Scientific Research Publishing

Food and Nutrition Sciences, 2024, 15, 548-564
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

# Dietary Diversity and Food Security Status among Cameroonian Adults Living in Semi-Urban Areas: A Cross-Sectional Study

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**How to cite this paper:** Tchuente, T.B.R., Hagbe, P.V., Eyenga, E.F., Dibacto, K.R.E., Ngoumen, N.D.J., Youovop, F.J.A., Takuissu, N.R.G., Ngondi, J.L. and Oben, J.E. (2024) Dietary Diversity and Food Security Status among Cameroonian Adults Living in Semi-Urban Areas: A Cross-Sectional Study. *Food and Nutrition Sciences*, **15**, 548-564.
https://doi.org/10.4236/fns.2024.157036

**Received:** May 17, 2024
**Accepted:** July 13, 2024
**Published:** July 16, 2024



## Abstract

**Introduction:** Food security is one of the greatest challenges that most African countries face. It is a concept that considers not only food quantity but also food quality. The objective of this study was to describe dietary diversity and food security status at the individual level in Cameroonian populations. **Methods:** A total of 1180 men and women aged 20 and over and living in the West, North West, and Littoral regions of Cameroon were recruited. Data on dietary habits were collected through the frequency of consumption of various food groups. Dietary diversity was assessed using a 24-hour dietary recall. Food security status was determined by combining two indicators (food consumption score and individual food diversity score). **Results:** The mean dietary diversity score of the population was 3.53 ± 1.44, $p < 0.05$. The frequencies of high dietary diversity (39.3%) were significantly higher in individuals living in the Littoral region compared to the other two regions. Regarding dietary habits, high consumption of energy-rich foods (cereals (80.5%), tubers (61.1%), and oils & fats (79.0%)) was observed in the general population with a preponderance in the populations living in the Littoral region. In general, 55.6% and 53.9% of participants had a low consumption of vegetables and fruits, respectively. This low consumption was more pronounced among participants in the North West (61.6%) for fruits while it was more important among individuals in the West (68.4%) for vegetables. The prevalence of food security was higher among populations in the Littoral region compared to the

other two regions (81.1%, $p < 0.05$). Male sex, education level, and high socio-economic level were independent predictors of food security in those participants. **Conclusion:** The diet diversity of adults living in the West, North West, and Littoral regions of Cameroon is medium. Although half of the study population was food secure, there is a need to implement food security policies further to reduce food insecurity among the Cameroonian population.

## Keywords

Dietary Diversity, Individual Food Security, Littoral, West, North West, Cameroon

## 1. Introduction

Hunger and malnutrition remain major problems affecting the world's population today. These concerns raise the notion of food consumption, which is acute in both developed and developing countries. Indeed, food security is a growing concern, as it is now recognized that it contributes significantly to health problems. According to the scientific community, food security exists when all human beings have, at all times, physical, economic, and social access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for active and healthy life [1]. This definition highlights four essential pillars: food availability, access to food, food use, and stability, and several components (quantity, quality, safety, and food preferences or cultural acceptability) [2]. Ensuring food security is not only about ensuring sufficient food production, providing safer food, ensuring better accessibility to food for all social strata, addressing food production conditions and thus environmental protection, or preserving people's health and nutrition but all this together [3]. Despite the commitment made by governments at recent food summits, there are still high rates of food insecurity. The Food and Agriculture Organization of the United Nations (FAO) estimates that the global prevalence of food insecurity has risen from 25.3% in 2019 to 29.6% in 2022 [4]. It was observed that 12.3% of American households were food insecure in 2016 [5]; 25% of Malian households and 16% of Senegalese households were food insecure [6] [7].

Often presented as a food-self-sufficient country with a cereal balance sheet that seems to be in balance [8], Cameroon is no exception to this scourge. Indeed, it has been estimated that 3.09 million people are food insecure [9]. Although the cause of these nutritional challenges is multifactorial, inadequate food consumption and sub-optimal food quality contribute significantly to these problems. In addition, to address these problems, governments and non-governmental organizations have put in place policies to reduce food insecurity. These policies have been oriented towards energy production and consumption at the expense of food diversity [10]. However, there is undoubted evidence that an

