ASSESSMENT OF CALORIE INTAKE AND MICRONUTRIENT CONSUMPTION IN RURAL NORTH-CENTRAL NIGERIA

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Abstract

Due to rising food insecurity and prices, rural households in Nigeria are increasingly resorting to adverse coping mechanisms, such as replacing nutritious diets with larger quantities of less-nutritious and energy-dense foods. Therefore, this study investigated the relationship between calorie status and micronutrient foods intake of rural households in North-Central Nigeria. By employing a three-stage random sampling procedure, a total of 494 households were selected via a well-structured questionnaire. The finding showed that 42.7% of the households were calorie sufficient, while 57.3% of them were calorie deficient. Furthermore, households with sufficient calorie intake had a higher average micronutrient food intake score (52.12), compared to those with calorie deficiencies (38.38). The logistic regression analysis revealed that an increase in total vegetable intake, total protein intake, and dairy products intake signals a higher likelihood of household being calorie sufficient while increase in seafood and plant protein intake is linked to lower odds of the household being calorie sufficient ($p < 0.05$). The findings suggest that micronutrient food intake should be a central component of household food security policy in rural areas. Consequently, food security initiatives in these regions must include programs that are focused on dietary adequacy to promote productive and healthy living.

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Introduction

Food security remained a critical policy consideration for successive Nigerian governments (Osabohien et al., 2020; Wudil et al., 2023). Country is currently faced with galloping inflation, particularly regarding the increase in prices of food products. This is coming at a period where the level of food insecurity already has alarming trend. About 21.4% Nigerians were estimated to be food insecure in 2020., and this is expected to increase in the next couple of years by 9.2% as a result of the Covid-19 pandemic and disruption of trade flows of both crops and livestock (FAO, 2021).

Also, the general reduction in farming activities arising from insurgency in the North-East, Banditry in the North-west and North-Central states has led to insecurity and displacement of large number of people, especially rural farming households and this continue to confound the food security situation in the country. About 43 million Nigerians are projected to be severely food insecure by 2030., representing the worst value among the West-African countries (Baquedano et al., 2020).

Amidst this situation, most studies focused on the relationship between households' food security status and coping strategies, with little or no attention on the quality of the diets. Food supplies the body with various nutrients, out of which, vitamins and minerals represent an essential aspect (Beal, Ortenzi, 2022). Vitamins and minerals are major micronutrients that are important for normal growth and development, though they are required in small quantity (Senbanjo et al., 2022). These nutrients cannot be synthesized within the body in sufficient quantity and are usually available through the consumption of micronutrient foods such as vegetables, fruits, dairy products, legumes, and animal source foods (Beal, Ortenzi, 2022).

Micronutrient malnutrition is more apparent in low and medium economy countries like Nigeria, where diets are majorly based on starchy staples, and deficient particularly in Fe, Zn, folates, vitamin A, Ca, and vitamin B12 (WHO, 2021; White et al., 2021). According to Stevens et al. (2022), deficiency in micronutrients is responsible for high rate of mortality in women and children, poor pregnancy outcome, high morbidity, retarded mental and physical development in children, and low productivity in adults. Out of the total death estimates in the 21st century, about 2.7 million can be linked to low diet in micronutrient foods such as fruits and

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vegetables (WHO, 2021). In Nigeria, micronutrient deficiencies remain a significant public health concern (Adams et al., 2024), and they have been linked with stunted physical growth, impaired cognitive function, weakened immunity, and an increased risk of degenerative and chronic diseases (Ibeanu et al., 2020). Nigeria is losing over 1.5 billion USD in GDP each year due to vitamin and mineral deficiencies (Senbanjo et al., 2022), with the most common deficiencies being in vitamin A, folate, Fe, I, and Zn (FGoN, IITA, 2024).

