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# From Food Access to Dietary Outcomes: Relationship between Food Security and Diet Quality in Nigeria's Food Belt

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## Abstract

**Background:** Food security and diet quality are interlinked but underexplored among farming households in Nigeria. This study used mixed-methods to examine this relationship in Nigeria's North Central zone, the primary food belt. **Methods:** Quantitative analysis utilized food insecurity (Food Insecurity Experience Scale (FIES), Food Consumption Score (FCS)) and Diet Quality Questionnaire (DQQ) data from 951 respondents in the 2023/2024 General Household Survey. Qualitative data were collected through interviews and focus groups with farmers, nutrition desk officers, and community members to capture perceptions of food access, preferences, and coping strategies. **Results:** Minimum dietary diversity score (DDS) and consumption of all five recommended food groups (All-5) was achieved by 31.1% and 14.2% of respondents, respectively. Prevalence of food insecurity differed by assessment method—44.5% for FIES and 22.2% for FCS. Food insecurity defined by FIES significantly increased odds of DDS (OR: 1.61, 95% CI 1.06 - 2.44), while poor/borderline FCS reduced DDS (OR: 0.22, 95% CI 0.11 - 0.45) and All-5 (OR: 0.20, 95% CI 0.06 - 0.62) odds. Qualitative narratives showed that diets were strongly influenced by agricultural seasonality and limited purchasing power. Coping mechanisms included reduced meal frequency, shift to cheaper staples, and substituting preferred foods with less nutritious alternatives. **Conclusion:** Farming households faced concurrent food insecurity and poor diet quality. Food security did not always translate to adequate diet quality. Policies must go beyond food access to address optimal diet quality. Differences in the relationship between FIES and FCS and diet quality may reflect different recall periods—30 days, 7 days, and 24 hours for FIES, FCS, and DQQ, respectively, and warrant further study.

**Keywords**

Food Security, Diet Quality, Dietary Diversity, Nutrition, Farming Households, Africa, Mixed Methods

## 1. Introduction

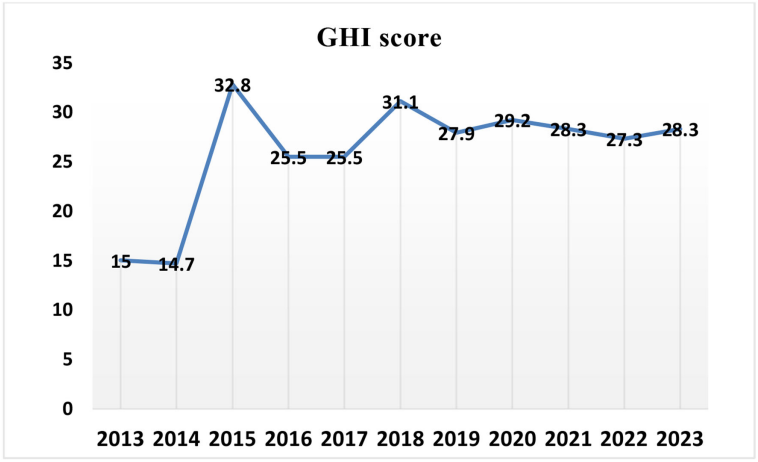
Food security remains a pressing global challenge, with an estimated 2.4 billion people experiencing moderate to severe food insecurity in 2022 [1]. In Sub-Saharan Africa, farming households paradoxically represent one of the groups most vulnerable to food insecurity, despite being primary food producers [2]. Beyond access to food, the quality of diets actually consumed by individuals within these households is of growing concern, as monotonous diets dominated by starchy staples often lead to hidden hunger and micronutrient deficiencies [3]. This dual challenge of ensuring both sufficient household food access and adequate individual diet quality underscores the urgency of research on the interconnections between food security and diet quality in rural farming contexts.

Existing approaches to addressing food insecurity have ranged from national-level agricultural policies and social protection programmes to household-level interventions such as improved crop production, livelihood diversification, and nutrition education [4] [5]. These efforts have shown varying degrees of success but have rarely captured the complex relationships between household food access, coping strategies, and the quality of diets consumed by different household members. Tools such as the Household Food Insecurity Access Scale (HFIAS), Food Consumption Score (FCS) and Household Dietary Diversity Score (HDDS) are widely applied to measure household food access [6]. However, these household-level measures do not necessarily reflect diet quality at the individual level, as they do not account for intrahousehold food allocation, individual nutrient needs, or nutrient density. Experience-based measures are also influenced by subjective perceptions.

The best practice, therefore, increasingly involves integrating multiple approaches, combining experiential, consumption, and coping-mechanism assessments, to capture a more holistic view of household food security; and complementing these with individual-level diet quality metrics where possible [7]. Yet, in Nigeria, evidence on the linkage between these two dimensions remains limited, particularly among farming households in the North Central zone, where seasonal food shortages, post-harvest losses, and high food prices persist despite high agricultural productivity potential [8].

Issues of food security and hunger remain areas of concern in Nigeria. A 2023 report by the United Nations Children's Fund (UNICEF) estimated that 25 million Nigerians were at risk of experiencing hunger [9]. The Global Hunger Index (GHI), which measures and tracks hunger at global, regional, and country levels, classifies hunger into five categories: low (≤9.9), moderate (10.0 - 19.9), serious

(20.0 - 34.9), alarming (35.0 - 49.9), and extremely alarming (≥50). According to its 2023 report, Nigeria was categorized as "serious" with a score of 28.3%, ranking 109th out of 125 countries [10]. **Figure 1** illustrates the trend of Nigeria's GHI scores over the past decade.