energy-rich diet is not synonymous with the supply of nutrients necessary for the body to function properly [11]. Therefore, in addition to providing people with sufficient calories, it is essential to enable them to have a food diversity that guarantees the intake of nutrients essential for a healthy and balanced diet [12]. Therefore, Dietary Diversity (DD) is known internationally as a vital component of a healthy diet [13] as it is a measure of dietary quality [14]. Dietary quality is defined as a dietary pattern or indicator of the diversity of key food groups relative to those recommended [15]. A good quality diet leads to higher nutrient intakes and a lower risk of diet-related non-communicable diseases [16]. The quality of the diet may be influenced by many factors, including cultural and dietary environment, socio-economic status, dietary habits, consumption patterns, and nutritional recommendations for age, gender, country, and/or culture of the individual [17]. From the above, we ask ourselves the following question: is food security at the individual level not associated with poor food quality? Therefore, this work aims to analyze diet diversity and food security status in the study population.

## 2. Methodology

### 2.1. Study Framework

The study was conducted in seven cities in three regions of Cameroon. In the West region, Bafoussam (the regional capital), Mbouda (the capital of the Bamboutos department), and Babadjou (a district located about 12 km from Mbouda) were the study sites in this region. In the littoral region, the survey was done in the city of Nkongsamba, the capital of the Mungo department. In the North West region, the investigation was conducted in the towns of Wum, Mbengwi, and Ndu. The study was carried out from August 2016 to August 2019.

### 2.2. Type and Study Population

The present study was a cross-sectional, descriptive, and analytical study. The study population consisted of adult volunteers of both sexes, of Cameroonians aged 20 years and older.

### 2.3. Inclusion and Non-Inclusion Criteria

Eligible participants were Cameroonians of both sexes who had been residing in the study areas for at least 6 months and had given free and informed consent. Pregnant or lactating women, as well as people with disabilities and those with mental health problems, were not included in the study.

### 2.4. Sample Size

The sample size was calculated using the Magnani formula [18]. Based on the 84% prevalence of food security produced in the 2017 Food Security and Vulnerability Analysis [9], a 95% confidence interval and a 5% margin of error were

used. The final sample size was 1180 participants.

$$\mathbf{n} = \frac{t^2 \times p(1-p)}{m^2}$$

**n** = required sample size.

t = confidence level at 95% (standard value of 1.96).

$p$ = estimated prevalence of food security in Cameroonian adult population was 84% [9].

m = margin of error at 5% (standard value of 0.05).

n = 207, we have 3 regions:

n = 207 × 3 = 621 participants.

Therefore, the total sample size required for this study was 621 participants.

A total of 1180 volunteers were recruited during the survey.

### 2.5. Ethical Considerations

This study was approved by the Ethics Committee at N 2014/08/488/EC/CNERSH. Authorization for data collection was obtained from the regional administrative and health authorities. Informed consent was obtained from all participants before the start of the interviews. The purpose and objectives of the study were explained to each participant before the interview. Participants were free to refuse or withdraw from the study at any time.

### 2.6. Data Collection Process and Instrument

Trained interviewers and supervisors collected data from volunteer participants. They used a structured questionnaire adapted from World Health Organization guidelines.

### 2.7. Administration of the Questionnaire

After freely and voluntarily consenting to participate in the study, a questionnaire was administered to participants. The administration of the said questionnaire was carried out by interview. This allowed us to obtain socio-economic and demographic information (age, sex, place of residence, marital status, occupation, and level of education); data on food quality (using individual food diversity score), food security information, and eating habits.

### 2.8. Assessment of Eating Habits: Frequency of Consumption of the Various Food Groups

Eating habits were assessed through a face-to-face interview with each participant. A 7-day recall food frequency questionnaire was used to evaluate the frequency of consumption of various food groups (cereals, roots & tubers; pulses; animal proteins; dairy products; fruits; vegetables; oils & fats; sweets; condiments & spices) [19]. Subsequently, the data obtained allowed us to classify each food group into 2 categories: 0 - 3 per week for low consumption; and 4 - 7 per week for high consumption. The food groups obtained were then aggregated in-

to three major food groups according to their function. These are energy foods (carbohydrates, cereals, fats and oils, sugar-rich foods); growth foods (pulses, animal protein, dairy products), and protective or health foods (fruits, vegetables, and condiments & spices).

