on the 2009 CKD-Epidemiology Collaboration equation without correction for Black race, and (3) the second group included individuals with glomerulonephritis, defined by an eGFR >15 mL/min per 1.73 m² and a biopsy-confirmed diagnosis of glomerulonephritis in the H3Africa cohort. Exclusion criteria for the DCA study aligned with the parent cohort and included those with: (1) HIV, (2) kidney transplant, (3) New York Heart Association Class III or IV heart failure, (4) cirrhosis, (5) pregnancy or breastfeeding, and (6) ESKD or adult-onset monogenic kidney diseases, among others. Institutional Review Board (IRB) approvals were obtained from all participating DCA sites in Nigeria and Ghana, as well as from the coordinating site at Boston Medical Center. Participants below 18 years were eligible for inclusion in the study. For these individuals, written informed consent was obtained from a parent or legal guardian, and written assent was obtained from the participant, in accordance with the study protocol approved by the IRB.

Furthermore, participants included in this study had CKD but were not dialysis-dependent at baseline. Participants with end-stage kidney disease (ESKD), kidney failure, or prior kidney transplantation were excluded at enrollment. However, a small number of participants progressed to CKD stage 5 (eGFR ≤ 15 mL/min per 1.73 m²) during follow-up. At the Annual Year 1 (A1) visit, four participants had documentation of dialysis prior to the visit; these individuals were retained in the analysis because ESKD was excluded only at enrollment and not during follow-up. Initiation of dialysis and progression to kidney failure were assessed as outcomes during follow-up. The study population included individuals across different stages of CKD, encompassing a range of

clinical and dietary management contexts.¹⁸

From the baseline cohort of 738 participants, 627 participants completed the first annual follow-up visit. After excluding 10 participants with incomplete data, 617 participants were included in our analyses. The data used were a combination of data at enrollment in the H3Africa studies, baseline, and annual year 1 follow-up for the DCA study (Table 1 and Supplemental Table 4).

2.1.3. Exposure

The primary exposure of interest was food insecurity, measured using a standardized questionnaire for food insecurity during the first annual follow-up visit. As in prior studies,²² DCA participants were asked: “In the last 12 months, did you or your household ever cut the size of your meals or skip meals because there wasn't enough money for food?” If the participants answered “yes,” they were classified as “food insecure”. Those who responded with “no” were categorized as “food secure”. We classified food insecurity as a binary variable, with “food secure” as the reference group.

2.1.4. Outcomes

Our primary outcomes were SBP and DBP, measured in millimetres of mercury (mmHg). During the first-year follow-up visits, trained co-ordinators obtained three seated BP measures using the Omron HEM-907XL digitally. We then averaged the three readings for both SBP and DBP. We further adjusted BP values for antihypertensive medication use. If any antihypertensive medication was reported at the year 1 follow-up, 10 mmHg was added to SBP and 5 mmHg to DBP values to account for medication effects.²³ This adjustment was done to accurately reflect underlying, untreated BP levels. Therefore, this approach reflects untreated physiological levels, enhances accuracy, and reduces bias in BP measurements.²³

2.1.5. Covariates

Covariates, including smoking status, annual income (low: <\$2,000, medium: \$2000-\$8,000, high: >\$8000 or not reported), educational status (pre-elementary/elementary school, secondary school, or higher education), alcohol use, and diabetes status, were collected from the parent H3Africa kidney disease study. Other covariates, including age, sex, height, weight, and body mass index (BMI), were collected from the DCA baseline in-person visits. We defined obesity as a baseline BMI >30.