Source: GHI report (2013-2023), developed by the authors.

**Figure 1.** Trends in the Global Hunger Index score for Nigeria over the past 10 years [10].

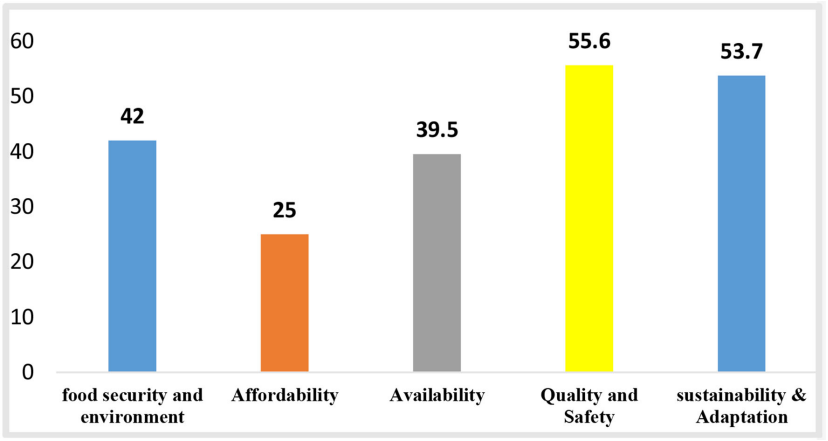



**Figure 2.** Nigeria's performance across global food security index pillars (2022).

Similarly, the Global Food Security Index (GFSI) report for 2022 indicated that Nigeria had a score of 42/100, ranking 107th out of 113 countries globally and 25th among 28 sub-Saharan African countries [11] [12]. For the pillars of food security used by this index, Nigeria ranked 113th in affordability and 108th in availability. For sustainability and adaptation, it ranked 57th, while for quality and safety, the country ranked 79th [11]. **Figure 2** illustrates Nigeria's performance across the five pillars of the 2022 GFSI. The figure shows substantial variation across pillars, with Nigeria scoring lowest in affordability (25/100) and availability (39.5/100), indicating significant constraints in economic and physical access to food. In contrast, the country performs relatively better in quality and safety

(55.6/100) and sustainability and adaptation (53.7/100), suggesting stronger capacity in food safety standards and long-term resilience. The score for food security and environment (42/100) falls in the mid-range, reflecting persistent environmental and systemic challenges that affect overall food stability. Together, these scores highlight Nigeria's uneven progress across food system dimensions and underscore the need to strengthen affordability and availability to improve national food security.

Similarly, diet quality has historically been poor in Nigeria and has been reported as the country's primary nutrition challenge [13]. In 2021, 25% of women aged 15 - 49 years achieved Minimum Dietary Diversity for Women (MDD-W) [14], and only 23% of adults consumed all five food groups recommended for daily consumption (All-5) [15]. Although a few studies have assessed factors influencing diet quality in Nigeria [16] [17], the relationship between food security and individual-level diet quality has been little studied.

This study seeks to address gaps in existing literature by 1) assessing the food security status and diet quality of farming households, and 2) examining the relationship between food security and diet quality. By employing both quantitative and qualitative methods, the study contributes to a nuanced understanding of how farming households experienced and navigate food insecurity, and how these experiences shape dietary patterns. Findings from the research are expected to inform policy and programme interventions aimed at strengthening food systems and improving diet quality, particularly in agrarian communities.

## 2. Materials and Methods

### 2.1. Study Design

The study employed a mixed-methods design. Quantitative data were obtained from the post-harvest (2024) round of the Nigeria General Household Survey-Panel (GHS-Panel, Wave 5, 2023/2024), while qualitative data were collected through household interviews. Integrating both methods provided statistical evidence alongside contextual insights [1].

### 2.2. Study Area

The study was conducted in the North-Central zone, comprising Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and the Federal Capital Territory (FCT, Abuja). This zone, with a population exceeding 20 million, is predominantly agrarian, producing crops such as yam, rice, sorghum, maize, and vegetables [2] [3]. It lies within the Guinea Savannah agro-ecological zone. The rainfall pattern is unimodal [18], and two major rivers, Rivers Benue and Niger, run through the zone and facilitate year-round food production [19] [20].

### 2.3. Quantitative Data and Sampling

The quantitative sample included North-Central farming households—defined as households that reported cultivating crops in the GHS-Panel. A total of 951 indi-

viduals (305 men and 646 women) from 527 households were included.

GHS-Panel Wave 5 is a nationally and zonally representative survey implemented by the National Bureau of Statistics (NBS) and the World Bank using a two-stage, cluster-randomized sampling design [4] [5]. Two rounds of data collection were conducted: post-planting (July-September 2023) and post-harvest (January-March 2024). Only the post-harvest round includes both food security and diet quality indicators; therefore, this round was used for the present analysis.

The GHS-Panel collects detailed information on household composition and demographics, education, health, labour and employment, childcare and early child development, migration and remittances, food and non-food consumption, housing and assets, non-farm enterprises, financial inclusion, exposure to shocks, and participation in safety-net programmes.

### 2.4. Qualitative Data and Sampling

Interviews with key informants were held for all the states in the north central zone and FCT. Purposive sampling using snowball technique was used to select participants, to ensure representation across key stakeholder groups involved in food production, food preparation, and nutrition decision-making. Sampling was conducted until data saturation was reached. Interviews were conducted across four levels: state, local government area (LGA), community and household.