### 2.9. Assessment of Individual Dietary Diversity Score

The Dietary Diversity Score (DDS) has been identified as an indicator of diet quality that is oppositely associated with chronic disease risk. It is also an approximate measure of the nutritional adequacy of the diet at the individual level [20]. Dietary Diversity Scores (DDSs) were calculated by counting the number of food groups (9) consumed by the respondent in 24 hours. A score of "1" was assigned if the group was present in the 24-hour recall and "0" if the group was absent. The dietary diversity score was the total of the ratings, for a maximum of 9. Participants were grouped into 3 classes according to their dietary diversity score: DDS [1 - 2] = low dietary diversity; DDS [3 - 4] = medium dietary diversity; and DDS [>4] = dietary diversity [21]. The higher the score, the better the quality of the individual's diet [22] (**Table 1**).

**Table 1.** Group of Food used in IDDS.

| Groups | Foods |
|---|---|
| 1-Cereals | Maize, rice, bread, pasta, wheat flour, wheat couscous, millet |
| 2-Root and tubers | Manioc, yam, plantain banana, sweet potato, potato |
| 3-Plants rich in Vit A | Lettuce, tomato, carrots, okra, cucumber, spinach, green beans |
| 4-Other fruits and vegetables | Mangoes, pineapples, bananas, avocados, guavas, melons, oranges, mandarins, cabbage |
| 5-Pulses/nuts | Beans, soybeans, peanuts, cola nuts, coconuts, palm nuts, sesame seeds |
| 6-Meat, poultry, fish, and seafood | Beef, mutton, goat, pork, rabbit, chicken, turkey, guinea fowl, fish, crabs, shrimps |
| 7-Eggs | Fried and boiled eggs |
| 8-Milk and milk products: | Whole milk powder, sweetened condensed milk, curdled milk, semi-skimmed milk, yogurt, local and imported cheeses |
| 9-Oil and fat | Vegetable oils, margarine, butter, mayonnaise |

### 2.10. Assessment of Food Security Method Modified by [23]

Two indicators were used in this study: the food consumption score and the individual food diversity score (as described above).

**Food consumption score** [24]

For the calculation of this score, eight food groups (cereals & tubers, pulses, vegetables, fruits, fruits, oils & fats, milk and dairy products, animal proteins,

and sugars) were considered. Then, a table was created indicating the consumption frequencies of each food group. Each food group has a corresponding quality weighting factor that reflects its energy value. This weighting factor is based on the density of nutrients contained in the food consumed. The consumption frequencies of each weighted and summed food group constitute the Food Consumption Score (FCS). The food consumption score is a composite score based on the diversity of the diet, the frequency of food consumption, and the importance of the nutrients contained in the different food groups.

$$FCS = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8$$

where: X = number of days of consumption of each food group during the past 7 days; a = weight assigned to the food group. 1 = cereals; 2 = pulses; 3 = vegetables; 4 = fruit; 5 = animal proteins; 6 = sugar; 7 = milk; 8 = oil.

The values of the scores thus calculated are reported on a scale with standard thresholds used to determine the three classes of food consumption: FCS [0 to 28] = low food consumption; FCS [28.5 to 42] = limited food consumption and FCS [>42] = acceptable food consumption (Table 2).

Table 2. Group of food used in FCS.

| Food item | Food group | Weight (a) |
|---|---|---|
| Maize, rice, sorghum, millet, bread, and other cereals | Cereals and tubers | 2 |
| Cassava, potatoes, and sweet potatoes | | |
| Beans, peas, groundnuts, and cashew nuts | Pulses | 3 |
| Vegetables, relish, and leaves | Vegetables | 1 |
| Fruits | Fruits | 1 |
| Beef, goat, poultry, pork, and fish | Meat and fish | 4 |
| Milk, yogurt, and other dairy products | Milk | 4 |
| Sugar and sugar products | Sugar | 0.5 |
| Oils, fats, and butter | Oil | 0.5 |

After calculating each of these two indicators, the Synthetic Food Security Index (SFSI) is determined by combining the scores obtained for the two indicators. And from this combination, four levels of food security are deduced, they are described in Table 3.

