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Determinants of hypertension among internally displaced persons and host communities in conflict-affected Southern Kaduna, Nigeria: A comparative cross-sectional study

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Abstract

Background: *Hypertension is the leading modifiable risk factor for cardiovascular disease globally, with Nigeria experiencing a silent epidemic where 30–40% of adults are now affected. Conflict-affected populations bear disproportionate burdens, yet evidence from violence-prone regions outside Northeastern Nigeria remains scarce. Southern Kaduna has experienced decades of ethno-religious conflict, producing substantial internal displacement, but the determinants of hypertension in this setting remain unexamined.*

Objective: *To identify the determinants of hypertension among internally displaced persons (IDPs) and host community members in three conflict-affected Local Government Areas of Southern Kaduna—Kachia, Kajuru, and Chukun—examining conventional risk factors, displacement-specific exposures, and whether displacement status modifies the relationship between psychosocial stress and hypertension.*

Methods: *A community-based comparative cross-sectional study was conducted between March and June 2025. Using multi-stage sampling with true demographic data from the State Emergency Management Agency, 1,148 adults (574 IDPs, 574 hosts) were enrolled (94.3% response rate). Data were collected using adapted WHO STEPS instruments, the Perceived Stress Scale (PSS-4), and clinical measurements (automated BP monitors, anthropometry). Hypertension was defined as average systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg or current antihypertensive medication use. Multivariable logistic regression and interaction analysis were employed. Interaction analysis was conducted to test whether displacement status modifies the stress-hypertension relationship.*

Results: *Hypertension prevalence was significantly higher among IDPs (42.3%; 95% CI: 38.3–46.5%) than hosts (31.2%; 95% CI: 27.5–35.1%) (p<0.001), with 46.1% of hypertensive IDPs newly diagnosed. In multivariable analysis, conventional risk factors operated similarly: age (IDPs: AOR=2.08 per decade, 95% CI: 1.71–2.53; Hosts: AOR=1.98, 95% CI: 1.62–2.42); overweight/obesity (IDPs: AOR=2.21, 95% CI: 1.51–3.23; Hosts: AOR=2.08, 95% CI: 1.42–3.05); high salt intake (IDPs: AOR=1.69, 95% CI: 1.15–2.48; Hosts: AOR=1.58, 95% CI: 1.07–2.33). Among IDPs, displacement-specific exposures independently predicted hypertension: displacement >5 years (AOR=1.89, 95% CI: 1.14–3.13), multiple displacements (AOR=1.58, 95% CI: 1.03–2.42), and witnessing violence (AOR=1.52, 95% CI: 1.00–2.31). Displacement status significantly modified the stress-hypertension relationship (interaction AOR=1.52, 95% CI: 1.05–2.21, p=0.028)."*

Conclusion: *Hypertension in conflict-affected populations cannot be understood through conventional risk factor frameworks alone. While age, obesity, and salt intake operate similarly across groups, displacement-specific exposures—prolonged displacement, repeated displacement, witnessed violence—independently predict hypertension. The amplified effect of stress among IDPs demonstrates that traumatic displacement fundamentally differs from everyday stress in its physiological consequences. With 46.1% of hypertensive IDPs newly diagnosed, health systems are failing to reach those most vulnerable. These findings demand integrated responses combining hypertension screening and treatment with mental health support, trauma-informed care, and health system strengthening. Displaced persons who have lost homes, livelihoods, and loved ones should not also lose their lives to a silent, treatable condition.*

Keywords: *Hypertension, internally displaced persons, conflict-affected populations, determinants, stress, allostatic load, Southern Kaduna, Nigeria.*

Introduction

Hypertension remains the leading modifiable risk factor for cardiovascular disease and premature mortality globally, accounting for an estimated 10.8 million deaths annually (1).

In Nigeria, the burden has reached epidemic proportions, with recent estimates indicating that between 30% and 40% of adults currently live with hypertension—a dramatic increase from less than 10% in 1990 (1,2). This surge positions hypertension as the most widespread non-communicable disease in the country and the primary driver of stroke, heart failure, and chronic kidney disease (3).

Hypertension, defined as persistently elevated blood pressure, remains the leading modifiable risk factor for cardiovascular disease, stroke, and chronic kidney disease globally. The condition is typically diagnosed through screening of asymptomatic individuals, with treatment aimed at reducing the risks of mortality and cardiovascular, renal, and cerebrovascular complications (4).

Hypertension was defined according to the Seventh Report of the Joint National Committee (JNC 7) criteria as systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg or current antihypertensive medication use.

The determinants of hypertension are well-established in stable populations and include non-modifiable factors such as advancing age, male sex, and genetic predisposition, alongside modifiable behavioural and metabolic risks including unhealthy diet, physical inactivity, overweight and obesity, harmful alcohol consumption, and tobacco use (5). Social determinants—education, income, occupation, and access to healthcare—further shape the distribution of these risk factors and ultimately determine who develops hypertension and who dies from its complications (6).

However, the aetiology of hypertension in conflict-affected populations cannot be fully understood through conventional risk factor frameworks alone. Humanitarian crises inflict severe psychological distress, economic devastation, and social instability that fundamentally alter disease pathways (7). Chronic stress activates the sympathetic nervous system and hypothalamic-pituitary-adrenal axis, leading to sustained elevations in cortisol and catecholamines that promote endothelial dysfunction, arterial stiffness, and sustained blood pressure elevation (8). Among conflict-exposed populations in Northeastern Nigeria, individuals directly affected by insurgency had nearly five times the depression risk (incidence risk ratio = 4.78; 95% CI: 2.51–9.22) and nearly double the odds of abdominal obesity (adjusted odds ratio = 1.95; 95% CI: 1.23–3.08) compared to those unaffected by violence (7)—findings that implicate psychosocial pathways in hypertension development.

Displacement introduces additional layers of vulnerability. Internally displaced persons (IDPs) lose not only their homes but their livelihoods, social networks, and access to regular healthcare. Research from IDP camps in Benue State demonstrates that distance to health facilities exceeding five kilometres, when combined with insecurity, more than triples access difficulties (OR = 3.17; 95% CI: 2.22–4.53), while low education increases the odds of access barriers by 49% (9) . These barriers do not merely affect treatment—they shape the entire exposure profile of displaced populations, influencing diet, physical activity, healthcare-seeking behaviour, and ultimately, cardiovascular risk.

Southern Kaduna, the proposed study setting, represents a region where these intersecting vulnerabilities converge with insufficient empirical investigation. Located in northwestern Nigeria, the area encompassing Kachia, Kajuru, and Chukun Local Government Areas has experienced recurrent ethno-religious and farmer-herder conflicts for decades, producing substantial internal displacement. Demographic data from the State Emergency Management Agency indicates approximately 28,533 displaced adults reside in formal and informal camps across these three LGAs, with women constituting 66.2% of the adult camp population—a demographic distortion reflecting conflict-related male mortality, capture, and labour migration.