Thus, investigating the level of micronutrient foods intake especially among rural households requires urgent attention as they are particularly vulnerable to food insecurity and malnutrition due to limited access to diverse and nutrient-rich foods, lower income levels, and inadequate healthcare infrastructure (Ogunniyi et al., 2021). The relationship between food security and coping strategies has been extensive explored in Nigeria (Omotesho et al., 2008; Agada, Igbokwe, 2014; Adebo, Falowo, 2015; Salau et al., 2022). There are no studies that investigate the relation between calorie intake and households' micronutrient food consumption. Therefore, the present study aimed to identify the level of micronutrient foods intake among the rural households in North-Central Nigeria, and its linkage with calorie intake.

Material and Methods

Study area

This study was performed in North-Central Nigeria, a region situated within the Southern Guinea Savannah agro-ecological zone. The area involves six states: Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and the Nigeria's Federal Capital Territory (FCT). Region stretches across the whole width of country, from the border with Cameroon to that with Benin, covering an area of about 251,425 km^2. It is settled with a population of over 20 million inhabitants (NNBS, 2020). Subsistence agriculture is one of the main activities in the study area, while farms are usually small, based on the use of manual labor and primitive implements, such as hoes and machetes (Agada, Igbokwe, 2014). Even observed the rural areas as food production segment of country, the level of food insecurity in them is around 58%, compared to 18% in urban areas (Mekonnen et al., 2021).

Sampling procedures and data collection

Among the North-Central states, Kwara and Niger were purposively selected as the sampling frame adequate for samples obtaining. This selection is based on two considerations: 1) Niger state is the poorest state in North Central Nigeria (WB, 2022); and 2) Kwara state is one of the oldest states in Nigeria, so it has witnessed the influx and indigenization of several ethnics particularly of North-Central origins. Thus, this study involves all rural households in Kwara and Niger states in Nigeria.

This could potentially provide a limitation as food intake may differ with respondents in other states, however, gaining access to such a population size would prove difficult and beyond the budget constraint of this study. Notwithstanding, Kwara and Niger states are cosmopolitan states within North-Central Nigeria, making them strong representatives of the region. A three-stage random sampling technique was used to select respondents for the study. This is appropriate as both states have equal numbers of senatorial districts. Thus, to ensure proportionate representation in both states, the study adopted an existing cluster which is the senatorial districts in each of the states.

In the first stage, two Local Government Areas (LGA) were selected randomly in each senatorial district. In the second stage, two rural communities were selected randomly in each LGA. In the final stage, every fifth household was selected within each community. In total, 494 respondent households were selected for the study research. Data were collected directly from face-to-face interviews using a structured questionnaire. The questionnaire was used to solicit information on all food items consumed within the household in the last 24 hours (24-hour recall). Specifically, households were asked about all types and quantity of all food items consumed during the last day.

Household calorie intake

The calorie intake of households was investigated by the development of calorie intake index. Index was developed based on three major steps: 1) study participants were required to state the quantities of all food items consumed within the households in previous 24 hours; 2) the calorie content of the food items consumed was then calculated using the parameters that convert edible portions into calories (Fawole et al., 2016); 3) per capita calorie intake was estimated by dividing previously assessed overall household calorie intake by the number of adult equivalent (AE) in certain household (Dercon, Pramila, 1998). An estimated calorie intake in line of 2,800 kcal/person/day was adopted based on the average per capita calorie consumption in developing countries (FAO, 2023). Thus, households whose daily per capita calorie consumption, i.e. per AE (adult equivalence) was equal or greater than 2,800 kcal/person/day were assumed as calorie sufficient, with assigned value of 1. Other, that are experiencing calorie deficit were considered as calorie deficient, with assigned value of 0.

Households' micronutrient food intake

Micronutrient food intake was expressed in scores based on the dietary guidelines for Americans' recommendation as highlighted in the Healthy Eating Index 2015 (Bardos et al., 2022). The micronutrient food components under the HEI-15 are total fruits, whole fruits, total vegetables, greens and beans, dairy foods, total protein foods, seafood and plant protein food. As the fruit juice is rarely consumed at local level, whole fruit and total fruit were jointed into fruits. Thus, fruits, total vegetables, greens and beans, dairy products, total protein foods, and seafood and plant proteins were used to represent micronutrient food in the research study. Furthermore, the food items have been categorized into four groups: fruits, vegetables (total vegetable, and greens and beans groups), proteins (total protein food group, and seafood and plant protein groups), and dairy products, while to each group was awarded a maximum score of 25, according to intake of recommended amounts. Mentioned leads to overall maximum score of 100, where higher achieved scores reflect higher intakes that meet predefined standards.

