Scientific Research Publishing

Food and Nutrition Sciences, 2024, 15, 1-26
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Assessement of Nutritional Status of Households Using Weighed Food Intake in North West Region of Cameroon

Ebai Nee Besong Patricia Ange[1], Gustave Mabiama[1], Eyenga Manga[1], Nyangono Biyegue Fernande C.[1] Winifred Fila Ogah[2], Eridiong O Onyenweaku[2]

[1]University of Douala, Higher Teacher Training College, For Technical Education, Douala, Cameroon
[2]Department of Biochemistry Faculty of Basic Medical Science, University of Calabar, Calabar, Nigeria
Email: anyingangrol@yahoo.com

How to cite this paper: Ange, E.N.B., Mabiama, P.G., Manga, E., Christine, N.B.F., Ogah, W.F. and Onyenweaku, E.O. (2024) Assessement of Nutritional Status of Households Using Weighed Food Intake in North West Region of Cameroon. *Food and Nutrition Sciences*, **15**, 1-26.
https://doi.org/10.4236/fns.2024.151001

Received: November 8, 2022
Accepted: January 9, 2024
Published: January 12, 2024

Abstract

This study determined the nutritional status of households in North western region of Cameroon using weighed food intake. Twenty–two rural and 106 urban households were randomly selected for weighed food intake Descriptive and inferential statistics were used to analyze collected data and significance at $p < 0.05$ accepted. Corn fufu with huckleberry was the most frequently consumed meal with little or no animal-source protein. Protein and B group vitamins intake of respondents in both communities were below the FAO/WHO recommended values while energy, iron, and vitamins A and C were in excess for most age groups. Adolescents 10 - 19 years and adults 20 years and above failed to meet at least 85% of RNI for calcium.

Keywords

Food Intake, Household, Nutrients, Nutritional Status

1. Introduction

Humans normally need food for growth and development and to lead an active and healthy life. Food, in essence, is any substance liquid or solid, which after consumption, digestion, and absorption by the body, nourishes the body, supplies energy, promotes good physical and intellectual growth and development, repairs the worn-out tissues, and regulates all the body processes. The materials necessary to perform these functions are referred to as nutrients. Nutrients are components in foods that an organism uses to survive and grow. Each nutrient has its own functions in the body and is vital to life. The nutrients must be consumed in the right proportion for the maintenance of good health. Metabolic processes become deranged when the nutrients in the body are present in abnormal quantities [1]. A number of different nutritional disorders may occur within the population, depending on which nutrients are inadequate, excessive, or disproportionate in the body [2].

Nutrition plays an integral role in the optimal functioning of the body. The health condition of an individual or group as influenced by diet, the level of nutrients in the body and the ability of those levels to maintain normal metabolic integrity is referred to as nutritional status [3]. Nutritional status according to [4] is the physiological condition of an individual that results from the balance between nutrient requirements and intake, and the ability of the body to use these nutrients. A healthy population is essential for any country in order to be productive and to promote national development. It is therefore the paramount duty of every nation to monitor and care for the health of its population. It can be determined by correlation of information obtained through a careful medical and dietary history, taking physical measurements of the body, clinical examination and appropriate laboratory investigations. [4] Also reported that nutritional status is influenced by food consumption patterns, income, religion, attitudes, cultural practices, gender, lifestyle, educational status, physiological state and age. These factors affect the quality and quantity of nutrient intake. Adequate food intake is essential as nutritional well-being plays an important role in health promotion and maintenance. Poor nutritional status is associated with inappropriate food intake.

The culture and socio-economic status of the population influence food intake and choices. The intake of some food items is likely to vary according to season and often based on availability and price. Food intake can be defined as the combination of foods that constitute the usual dietary intake of an individual over certain periods. It fundamentally reflects the nutritional well-being of the individual [5]. Food intake of people change over time, the major lead for such changes being the developments in technology. Inappropriate food intake may sometimes cause overweight or obesity, tooth decay, high cholesterol levels, high blood pressure, heart disease and stroke, type 2 diabetes, osteoporosis and some cancers. According to [6], the cumulative effects of inappropriate food intake may be evident in adulthood, causing a reduction in work capacity, workplace absenteeism, and an overall reduction in a person's lifetime earning potential as well as the ability to contribute to the national economy. Overnutrition (overweight and obesity) which was a nutritional disorder of great concern in industrialised countries, is also becoming a problem in developing countries like Cameroon [7].