Table 3. Food security levels.

| | Poor food consumption | Borderline food consumption | Acceptable food consumption |
|---|---|---|---|
| Poorly diversified Diet | High food insecurity | Moderate food insecurity | Moderate food security |
| Moderately diversified diet | Moderate food insecurity | Moderate food security | Moderate food security |
| Diversified diet | Moderate food insecurity | Moderate food security | High food security |

### 2.11. Data Entry, Processing, and Statistical Analysis

The data were entered into Excel 2016 and transferred to Statistical Package for Social Sciences (SPSS) software version 20.0 for Windows for statistical analysis. The results are expressed as means ± standard deviation (SD) for continuous and frequency (%). Pearson's Chi-square test was used to compare the proportions between the categorical variables and one-way Analysis of Variance (ANOVA) followed by post hoc LSD was used to compare continuous variables. Regression analyses were performed to evaluate risk. The significance threshold was set at $p < 0.05$.

## 3. Results

### 3.1. Socio-Demographic Characteristics of the Study Population

The application of the inclusion and non-inclusion criteria resulted in a total of 1180 participants. These were distributed as follows: 437 participants in the Littoral region, 345 participants in the Western region, and 398 participants in the North West region. The analysis of the socio-demographic data shows that women were predominantly represented in the study population (69.2%), with a greater predominance in the West Cameroon region where 72% of the participants were women. In terms of age, we found that participants aged 50-59 years were the most represented in the study population (26.4%). This age group was more preponderant in the Littoral region (32.1%) followed by the West region (24.7%). Concerning the level of education, we noted that the secondary level was more represented in the population (44.2%). This high propensity of secondary education was observed in the Littoral (49.4%) and West (49.1%) regions, while in the North West, primary education was more important (48.6%). As for marital status, it appears that people living with a partner represented more than half of the study population (66.1%). We also noted that regardless of the study region, participants who had been living in the study region for more than 10 years were the most represented, 84.1%, 84.8%, and 80.4% respectively in the Littoral, the West, and the North West (**Table 4**).

### 3.2. Frequency of Consumption of Energy, Growth, and Health Foods in the Study Population

Assessment of the frequency of consumption of energy, growth, and health foods in the study population shows that the consumption of energetic foods was high (≥4 times/week) in the study population. These high frequencies were significantly higher in participants from the Littoral region by 100%; 93.3%; and 97.2% ($p < 0.05$) for cereals, tubers, and oils & fats respectively. However, 65.1% of the population had a low sweet intake (1 - 3 times/week). Regarding healthy foods, it was generally found that the low consumption (1 - 3 times/week) of these foods was significantly higher in the population ($p < 0.05$), with frequencies of 55.5%, 53.6%, and 53.1%, respectively for leafy vegetables, condiments & spices, and fruits. This low consumption was significantly higher in the populations of the

**Table 4.** Socio-demographic characteristics of the study population.

| Variables | | General population | Littoral % (N) | West % (N) | North West % (N) |
|---|---|---|---|---|---|
| Sex | Woman | 69.2 (816) | 69.1 (302) | 72 (248) | 66.8 (266) |
| | Man | 30.8 (364) | 30.9 (135) | 28 (97) | 33.2 (132) |
| Age | 20 - 29 years | 19.3 (227) | 18.3 (80) | 17.5 (60) | 21.9 (87) |
| | 30 - 39 years | 17.1 (201) | 15.8 (69) | 13.9 (48) | 21.1 (84) |
| | 40 - 49 years | 23.6 (278) | 23.6 (103) | 24.7 (85) | 22.6 (90) |
| | 50 - 59 years | 26.7 (315) | 32.1 (141) | 24.7 (85) | 22.4 (89) |
| | ≥60 years | 13.4 (159) | 10.1 (44) | 19.3 (67) | 12.1 (48) |
| Level of education | Illiterate | 9.3 (111) | 2.7 (12) | 11.5 (40) | 14.8 (59) |
| | Primary school | 38.3 (451) | 33.2 (145) | 32.7 (113) | 48.6 (193) |
| | Secondary school | 44.2 (522) | 49.4 (216) | 49.1 (169) | 34.3 (137) |
| | Academic school | 8.2 (96) | 14.6 (64) | 6.7 (23) | 2.3 (9) |
| Socio-economic level | Weak | 18.4 (217) | 11.4 (50) | 24.3 (84) | 20.9 (83) |
| | Medium | 65.1 (768) | 67.5 (295) | 64.3 (222) | 63.1 (251) |
| | High | 16.5 (195) | 21.1 (92) | 11.3 (39) | 16.1 (64) |
| Marital status | Single | 17.4 (205) | 22.1 (97) | 17.5 (60) | 12.0 (48) |
| | Married | 66.1 (779) | 65.1 (284) | 63.9 (220) | 69.1 (275) |
| | Divorced/widowed | 16.6 (196) | 12.8 (56) | 18.7 (65) | 18.9 (75) |
| Length of stay in the area | Less than 1 year | 3.2 (34) | 6.4 (27) | 1.7 (6) | 0.3 (1) |
| | 1 - 2 years | 3.1 (37) | 2.3 (10) | 1.7 (6) | 5.3 (21) |
| | 2 - 5 years | 3.3 (39) | 2.3 (10) | 5.0 (17) | 3.0 (12) |
| | 5 - 10 years | 7.4 (89) | 4.8 (21) | 7.0 (24) | 11.0 (44) |
| | More than 10 years | 83.1 (981) | 84.1 (369) | 84.8 (292) | 80.4 (320) |