In this research, the maximum and minimum intake were based on individual household's daily calorie requirement and score were assigned based on every 1,000 kcal consumed within the household as recommended in HEI-2015 (Krebs Smith et al., 2018). For fruits, the consumption of 0.4 cup equivalent or higher than 1,000 kcal assigns maximum score of 25, while no fruit consumption will amount to minimum score of zero. Total vegetables comprise all vegetables and legumes (beans and peas), while consumption of 1.1 cup equivalent or higher per 1,000 kcal will be underlined as maximum score of 12.5. Lack of vegetable consumption will be marked with minimum score of 0. Greens and beans component comprise legumes and dark-green leafy vegetables (i.e. spinach and jute leaves). The consumption of 0.2 cup equivalent or higher per 1,000 kcal will be expressed with maximum score of 12.5, while no consumption will amount to score of zero. The predefined score of 12.5 in both previous cases is because the group vegetable was divided into total vegetables, and greens and beans, what is in line to recommendation of HEI-15. The component dairy comprises to all dairy products, such are evaporated milk, yogurt, cheese, and soy beverages, whose consumption of 1.3 cup equivalent or higher per 1,000 kcal will be assigned the maximum score of 25, while lack of diary food intake will amount to 0. The total protein foods component pertains to all foods made from lean portion of meat, poultry, seafood, beans and peas, eggs, soy products, nuts, and seeds. Consumption of 2.5 cup equivalent or more per 1,000 kcal will attract a maximum score of 12.5, while no consumption of protein foods will amount 0. The seafood and plant proteins component consist of seafood, nuts, seeds, soy products (other than beverages), and legumes (beans and peas).

Table 1. Cup and ounce equivalence of common micronutrient foods

Micronutrient foods	g/ml	Equivalence in cup or ounce
Green leafy vegetables	200g	1 cup
Tomato	180g	1 cup
Pepper	150g	1 cup
Onion	160g	1 cup
Okro	100g	1 cup
Cabbage	89g	1 cup
Cucumber	102g	1 cup
Carrot	128g	1 cup
Potato	150g	1 cup
Corn	145g	1 cup
Mango	168g	1 cup
Orange	180g	1 cup
Pineapple	165g	1 cup
Pawpaw	230g	1 cup
Watermelon	154g	1 cup
Dates	147g	1 cup
Apple	125g	1 cup
Banana	136g	1 cup
Egg plant	82g	1 cup
Coconut	80g	1 cup
Guava	165g	1 cup
Cowpea	167g	1 cup/6 ounces
Peas	145g	1 cup/5 ounces
Soybeans	186g	1 cup/6 ounces
Eggs	50g	1.6 ounces
Fish	100g	3.5 ounces
Meat (mutton etc.)	100g	3.5 ounce
Chicken	100g	3.5 ounces
Soymilk	200ml	1 cup
Skimmed milk	200ml	1 cup
Full cream milk	300ml	1 cup
Powdered milk	124g	1 cup
Yogurt	125g	1 cup
Cheese	244g	1 cup

Source: According to author's computation.

The consumption of 0.8 cup equivalent or more per 1,000 kcal will amount to a maximum score of 12.5, while lack of their consumption will be marked as zero. Case of protein group is similar to group vegetable, as it was also divided into total protein foods, and seafood and plant protein food based on HEI-15 recommendation, where both of them could be maximally awarded with the score of 12.5 respectively. Finally, proportional scores were assigned to consumption between minimum and maximum standards. In Table 1. are displayed the cup and ounce equivalence of common micronutrient foods.