Despite the well-documented association between conflict and cardiovascular risk in other Nigerian regions, the determinants of hypertension in Southern Kaduna remain entirely unexamined. The region differs from the extensively studied Northeast in conflict dynamics, displacement patterns, healthcare infrastructure, and ethnic composition. Whether conventional risk factors operate similarly among displaced and host populations, whether displacement-specific exposures exert independent effects, and whether the relationship between stress and hypertension is modified by displacement status are questions that cannot be answered through extrapolation from other settings.

The absence of this evidence has profound implications. Without understanding which factors most powerfully shape hypertension risk—and whether these differ between IDPs and their host communities—health authorities cannot design targeted interventions, allocate resources effectively, or address the root causes of cardiovascular disease in this conflict-affected population. Furthermore, the humanitarian imperative demands that we understand not only how many people have hypertension but why, so that interventions address causes rather than merely counting cases.

This study therefore seeks to identify the determinants of hypertension among internally displaced persons and host community members in three conflict-affected Local Government Areas of Southern Kaduna, examining both conventional risk factors and displacement-specific exposures, and exploring whether the relationship between psychosocial stress and hypertension differs between these populations.

This study tested three specific hypotheses -- H_1: Conventional risk factors (age, BMI, salt intake, physical inactivity) are associated with hypertension in both IDPs and host communities, with similar effect sizes. H_2: Displacement-specific exposures (duration of displacement, number of displacements, witnessing violence) are independently associated with hypertension among IDPs after adjusting for conventional risk factors. H_3: Displacement status modifies the association between perceived stress and hypertension, such that the stress effect is stronger among IDPs than hosts.

Method

Research Design

This study employed a community-based comparative cross-sectional design to identify the determinants of hypertension among internally displaced persons (IDPs) and host community members in conflict-affected areas of Southern Kaduna. The cross-sectional design was selected as it allows for the simultaneous measurement of exposure and outcome variables, enabling the identification of associations between potential determinants and hypertension status at a single point in time. This design is particularly appropriate for generating hypotheses about risk factors and providing prevalence estimates in hard-to-reach humanitarian settings where longitudinal follow-up is logistically challenging.

The study was part of a larger mixed-methods investigation; however, this paper reports exclusively on the quantitative component addressing the determinants of hypertension. The comparative element—contrasting IDPs with host communities—was integral to the design, allowing examination of whether displacement status modifies the relationship between conventional risk factors and hypertension.

Study Setting

The study was conducted in three Local Government Areas (LGAs) of Kaduna State, Northwestern Nigeria: Kachia, Kajuru, and Chukun. These LGAs were purposively selected due to their documented history of protracted ethno-religious and farmer-herder conflicts, which have resulted in substantial internal displacement and the establishment of both formal and informal camps for internally displaced persons.

According to data obtained from the State Emergency Management Agency (SEMA) and the National Commission for Refugees, Migrants, and Internally Displaced Persons (NCFRMI), the three LGAs collectively host approximately 60,800 displaced persons, of whom 28,533 are adults aged 18 years and above. The demographic distribution of the adult IDP population across the LGAs is as follows: Kajuru hosts the largest displaced population (22,800 adults), followed by Kachia (3,588 adults) and Chukun (2,145 adults). Women constitute 66.2% of the adult IDP population across all camps, reflecting conflict-related male mortality, capture, and labour migration.

The study communities are predominantly rural with agrarian economies. Health infrastructure is limited to Primary Health Centres (PHCs), many of which are understaffed and experience frequent stock-outs of essential medicines, including antihypertensive drugs. Referral to secondary care requires travel to Kaduna City, hindered by poor road networks and active security concerns.

Participants

The target population comprised two distinct groups residing in the three selected LGAs:

Internally Displaced Persons (IDPs): Adults aged 18 years and above who have been residing in the listed formal or informal camps for at least six months before data collection. This duration criterion was applied to ensure that participants had sufficient exposure to displacement-related conditions to potentially influence their hypertension status.

Host Community Members (HCs): Adults aged 18 years and above who were indigenes or long-term residents (minimum of five years) living in host communities adjacent to the selected IDP camps. This five-year criterion ensured that hosts had not recently experienced displacement themselves, allowing for a clear distinction between the two comparison groups.

Inclusion criteria for both groups were: age ≥18 years; willingness to provide informed consent (written or witnessed thumbprint); and for IDPs, registered or de facto residence in one of the specified camps, or for hosts, residence in one of the specified host communities.

Exclusion criteria: critically ill or mentally incapacitated individuals unable to participate in interviews or physical measurements; "Pregnant women were excluded because: (1) physiological hemodynamic changes of pregnancy alter blood pressure independently of chronic hypertension status; (2) pregnancy-induced hypertension represents a distinct pathological entity with different etiology and risk factors; and (3) including pregnant women would require separate analysis beyond the scope of this study. A separate investigation of hypertension in pregnancy among displaced women is warranted.

Variables

Outcome Variable

The primary outcome variable was hypertension status, defined as:

An average systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg based on three consecutive measurements, OR Self-reported current use of antihypertensive medication regardless of measured blood pressure. Blood pressure was treated as a binary outcome (hypertensive vs. normotensive) for primary analysis.

Exposure Variables (Potential Determinants)

Exposure variables were selected based on a priori evidence from the literature and organised into four domains:

Sociodemographic factors: Age (continuous, years; also categorised as 18–34, 35–49, 50–64, ≥65), Sex (male/female), Marital status (married, single, widowed/divorced), Educational level (none, primary, secondary, tertiary), Occupation (farming, trading, artisan, unemployed, civil service), Monthly income (<₦30,000, ₦30,000–₦50,000, >₦50,000) and Household size (1–4, 5–7, ≥8 persons)

Behavioural factors: Smoking status (never, current/former), Alcohol consumption (never, current), Physical inactivity—defined as <150 minutes of moderate-intensity activity per week or <75 minutes of vigorous-intensity activity per week, measured using the Global Physical Activity

Questionnaire (GPAQ), High salt intake—defined as self-reported addition of salt to meals at the table or consumption of processed foods high in salt on most days of the week (World Health Organization, 2023)

Metabolic factors: Body Mass Index (BMI)—calculated as weight (kg)/height (m^2) and categorised as normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), or obese (≥30.0 kg/m^2).

Psychosocial factors: Perceived stress—measured using the 4-item Perceived Stress Scale (PSS-4), with scores ≥6 categorised as moderate/high stress, and social support—defined as availability of someone to accompany participant to a clinic if needed (yes/no)

Displacement-specific factors (assessed only for IDPs): Duration of displacement (<2 years, 2–5 years, >5 years), Number of displacements (1, ≥2), Loss of property/assets during conflict (yes/no) and Witnessing violence during conflict (yes/no)

Clinical Management Protocol: Participants with average BP ≥160/100 mmHg or symptomatic hypertension were referred immediately to the nearest Primary Health Centre with a referral note. All participants received health education about hypertension and were provided with their BP readings. Newly diagnosed hypertensives were given information about free screening services available at PHCs.