Western region for leafy vegetables (68.4%) ($p < 0.05$). On the other hand, for fruits and condiments & spices, the low consumption (1 - 3 times/week) was significantly higher in the populations of the North West region, 61.6%, and 85.7% respectively ($p < 0.05$). When we look at growth foods, it was found that the majority of the population had a high consumption of pulses (74.8%) and animal proteins (67.7%) ($p < 0.05$). However, the populations of the Littoral region consumed more of these foods compared to the other two study populations ($p < 0.05$). As for dairy products, 80.1% of the population had low consumption of these products ($p < 0.05$); this low consumption was significantly higher in the Western region (91.3%) compared to the other two study regions ($p < 0.05$) (Table 5).

Table 5. Frequency of consumption of energy-rich, growth, and healthy foods in the study population.

| Food groups | | General population | Littoral % (N) | West % (N) | North West % (N) |
|---|---|---|---|---|---|
| **Energy-rich foods** | | | | | |
| **Cereals** | Low (0 - 3 per week) | 19.5 (230) | 0 (0) [a] | 25.8 (89) [b] | 35.4 (141) [c] |
| | High (4 - 7 per week) | 80.5 (950) * | 100 (437) [a] | 74.2 (256) [b] | 64.6 (257) [c] |
| **Tubers** | Low (0 - 3 per week) | 38.9 (459) | 6.9 (30) [a] | 51.9 (179) [b] | 62.8 (250) [c] |
| | High (4 - 7 per week) | 61.1 (721) * | 93.1 (407) [a] | 48.1 (166) [b] | 31.2 (148) [c] |
| **Oils & Fats** | Low (0 - 3 per week) | 21.0 (248) | 2.8 (12) [a] | 12.5 (43) [b] | 48.5 (193) [c] |
| | High (4 - 7 per week) | 79.0 (932) * | 97.2 (425) [a] | 87.5 (302) [b] | 51.5 (205) [c] |
| **Sweets** | Low (0 - 3 per week) | 65.1 (768) * | 49.5 (216) [a] | 66.1 (228) [b] | 81.4 (324) [c] |
| | High (4 - 7 per week) | 34.9 (412) | 50.5 (221) [a] | 33.9 (117) [b] | 18.6 (74) [c] |
| **Healthy foods** | | | | | |
| **Leafy vegetables** | Low (0 - 3 per week) | 55.5 (655)* | 51.1 (223) [a] | 68.4 (236) [b] | 49.2 (196) [a] |
| | High (4 - 7 per week) | 44.5 (525) | 48.9 (214) [a] | 31.6 (109) [b] | 50.8 (202) [a] |
| **Fruits** | Low (0 - 3 per week) | 53.1 (626) * | 50.9 (222) [a] | 46.2 (159) [a] | 61.6 (245) [b] |
| | High (4 - 7 per week) | 46.9 (554) | 49.1 (215) [a] | 53.8 (186) [a] | 38.4 (153) [b] |
| **Condiments and spices** | Low (0 - 3 per week) | 53.6 (633) * | 1.1 (5) [a] | 83.1 (287) [b] | 85.7 (341) [b] |
| | High (4 - 7 per week) | 46.4 (547) | 98.9 (432) [a] | 16.9 (58) [b] | 14.3 (57) [b] |
| **Growth foods** | | | | | |
| **Pulse** | Low (0 - 3 per week) | 25.2 (297) | 9.6 (42) [a] | 31.0 (107) [b] | 37.2 (148) [b] |
| | High (4 - 7 per week) | 74.8 (883) * | 90.4 (395) [a] | 69.0 (238) [b] | 62.8 (250) [b] |
| **Animal protein** | Low (0 - 3 per week) | 32.3 (381) | 11.5 (50) [a] | 46.4 (160) [b] | 43.0 (171) [b] |
| | High (4 - 7 per week) | 67.7 (799) * | 88.5 (387) [a] | 53.6 (185) [b] | 57.0 (227) [b] |
| **Dairy products** | Low (0 - 3 per week) | 80.1 (945) * | 68.8 (301) [a] | 91.3 (315) [b] | 82.7 (329) [c] |
| | High (4 - 7 per week) | 19.9 (235) | 31.2 (136) [a] | 8.7 (30) [b] | 17.3 (69) [c] |