APOL1 risk status (high-vs. low-risk genotype) was determined in biospecimens processed at Wake Forest University during baseline visits, as previously described in the H3Africa parent study.²⁰ High-risk individuals were defined as having two *APOL1* risk alleles (G1G1, G2G2, or G1G2) while low-risk individuals are with 0-1 *APOL1* risk alleles (G1G0, G2G0, or G0G0). Meal count (number of meals consumed per day) and total daily energy intake (kilocalories) were derived from 24-h dietary recall questionnaires administered at baseline DCA study visit. Laboratory measurements included urine protein, urine creatinine, protein-to-creatinine ratio, and serum creatinine, which were collected from DCA baseline visits. The protein-to-creatinine ratio is defined as: normal to mildly increased (<150 mg/g), moderate (150-500 mg/g), and severely increased (≥500 mg/g).²⁰ We calculated glomerular filtration rate (eGFR) with the 2009 CKD-Epidemiology Collaboration (CKD-EPI) equation without correction for Black race, consistent with H3Africa protocol, and expressed in mL/min per 1.73 m². Laboratory measurements were performed at SYNLAB laboratories in Nigeria and Ghana. Serum creatinine was measured using isotope-dilution mass spectrometry (IDMS)-traceable enzymatic assay, urine isotope-dilution mass spectrometry (IDMS)-traceable enzymatic assay, urine protein, and urine creatinine were measured using automated colorimetric assays.

Anti-hypertension medications were collected from the follow-up year 1 questionnaire. We defined hypertension as any reported history of hypertension or a measured SBP≥140 or DBP≥90 at baseline or annual year 1 visit. For the fully adjusted model, we included age, sex,

Table 1

Sociodemographic characteristics by food insecurity in the West African diet, CKD, and apolipoprotein L1 (DCA) cohort.

N	Overall	Food Insecure Population	Food Secure Population	p-value
	617	169 (27%)	448 (73%)	
Age, years [~]	49 (18)	47 (16)	50 (18)	0.084
	49 (34, 64)	46 (34, 63)	49 (34, 64)	
Male [#]	329 (53%)	82 (49%)	247 (55%)	0.14
Education Level				0.026
Pre-primary or Primary	97 (16%)	27 (16%)	70 (16%)	
Secondary	183 (30%)	64 (38%)	119 (27%)	
Higher	334 (54%)	77 (46%)	257 (57%)	
Annual Household Income [#]				<0.001
Low Income: <\$2000	194 (31%)	63 (37%)	131 (29%)	
Medium Income: \$2000-\$8000	133 (22%)	26 (15%)	107 (24%)	
High Income: >\$8000	31 (5.0%)	1 (0.6%)	30 (6.7%)	
Don't Wish to answer	257 (42%)	78 (46%)	179 (40%)	
Hypertension [#]	392 (64%)	107 (64%)	285 (64%)	>0.9
Diabetes [#]	145 (24%)	37 (23%)	108 (24%)	0.6
Smoking [#]	33 (5.4%)	5 (3.1%)	28 (6.3%)	0.12
Alcohol Use [#]	251 (41%)	69 (42%)	182 (41%)	0.8
Body Mass Index, kg/m² [~]	26.0 (5.8)	25.5 (5.1)	26.2 (6.0)	0.3
Systolic blood pressure, measured, mmHg [~]	128 (22)	127 (24)	128 (21)	0.2
Diastolic blood pressure, measured, mmHg [~]	79 (15)	80 (15)	78 (15)	0.066
eGFR 2021, ml/min per 1.73m²	74 (40, 105)	88 (41, 112)	68 (39, 101)	0.028
APOL1 Risk Strata [#]				0.13
High Risk	154 (25%)	43 (25%)	111 (25%)	
Low Risk	356 (58%)	105 (62%)	251 (56%)	
Missing	107 (17%)	21 (12%)	86 (19%)	
Meal Count, per day	3.50 (3.00, 4.00)	3.50 (3.00, 4.00)	3.50 (3.00, 4.00)	0.1
Total Kcal Intake, per day	2342 (1,856, 3002)	2366 (1,841, 3043)	2336 (1,863, 2993)	0.7
UPCR Levels (Annual year 1 follow-up)				0.7
Normal to mildly increased: <150 mg/g	249 (42%)	178 (42%)	71 (43%)	
Moderately increased: 150 – 500 mg/g	155 (26%)	115 (27%)	40 (24%)	
Severely increased: ≥500 mg/g	188 (32%)	132 (31%)	56 (34%)	

1) The characteristics are presented as: #: n (%), ~: mean (standard deviation), otherwise median (IQR).

2) P-value calculated from Pearson's Chi-squared test for categorical variables and Wilcoxon rank sum test for continuous variables.