Sample Size and Sampling Technique
Sample Size Determination
Sample size was calculated using the standard formula for comparing two independent proportions.
$n = (Z\alpha/2 + Z\beta)^2 \times [p_1(1-p_1) + p_2(1-p_2)] / (p_1-p_2)^2$
Where:
- $Z\alpha/2 = 1.96$ (95% confidence level)
- $Z\beta = 0.84$ (80% power)
- $p_1 = 0.32$ (estimated hypertension prevalence in host communities, derived from the Nigeria WHO STEPS survey)
- $p_2 = 0.42$ (estimated hypertension prevalence in IDPs, based on systematic review of conflict-affected populations in Sub-Saharan Africa)
- $(p_1-p_2) = 0.10$ (10% absolute difference)

The calculation yielded a baseline sample size of 362 participants per group. To account for the cluster sampling design (households within camps and communities), a design effect of 1.5 was applied, increasing the sample to 543 per group. An additional 10% was added to account for non-response and incomplete data, giving a final sample size of 604 participants per group, and a total sample of 1,208 participants.

5.2 Sampling Technique
A multi-stage sampling technique was employed:
Stage 1: Selection of LGAs and camps. Kachia, Kajuru, and Chukun LGAs were purposively selected based on documented conflict history and availability of demographic data from SEMA and NCFRMI. All camps listed in the official registry within these LGAs were included in the sampling frame.

Stage 2: Proportionate allocation by LGA. The 604 IDP samples were allocated proportionally across the three LGAs based on each LGA's share of the total adult IDP population. Kajuru received 483 samples (79.9%), Kachia 76 samples (12.6%), and Chukun 45 samples (7.5%).
Stage 3: Gender stratification within the IDP sample. To ensure the sample reflected the true gender distribution of the camps and allowed for gender-disaggregated analysis, men and women were sampled proportionally within each LGA based on the camp demographic data. This resulted in target samples of 204 men and 400 women across all IDP camps.
Stage 4: Selection of households. Within camps, systematic random sampling was used. An initial household was randomly selected, and subsequent households were chosen at a fixed interval (k = N/n). In host communities, a modified cluster sampling technique was used: communities were mapped, divided into zones, and households selected systematically from random starting points.
Stage 5: Selection of individual participants. In households with multiple eligible adults, the Kish method was used to randomly select one participant, ensuring balanced age and gender representation (Kish, 1949). Recruitment continued until the required number of men and women for each LGA was achieved.
Stage 6: Host community sampling. An equal number of host community participants (604) sampled, distributed proportionally across the three LGAs. A 50% male, 50% female split was targeted to serve as a balanced comparator group.

6. Data Measurement
6.1 Questionnaire Administration
Data were collected using a pretested, interviewer-administered structured questionnaire adapted from the WHO STEPS instrument for chronic disease risk factor surveillance . The questionnaire was translated into Hausa and Adara (the predominant local languages) and backtranslated into English to ensure accuracy. Trained research assistants fluent in these languages administered the questionnaire in private settings within participants' homes or camp shelters.
The questionnaire captured information on:
- Sociodemographic characteristics
- Conflict and displacement history (for IDPs)
- Behavioural risk factors (smoking, alcohol, diet, physical activity)
- Psychosocial factors (perceived stress, social support)
- Healthcare access and history (previous BP screening, treatment, medication adherence using the 4-item Morisky Medication Adherence Scale, MMAS-4) (10).

6.2 Clinical Measurements
Blood pressure measurement: Blood pressure was measured using validated, automated oscillometric monitors (OMRON M6). Participants were seated comfortably with their left arm supported at heart level and were required to rest for at least 10 minutes before measurement.

Three readings were taken at 3–5-minute intervals, and the average of the last two readings was recorded. Different cuff sizes were available to accommodate varying arm circumferences.

Anthropometric measurements: Weight was measured using a calibrated SECA scale to the nearest 0.1 kg, with participants wearing light clothing and no shoes. Height was measured using a portable stadiometer to the nearest 0.1 cm, with participants standing upright without shoes, with heels together and head positioned in the Frankfort plane. BMI was calculated as weight (kg) divided by height squared (m^2).

6.3 Quality Assurance

All research assistants underwent a three-day training programme covering ethical conduct, interview techniques, standardised administration of questionnaires, and correct use of BP monitors and weighing scales. Inter-rater reliability for BP measurement was assessed during training, with a target kappa statistic ≥0.80. The questionnaire was pre-tested on 5% of the sample size (60 individuals) in a similar conflict-affected community outside the study area (Zangon Kataf LGA) to assess clarity, comprehensibility, and cultural appropriateness. Cronbach's alpha was calculated to assess internal consistency of scaled items (PSS-4: α=0.78; MMAS-4: α=0.72).

7. Statistical Analysis

7.1 Data Management and Descriptive Analysis

Data were entered directly into tablet computers using the Open Data Kit (ODK) platform and exported to IBM SPSS Version 25 for cleaning and analysis. Data were checked for outliers, inconsistencies, and missing values. Continuous variables were assessed for normality using the Shapiro–Wilk test and visual inspection of histograms.

Descriptive statistics were computed for all variables. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean (standard deviation) for normally distributed data or median (interquartile range) for non-normally distributed data. Differences in sociodemographic characteristics between IDPs and hosts were assessed using the chi-square test for categorical variables and the independent t-test or Mann–Whitney U test for continuous variables.

7.2 Bivariate Analysis

Bivariate analysis was conducted to examine the crude association between each potential determinant and hypertension status, stratified by population group (IDPs vs. hosts). For categorical variables, chi-square tests were used; for continuous variables, independent t-tests or Mann–Whitney U tests were applied. Odds ratios (OR) with 95% confidence intervals (CI) were calculated using simple logistic regression. Variables with a p-value <0.20 in bivariate analysis were retained for inclusion in multivariable models (11).

7.3 Multivariable Analysis

Two separate multivariable logistic regression models were constructed—one for IDPs and one for hosts—to identify independent determinants of hypertension within each population. Variables meeting the bivariate screening threshold ($p<0.20$) were entered into the models using a purposeful selection approach (Hosmer et al., 2013). Adjusted odds ratios (AOR) with 95% CI were calculated, and statistical significance was set at $p<0.05$.

Multicollinearity among independent variables was assessed using variance inflation factors (VIF), with values >10 indicating problematic collinearity. Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test, with $p>0.05$ indicating adequate fit.

7.4 Interaction Analysis

To formally test whether displacement status modifies the effect of stress on hypertension, a pooled multivariable logistic regression model was constructed, including both IDPs and hosts. The model included:

- Main effect for displacement status (IDP vs. host)
- Main effect for perceived stress (moderate/high vs. low)
- Interaction term (displacement status × perceived stress)

The statistical significance of the interaction term was assessed at $p<0.05$. The odds ratio for stress among IDPs was calculated as the product of the main effect for stress and the interaction term (12).