Note: The frequencies assigned to the same letters are not significantly different between the study regions at the 0.05 threshold; *significantly different between the frequencies of consumption in the general population at the 0.05 threshold.

### 3.3. Evaluation of Dietary Diversity of the Study Population

The mean dietary diversity scores were 3.53 ± 1.44. These values overall reflect inadequate food quality. When we look at regional differences, the mean individual dietary diversity score was significantly higher in the Littoral region (4.13 ± 1.44; $p < 0.05$) than in the other regions of the study. When participants were classified according to their scores, 49.4% of them had a moderately diverse diet (IDDS between 3 and 4 food groups). This moderate diversity was higher in the Western region (51.3%) and while the high dietary diversity was higher in Littoral (39.3%). However, low dietary diversity was significantly more pronounced among participants in the North West region (36.4%) ($p < 0.05$) (Table 6).

**Table 6.** Evaluation of dietary diversity of the study population.

| | General population | Littoral % (N) | West % (N) | North West % (N) |
|---|---|---|---|---|
| Individual dietary diversity (%) | | | | |
| Low diversity | 25.8 (304) | 11.9 (52) [a] | 31.0 (107) [b] | 36.4 (145) [c] |
| Medium diversity | 49.4 (583) | 48.8 (213) [a] | 51.3 (177) [b] | 48.2 (192) [a] |
| High diversity | 24.8 (293) | 39.3 (172) [a] | 17.7 (61) [b] | 15.4 (61) [b] |
| Dietary diversity score (M ± SD) | 3.53 ± 1.44 | 4.13 ± 1.44 [a] | 3.26 ± 1.44 [b] | 3.12 ± 1.35 [b] |

Note: Frequencies and means assigned to the same letter are not significantly different between regions at the 0.05 level.

### 3.4. Prevalence of Food Security Status in the General Population and by Region

Table 7 provides the prevalence of food security status in the population. It shows that 50.7% of the population was food secure (15.1% in high food security and 35.6% in moderate food security). This food security was significantly higher among the populations of the Littoral region (81%) (36.0% in high food security and 45.0% in moderate food security) than in the other two regions ($p < 0.05$). On the other hand, we observed that the West and North West regions were the most affected by food insecurity with proportions of 68.1% (53.3% in moderate food insecurity and 14.8% in high food insecurity) and 66.3% (47.0% in moderate food insecurity and 19.3% in high food insecurity) respectively.

**Table 7.** Prevalence of food security levels in the population.

| | General population % (N) | Littoral % (N) | West % (N) | North West % (N) |
|---|---|---|---|---|
| High food security | 15.1 (178) | 36.0 (157) [a] | 2.9 (10) [b] | 2.8 (11) [b] |
| Moderate food security | 35.6 (420) | 45.0 (197) [a] | 29.0 (100) [b] | 30.9 (123) [b] |
| Moderate food insecurity | 37.5 (443) | 16.4 (72) [a] | 53.3 (184) [b] | 47.0 (187) [b] |
| High food insecurity | 11.8 (139) | 2.5 (11) [a] | 14.8 (51) [b] | 19.3 (77) [b] |

Note: The frequencies assigned to the same letters are not significantly different between the study regions at the 0.05 threshold.