Statistical analysis

Collected data were analyzed using SPSS software (Statistical Package for Social Sciences, Statistical Software Program, Version 24.0, 2016, IBM Corp., Armonk, NY, USA), while statistical significance was set at 5%. Frequency and share were utilized to summarize the categorical data, while mean and standard deviation were utilized to summarize the continuous data. Independent sample T-test, and Chi-square test were utilized for numerical test comparisons between observed groups. A binary logistic regression analysis was applied to examine the relations between household calorie intake status and micronutrient foods intake. The logistic regression model has next formula:

$$z_i = \text{Log}\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 FT_i + \beta_2 GB_i + \beta_3 TV_i + \beta_4 SPP_i + \beta_5 TP_i + \beta_6 DP_i + \varepsilon_i$$

Where: z_i = calorie intake status of household i (Calorie sufficient = 1, otherwise = 0); P_i = the likelihood that household i will be calorie sufficient; $1 - P_i$ = the likelihood that household i will not be calorie sufficient; β_0 = coefficient of constant term; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 = slope coefficients; ε_i = error term; FT = fruit consumption score (count); GB = greens and beans consumption score (count); TV = total vegetable consumption score (count); SPP = seafood and plant proteins consumption score (count); TP = total protein consumption score (count); DP = dairy products consumption score (count).

Results

The sociodemographic characteristics of the households was examined based on their micronutrient foods consumption. In line to this, statistically significant difference was observed between the sociodemographic characteristics and intake of specified groups, i.e. greens and beans, total vegetable, total protein, seafood and plant protein, fruits, and dairy products. Micronutrient foods intake differs significantly due to household size, while these significant differences were observed in all foods considered except dairy products. Households with less than four members consumed more micronutrient foods except fruits. There was no statistically significant difference between off-farm employment and micronutrient foods consumption except for fruit intake (Table 2.).

Table 2. Sociodemographic characteristics based on micronutrient foods consumption (in g)

Element	n (%)	GB	TV	SPP	TP	FT	DP
Sex							
Male	443 (89.7)	106.87	111.53	107.28	181.62	29.66	5.32
Female	51 (10.3)	82.51	85.57	86.07	139.17	54.39	2.89
P-value		***0.129***	***0.004***	***0.121***	***0.004***	***0.001***	***0.520***
Age (years)							
20 – 45	185 (37.4)	133.09	137.68	134.46	210.24	34.32	4.76
46 – 65	293 (59.3)	85.28	89.67	85.82	156.07	31.89	5.53
65 – 75	14 (2.9)	133.39	139.18	128.51	197.83	9.13	-
> 75	2 (0.4)	34.88	36.37	37.62	65.33	10.20	-
P-value		***0.080***	***0.648***	***0.085***	***0.001***	***0.008***	***0.344***
Household size (members)							
< 4	99 (20.2)	194.06	201.07	195.43	291.69	35.24	10.15
5 – 8	306 (61.8)	87.19	91.24	87.52	156.87	35.75	3.27
9 – 12	78 (15.8)	54.61	57.91	55.55	112.26	16.79	5.70
> 12	11 (2.2)	138.43	141.35	126.07	168.79	15.03	4.56
P-value		***0.000***	***0.000***	***0.000***	***0.000***	***0.015***	***0.135***
Farm size (ha)							
< 4	409 (82.7)	106.35	110.67	107.88	180.12	36.05	2.73
4 -8	65 (13.2)	114.40	119.33	111.97	174.40	12.26	5.09
> 8	20 (4.1)	27.96	34.83	26.22	130.03	17.06	53.55
P-value		***0.000***	***0.009***	***0.000***	***0.116***	***0.000***	***0.021***
Farm income (NGN/year)							
150,000 – 1,000,000	291 (58.9)	110.49	115.81	113.14	183.97	41.62	2.08
1,000,001 –2,000,000	129 (26.1)	90.74	94.62	90.11	159.06	21.11	2.98
>2,000,000	74 (15.0)	104.15	124.11	100.21	184.50	14.06	20.46
P-value		***0.222***	***0.001***	***0.121***	0.***305***	***0.000***	***0.002***
Off-farm employment							
Yes	206 (41.2)	111.99	116.20	112.46	189.50	40.3001	4.3195
No	288 (58.8)	98.86	103.55	99.89	168.62	26.2093	5.6163
P-value		***0.170***	***0.120***	***0.188***	***0.068***	***0.004***	***0.577***
Educational Level							
No formal education	267 (54.3)	97.48	102.19	98.27	171.41	33.21	3.17
Primary education	140 (28.1)	98.28	102.26	99.47	161.52	12.45	8.61
Secondary education	59 (11.9)	139.41	143.96	140.26	218.95	71.59	4.86
Tertiary education	28 (5.7)	127.09	132.05	124.78	225.71	37.65	5.95
P-value		***0.030***	***0.087***	***0.035***	***0.001***	***0.000***	***0.269***
Access to credit							
Yes	49 (9.9)	162.04	169.31	160.82	241.26	33.92	0.23
No	445 (90.1)	98.19	102.39	99.09	170.40	31.96	5.60
P-value		***0.004***	***0.001***	***0.006***	***0.227***	***0.798***	***0.000***