7.5 Subgroup and Sensitivity Analyses

To explore whether determinants varied by gender, separate multivariable models were constructed for men and women within each population group, though these analyses were considered exploratory given the smaller sample sizes in some subgroups. Sensitivity analyses were conducted excluding participants with self-reported hypertension who were normotensive on measurement, to assess the impact of this definition on the findings.

8. Bias Mitigation

Several strategies were employed to minimise potential biases:

Selection bias: The use of true demographic data from SEMA and NCFRMI to construct the sampling frame ensured that the sample accurately reflected the age and gender distribution of the camp populations. Systematic random sampling within camps and communities reduced the risk of selective enrolment. The Kish method for selecting individual participants within households prevented within-household selection bias (13) .

Information bias: Standardised, internationally validated instruments (WHO STEPS, PSS-4, GPAQ, MMAS-4) were used to ensure consistency and comparability of measurements. Research assistants underwent rigorous training and standardisation of BP measurement protocols, with inter-rater reliability assessed before fieldwork commenced. The use of automated BP monitors eliminated observer bias in reading measurements.

Questionnaires were translated into local languages and pretested to ensure comprehension and cultural appropriateness, reducing the risk of misinterpretation.

Recall bias: To minimise recall bias for displacement-related exposures, participants were asked about specific, salient events (number of times displaced, witnessed violence) rather than subjective estimates. For behavioural factors, standardised recall periods (past 7 days for physical activity, past 30 days for alcohol consumption) were used as per WHO STEPS guidelines.

Social desirability bias: Interviews were conducted in private settings by trained research assistants who were not members of the participants' communities. The sensitive nature of questions about alcohol use, trauma, and displacement was acknowledged, and participants were reassured about confidentiality. The use of local language interviewers helped build rapport and trust.

Confounding: Multivariable logistic regression was used to adjust potential confounders simultaneously. The inclusion of displacement-specific variables alongside conventional risk factors allowed for examination of independent effects. Stratified models for IDPs and hosts further controlled for confounding by population group.

Missing data: The proportion of missing data was low (<3% for any variable) due to real-time data entry with built-in validation checks. Where missing data occurred, list wise deletion was used for multivariable analysis, as the proportion was below the threshold where imputation would substantially alter results (14).

Security-related bias: Ongoing insecurity in parts of Southern Kaduna posed a risk of selection bias if the most dangerous areas were inaccessible. The research team worked closely with local security committees to ensure safety and documented all deviations from the sampling plan. Sensitivity analyses comparing accessible and partially accessible areas were planned but not implemented due to the overall high response rate (94.3%).

Ethical Considerations

Ethical approval was obtained from the Kaduna State Health Research Ethics Committee. The study design and implementation were discussed with community leaders and camp coordinators in each LGA before data collection. Findings will be disseminated through community meetings, summary reports to SEMA and NCFRMI, and policy briefs for the Kaduna State Ministry of Health.

All participants provided written informed consent after receiving detailed explanations of the study's purpose, procedures, potential benefits and risks, and their rights to withdraw at any time without consequence. For participants with limited literacy, the consent form was read aloud in the presence of a witness, and thumbprint impressions were accepted in place of signatures.

Results

Participant Characteristics

Response Rate

A total of 1,208 adults were enrolled in the study, comprising 604 internally displaced persons and 604 host community members, distributed across the three LGAs as per the sampling framework. The overall response rate was 94.3%, with 72 individuals (5.7%) either declining participation or providing incomplete data. Non-response was higher in Kachia LGA (8.1%) due to security concerns during data collection periods. The final analytical sample comprised 1,148 participants—574 IDPs and 574 host community members.

Socio-Demographic Characteristics

The socio-demographic characteristics of participants, stratified by population groups, are presented in Table 4.1. The sampling strategy successfully achieved the predetermined gender stratification: among IDPs, 380 women (66.2%) and 194 men (33.8%) were enrolled, precisely matching the camp demographic structure where women constitute 66.2% of the adult population (target: 400 women, achieved 95.0% of target; target: 204 men, achieved 95.1%). Among hosts, a balanced 50.9% female (n=292) and 49.1% male (n=282) sample was achieved.

Table 4.1: Socio-Demographic Characteristics of Participants by Population Group

Characteristic	Category	IDPs (n=574) n (%)	Hosts (n=574) n (%)	Total (N=1,148) n (%)	χ^2	p-value
Age Group (years)	18–34	198 (34.5)	212 (36.9)	410 (35.7)	8.24	0.041
	35–49	241 (42.0)	208 (36.2)	449 (39.1)		
	50–64	98 (17.1)	112 (19.5)	210 (18.3)		
	≥65	37 (6.4)	42 (7.3)	79 (6.9)		
Sex	Male	194 (33.8)	282 (49.1)	476 (41.5)	28.46	<0.001
	Female	380 (66.2)	292 (50.9)	672 (58.5)		
Marital Status	Married	412 (71.8)	438 (76.3)	850 (74.0)	5.92	0.052
	Single	89 (15.5)	92 (16.0)	181 (15.8)		
	Widowed/Divorced	73 (12.7)	44 (7.7)	117 (10.2)		
Education Level	None	267 (46.5)	128 (22.3)	395 (34.4)	89.34	<0.001
	Primary	181 (31.5)	192 (33.4)	373 (32.5)		
	Secondary	98 (17.1)	178 (31.0)	276 (24.0)		
	Tertiary	28 (4.9)	76 (13.2)	104 (9.1)		
Occupation	Farming	198 (34.5)	312 (54.4)	510 (44.4)	62.18	<0.001
	Trading	112 (19.5)	124 (21.6)	236 (20.6)		
	Artisan	67 (11.7)	58 (10.1)	125 (10.9)		
	Unemployed	176 (30.7)	58 (10.1)	234 (20.4)		
	Civil Service	21 (3.7)	22 (3.8)	43 (3.7)		
Monthly Income	<₦30,000	412 (71.8)	286 (49.8)	698 (60.8)	58.67	<0.001
	₦30,000–₦50,000	112 (19.5)	168 (29.3)	280 (24.4)		
	>₦50,000	50 (8.7)	120 (20.9)	170 (14.8)		
Household Size	1–4 persons	187 (32.6)	212 (36.9)	399 (34.8)	2.98	0.225
	5–7 persons	268 (46.7)	248 (43.2)	516 (45.0)		
	≥8 persons	119 (20.7)	114 (19.9)	233 (20.3)		

***Note**: χ^2 tests with degrees of freedom: Age group (df=3), Sex (df=1), Marital status (df=2), Education (df=3), Occupation (df=4), Income (df=2), Household size (df=2).*

The demographic profile reveals significant disparities between IDPs and host communities. IDPs had substantially lower educational attainment, with 46.5% having no formal education compared to 22.3% of hosts (p<0.001). Unemployment was three times higher among IDPs (30.7% vs. 10.1%, p<0.001), and the proportion earning below ₦30,000 monthly was significantly higher in the IDP population (71.8% vs. 49.8%, p<0.001). These differences reflect the economic devastation wrought by displacement, where livelihoods are disrupted and assets lost.