At the state level, interviews were held with agricultural extension officers and staff of the Women-in-Agriculture Unit within the State Ministry of Agriculture. At the LGA level, interviews included agricultural officers and women-in-agriculture staff deployed to LGA departments. At the community and household levels, interviews were conducted with community leaders, heads of farming households, and primary food preparers within the households.

Data collection was conducted using a semi-structured interview guide, allowing flexibility to probe emerging issues. Questions addressed the factors influencing diet quality and food security, coping mechanisms during food insecurity, and unique challenges faced by farming households. Interviews were conducted by local research assistants in English or local languages and were audio-recorded with consent.

Ethical approval for the study was obtained from the research and ethics committee of each State Ministry of Health, as well as the FCT Health Research Ethics Committee.

### 2.5. Quantitative Exposure and Outcome Definition

Food security was defined using the Food Insecurity Experience Scale (FIES) [6] and the Food Consumption Score (FCS) [21]. Diet quality was defined using the diet quality questionnaire (DQQ). FIES data was collected using a 30-day recall period. Data from the FIES questions were analysed using the Rasch model via an online calculator (https://foodandagricultureorganization.shinyapps.io/fies/) from the Food and Agriculture Organization of the United Nations. Households were

considered to experience moderate/severe food insecurity if the probability of food insecurity was > 0.5. FCS was collected and calculated with a recall period of 7 days, using standard methods [21]. Food insecurity using the FCS was defined as poor or borderline FCS.

The DQQ data was collected for a 24-hour recall period, also using standard methods [15], and was used to compute whether or not respondents achieved the minimum dietary diversity score (DDS), consumption of all five food groups recommended in dietary guidelines (All-5), noncommunicable disease risk score (NCD-risk), noncommunicable protect score (NCD-protect), and the global dietary recommendations score (GDR) [22].

- Minimum Dietary Diversity Score (DDS): a binary indicator of micronutrient adequacy. An individual is classified as achieving minimum dietary diversity if they consumed foods from at least five out of the following ten food groups in the previous 24 hours: 1) grains, white roots, tubers, and plantains; 2) pulses; 3) nuts and seeds; 4) dairy products; 5) meat, poultry, and fish; 6) eggs; 7) dark green leafy vegetables; 8) other vitamin A-rich fruits and vegetables; 9) other vegetables; 10) other fruits.
- All-5: a binary measure aligned with global food-based dietary guidelines. An individual is considered to achieve All-5 if they consumed all five recommended food groups in the previous 24 hours. The five groups are: fruits; vegetables; legumes; animal-source foods; starchy staples.
- NCD-risk score: a continuous score reflecting consumption of food groups associated with increased risk of noncommunicable diseases. There are eight food groups: 1) soft drinks; 2) baked/grain-based sweets; 3) other sweets; 4) processed meat; 5) unprocessed red meat; 6) deep fried food; 7) fast food and instant noodles; and 8) packaged ultra-processed salty snacks. The score ranges from 0 to 9, with consumption of each food group having a score of 1 except processed meat that has a score of 2.
- NCD-protect score: a continuous score capturing intake of nine food groups protective against NCDs. The food groups are 1) whole grains; 2) pulses; 3) nuts and seeds; 4) vitamin a-rich orange vegetables; 5) dark green leafy vegetables; 6) other vegetables; 7) vitamin A-rich fruits; 8) citrus; 9) other fruits. The score ranges from 0 to 9.
- Global Dietary Recommendations (GDR) score: a composite measure evaluating alignment with WHO global dietary guidelines across healthy and unhealthy food groups. The GDR score ranges from 0 to 18 and is calculated using the formula NCD-Protect – NCD-Risk + 9.

In addition to individual consumption, household access to the food groups that comprise each of these five diet quality indicators was used to compute a household-level version of each indicator. Household access was defined as at least one member of the household reporting consumption of the food group in the 7 days preceding the survey, even if the respondent had not consumed the food group.

The inclusion criteria for the analysis were farming households in the North-Central zone with complete data on socioeconomic and food security indicators. Households without dietary diversity data or outside the study zone were excluded.

### 2.6. Data Analysis

The quantitative data was analysed as cross-sectional study and used appropriate sampling weights included in the data set.

The DDS and All-5 were coded as 0/1 outcomes, while the NCD-protect, NCD-risk and GDR were scores. Food insecurity from both FIES and FCS as 0/1.

Descriptive statistics were used to assess the food security and diet quality status of households, and regression models were used to explore associations. Covariates included gender (male/female); location (rural/urban); age; formal education level completed (none, primary, secondary, or tertiary); relationship status (have partner or no partner); household wealth index (using deciles of wealth as a continuous variable, range of 0 to 10); dependency ratio (ratio of dependents (<15 years old and >64 years old) to working population (15 to 64 years old)); eating out of home (yes/no) and number of occupations (range of 0 to 4, 1 for each occupation—engage in family agricultural business, employed out of home, own non-farm business, work at non-farm business of other family member).

The probability of decision error was set at 5% and variables were considered to be significant in the model if the probability (p) was $< 0.05$. Variables with $p > 0.05$ but $p < 0.10$ were considered to be marginally significant and noteworthy for further investigation.

For the qualitative data, interviews were transcribed verbatim, translated where necessary, and anonymized prior to analysis. Transcripts were analyzed thematically in Dedoose version 10.3.2, using a codebook developed based on the study's objectives. Findings from the interviews were subsequently triangulated with survey findings.

## 3. Results

The results of the quantitative data are presented first.