3) The UPCR (urine protein creatinine ratio) at A1 has total missing N = 25 (Regular Meals N = 23, Cut or Skip Meal N = 2).

education, income, smoking, diabetes, obesity, and clinical site as random effects. The selection was consistent with previously published models examining similar associations.⁵

Baseline demographic and socioeconomic covariates were used in analyses because these variables are generally stable over the one-year follow-up period. Food insecurity and BP were assessed at the year-1 visit, with hypertension defined using information from both baseline and follow-up to reflect the most recent measurement.

2.2. Statistical analysis

We compared participants' characteristics across the food-secure and food-insecure groups. Descriptive statistics were reported for socio-demographic and clinical factors. For continuous variables, means and standard deviations were reported when normally distributed, and medians with interquartile ranges (IQR) were reported otherwise. Categorical variables were summarized as counts and percentages. We tested differences across groups using the Wilcoxon rank sum test for continuous variables and the Chi-squared test for categorical variables. Crude prevalences are presented to describe DCA overall food insecurity and region-level differences.

To assess the effect of food insecurity on SBP and DBP, we utilized mixed-effects linear regression, accounting for clinical sites as a random effect. The fully adjusted model included age, sex, education, smoking, diabetes, and BMI. We conducted analyses stratified by selected socioeconomic factors and, separately, by sex to examine potential differences between subgroups such as males and females.

We reported the crude and adjusted-beta coefficients and their 95% confidence intervals of the estimated effects. To account for multiple testing of the primary outcomes (SBP and DBP), statistical significance for the fully adjusted models was defined as $p < 0.025$. No formal adjustment for multiple comparisons was applied to subgroup analyses or analyses examining factors associated with food insecurity, as these were exploratory in nature.²⁴ Therefore, these results may be more susceptible to type 1 error and should be interpreted as hypothesis-generating. All statistical analyses were performed using R version 4.2.3.

3. Results

3.1. Prevalence of Food Insecurity

The overall prevalence of food insecurity in the West African cohort was 27% (Table 1). Prevalence varied across geographic regions, with the highest observed in South-East Nigeria (67%) and the lowest in Central Nigeria (2%). In the Greater Accra Region of Ghana, the prevalence was 13%, while in Nigeria overall, it was 30% (Fig. 1).

3.2. Factors associated with food insecurity

Our findings on socioeconomic variables associated with food insecurity are presented in Table 1. The mean age of participants was 49 years (SD = 18), with no significant age difference between food-secure and insecure groups. Compared to food-secure individuals, those experiencing food insecurity had lower household income ($p < 0.001$), lower educational attainment (all $p < 0.05$), and a lower median eGFR (68 vs. 88 mL/min per 1.73 m²; $p = 0.028$).

Regarding albuminuria, the distribution of UPCR levels was generally similar between food-secure and food-insecure participants. A slightly higher proportion of food-secure individuals had severely increased UPCR (≥ 500 mg/g: 34% vs 31%), while the food-insecure group had a larger proportion with moderately increased UPCR (27% vs. 24%). At the one-year follow-up, 42% of the food-secure and 43% of the food-insecure group had normal or mildly increased UPCR levels (< 150 mg/g) (Table 1). When examining CKD risk stages across food insecurity groups in the DCA cohort, there was a significant difference in the distribution of CKD risk categories between food-secure and food-insecure participants ($p = 0.043$; Supplemental Table 2). Similarly, when examining eGFR-based CKD stages alone, food-insecure participants were more likely to fall into lower eGFR categories compared with food-secure individuals ($p = 0.002$; Supplemental Table 3).