Determinants of Hypertension

Bivariate Analysis of Factors Associated with Hypertension

Bivariate analysis was conducted to examine the association between each potential determinant and hypertension status, stratified by population group. The results are presented in Table 4.2. Variables with p<0.20 were retained for multivariable analysis.

Table 4.2: Bivariate Analysis of Factors Associated with Hypertension

Variable	Category	IDPs		Hosts	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age (per 10-year increase)		2.18 (1.82–2.61)	<0.001	2.06 (1.71–2.48)	<0.001
Sex	Male	Reference		Reference	
	Female	1.26 (0.89–1.78)	0.182	0.88 (0.61–1.26)	0.421
Education	None	Reference		Reference	
	Primary	0.78 (0.53–1.14)	0.198	0.81 (0.52–1.26)	0.351
	Secondary+	0.52 (0.32–0.85)	0.009	0.59 (0.38–0.92)	0.019
Income	<₦30,000	Reference		Reference	
	≥₦30,000	0.68 (0.46–1.01)	0.054	0.71 (0.49–1.03)	0.068
Smoking	Never	Reference		Reference	
	Current/Former	1.42 (0.91–2.22)	0.118	1.38 (0.88–2.16)	0.157
Alcohol use	Never	Reference		Reference	
	Current	1.31 (0.89–1.93)	0.172	1.24 (0.84–1.83)	0.271
Physical inactivity	Active	Reference		Reference	
	Inactive	1.58 (1.11–2.25)	0.011	1.49 (1.03–2.15)	0.032
High salt intake	No	Reference		Reference	
	Yes	1.87 (1.32–2.65)	<0.001	1.71 (1.19–2.46)	0.004
BMI category	Normal	Reference		Reference	
	Overweight	1.92 (1.28–2.88)	0.002	1.84 (1.22–2.78)	0.003
	Obese	2.68 (1.68–4.28)	<0.001	2.51 (1.58–3.99)	<0.001
Perceived stress	Low	Reference		Reference	
	Moderate/High	2.14 (1.51–3.04)	<0.001	1.62 (1.12–2.35)	0.010
Displacement-specific factors					
Duration of displacement	<2 years	Reference		—	
	2–5 years	1.48 (0.94–2.33)	0.089	—	
	>5 years	2.12 (1.32–3.41)	0.002	—	
Number of displacements	1	Reference		—	
	≥2	1.76 (1.18–2.62)	0.005	—	
Lost property/assets	No	Reference		—	
	Yes	1.92 (1.28–2.88)	0.002	—	
Witnessed violence	No	Reference		—	
	Yes	1.68 (1.14–2.48)	0.008	—	

Among IDPs, all displacement-specific factors showed significant associations with hypertension. Duration of displacement exceeding five years more than doubled the odds of hypertension (OR=2.12, 95% CI: 1.32–3.41), while multiple displacements (OR=1.76), loss of property (OR=1.92), and witnessing violence (OR=1.68) were also strongly associated.

Multivariable Logistic Regression: Determinants of Hypertension Among IDPs

Variables with p<0.20 in bivariate analysis were entered into multivariable logistic regression models, constructed separately for IDPs and hosts to allow comparison of determinant patterns. Table 4.3 presents the results for IDPs.

Table 4.3: Multivariable Logistic Regression — Determinants of Hypertension Among IDPs (n=574)

Variable	Category	Adjusted Odds Ratio (AOR)	95% CI	p-value
Age	Per 10-year increase	2.08	1.71–2.53	<0.001
Sex	Male	Reference		
	Female	1.18	0.79–1.76	0.412
Education	None/Primary	Reference		
	Secondary+	0.61	0.36–1.03	0.064
Physical inactivity	No	Reference		
	Yes	1.42	0.96–2.10	0.078
High salt intake	No	Reference		
	Yes	1.69	1.15–2.48	0.007
BMI	Normal	Reference		
	Overweight/Obese	2.21	1.51–3.23	<0.001
Perceived stress	Low	Reference		
	Moderate/High	1.78	1.21–2.62	0.003
Duration displaced	<2 years	Reference		
	2–5 years	1.38	0.85–2.24	0.192
	>5 years	1.89	1.14–3.13	0.013
Number of displacements	1	Reference		
	≥2	1.58	1.03–2.42	0.036
Witnessed violence	No	Reference		
	Yes	1.52	1.00–2.31	0.049

Among IDPs, the strongest independent determinants were age (AOR=2.08 per decade), overweight/obesity (AOR=2.21), and displacement duration exceeding five years (AOR=1.89). The persistence of displacement-related factors—multiple displacements (AOR=1.58) and witnessing violence (AOR=1.52)—after adjusting for conventional risk factors demonstrates that conflict exposure exerts an independent effect on hypertension risk, beyond its influence on lifestyle and socioeconomic status. High salt intake (AOR=1.69) and perceived stress (AOR=1.78) also remained independently associated.

The Hosmer–Lemeshow test indicated good model fit (χ^2=6.84, p=0.554), and variance inflation factors were all below 2.5, indicating no problematic multicollinearity.

Multivariable Logistic Regression: Determinants of Hypertension Among Hosts

Table 4.4 presents the multivariable results for host community members.

Table 4.4: Multivariable Logistic Regression — Determinants of Hypertension Among Hosts (n=574)

Variable	Category	Adjusted Odds Ratio (AOR)	95% CI	p-value
Age	Per 10-year increase	1.98	1.62–2.42	<0.001
Sex	Male	Reference		
	Female	0.84	0.57–1.24	0.378
Education	None/Primary	Reference		
	Secondary+	0.68	0.44–1.05	0.082
Physical inactivity	No	Reference		
	Yes	1.38	0.93–2.05	0.108
High salt intake	No	Reference		
	Yes	1.58	1.07–2.33	0.020
BMI	Normal	Reference		
	Overweight/Obese	2.08	1.42–3.05	<0.001
Perceived stress	Low	Reference		
	Moderate/High	1.42	0.95–2.12	0.086

Among hosts, the determinant pattern was more conventional, with age (AOR=1.98 per decade), BMI (AOR=2.08), and high salt intake (AOR=1.58) emerging as significant independent determinants. Notably, perceived stress was not independently associated with hypertension in the host population after adjustment (AOR=1.42, p=0.086), contrasting sharply with its strong effect among IDPs (AOR=1.78, p=0.003). This divergence suggests that the stress of displacement is qualitatively different from everyday stressors faced by stable populations.

The Hosmer–Lemeshow test indicated good model fit (χ^2=5.91, p=0.657), and variance inflation factors were all below 2.5.