Inappropriate food intake often results in various physiological disorders and increased susceptibility to disease. Overnutrition is a form of malnutrition caused by an excess intake of certain nutrients (such as saturated fats and added sugars) in combination with low levels of physical activity that may result in obesity, diabetes, heart diseases and other metabolic disorders [8].

Lack of food is not the only cause of malnutrition. Different combinations of etiological factors can lead to the prevalence of malnutrition in a population [5]. The availability of a variety of foods in households does not necessarily translate to adequate nutrition [5].

The health consequences of overweight and obesity contribute to an estimated four million deaths globally. Stunting among children under five years has fallen from 32.6% in 2000 to 22.2% in 2017 [9]. Yet, while stunting in children under five years of age is declining at a global level, the numbers in Africa are increasing. The number of stunted children has steadily increased from 50.6 million in 2000 to 38.7 million in 2017. Cameroon has a diversity of food resources sufficient to feed its population but malnutrition still remains a public health problem affecting all age groups: infants, preschool and school children, adolescents, pregnant and lactating mothers and the aged. Food is physically available in the rural and urban markets [4] [10]; however, it has often been lacking from the qualitative and quantitative point of view in some communities resulting in the occurrence of malnutrition.

[11] report indicates that 35.4 percent of children in Cameroon are suffering from malnutrition resulting in serious growth stunting among them. It also stated that global acute malnutrition stands at 2.5%. Data from various surveys showed that Cameroon is experiencing a double burden; a rising prevalence of overnutrition, alongside a high incidence of undernutrition [12]. Approximately 45,000 children die each year in Cameroon due to malnutrition [13]. The development Initiatives report of the nutrition profile of Cameroon in line with [11] showed that in children below five, 33% are stunted, 15% are underweight, 6% are affected by wasting and 7% are overweight. With regards to the nutritional status of adolescents and adults, the report indicated that amongst women of reproductive age, 8% had thinness (wasting) and 1% had stunting (chronic malnutrition). The report also indicated that 42% of females and 33% of males were overweight (BMI ≥ 25); 15% of females and 7% of males had obesity (BMI ≥ 30). In relation to the micronutrient status of the population, the report stated that 42% of women of reproductive age had anaemia and 39% of preschool children had vitamin A deficiency (VAD). It also indicated risk factors for metabolic diseases in Cameroon are the same in both sexes; 43% of the population had raised blood pressure, 10% had raised blood glucose levels, and 22% had raised blood cholesterol. These diet-related diseases are on the rise in Cameroon [14]. According to [15] Cameroon's adult population is also facing malnutrition burden. Forty –one percent (41.4%) of women of reproductive age have anaemia, and 6.9% of adult women have diabetes, compared to 6.5% of men. Meanwhile, 16.4% of women and 6.1% of men have obesity.

The Nutrition Improvement Program of the Cameroon Baptist Convention Health Board [16], for the North West Region reported that of all the clients received in their health sectors 25% were obese/hypertensive, 30% diabetic and 10% of the under fives had chronic undernutrition [16]. There is no clear data on over-nutrition in children [5]. Despite the abundance of various foodstuffs in the North-West region of Cameroon, under nutrition rates among children under 5 years and the other vulnerable groups still persist and are on the rise [17]. This research is therefore intended to assess the and nutritional status of the households in the North West Region of Cameroon using weighed food intake.

2. Literature Review

2.1. The Concept of Food

Food is a basic necessity for survival and performance of vital life functions [1]. In a very broad sense, food is any substance that contains nutrients. The major nutrients that must be present in a healthy diet of individuals are proteins, carbohydrates, fats, minerals, vitamins, water and fiber. However, most people eat whatever food is available and appealing to their taste without due consideration whether it provides the needed nutrients. Food intake may be influenced by factors such as geographical, social, economic, and individualized as well as by trade-cultural choices [18]. Adequate food intake plays a very important role in child survival; it promotes healthy growth, and development and contributes to better cognitive and economic development. It also reduces morbidity and mortality rates, and the risk of diseases such as cardiovascular disease, diabetes, kwashiorkor, marasmus, and hypertension, even in adulthood [19]. Man's diet is determined qualitatively by what is available and quantitatively by how much is available. Malnutrition results when poor quality and insufficient food is consumed.