3.3. Univariable/unadjusted models only

We examined the sociodemographic and clinical factors associated with food insecurity using mixed-effects logistic regression (Supplemental Table 1). Individuals experiencing food insecurity were more likely to have lower BMI (OR = 0.96, $p = 0.04$) (Supplemental Table 1). Compared to participants with low income, those with medium



Fig. 1. Prevalence of Food Insecurity at the Diet, CKD, and Apolipoprotein L1 (DCA) Sites Across Regions in Nigeria and Ghana
The spatial map showing the prevalence of food insecurity in Nigeria and Ghana across regions, categorized by site. South-East Nigeria (67%, 49 out of 73) has the highest prevalence of food insecurity, followed by South-West Nigeria (28%, 106 out of 385), then Greater Accra Region, Ghana (13%, 13 out of 102), and Central Nigeria (2%, 1 out of 57), with the lowest food insecurity prevalence. South-west Nigeria contained the highest number of sites (N = 4); the other regions had one site each.

or high income had significantly lower odds of food insecurity (OR = 0.56, 95% CI: 0.31–1.00, $p = 0.05$). Food insecurity was observed more frequently among females than males (30.2% vs 25%), and less common among those with higher education compared to pre-primary or primary education (23% vs 27.8%). However, the differences were not statistically significant (sex: OR = 1.3, 95% CI: 0.85–2.00, $p = 0.22$, and higher education: OR = 0.66, 95% CI: 0.36–1.21, $p = 0.17$), and these findings should be interpreted with caution. Age was not significantly associated with food insecurity (OR = 0.99, 95% CI: 0.98–1.00, $p = 0.12$).

3.4. Association between food insecurity and BP

Overall, in both adjusted and unadjusted analyses, there were no significant associations observed between food insecurity and SBP or DBP (Table 2). However, we further stratified the population's socioeconomic variables to investigate how the food insecurity effect works for different patients. The subgroup analysis revealed a positive association between food insecurity and DBP in females ($\beta = 4.79$, 95% CI: 0.63, 8.94, $p = 0.03$) (Fig. 2B).

4. Discussion

In our study of individuals with CKD in West Africa, the prevalence of reported food insecurity was 27%. While we did not find significant associations between food insecurity and SBP or DBP overall, we observed notable regional disparities in the prevalence of food insecurity. Subgroup analyses also revealed a positive association between food insecurity and higher mean DBP among females.²⁵

The observed 27% prevalence of food insecurity in this West African cohort is consistent with previous studies reporting 26% moderate food insecurity in African settings.²⁶ The highest prevalence of food insecurity was seen in southeastern Nigeria, potentially due to socioeconomic inequities, cultural practices, and structural challenges unique to the region.²⁷ Southeastern Nigeria also has a high prevalence of the *APOL1* two-risk variants,²⁸ because of the large Igbo population, which may contribute to the region's elevated CKD burden.^{20,29} The high prevalence of CKD and *APOL1* in this region underscores the need for region-specific interventions addressing both genetic and modifiable risk factors, such as diet. Addressing food insecurity may be a cost-effective modifiable risk factor for improving CKD outcomes in this high-risk population.

Contrary to studies from high-income countries, including a systematic review by Beltrán et al., we found no significant overall association between food insecurity and BP.^{8,10,11,16,30,31} Prior research has reported links between food insecurity and hypertension in both children and adults,^{32,33} particularly in the U.S., but we did not assess hypertension status directly. Our results align more closely with studies in which measured BP was not significantly associated with food insecurity,⁸ possibly due to routine hypertension management among CKD patients, dietary differences, or unmeasured confounders such as inflammation or malnutrition.

In subgroup analysis, food-insecure females exhibited significantly

higher DBP. These findings suggest that sex and socioeconomic status may modify the relationship between food insecurity and BP. Previous research has shown that women in African and African American communities disproportionately experience food insecurity due to socio-environmental factors.³⁴ This may contribute to their higher risk for obesity, diabetes, and other metabolic conditions.³⁵ Similarly, the lower odds of food insecurity among participants with higher or medium income may reflect the protective role of socioeconomic resources. However, food insecurity remains a critical social determinant of health, highlighting the need for further investigation into its complex effects on BP and CKD progression.³⁶ While there may be a potential association between income and gender, the study population does not provide sufficient support for an interaction analysis. Further research is required to confirm the potential interaction between income and gender.