### 3.1. Socio-Demographic Characteristics

The majority of respondents were female (68.6%), rural dwellers (87.8%), and had no formal education (40.7%). The mean age was 31 years. Educational attainment among respondents showed that a significant proportion (40.7%) had no formal education, while only 9.8% attained tertiary education. Primary and secondary education was achieved by 24% and 25%, respectively.

### 3.2. Food Security and Diet Quality Indicators

The mean dietary diversity score was 3.6 food groups out of 10. The mean score for the diversity of foods accessed at household level was higher (4.5 food groups).

Mean household FCS was 46.1.

Table 1 presents the food security and diet quality indicators among the 951 respondents. Only 31.1% (95% CI: 26.8 - 35.4) of individuals achieved the minimum dietary diversity, while just 14.2% (95% CI: 10.9 - 17.4) consumed all five recommended food groups. Regarding food insecurity, nearly half of the households (44.5%, 95% CI: 37.0 - 52.0) reported moderate or severe food insecurity based on the FIES. Further, 22.2% (95% CI: 14.8 - 29.6) had poor or borderline FCS. Household-level analysis showed that 49.2% of respondents (95% CI: 42.5 - 55.9) belonged to households that had accessed sufficient diversity of foods in the preceding 7 days to achieve the DDS; but only 22.7% (95% CI: 17.4 - 28.0) of households had accessed all the foods to meet the all-5 food groups benchmark.

Table 1. Food security and diet quality indicators among respondents (n = 951).

| Indicator | % | 95% CI Lower | 95% CI Upper |
|---|---|---|---|
| Achieved minimum dietary diversity food groups | 31.1 | 26.8 | 35.4 |
| Achieved all 5 recommended food groups | 14.2 | 10.9 | 17.4 |
| Moderate/severe food insecurity (FIES) | 44.5 | 37.0 | 52.0 |
| Poor/borderline food consumption | 22.2 | 14.8 | 29.6 |
| Household accessed minimum dietary diversity food groups (past 7 days) | 49.2 | 42.5 | 55.9 |
| Household accessed all 5 recommended food groups (past 7 days) | 22.7 | 17.4 | 28.0 |

### 3.3. Individual Food Group Consumption

Dietary diversity was largely driven by consumption of starchy staples (94.6%), while nutrient-dense food groups were less represented. Only 10.5% consumed dairy, 4.4% consumed eggs, and fewer than 20% consumed dark green leafy vegetables or vitamin A-rich fruits and vegetables. Animal-source food intake (meat, poultry, fish) was reported by 50.9% of individuals. Table 2 summarizes the breakdown of DDS food group intake.

Table 2. Individual dietary diversity and food group consumption.

| Food Group | % | 95% CI Lower | 95% CI Upper |
|---|---|---|---|
| Grains, roots, tubers, plantains | 94.6 | 92 | 97.2 |
| Pulses (beans, peas, lentils) | 58.1 | 50.1 | 66.2 |
| Nuts and seeds | 27 | 22.5 | 31.5 |
| Dairy | 10.5 | 7.3 | 13.8 |
| Meat, poultry, fish | 50.9 | 42.2 | 59.5 |
| Eggs | 4.4 | 2.4 | 6.4 |
| Dark green leafy vegetables | 19.9 | 15.8 | 24.1 |
| Vitamin A-rich fruits and vegetables | 18.9 | 14.6 | 23.1 |
| Other vegetables | 55.5 | 49.2 | 61.7 |

### 3.4. Comparison of Household Access and Individual Food Consumption for Dietary Diversity Food Groups

Households reported higher access of nearly all food groups compared to individual consumption. Household access patterns revealed a high reliance on starchy staples, with 99.7% reporting consumption of grains, roots, and tubers, compared to 94.6% at the individual level (Figure 3). Similarly, household-level access to protein sources such as pulses (81.1%) and meat, poultry, and fish (75.5%) was markedly higher than individual-level consumption 58.1% and 50.9%, respectively, for pulses and meat). The food groups for which reported individual-level consumption was higher than household consumption were fruit and vegetable categories (Figure 3).

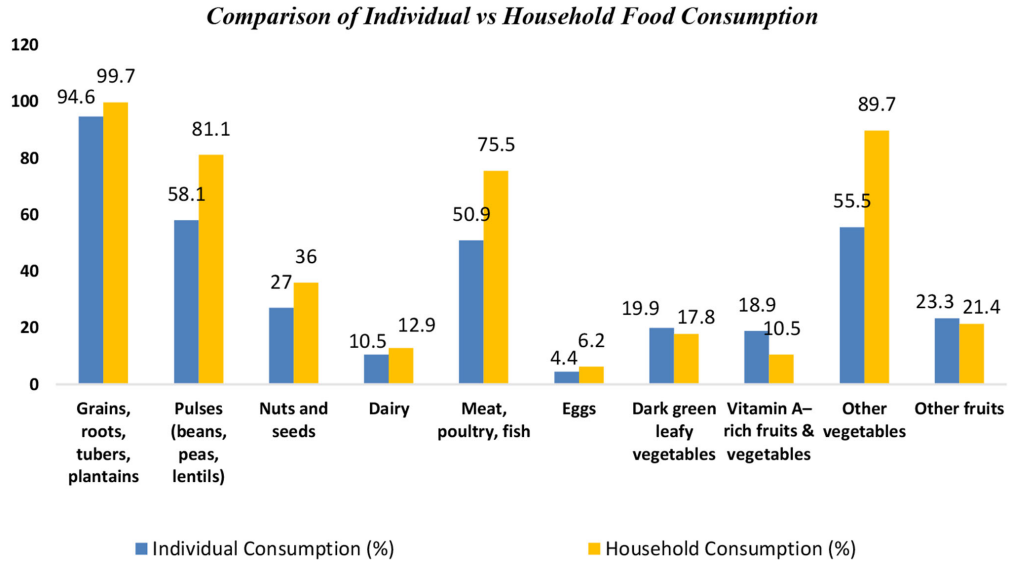



Figure 3. Comparison of individual vs. household food group consumption among farming households in north central Nigeria.