Source: Abubakar et al., 2024.

Generally, the highest amount of total protein intake was noted among male headed households, particularly those within the age group of 20-45 years. Households with an annual farm income greater than 2 million NGN and those engaging in off-farm activities also showed higher total protein intake. Additionally, households with less than four members, those who had attained tertiary education, and those with access to credit for farming activities reported higher total protein consumption.

Similarly, The highest amount of total vegetable intake was observed among male-headed households, especially those within the age group of 65-75 years. Households with an annual farm income greater than 2 million NGN, those engaged in off-farm activities, and those with less than four household members also had higher total vegetable consumption. In addition, households with access to credit for farming operations demonstrated a higher total vegetable intake. Interestingly, fruit intake was significantly higher among female headed households. So, in previous table (Table 2.) was showed households' sociodemographic characteristics based on micronutrient foods consumption.

Out of the 494 households included in the study, 42.71% (211) of them were calorie sufficient, while 57.29% (283) were calorie deficient. In the group vegetable, average scores for greens and beans intake and total vegetable intake were higher among calorie sufficient than calorie deficient households. Similar results were obtained for all other micronutrient foods. Looking at total average score, the calorie sufficient households have total average score of 52.12 (out of 100), showing average consumption of micronutrient foods and diets that has to be improved. On the other hand, the calorie deficient households have a total average score of 38.38 (out of 100), what signifies poor micronutrient foods consumption, or diets that require significant improvement. In next table (Table 3.) is presented micronutrient food scores among the calorie sufficient and calorie deficient households.

Table 3. Calorie intake status and micronutrient food scores

Element	Calorie sufficient (n = 211)	Calorie deficient (n = 283)
Food Scores	Mean (SD)	Mean (SD)
Green and Beans	11.89 (1.30)	10.44 (2.52)
Total Vegetable	9.63 (1.05)	7.69 (1.61)
Total Protein Foods	9.46 (1.50)	5.82 (2.25)
Seafood and Plant Proteins	10.92 (2.01)	7.71 (3.91)
Fruit	10.05 (11.60)	6.64 (9.96)
Diary	0.18 (0.07)	0.08 (0.04)
Total	52.13	38.38

Source: Abubakar et al., 2024.

Furthermore, a statistically significant difference was observed between the groups based on greens and beans intake, total vegetable intake, seafood and plant protein intake, total protein intake, fruit intake and dairy products intake. In Table 4. is presented the independent sample t-test results.

Table 4. Differences between calorie sufficient and calorie deficient households based on micronutrient food scores

Variables	T	P	ETA squared	95% C.I. of the difference	
				Lower	Upper
GB	7.458	0.000	0.100	1.07264	1.84048
TV	16.198	0.000	0.345	1.70326	2.17353
TP	21.572	0.000	0.483	3.30640	3.96908
SPP	11.873	0.000	0.221	2.67380	3.73455
FT	3.458	0.000	0.023	1.47118	5.34572
DP	2.455	0.015	0.012	0.02133	0.19410

Source: Abubakar et al., 2024.