Although not the primary focus of this study, we observed that food-insecure participants had lower median eGFR despite similar UPCR levels. This may suggest that food insecurity affects albuminuria through mechanisms independent of proteinuria. Poor dietary quality and limited healthcare access, both common among food-insecure individuals, may contribute to worsened kidney outcomes.¹⁹ (Supplemental Tables 1 and 2)

Our findings also emphasize the sociodemographic complexity of food insecurity. Higher BMI and medium/high income were inversely associated with food insecurity, reinforcing established links between socioeconomic status and food access. Notably, the inverse association between BMI and food insecurity contrasts with patterns typically seen in high-income countries such as the United States, where food insecurity is associated with higher BMI due to reliance on inexpensive and typically unhealthy foods.³⁷ Age and education were not significantly associated, suggesting that structural barriers may outweigh individual-level factors in this population.

Food insecurity can undermine dietary adherence, leading patients to prioritize cheaper, less nutritious foods. This compromises BP control¹⁷ and CKD management.¹⁸ Despite the high burden of both hypertension and CKD in the African population, research on how food insecurity affects these conditions remains limited. Local dietary patterns, poor adherence to clinical guidelines, and limited access to essential nutrients may further complicate this relationship.

5. Limitations

Our study had several limitations. Food insecurity was assessed using a single-item, binary measure, which does not capture severity or duration and does not allow for a detailed assessment of dietary quality or nutritional composition that may influence blood pressure and CKD outcomes.

Food insecurity was assessed using a 12-month recall period, which may be subject to recall bias and could lead to under- or over-reporting of participants' experiences. However, using a 12-month recall is a common approach in population-based studies, designed to capture sustained patterns of food insecurity that are relevant to chronic disease outcomes.³⁸ Additionally, we conducted stratified subgroup analyses (e. g., by sex and education) without formal correction for multiple comparisons, increasing the risk of type I error. As a result, these findings should be interpreted cautiously and considered hypothesis-generating rather than confirmatory."

The cross-sectional design of certain analyses limited the ability to draw causal inferences about food insecurity's effect on BP and albuminuria. Additionally, income data were incomplete, 46% of food-insecure and 40% of food-secure participants declined to report household income, potentially introducing information bias, especially in regions with high food insecurity prevalence. Additionally, some sociodemographic characteristics may have changed between baseline and year-1 follow-up; using baseline covariates could result in misclassification of these time-varying factors and potential residual

Table 2
The Association of Food Insecurity with estimated SBP and DBP in the Diet, CKD, and Apolipoprotein L1 (DCA) Study.

	Unadjusted Model	p-value	Fully Adjusted Model	p-value
Systolic blood pressure	−1.45 (−6.07 to 3.08)	0.53	0.72 (−3.78 to 5.09)	0.75
Diastolic blood pressure	1.17 (−1.83 to 4.24)	0.45	1.71 (−1.38 to 4.85)	0.29

1) SBP and DBP were also averaged from the three BP readings and further adjusted by +10 mmHg and +5 mmHg for SBP and DBP, respectively, if any antihypertensive medication was used.
2) Fully Adjusted Model: Adjust for age, sex, education, income, smoking, diabetes, and obesity, and clinical site as a random effect.