### 3.5. Noncommunicable Diseases-Related Food Group Consumption

Analysis of food group consumption revealed a co-existence of consumption of NCDs-protective foods and NCDs risk-inducing items. While NCD-protective foods such as pulses (58.1%), vegetables (55.5%), and nuts/seeds (27.0%) were frequently consumed, there was also notable intake of NCD-risk foods, including unprocessed red meat (31.9%) and soft drinks (17.6%) (Figure 3). The mean NCD-protect score, NCD-risk score, and GDR score was 2.2 (95% CI 2.1 - 2.4), 0.7 (95% CI 0.6 - 0.9), and 10.5 (95% CI 10.3 - 10.6), respectively.

Again, there were some differences between household access to food groups and individual consumption. While household access was higher than individual consumption for some, mostly protective, food groups such as pulses, nuts and seeds, and vegetables; individual consumption was higher than reported household access for other food groups, including both protective and risk-related food

groups (Figure 4).

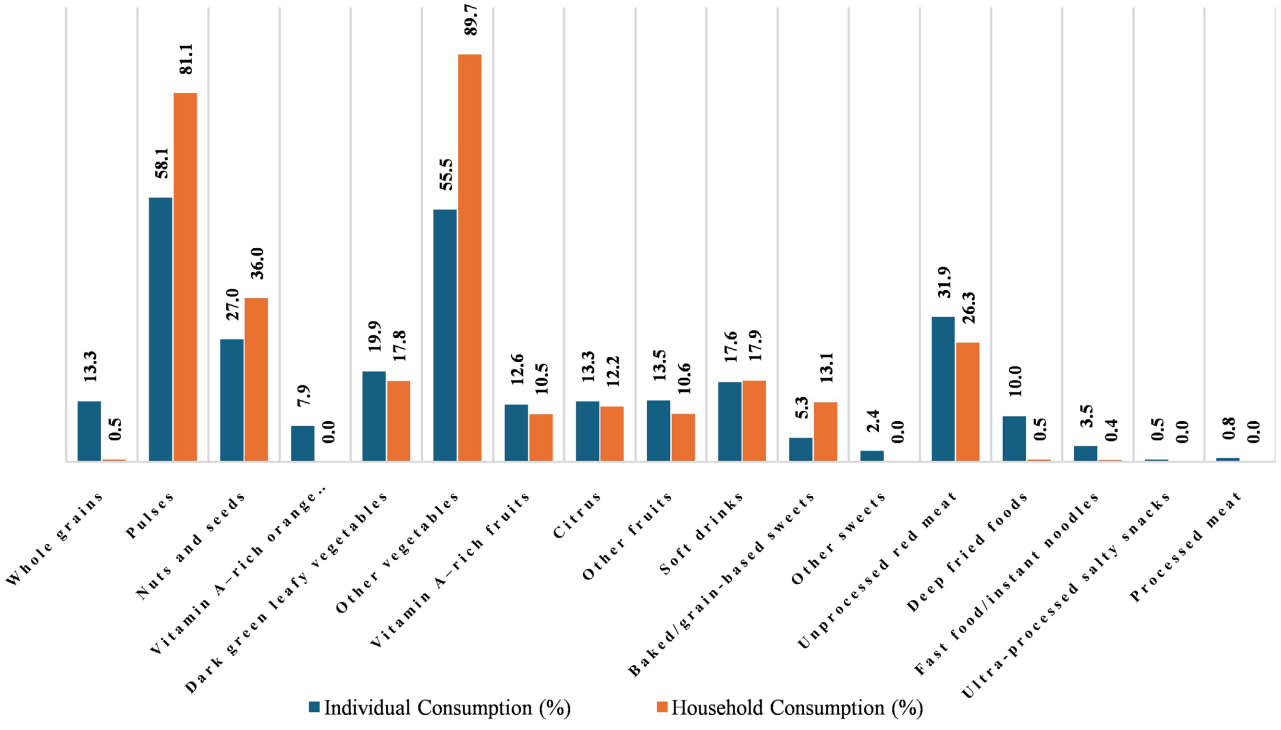



**Figure 4.** Comparison of NCD-protective and NCD-risk food group consumption at individual and household levels.

## 3.6. Association between Food Insecurity and Diet Quality

### 3.6.1. FIES Food Insecurity and Diet Quality

There was a positive relationship between food insecurity measured using FIES, and achievement of DDS, meaning that food insecure respondents were more likely to achieve DDS—odds ratio (OR) 1.61, 95% confidence interval (CI) 1.06 - 2.44. Other factors that were significantly associated with achieving DDS in this model included eating out of home (OR 2.42, 95% CI 1.52 - 3.85) and increasing number of occupations (OR 1.54, 95% CI 1.01 - 2.37). Use of clean fuel (OR 2.11, 95% CI 1.00 - 4.47) and increasing wealth index (OR 0.99 - 1.21) were marginally significant.