Examining relation between micronutrient foods consumption and households' calorie intake, statistically significant relationship was found between the dependent variable (household calorie intake status) and four out of the six independent variables (total vegetable intake, seafood and plant protein intake, total protein intake and dairy products intake). The result of the binary logistic regression (Table 5.) showed that total vegetable intake, total protein intake, and dairy products intake decreased households' odds of being calorie deficient by 162%, 528% and 702% respectively, while seafood and plant protein intake increased households' odds of being calorie deficient by 78% ($p < 0.05$). The intake of fruits, and greens and beans appeared insignificant.

Table 5. Relationship between Micronutrient foods Consumption and Households' calorie intake

Variable	B	S.E.	Wald	df	p-value	Exp(B)
GB	0.001	0.224	0.000	1	0.996	1.001
TV	0.964	0.192	25.202	1	0.000	2.621
SPP	-1.551	0.256	36.779	1	0.000	0.212
TP	1.838	0.241	57.996	1	0.000	6.283
FT	-0.006	0.026	0.058	1	0.810	0.994
DP	2.083	0.656	10.074	1	0.002	8.025
C	-31.058	4.257	53.234	1	0.000	0.000
Cox & Snell R^2	0.669					
Nagelkerke R^2	0.897					
-2 Log likelihood	132.281				0.000	
Hosmer and Lemeshow Test	2.456				0.864	

Source: Abubakar et al., 2024.

Discussion

The primary finding of this study is that calorie-sufficient households consume more micronutrient-rich foods than calorie-deficient households. Additionally, households that consume higher quantities of total vegetables, total proteins, and dairy products are less likely to be calorie deficient, while those consuming more seafood and plant proteins are less likely to be calorie sufficient. Furthermore, a large difference was observed between the two groups in terms of total vegetables, total proteins, and seafood and plant proteins intake. A moderate difference was found in greens and beans intake, while a minimal difference was observed in fruit and dairy products intake.

However, the micronutrient food consumption of both calorie-sufficient and calorie-deficient households remain below the recommended levels outlined in the HEI-2015. In particular, fruit and dairy products' consumption was notably low in both groups. This finding is consistent with the research of Otuneye et al. (2017), who reported infrequent intake of fruits as one of the poor dietary habits exhibited by adolescents in Abuja municipal area council. Litton and Beavers (2021) also noted that the intake of foods with healthy markers such as fruits and vegetables was lower among food insecure households compared to food secure one.

The consumption of micronutrient foods below the required standards, particularly among calorie-deficient households, may pose significant health risks. This is due to the fact that many of nutrients obtained from mentioned foods cannot be synthesized in sufficient quantities by the body, while they are essential for healthy development. The persistent increase in food prices continues to pose a significant threat to household food intake and, consequently, their food security status. This, in turn, may lead to considerable risks in their micronutrient food intake as households may resort to substitute quality diets with larger quantities of starchy foods, which can further exacerbate potential health issues.

The logistic regression results revealed that households that consumed more dairy products, total proteins and total vegetables were approximately 8, 6, and 2 times more likely to be calorie sufficient than those consuming lower amounts, respectively. Conversely, for every additional intake of seafood and plant proteins, households were 0.21 times less likely to be calorie sufficient. The basic understanding is that as households consume more calories, the more likely they will be calorie sufficient. While this current finding does not contradict that notion, it suggests that as households become more calorie deficient, they tend to consume more proteins from seafood and plant sources, or less from animal sources. Given the ready availability of plant proteins like beans, soybeans, or seafood like crab, especially in rural areas, calorie-deficient households may opt for these more affordable alternatives over more expensive eggs and different types of meat. Thus, consuming more plant-based protein foods, such as local delicacies like beske (a soybean byproduct), as substitutes for meat, cheese, and eggs can be an indicator of calorie deficiency and, by extension, food insecurity.