Comparison of Determinants Between IDPs and Hosts

Table 4.5 presents a comparative summary of independent determinants identified in the two populations.

Table 4.5: Comparative Summary of Independent Determinants of Hypertension

Determinant	IDPs (AOR, 95% CI)	Hosts (AOR, 95% CI)
Age (per decade)	2.08 (1.71–2.53)***	1.98 (1.62–2.42)***
Overweight/Obese	2.21 (1.51–3.23)***	2.08 (1.42–3.05)***
High salt intake	1.69 (1.15–2.48)**	1.58 (1.07–2.33)*
Perceived stress	1.78 (1.21–2.62)**	1.42 (0.95–2.12)
Duration displaced (>5 years)	1.89 (1.14–3.13)*	—
Multiple displacements (≥2)	1.58 (1.03–2.42)*	—
Witnessed violence	1.52 (1.00–2.31)*	—

****p<0.001, **p<0.01, p<0.05*

Three key observations emerge from this comparison. First, conventional risk factors—age, overweight/obesity, and high salt intake—operate similarly in both populations, with comparable effect sizes. Second, displacement-specific factors (prolonged displacement, multiple displacements, witnessed violence) independently predict hypertension among IDPs after controlling for conventional risks. Third, perceived stress is a significant determinant only among IDPs, suggesting that the nature and intensity of stress experienced by displaced persons differ fundamentally from that experienced by stable populations.

Interaction Analysis: Displacement Modifies the Effect of Stress

To formally test whether displacement status modifies the effect of stress on hypertension, an interaction term (displacement status × perceived stress) was included in a pooled multivariable model incorporating both populations (N=1,148). The results are presented in Table 4.6.

Table 4.6: Interaction Effect — Displacement Status and Perceived Stress

Model	AOR	95% CI	p-value
Main effect: Displacement (IDP vs. Host)	1.58	1.18–2.12	0.002
Main effect: Moderate/High stress	1.38	0.98–1.94	0.064
Interaction: Displacement × Stress	**1.52**	**1.05–2.21**	**0.028**

The interaction term was statistically significant (p=0.028), confirming that the association between stress and hypertension differs by displacement status. The odds ratio for stress among hosts is 1.38 (non-significant), while the odds ratio for stress among IDPs is the product of the main effect and the interaction: 1.38 × 1.52 = 2.10. Thus, stress more than doubles hypertension odds among IDPs but has no significant effect among hosts a striking illustration of how displacement amplifies vulnerability to the cardiovascular consequences of psychosocial stress.

Summary of Key Findings

Table 4.7: Summary of Key Findings on Determinants of Hypertension

Finding	Statistical Evidence	Interpretation
Conventional risk factors operate similarly	Age: AOR≈2.0 per decade in both groups BMI: AOR≈2.1 in both groups Salt: AOR≈1.6 in both groups	The biological pathways linking age, adiposity, and diet to hypertension are preserved despite displacement
Displacement-specific factors independently predict hypertension	Duration >5 years: AOR=1.89 Multiple displacements: AOR=1.58 Witnessed violence: AOR=1.52	Conflict exposure exerts effects beyond those mediated through conventional risk factors
Stress effect is modified by displacement	Interaction AOR=1.52, p=0.028 Stress OR among IDPs=2.10 Stress OR among hosts=1.38 (ns)	The traumatic stress of displacement is qualitatively different from everyday stress
Conventional determinants alone insufficient for IDPs	Displacement-specific variables retained significance after adjustment	Risk prediction models for displaced populations must include conflict-related exposures

These findings demonstrate that hypertension in conflict-affected populations cannot be fully understood through conventional risk factor frameworks alone. Displacement-specific exposures—prolonged displacement, repeated displacement, and witnessed violence—independently contribute to hypertension burden, and the physiological impact of stress is amplified among those who have experienced displacement. Effective intervention strategies must address both conventional risk factors and the unique psychosocial consequences of conflict and displacement.

Discussion of findings

Summary of Major Findings

This study produced four major findings. First, conventional risk factors—age, overweight/obesity, and high salt intake—independently predicted hypertension in both populations with comparable effect sizes. Age approximately doubled odds per decade; overweight/obesity more than doubled odds; and high salt intake increased odds by 60–70%. These findings confirm that fundamental biological pathways linking these factors to hypertension are preserved despite displacement.

Second, displacement-specific exposures independently predicted hypertension among IDPs after adjusting for conventional risk factors. Prolonged displacement exceeding five years nearly doubled hypertension odds (AOR=1.89); multiple displacements increased odds by 58% (AOR=1.58); and witnessing violence increased odds by 52% (AOR=1.52). These findings demonstrate that specific conflict-related exposures capture cardiovascular risk beyond displacement status alone.

Third, the relationship between perceived stress and hypertension was significantly modified by displacement status. Among hosts, stress showed no independent association with hypertension after adjustment. Among IDPs, stress more than doubled hypertension odds (AOR=1.78), with formal interaction testing confirming effect modification (interaction AOR=1.52, p=0.028). This indicates that displacement amplifies physiological vulnerability to psychosocial stress.

Fourth, despite marked socioeconomic disparities between IDPs and hosts, these factors did not retain independent associations with hypertension after multivariable adjustment, suggesting that displacement-specific psychosocial exposures may mediate conventional socioeconomic pathways.

Interpretation and Discussion of Results

The finding that conventional risk factors operate similarly in both populations aligns robustly with global literature. The age-hypertension gradient is consistent with the Nigeria WHO STEPS survey (2) international meta-analyses (15) The strong BMI-hypertension association mirrors Stephen and colleagues' finding that conflict-affected populations in Northeastern Nigeria had nearly double the odds of abdominal obesity(7). The independent effect of high salt intake is well-documented and has particular relevance in humanitarian settings where displaced populations often rely on preserved foods with high sodium content(7) .

The identification of prolonged displacement, multiple displacements, and witnessed violence as independent predictors represents a novel contribution. While Stephen and colleagues documented increased depression and obesity risk among conflict-exposed individuals, their study did not examine whether specific displacement characteristics independently predicted cardiovascular outcomes ((7). Our findings extend this work by demonstrating dose-response relationships: longer displacement and repeated displacement confer greater risk, patterns that align with research among Syrian refugees in Jordan (16) and multi-country studies of conflict-affected populations (17).

The finding that displacement status modifies the stress-hypertension relationship is the first formal demonstration of this interaction in a Nigerian conflict-affected population. The interaction AOR of 1.52 indicates that the same level of perceived stress has 52% greater effect on hypertension odds among IDPs than among hosts, challenging the assumption that stress operates uniformly across populations.

Biological and Epidemiological Plausibility

The observed relationships are supported by well-established biological mechanisms. Chronic stress activates the sympathetic nervous system and hypothalamic-pituitary-adrenal axis, leading to sustained elevations in cortisol, catecholamines, and inflammatory markers (8). These neuroendocrine changes promote endothelial dysfunction, arterial stiffness, sodium retention, and sustained blood pressure elevation.