Malnutrition (undernutrition/overnutrition) is really a public health problem of significant importance in developing countries [20]. It cuts across all strata of a community, but infants, preschool children and adolescents are the most vulnerable because of their high nutritional needs for growth and development.

2.2. Factors Affecting Food Intake and Nutritional Status of Households

Food intake refers to the available foods within households and the quantities they consume daily. Nutritional status is a continuous process that is influenced by a host of factors and their interactions [21] [22]. The food choices households make either benefit or impair the health of its members [23].

2.2.1. Income Level and Socio-Economic Status

Household income factors are strong indicators of a child nutritional status. Usually children belonging to higher-income households have better nutritional status than the children of lower-income households [24]. It is widely recognized in the literature that households' accessibility to food has also been shown to be affected by demographic and socio-economic factors, accounting for variations in diet quality. Households with low-income levels often consume unhealthy diets [25]. What, how much and how often a person eats are frequently affected by socio-economic status. Household income could significantly influence food access which are direct predictors of nutritional status. Low income has been associated with growth retardation leading to low Z scores for HA, WH and

WA, [26]. Studies have shown that households which have greater income and resources tend to have more diverse diets as food access is determined by income and the prices of foods [27]. The risk of malnutrition is increased in families with poor incomes [28].

2.2.2. Education and Nutritional Knowledge of Parents

Child malnutrition has been seen to be associated with a poor educational background of mothers [29]. Poorly educated mothers are likely to have malnourished children, mainly due to poor job opportunities and poor basic knowledge on child nutrition [30].

2.2.3. Religious Dietary Practices

Religious affiliation of a household especially the head has a strong linkage with nutritional status of members [31]. Some religions forbid the consumption of certain food items which may be nutritious and locally available. Such dietary practices may not ensure good health.

2.2.4. Health Status of Household Members

According to [4], an individual's health status greatly affects eating habits and nutritional status. The lack of teeth, ill-fitting dentures, or a sore mouth make chewing food difficult. Difficulty swallowing due to a painfully inflamed throat or a stricture of the esophagus can prevent a person from obtaining adequate nourishment. Disease processes and surgery of the gastrointestinal tract can affect digestion, absorption, metabolism and excretion of essential nutrients. Gastrointestinal and other diseases also create nausea, vomiting and diarrhoea, all of which can adversely affect a person's appetite and nutritional status. Metabolic processes can be impaired by diseases of the liver, gall bladder and pancreas [4].

2.2.5. Medication and Therapy of Household Members

The effects of drugs on nutrition vary considerably. They may alter appetite, disturb taste perception, or interfere with nutrient absorption or excretion. Some nutrients decrease, while others enhance drug absorption. Calcium in milk hinders the absorption of the antibiotic tetracycline but enhances the absorption of the antibiotic erythromycin. The elderly are particularly at risk of drug-food interactions due to the number of medications they may take. Certain therapies such as Chemotherapy and radiation therapy prescribed for certain diseases may also adversely affect eating patterns and nutritional status [27].

2.2.6. Cultural Influence

Some cultures forbid the consumption of certain foods which are actually excellent sources of nutrients. In areas where these cultural preferences are deep rooted, members are likely to be malnourished [27]. Many customs and beliefs affect largely vulnerable groups-infants, toddlers, expectant and lactating women.

2.2.7. Food Security

Food insecurity leads to decreased food intake, skipping of meals as well as a lack of nutritious foods to meet the dietary needs of household members. Many households consume the same foods for most meals [32]. The positive relationship between food security and good nutrition therefore suggests that poor households are not able to meet their daily dietary needs.

2.2.8. Goegraphic Location of Household

Type and location of residence had a significant effect on child underweight. The likelihood of a child being underweight was lower in rural areas compared to urban areas. This may be due to the fact that the children in the urban areas belong to single families and might have less care from other relatives when parents are working outside. Another reason may be that these children have less access to physical exercise compared to children in rural areas [33].