### 3.5. Assessment of Predictive Factors for Food Security in the Study Population

Logistic regression was used to predict the risk of an individual being food secure in the study population. Thus, the analysis showed that certain factors were associated with food security including, gender (male) (OR = 1.351, CI: 1.053 - 1.734, p = 0.018), age (20 - 39 years) (OR = 1.541, CI: 1.060 - 2.240, p = 0.024) and age (40 - 59 years) (OR = 1.818, CI: 1.262 - 2.599, p = 0.001); high socio-economic level (OR = 3.974, CI: 2.636 - 5.992, p = 0.0001) and medium socio-economic level (OR = 2.351, CI: 1.709 - 3.234, p = 0.0001); university education (OR =

2.840, CI: 1.789 - 4.509, p = 0.0001) and secondary education (OR = 1.987, CI: 1.556 - 2.537, p = 0.0001) (Table 8)

Table 8. Assessment of factors predicting food security in the study population.

| Variables | | Odds ratio | 95% confidence interval | p-value |
|---|---|---|---|---|
| Sex | Woman | 1 | | |
| | Male | 1.351 | 1.053 - 1.734 | 0.018 |
| Age | ≥60 years | 1 | | |
| | 40 - 59 years | 1.818 | 1.262 - 2.599 | 0.001 |
| | 20 - 39 years | 1.541 | 1.060 - 2.240 | 0.024 |
| Socio-economic level | Low | 1 | | |
| | Medium | 2.351 | 1.709 - 3.234 | 0.0001 |
| | High | 3.974 | 2.636 - 5.992 | 0.0001 |
| Education level | Illiterate/primary | 1 | | |
| | Secondary | 1.987 | 1.556 - 2.537 | 0.0001 |
| | University | 2.840 | 1.789 - 4.509 | 0.0001 |
| Marital status | Single | 1 | | |
| | Married | 0.875 | 0.640 - 1.197 | 0.403 |
| | Divorced/widowed | 0.499 | 0.332 - 0.744 | 0.001 |

## 4. Discussion

The study of the description of the dietary habits in our population revealed that the frequency of consumption of the different food groups varied according to the different study regions. Indeed, we noted that in the energy food class, cereals, oils & fats and tubers are the most consumed food groups and this high consumption was more important in the Littoral region (Table 5). Health foods (leafy vegetables, fruits, and condiments & spices) were lower consumed. This propensity for low consumption was subjugated in the North West region for fruits and condiments & spices and in the West region for vegetables as well as condiments & spices (Table 5). The farming system could explain these results. In addition, the high consumption of cereals and tubers could be explained by the fact that they represent subsidence crops and are therefore grown throughout the country, which would lead people to choose these foodstuffs for food [25]. It is also noted that the Littoral region belongs to the ecological zone of the Littoral lowlands in which, we find preferentially the cultivation of oil palm (industrial production), plantain, cassava, and also corn. The West and North West represent the highlands where corn, cocoa, coffee, beans, potatoes, and vegetables are grown. They are considered the granary of Cameroon. Thus, the low consumption of these food groups in these two regions could be explained by the fact that their crops are mainly oriented for commercialization and therefore

these populations consume less. As for vegetables and fruits, their low consumption could be attributed to a lack of nutritional education. The populations are not informed or have little knowledge about the benefits of dietary fiber and antioxidants contained in fruits and vegetables to protect against cardiovascular diseases [26]. It is evident from this study that the diet of the study population is characterized by high consumption of energy foods (cereals, roots & tubers, oils & fats) and low consumption of healthy foods (fruits, vegetables, condiments & spices). These results are in line with those of the WFP [9] which showed that the consumption of cereals, roots & tubers; oils, and fats was high in the Cameroonian population. The finding of this study has already been indicated: Cameroonian dietary habits are mainly characterized by low consumption of fruits and vegetables, added to higher consumption of foods rich in starch and sugar [27] [28].

Dietary diversity better predicts diet quality [29], and this study is consisted of counting the number of food groups consumed during a 24-hour reference period. The average dietary diversity was 3.53 (**Table 6**). This is lower than the average obtained in adult Sahrawi refugees living in Algeria (3.8 ± 1.4) [30]; at the national level among adult South Africans [31] and in medical science employees at Kermanshah University in Iran (5.68 ± 1.73) [32]. Given the importance of individual dietary diversity scores in determining nutritional status [14] [29], this low dietary diversity suggests high vulnerability and severe nutritional insufficiency in the study population [22]. Overall, 25.8% had a poorly diversified diet. The percentage of poorly diversified diets observed in our study was lower than that observed by the WFP in 2021, which showed that 32.4% of Cameroonian households had a poorly diversified diet [33].