Essentially, the rate of consumption of seafood and plant proteins can be used to distinguish calorie sufficient from calorie deficient households. This is corroborated by finding of Amao (2013) who noticed that majority of households that could afford protein foods spend more on animal protein than plant protein sources. Abdulraheem et al. (2016) also found some statistical difference between food secure and insecure households based on their protein consumption.

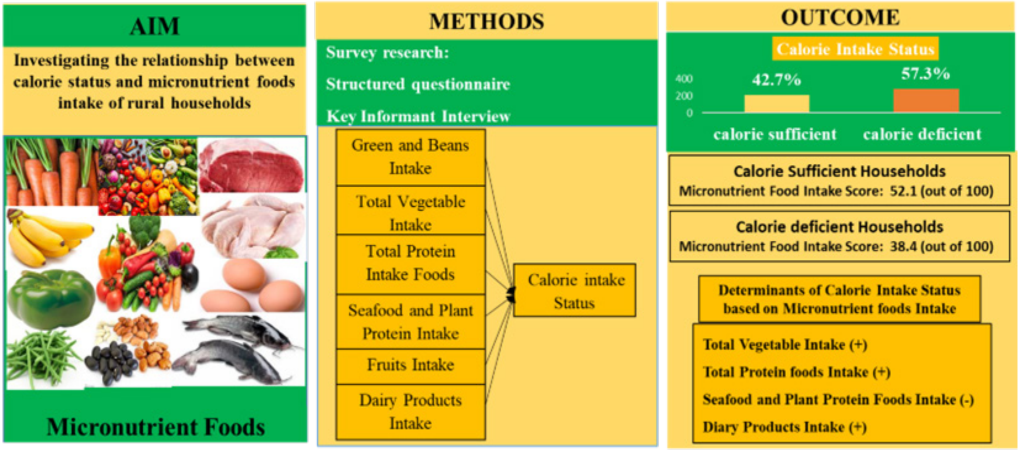
The consumption of fruits, greens and beans have appeared insignificant. Greens, such as jute leaf, spinach, and baobab leaf, were consumed daily by the majority of households, both calorie-sufficient and calorie-deficient, particularly combined with swallow foods like pounded yam, yam flour, and cassava flour, which are prevalent in the study area. Furthermore, bean consumption appeared to be insignificant, primarily due to the fact that households that cultivated more beans are consuming larger quantities than those cultivated less areas. Lastly, the insignificance of fruit consumption might be because fruit intake in rural areas is often habitual, with households consuming more or less based on seasonal availability rather than their overall calorie intake or food security status. That is, fruit consumption may not directly reflect a household's nutritional or caloric needs, but rather the accessibility of fruits during certain times of the year. This is consistent with Leung et al. (2014) who noted that there is no observable difference in consumption of fruits among food secure and food insecure adults in the USA. Diana et al. (2020) also noted that fruits that are highly available with low prices were consumed by all households in Madura Island (Indonesia) regardless to their food security status.

This research employed the 24 hours' recall method to collect information on households' micronutrient foods consumption. Thus, a longer recall instrument may provide more information on households' micronutrient foods intake.

Conclusions

Majority of the households in the study area are currently experiencing calorie deficiency and inadequate micronutrient food intake. Despite higher micronutrient consumption among calorie-sufficient households, overall intake remains below recommended levels. Notably, dairy products, total protein foods, and total vegetables intake are associated with increased calorie sufficiency, while seafood and plant proteins are linked to higher calorie deficiency. This suggests that households may prioritize seafood and plant proteins over vegetables and animal-source foods when facing calorie deficits. Brief presentation of performed research could be done in next graph (Graph 1.).

Graph 1. Structure and the flow of the performed research



Given the critical role of these foods in supporting the health and well-being of women, children, and adults, nutritional adequacy campaigns should be a cornerstone of any food security intervention in the rural areas. These campaigns should focus on educating households about the benefits and implications of mentioned foods. Moreover, food security programs must not only address the quantity of food consumed but also prioritize the quality of diets to promote productive and healthy living. Finally, conducting a comprehensive assessment of specific nutrient deficiencies (i.e. vitamins and minerals) in rural areas is necessary to identify key areas where dietary interventions are needed.

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