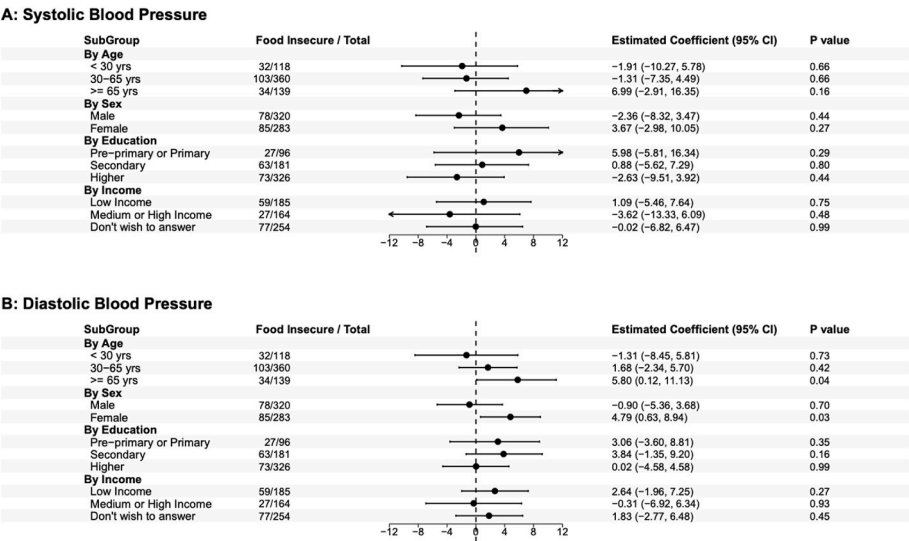


Fig. 2. Stratified Analysis of the Association of Food Insecurity with SBP and DBP in the Diet, CKD, and Apolipoprotein L1 Study.
1) SBP and DBP were also averaged from the three BP readings and further adjusted by +10 mmHg and +5 mmHg for SBP and DBP, respectively, if any antihypertensive medication was used.
2) Fully Adjusted Model: Adjust for Age, Sex, Education, Income, Smoking, Diabetes, and Obesity, and Clinical Site as a Random Effect.

confounding.³⁹ However, we expect these changes to be minimal over the relatively short follow-up period.¹⁸

Self-reported data on food access may be subject to social desirability bias, leading to misclassification of exposure. Furthermore, food insecurity data were assessed during the second year of the DCA study, potentially introducing sampling bias as individuals lost to follow-up were not included in the analysis.

While antihypertensive medication use was included as a covariate in the BP models, this adjustment may not fully account for treatment-related reductions in SBP and DBP. The inclusion of participants across CKD stages may have influenced dietary behaviors, as individuals with more advanced CKD are more likely to follow restrictive dietary recommendations.

6. Conclusion

Our study highlights significant regional disparities in food insecurity prevalence and nuanced associations between food insecurity, albuminuria, and BP among individuals with CKD in West Africa. While food insecurity was not directly associated with BP in the overall participants, the observed differences in eGFR and the elevated DBP among food-insecure females suggest potential indirect effects on disease progression. The findings emphasize the importance of addressing food insecurity as a public health priority in CKD management, particularly in resource-limited settings. While food insecurity was not directly associated with BP, the observed disparities in eGFR and regional food insecurity prevalence highlight its potential indirect effects on disease progression. Understanding the interplay of structural inequities, dietary patterns, and health outcomes in African populations is critical for designing culturally tailored interventions.

Future research should adopt longitudinal designs to explore the long-term impact of food insecurity on CKD outcomes, focusing on dietary quality, nutrient intake, and access to care. Addressing food insecurity through targeted policies and programs has the potential to mitigate its adverse effects on CKD progression and cardiovascular health, ultimately improving outcomes in this vulnerable population.

Creditauthor statement

Conceptualization, Methodology: Christiana O. Amira, Tolulope

Adebile, Edward Kwakyi, Nanna Ripiye, Bolanle A. Omotoso, Yemi R. Raji, Manmak Mamven, Adaobi Solarin, Rotimi Braimoh, Theophilus Umeizudike.

Investigation, Resources, Data curation: Tolulope Oluwadare, Ernestina Efulful, Bola Fatima Olokode, Sebastian Ekenze, Chinwuba Ijoma, Amisu A. Mumuni, Fatiu Arogundade, Yvette C. Cozier, Lisa M. Quintiliani, Suzanne Judd, Babatunde L. Salako, Ifeoma Ulasi, Rulan S. Parekh, Rasheed Gbadegesin, Dwomoa Adu, Akinlolu Ojo, Cheryl A.M. Anderson, Sushrut S. Waikar, Titilayo O. Ilori

Formal analysis, Validation: Runqi Zhao, Titilayo O. Ilori.

Writing - original draft: R. Neupane, Runqi Zhao, Nicolas Dardet, Sebastian Ekenze, Titilayo O. Ilori.

Writing - review & editing: R. Neupane, Runqi Zhao, Nicolas Dardet, Sebastian Ekenze, Titilayo O. Ilori.

Visualization: Runqi Zhao.

Supervision, Project administration, Funding acquisition: Titilayo O. Ilori.

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Declaration of competing interest

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Appendix A. Supplementary data

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