There was no relationship between FIES food insecurity and achieving All-5. However, eating out of home was significantly associated with achieving All-5 (OR 5.45; 95% CI 2.75 - 10.83); and increasing number of occupations was marginally associated with achieving All-5 (OR 1.53, 95% CI 0.92 - 2.57).

For NCD-protect score, there was again a positive relationship with FIES food insecurity ($\beta$ = 0.44, 95% CI 0.16 - 0.72). Eating out of home ($\beta$ = 0.52, 95% CI 0.31 - 0.72) and increasing number of occupations ($\beta$ = 0.32, 95% CI 0.03 - 0.60) also had a positive relationship with NCD-protect. Being female however had a negative relationship with NCD-protect ($\beta$ = −0.25, 95% CI −0.46 - −0.04).

There was no relationship between FIES food insecurity and the NCD-risk

score but eating out of home had a positive relationship with NCD-risk score ($\beta$ = 0.56, 95% CI 0.37 - 0.76), while living in a rural area had a negative relationship ($\beta$ = −0.48, 95% CI −0.87 - −0.10).

Food insecurity FIES was positively associated with the GDR score, meaning that food insecure respondents had higher GDR scores ($\beta$ = 0.50, 95% CI 0.15 - 0.85). Having a higher number of occupations was the only other variable with an association with GDR score in this model ($\beta$ = 0.29, 95% CI 0.09 - 0.48).

#### 3.6.2. FCS Food Insecurity and Diet Quality

Food insecurity measured by FCS significantly reduced the odds of achieving DDS (OR 0.22; 95% CI 0.11 - 0.45). On the other hand, eating out of home (OR 2.30; 95% CI 1.45 - 3.63) increased the odds of achieving DDS. Further, increasing number of occupations (OR 1.44; 95% CI 0.98 - 2.11) and use of clean fuel (OR 2.55; 95% CI 0.88 - 7.42) were marginally significant in the model.

The odds of achieving All-5 reduced with food insecurity (OR 0.20; 95% CI 0.06 - 0.62). Again, eating out of home increased the odds of achieving All-5 (OR 4.96; 95% CI 2.58 - 9.53), while being married reduced the odds (OR 0.44; 95% CI 0.19 - 0.99).

NCD-protect score was negatively associated with food insecurity measured through FCS ($\beta$ = −0.64, 95% CI −0.97 - −0.32), while eating out of home ($\beta$ = 0.54, 95% CI 0.33 - 0.74) and increasing number of occupations ($\beta$ = 0.28, 95% CI 0.02 - 0.55) were positively associated with the NCD-protect.

The NCD-risk score was also negatively associated with FCS food insecurity ($\beta$ = −0.41, 95% CI −0.56 - −0.25). Living in a rural area was also negatively associated with the NCD-risk score ($\beta$ = −0.42, 95% CI −0.81 - −0.03); while having tertiary education compared to no formal education was marginally significant ($\beta$ = −0.27, 95% CI −0.58 - −0.04). Eating out of home was positively associated with NCD-risk score ($\beta$ = 0.48, 95% CI 0.31 - 0.64).

For the GDR score, the FCS food insecurity was negatively associated, but this was only marginally significant ($\beta$ = −0.24, 95% CI −0.52 - 0.04). Increasing wealth index also had a significant negative association with the GDR score ($\beta$ = −0.07, 95% CI −0.14 - −0.004). Increasing number of occupations was positively associated with the GDR score ($\beta$ = 0.27, 95% CI 0.07 - 0.48).

### 3.7. Qualitative Findings

A total of 81 participants were interviewed. More than half were male (57.5%), while 42.5% were female. Age was recorded for 50 respondents and was a mean age of 27 years. Educational status was provided by 44 participants: two had no formal education, one completed secondary education, and the remaining 41 had attained tertiary education, indicating a relatively literate respondent group. Household size was reported by 49 respondents and was an average of 4 people per household.

The qualitative interviews provided deeper insights into how farming households experience food availability, access, and diet quality. Respondents consist-

ently emphasized that while food is often available during harvest, access and diet quality are constrained by seasonal variation, income limitations, and market challenges. Extension workers also highlighted the gap between food quantity and nutritional adequacy.

#### 3.7.1. Food Availability and Its Role in Household Food Security

Respondent highlighted the central role of farmland, backyard gardens, and seasonal harvests in ensuring food availability. However, insecurity, poor roads, and declining soil fertility were major constraints. As one farmer explained, "*Food is plenty during harvest, but hunger follows when the stores run dry*". Extension workers also emphasized the seasonal nature of food access, noting that "*availability is not the same as stability—once the season ends, many households struggle to find alternatives*".

#### 3.7.2. Food Access and Constraints to Secure Diets

Economic hardships and fluctuating market prices emerged as key barriers to food access. Several respondents reported dependence on cheaper staples: "*We eat yam and cassava most times because meat or milk is too expensive*". Market disruptions due to insecurity and poor transportation also restricted access, particularly in remote areas. An agricultural extension officer explained, "*Farmers may grow food, but selling it or buying other foods from the market is often impossible because of insecurity on the roads*".

#### 3.7.3. Diet Quality as an Outcome of Access and Security

The Quality of diets was closely tied to both food availability and access. Meals were often monotonous and dominated by starchy staples. One female respondent noted, "*We wish to eat vegetables and fruits every day, but most times it is only during harvest we can afford them*". Seasonal variation was a recurring theme, with another participant stating, "*In the rainy season, we eat more vegetables. During the dry season, the diet becomes poorer*".