Lack of financial resources, low availability of certain food groups, high cost, and attachment to traditional (monotonous) meals may account for this low diversity [34] [35]. In addition, the level of education observed in our study population would also explain this dietary diversity. Studies have shown an association between education level and dietary diversity [36]. People with less education are less concerned about their nutritional balance and diet and therefore their dietary diversity tends to decrease. However, dietary diversity was higher in the Littoral region (39.3%) compared to the Western (17.7%) and North West (15.4%) regions ($p < 0.05$). The high socio-economic status in the Littoral region is believed to be the reason for the high dietary diversity observed in this region. Studies have indicated that high socio-economic status may be associated with overall healthier dietary habits, quality, and diversity in developing countries [37].

Food security was assessed by juxtaposing the food consumption score and the dietary diversity score. This method allows us to take into account the nutritional aspect of food security at the individual level. Thus, the results show that 49.4% were food insecure. These results are high compared to the 16% found at the Cameroonian national level (WFP, 2017) [9]. They are also higher than the

21% and 25% found in Mali [6] and Chad [7] respectively. However, our results are also lower than those obtained by Bushara and Ibrahim [38] in Al-Qadarif, Sudan (91% food insecure); Omotesho *et al*. [39] found that 51.72% of rural households in Kwara State, Nigeria, were food insecure. The observed differences would be due to dissimilarities between the study populations, such as rural and urban areas, as well as to the different characteristics of the study populations. It can be assumed that the prevalence of food insecurity is higher in rural areas and small towns compared to large cities [40]. In addition, different food security assessment methods could be indexed. Indeed, for the results previously mentioned, the authors used the Household Food Insecurity Access Scale, the Radimer/Cornell Hunger, and the 18 questions of the US Department of Agriculture Food Security (USDA) questionnaire. In this work, the assessment of food security was done by juxtaposing two indicators.

Analysis of the predictors of food security status in our population reveals that high socio-economic level (OR = 3.974, CI: 2.636 - 5.992, p = 0.0001); education level (university) (OR = 3.744, CI: 2.088 - 6.712, p = 0.0001); high dietary diversity (OR = 2.998, CI: 2.361 - 3.808, p = 0.0001); younger age (20 - 29 yrs) (OR = 1.794, CI: 1.213 - 2.651, p = 0.003) and gender (male) (OR = 1.351, CI: 1.053 - 1.734, p = 0.018) have a positive and significant association with food security in the study population.

Our results indicate that university education level and high socio-economic level increase the risk of being food secure in our study population by almost 4 times. This result could be explained by the fact that a high level of education increases the chances of having a job or a job with a large salary [41]. This is because the higher the individual's salary, the more financial capacity they have to feed themselves. It has been shown that one of the main indicators to promote food security is the level of education.

Regarding gender, our work shows that men are more likely to be food secure than women (OR = 1.351, CI: 1.053 - 1.734, p = 0.018). This result is consistent with the distribution of food security status by gender where men were more food secure than women. This is because of social and economic inequalities to the detriment of women [42]. In addition, it was shown that female-headed households had lower food access (food insecurity) than male-headed households [42].

## 5. Conclusion

This cross-sectional study analyzed food security and dietary diversity among Cameroonian adults. It shows that dietary diversity was moderate and the prevalence of food insecurity was fairly high in the study population. The determinants of food security were high socio-economic level, secondary and university education, and male gender. This study suggests that food security policies should be further implemented to reduce the increase in food insecurity among the Cameroonian population.

## Acknowledgements

The authors would like to thank the population of the various study sites for agreeing to participate in this study.

## Availability of Data and Material

Data and material of this study are available request from the corresponding author.

## Authors' Contributions

TBRT and JLN conceived and designed the study. TBRT, PVH, EFE, and KRED collected the data and conducted the laboratory analyses. TBRT, NDJN, FJAY, and NRGT carried out the statistical analysis. TBRT, NRGT, and NDJN wrote the paper. JLN revised the manuscript. JLN and JEO supervised the work. All authors read and approved the final version of the manuscript.

## Conflicts of Interest

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

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