Among displaced populations, this physiological burden is amplified. Stressors are chronic and unpredictable; protective factors—social networks, predictable routines, and healthcare access—are disrupted; and co-exposures such as malnutrition and sleep deprivation may synergistically increase

cardiovascular vulnerability. The dose-response relationships observed support a cumulative burden model, aligning with allostatic load theory, which posits that chronic stress exposure leads to cumulative physiological dysregulation across multiple systems (8).

Contextual Analysis

Several contextual factors specific to Southern Kaduna influenced the observed outcomes. The protracted nature of conflict—spanning decades—means many IDPs have experienced repeated displacement, reflected in our finding that 34% reported two or more displacements. The demographic structure of camps—women constituting 66.2% of the adult population—reflects conflict-related male mortality and labour migration, with women bearing cumulative burdens of caregiving and psychological stress.

The collapse of livelihoods and extreme poverty among IDPs (71.8% earning below ₦30,000 monthly) shapes every aspect of cardiovascular health, constraining dietary choices, limiting healthcare access, and generating chronic stress. The security situation—with active banditry and ethno-religious violence—means displacement is an ongoing reality, sustaining neuroendocrine activation. Limited health infrastructure—understaffed PHCs, frequent drug stock-outs, absence of screening programmes—means hypertension remains largely undetected, with 46.1% of hypertensive IDPs newly diagnosed during this survey.

Implications of the Study

Clinical and Practical Implications

Conventional cardiovascular risk assessment focusing on age, BMI, and diet is necessary but insufficient for displaced populations. Clinicians should systematically assess displacement history, including duration, number of displacements, and violence exposure, as these factors independently predict hypertension and identify individuals requiring prioritised intervention.

The finding that stress more than doubles hypertension odds among IDPs—but not among hosts—suggests that psychosocial support should be integrated into hypertension care. Screening for psychological distress, mental health first aid, and referral to counselling services should accompany pharmacological treatment. The current separation of mental health and NCD services in humanitarian responses is neither clinically nor scientifically justified.

The high proportion of newly diagnosed hypertension underscores the urgent need for systematic screening in camp settings. Community-based screening campaigns, using validated automated BP monitors and linked directly to treatment initiation, are essential. Community health workers based within camps could provide ongoing monitoring, adherence support, and early referral.

The independent effect of high salt intake highlights an actionable intervention point. Nutrition education tailored to camp life—addressing salt reduction when relying on relief food, promoting local herbs for flavouring, advocating for lower-sodium food aid—could complement pharmacological treatment.

Policy Implications

At the state level, these findings provide Kaduna State's Ministry of Health with locally generated evidence to guide the "Project 10 Million" screening initiative. Targeted outreach strategies—mobile clinics, camp-based screening, elimination of out-of-pocket costs for diagnosed hypertensives—are essential to reach displaced populations.

At the national level, the findings support advocacy for including NCD care in humanitarian response frameworks. Nigeria's humanitarian health responses have historically focused on communicable diseases, maternal and child health, and malnutrition. This study demonstrates that NCDs affect a substantial proportion of displaced adults (42.3% hypertension prevalence) and that ignoring these conditions perpetuates suffering. The National Policy on Internally Displaced Persons should be revised to explicitly address NCD prevention and control.

For humanitarian actors, the findings underscore the need to integrate mental health and NCD services. The interaction between displacement and stress demonstrates that these are interconnected dimensions of health in humanitarian crises. Funding streams, programmatic frameworks, and monitoring systems should reflect this integration.

The findings also have implications for food aid policy. The independent effect of high salt intake, combined with qualitative accounts of reliance on relief food, suggests that the nutritional quality of food assistance matters for chronic disease prevention. Agencies should prioritise lower-sodium options and include nutrition education on salt reduction.

Theoretical Contributions

This study makes several theoretical contributions. First, it demonstrates that displacement is not merely a social category but a biological exposure with measurable physiological consequences. The dose-response relationships observed support conceptualising displacement as a continuum of exposure rather than a binary status.

Second, the finding that displacement modifies the stress-hypertension relationship extends allostatic load theory to humanitarian contexts, demonstrating that the physiological impact of stress is amplified among those who have experienced traumatic displacement.

Third, the study contributes to emerging frameworks integrating social determinants, psychosocial factors, and conflict-specific exposures in understanding cardiovascular health disparities, supporting the development of expanded frameworks that include displacement characteristics, trauma exposure, and stress-process interactions.

Limitations of the Study

Several limitations must be acknowledged. The cross-sectional design precludes causal inference; longitudinal studies are needed to establish temporal sequences. Self-reported data on sensitive behaviours and trauma exposure are subject to recall and social desirability bias, though standardised

questionnaires, trained local language interviewers, and private settings mitigated this.

Perceived stress was measured using the PSS-4, which may not fully capture cumulative, traumatic stress. Future studies should incorporate trauma-specific measures and biological markers. Despite adjusting for comprehensive confounders, residual confounding remains possible.

Selection bias may have occurred as the sampling frame used official registries that may not capture all displaced persons, particularly those in informal settlements. Security constraints limited access to some remote areas, though the high response rate (94.3%) mitigates this concern.

Findings are specific to three LGAs in Southern Kaduna and may not be generalizable to all conflict-affected populations, though consistency with studies from Northeastern Nigeria and Benue State suggests broader relevance. Pregnant women were excluded, leaving hypertension in pregnancy unexamined. Gender subgroup analyses were exploratory due to limited sample sizes in some locations.

Generalizability (External Validity)

The generalizability of findings from this study must be considered within the context of its design and setting. The study was conducted in three Local Government Areas of Southern Kaduna—Kachia, Kajuru, and Chukun—selected due to their documented history of protracted ethno-religious and farmer-herder conflicts. As such, the findings are most directly applicable to displaced populations residing in formal and informal camps within similar rural, conflict-affected regions of Northwestern Nigeria.

Several factors may limit extrapolation to other settings. First, conflict dynamics vary considerably across regions—the insurgency in Northeastern Nigeria, farmer-herder conflicts in the Middle Belt, and banditry in the Northwest differ in their intensity, duration, and patterns of displacement. These variations may influence the nature and severity of trauma exposure, the demographic composition of displaced populations, and the availability of coping resources. Second, healthcare infrastructure, humanitarian response mechanisms, and socioeconomic conditions differ across states, potentially modifying the relationships between displacement exposures and hypertension outcomes. Third, ethnic and cultural differences may shape dietary practices, stress appraisal, and health-seeking behaviours in ways that could alter the observed associations.

However, several considerations support cautious generalisation. The consistency of our findings with studies from Northeastern Nigeria (7) and Benue State (9) suggests that the underlying biological and psychosocial pathways linking displacement to hypertension may operate similarly across conflict contexts. The conventional risk factor associations—age, BMI, salt intake—are biologically fundamental and likely universal. The dose-response relationships observed for displacement duration and frequency align with cumulative stress models that transcend geographic boundaries.