#### 3.7.4. Linking Food Security to Dietary Outcomes

Findings underscore that food security directly influences diet quality. While households often secured enough calories, they struggled to meet nutritional adequacy. As one extension worker summarized, "*Households are food secure in terms of quantity but not in terms of quality.*" The evidence suggests that improving diet quality requires interventions that go beyond food production to address income, affordability, and access to diverse foods.

These findings align with the study's objective of assessing the food security status and diet quality of farming households and examining their interconnection. The voices of farming households and frontline extension workers highlight the continuum from food access to dietary outcomes: while availability may provide temporary security, limited access to diverse foods ultimately undermines diet quality. This link is central to understanding the nutritional challenges facing farming households and sets the stage for deeper discussion on policy and pro-

grammatic responses (Table 3).

Table 3. Illustrative quotes supporting quantitative findings on food security and diet quality among farming households in north-central Nigeria.

| Theme/Variable | Quantitative Finding with FCS (Summary) | Illustrative Quote | Interpretation/Triangulation |
|---|---|---|---|
| **Food insecurity and dietary diversity (DDS)** | Food insecurity (using FCS) reduced the odds of achieving the DDS (OR = 0.22, p < 0.001). | "Sometimes we skip meals or eat the same thing all week because food is expensive." (Female farmer, Benue) | Indicates that income and availability constraints limit food variety. |
| **Eating out of home** | Eating outside significantly improved dietary diversity (OR = 2.30, p < 0.001). | "When we buy food from vendors, we taste different dishes we can't cook at home." (Male farmer, Nasarawa) | Suggests that exposure to varied meals outside the home increases diversity. |
| **Clean cooking fuel use** | Clean-fuel users had marginally significantly higher odds of dietary diversity (OR = 2.55, p = 0.085). | "Using gas makes cooking faster and easier; I can cook two or three different meals." (Female respondent, Kwara) | Convenience and time savings from clean fuel enhance meal variety. |
| **Multiple income sources (Occupation diversity)** | Number of occupations positively associated with achieving DDS (OR = 1.44, p = 0.065). | "We do petty trading and farm work; when there's extra income, we buy more food types." (Female trader–farmer, Plateau) | Diversified livelihoods improve household purchasing power and diet quality. |
| **Gender and decision-making (All5 score)** | Married women had lower odds of achieving All5 score (OR = 0.44, p = 0.048). | "My husband decides what to buy; I just cook what's available." (Woman, FCT) | Reflects limited autonomy of married women affecting food decisions. |
| **NCD risk behaviors (NCD_risk_score)** | Eating out increased NCD risk score (Coef = 0.48, p < 0.001). | "Most foods sold outside are oily or fried, but that's what we can afford." (Male, urban Benue) | Links economic constraints to consumption of calorie-dense, risky foods. |
| **Gender dietary risk (GDR_score)** | Food insecurity lowered GDR score (Coef = −0.24, p = 0.099). | "Women eat last and less; sometimes we skip meals for the children." (Female, rural Nasarawa) | Shows gendered vulnerability within food-insecure households. |

## 4. Discussion

### 4.1. Summary of Findings

This study revealed remarkable interlinkages between food security and diet quality among farming households. Quantitative results showed that less than a third of individuals achieved the minimum dietary diversity score, and fewer than one in five achieved consumption of all five recommended food groups, reflecting low diet quality and nutrient intake inadequacy. At the household level, nearly half experienced moderate or severe food insecurity (FIES), while more than 20% had poor or borderline food consumption (FCS). The study also identified a clear gap between household-level food group access and individual-level consumption.

While food insecurity based on FIES was positively associated with achieving DDS, NCD-protect score, and GDR score; food insecurity based on FCS was negatively associated with all five diet quality indicators assessed (DDS, All-5, NCD-protect score, NCD-risk score, GDR score). Qualitative findings corroborated a negative relationship between food insecurity and poor diet quality, highlighting that seasonal food shortages, dependency on rain-fed agriculture, and high food

prices were key drivers of household food insecurity.

The findings that food insecurity is high, and diet quality is poor are similar to other studies that have been conducted in Nigeria. However, this study reports poorer diet quality than other studies. For instance, a 2021 study by Beal *et al.* [15] found that just 23% of adults in Nigeria achieved All-5. Another study [23] conducted in three states from the North East and North West geopolitical zones found that 56% of respondents achieved DDS and 36% achieved All5; NCD-protect, NCD-risk, and GDR scores were 3.3, 1.6, and 10.7, respectively.

For food insecurity, the prevalence reported using FIES in our study is lower than data from some other sources. In the 2024 Nigeria Demographic and Health Survey, FIES food insecurity in the North Central zone was 63% [24]. Differences in prevalence of poor diet quality and food insecurity for data collected in the same location may be due to seasonal variability in food access which was highlighted in our study and has been observed by other authors [25]. Differences in months of data collection across surveys/studies can lead to results that reflect differences in season of data collection.

### 4.2. Interpretation of Findings

The results show that poor diet quality, particularly the percentage of respondents that did not achieve DDS or All-5, was a lot more prevalent than food insecurity. This was further underscored by the gap observed between household access to food groups and individual consumption of those food groups. There are other studies that have reported that being food secure does not always guarantee a high-quality or diverse diet in Nigeria [25] [26]. Still, our study found for FCS, and other studies [27] [28] corroborate, that food insecurity increases the likelihood of poor diet quality. The divergence between household access and individual consumption, where household access was higher, strongly suggests intra-household differences in food allocation, where certain household members may not receive some food groups despite overall household availability. Existing studies [29] [30] have reported sociocultural norms that prioritize some household members, including males, over others. Food groups where individual consumption was greater than household access suggest consumption of such foods more out of home than at home.