Furthermore, the finding that displacement modifies the stress-hypertension relationship may represent a generalizable phenomenon, as the qualitative nature of traumatic stress—loss, insecurity, existential threat shares core features across humanitarian crises.

Thus, while the findings are statistically representative of the three LGAs studied, they offer analytical generalizability to theoretical propositions about displacement, stress, and cardiovascular health. Researchers and policymakers in other conflict-affected regions should interpret these findings as providing plausible hypotheses and comparative reference points, while recognising the need for local contextualisation.

Recommendations

Recommendations for Future Research

Longitudinal studies following newly displaced populations over time are urgently needed to establish causal relationships. Mechanistic studies incorporating biomarkers (cortisol, inflammatory markers) and ambulatory blood pressure monitoring could elucidate pathways linking trauma to cardiovascular outcomes. Intervention research is needed to determine which service delivery models are most effective and cost-effective. Dedicated studies examining hypertension in pregnancy among displaced women are required. Comparative research across conflict settings in Nigeria would enable meta-analysis and identification of context-specific versus universal determinants. Qualitative research exploring how displaced persons understand links between experiences and health could inform culturally appropriate interventions.

Actionable Recommendations for Stakeholders

For Kaduna State Ministry of Health: Integrate displacement history into routine cardiovascular assessment under "Project 10 Million." Establish camp-based hypertension screening and treatment programmes with monthly outreach clinics. Provide free antihypertensive medications for diagnosed IDPs. Train health workers in trauma-informed care.

For humanitarian actors and NGOs: Integrate NCD screening into emergency responses. Support community health worker programmes recruiting displaced persons. Address food quality in relief supplies by advocating for lower-sodium options. Integrate mental health and NCD services with established referral pathways.

For national policymakers: Revise the National Policy on Internally Displaced Persons to explicitly address NCD prevention and control. Include NCDs in humanitarian response frameworks with dedicated funding and supply chains. Strengthen health system capacity to serve displaced populations through regular drug supplies and trained personnel.

Contribution to Knowledge

This study makes several original contributions to scientific literature on hypertension in conflict-affected populations.

First, it provides the first comprehensive empirical evidence on the determinants of hypertension among internally displaced persons and host communities in Southern Kaduna, addressing a significant geographic gap in Nigerian NCD research. Previous studies have concentrated on Northeastern Nigeria (7) and Benue State (9) , leaving other violence-prone regions empirically neglected. By extending inquiry to Southern Kaduna, this study enables comparative analysis across Nigerian conflict zones and establishes baseline data for future research and intervention.

Second, the study demonstrates that displacement-specific exposures—prolonged displacement exceeding five years, multiple displacements, and witnessed violence—independently predict hypertension after controlling conventional risk factors. While previous research has documented associations between conflict exposure and mental health outcomes or obesity (7) , this study is the first to systematically examine and quantify the independent effects of specific displacement characteristics on hypertension risk. The dose-response relationships observed strengthen causal inference and support conceptualising displacement as a continuum of exposure rather than a binary status.

Third, this study provides the first formal demonstration of effect modification by displacement status on the stress-hypertension relationship in a Nigerian conflict-affected population. The finding that stresses more than doubles hypertension odds among IDPs while having no independent effect among hosts—with a statistically significant interaction (AOR=1.52, p=0.028)—represents a novel contribution to the literature. It challenges the assumption that stress operates uniformly across populations and suggests that the traumatic stress of displacement is qualitatively different from everyday stress in its physiological consequences. This finding extends allostatic load theory (8) to humanitarian contexts, demonstrating that the context in which stress is experienced fundamentally shapes its biological impact.

Fourth, the study advances methodological practice in humanitarian NCD research by demonstrating the value of true demographic data from SEMA and NCFRMI for constructing sampling frames, ensuring accurate representation of camp populations. The proportionate allocation by LGA and gender stratification based on actual camp demographics provides a model for future research in hard-to-reach humanitarian settings where census data are often unavailable or unreliable.

Fifth, the study contributes to theoretical frameworks for understanding cardiovascular health disparities in conflict settings. By demonstrating that conventional risk factors operate similarly in both populations while displacement-specific exposures confer additional risk, the findings support the development of expanded conceptual models that integrate biological, psychosocial, and conflict-specific determinants. This has implications for risk prediction, intervention design, and health system planning.

Finally, by documenting the failure of current health systems to reach displaced populations—with 46.1% of hypertensive IDPs newly diagnosed during this survey—the study provides an evidence base for advocacy and programmatic action. It demonstrates that ignoring NCDs in humanitarian responses is not merely a research gap but a moral failure with measurable consequences for some of Nigeria's most vulnerable populations. The findings support the imperative to integrate NCD care into emergency response frameworks and to address the structural determinants of health inequity in conflict settings.

Conclusion

This study provides the first comprehensive evidence on the determinants of hypertension among internally displaced persons and host communities in conflict-affected Southern Kaduna. The findings demonstrate that hypertension cannot be fully understood through conventional risk factor frameworks alone. While age, overweight/obesity, and high salt intake operate similarly in both populations, displacement-specific exposures—prolonged displacement, multiple displacements, witnessed violence—independently contribute to cardiovascular risk. Critically, the relationship between psychosocial stress and hypertension is significantly modified by displacement status: stress more than doubles hypertension odds among IDPs while having no independent effect among hosts.

These findings have profound implications. They demonstrate that displacement is a biological exposure with measurable health consequences, that conventional cardiovascular risk assessment misses half the story for displaced populations, and that current health systems are failing those most in need, with 46.1% of hypertensive IDPs diagnosed for the first time during this survey.

The humanitarian imperative is clear. The women who run to clinics through unsafe roads, the elderly men choosing between feeding their children and buying medicine, the survivors who have lost everything—these are not abstract statistics but the human faces of health inequity in conflict settings. Hypertension does not pause during displacement; it accelerates. The health system's failure to respond compounds to the original trauma of displacement.

This study contributes to a growing evidence base demonstrating that non-communicable diseases must be central to humanitarian response. The determinants of hypertension in conflict-affected populations are multiple and interconnected: biological and psychosocial, individual and structural, conventional and conflict-specific. Addressing them requires integrated responses combining screening and treatment with mental health support, economic empowerment, and health system strengthening.

Ultimately, this study is a call to action. The evidence is now clear: displaced persons in Southern Kaduna bear a disproportionate hypertension burden driven by factors directly attributable to conflict. Addressing this burden is not merely a matter of clinical effectiveness but of basic human rights. Those who have lost homes, livelihoods, and loved ones should also not lose their lives to a silent, treatable condition

because the health system failed to reach them. The question is no longer whether displacement affects cardiovascular health, but whether we will act on what we now know.

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