In fact, our study found that eating out of home was significantly associated with better dietary outcomes. Other studies have highlighted a similar relationship between eating and other low- and middle-income countries out of home and diet quality in Nigeria [23] [31] and other low- and middle-income countries [32], with authors noting that the convenience of out-of-home foods enables consumption of greater diversity, compared to home cooking. The simultaneous increase in dietary risk factors for noncommunicable diseases with eating out of home has likewise been reported in other studies [23] [32] [33]. The duality of protective and risky dietary intakes reflects a nutrition transition in rural farming households, raising concerns about future health outcomes [34] [35].

Higher number of occupations was also found to be associated with better diet quality. This association likely reflects higher incomes and income stability from livelihood diversification, which increases households' purchasing power, thereby enabling greater access to diverse foods [36]-[38].

### 4.3. Implications for Policy and Programs

Interventions to improve diet quality in Nigeria frequently prioritize nutrition education. Our findings emphasize that even primary food producers are not necessarily food secure and it is important to improve food security to ensure optimal diet quality in Nigeria [39] [40]. The observed discrepancy between household food access and individual consumption highlights the need for policies that explicitly consider intra-household food distribution dynamics. Programs must ensure that household food security translates equitably into better diets for all household members including children, women, and other potentially vulnerable groups. Thus, increasing nutrition knowledge and behavior change communication also remains crucial for improving diet quality.

Furthermore, it is important for programs to assess other factors that can affect diet quality even when there is food security, such as time availability for preparing and consuming nutritious meals [41]-[43], fuel availability and convenience [44]-[46], and ability and self-efficacy to transform available foods into nutritious meals [47] [48].

### 4.4. Methodological Considerations

The strengths of this study include its use of validated tools such as FIES, FCS, and DQQ. Despite growing attention to food security, significant gaps persist in the measurement and monitoring of diet quality. Existing assessments often emphasize caloric sufficiency and food availability, while neglecting indicators of nutrient adequacy, dietary diversity, and non-communicable disease (NCD)-related risks [39]. This limits the ability to capture the multidimensional nature of nutrition outcomes beyond food access.

Furthermore, indicators such as MDD-W, All-5 food group scores, and NCD-protective versus NCD-risk food group consumption are rarely integrated into national food security surveys, creating a data gap for nutrition-sensitive policy planning [1]. Our study not only assesses food insecurity and various diet quality indicators, but also measures linkages between food insecurity and diet quality, addressing gaps in literature. Our study thus underscores the importance of collecting DQQ data in national surveys, to support more effective program design and planning.

Nevertheless, the study had a few limitations, including use of cross-sectional, self-reported data that also did not account for seasonality in food security. As was previously noted, seasonality affects both food security and diet quality [49]-[51]. In addition, there were differences in the recall periods used for data collection across the FIES, FCS, and DQQ. Whereas the recall period for the FCS and DQQ

were closely aligned (7 days and 24 hours, respectively), the FIES measured food insecurity over a 30-day recall period, which may have captured recent food access constraints that are not necessarily concurrent with the shorter recall windows used for the FCS and DQQ. The difference in recall period between the FIES and the FCS may explain the higher prevalence of food insecurity using the FIES, as well as the differential relationship between food insecurity and diet quality linkages based on FIES and FCS. While the 30-day FIES reflects recent experiences of food insecurity, it may capture episodic or transitory food access constraints that do not immediately translate into reduced dietary diversity, particularly in contexts where households rely on short-term coping strategies or seasonal food availability [52]. In contrast, the FCS assesses household food consumption patterns over a 7-day period and may therefore be more closely aligned with short-term diet quality measures, such as those used in this study.

Previous work corroborates that FIES and FCS may not produce comparable estimates of food insecurity in Nigeria. It has been reported that food insecurity in Nigeria based on FIES is poorly aligned with poverty and other measures of well-being and food security, whereas FCS is directly aligned [53]. Apart from the recall period, FIES measures the subjective experience of inadequate access to food, while FCS is a consumption-based measure and proxy for diet frequency and quality. People usually answer subjective questions based on their own understanding, knowledge, experiences, aspirations, and perceived social and economic ranking [54]. This subjectiveness does not mean that the data produced by the FIES is not valid or useful [55] [56]. Even if the subjective answers from the FIES scores do not closely match the objective measures of food security based on consumption, the FIES data is still valuable. It provides insight into how people personally experience hunger and food insecurity, which is an important part of understanding their overall well-being [54]. Comparison of other experience-based food insecurity scales and food consumption measures have similarly reported higher food insecurity prevalence from experience-based measures [57].

## 5. Conclusions

This study examined the interconnections between food security and diet quality among farming households, revealing how food access constraints shape dietary outcomes in rural settings. Quantitative findings showed that despite active involvement in food production, many farming households remain food insecure and exhibit low dietary diversity, reflecting limited consumption of nutrient-rich foods such as fruits, vegetables, and animal-source products. Also, diet quality was poor even in some households that were food secure. The qualitative insights further highlighted that food availability and access are strongly influenced by seasonal fluctuations, dependence on rain-fed agriculture, and limited income-generating opportunities, which collectively restrict households' ability to maintain consistent, diverse diets throughout the year.

Therefore, addressing food insecurity and poor diet quality among farming

households in Nigeria demands integrated policy actions that combine multiple strategies to first safeguard household food security, and then ensure that food security translates into optimal diet quality for every household member. A systems-based approach enables households to move from food access to sustainable dietary well-being.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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