2.2.9. Household Head Characteristics

Children in female-headed households were more likely to be underweight than their counterparts in male-headed households which could be attributed to extreme poverty in female-headed households [31] [34]. The occupation of household heads and mothers appears to be the major factor influencing the level of wasting in most studies. A child whose household head was in an occupation or profession that yields high income was better nourished [31]. Children of mothers who leave home to farm or undertake other economic activities are often left in the care of older siblings, neighbours, or relatives who often do not provide optimal childcare. These children are more likely to be wasted than children whose mothers spend time with them. Care has become increasingly recognized as an important determinant of child nutritional status [31].

2.2.10. Household/Family Size

Family size can affect the quantity and quality of food that is available to them. According to [35], children from large families are prone to malnutrition and infection and are unlikely to achieve optimum growth and development than children from small families. Large household size is a well-documented risk factor for child malnutrition in developing countries.

2.2.11. Marital Status of Women

[35] in Botswana; [36] in South Africa; [31] in Kenya found that severe malnutrition was common among the children of single mothers. They added that malnutrition is higher among unmarried rural and divorced/separated urban women compared to married ones [37] [38].

2.2.12. Intra Household Food Distribution

In certain rural communities, food distribution is done according to gender norms with disregard for nutritional needs of individual family members. Some members of the family are disadvantaged when it comes to food sharing. The father usually consumes the lion share particularly of high protein-rich foods.

The children with high potential for growth, and mothers with additional requirements for childbearing are deprived. [37] [38]

2.2.13. Gender

Food distribution in certain communities is governed by gender norms. Studies show that nutritional habits may vary with gender and age group. In some communities, males and females eat separately and the females often eat only when the males are satisfied. [38] showed that energy intake from carbohydrates by women in rural Cameroon was higher than for rural men.

2.2.14. Women's Employment

Employment may increase women's status and power and may bolster a woman's preference to spend her earnings on health and nutrition. Studies in Africa have indicated that, at similar levels of income, households in which women have greater control over their income are more likely to be food secure [39] [40].

2.2.15. Occupation of Household Head

Children of poor households have a higher risk of being chronically malnourished than the children of wealthy households [39]. [40] Identified that malnutrition is significantly more likely among children from agriculture-based families. The level of malnutrition appears to be influenced by the occupation of household heads and mothers.

2.2.16. Climate, Food Availability, Convenience and Economy

According to [41], seasonality, location with its climate and agricultural practices are among the factors that affect food availability in any locality. The season can affect the quantity of food consumed and the meal frequency. Similarly, availability plays a primary role in determining food choice and the quantity of food consumed. Also, carbohydrate foods such as cassava, maize and rice are cheaper and consumed by low-income households [42].

2.2.17. Source of Water and Availability of Toilet Facility

Poor water and sanitation can increase the probability of infectious diseases and indirectly cause certain types of malnutrition [14]. Unprotected water sources have been associated with chronic diarrhoea and low child stature. Thus, improved access to safe water and sanitation may have enormous potential to reduce the burden of disease on the continent. Open defecation is associated with a lack of latrines and poverty. Poverty, poor hygiene, lack of knowledge, no access to water supplies, poor housing and health services, cultural practices and discriminatory social structure often occur together and these create an environment of poor nutrition and susceptibility to infectious diseases [43].

2.2.18. Urbanization

Food habits and dietary patterns in urban areas have drastically changed in the last decades. Family members in rural settings sometimes eat from the same pot and this can negatively affect the nutrient intake of some members of the household who do not eat fast enough e.g. children.

Nutritional habits are rapidly changing in Cameroon due to changes in lifestyle. In urban areas, traditional values have been marginalized in favour of western diets. This together with inadequate physical activity is predisposing factors to metabolic diseases [38].

2.2.19. Location of Household

The geographic location of a child is an important determinant of its nutritional status. Studies have found children in rural and remote areas to be more stunted than those in urban areas. Stunting is also known to be more pronounced in locations where economic conditions are poor. Similarly, rural women are more likely to suffer from chronic energy deficiency than women in urban areas [14].

3. Materials and Methods

A Portable kitchen scale (Sayonapps and Naval) and food composition table by [43] were used for determining the food intake of households. A 3-day weighed food intake survey was carried out on 600 subjects from one hundred and twenty-eight households (106 from the urban and 22 from the rural communities). The nutrient intakes of children between six months to 5 years, adolescents, women of childbearing age, and other adults were calculated on an individual basis. The weights of all the food ingredients used for the preparation of the family meals were measured with Salter weighing scale and recorded. The total cooked food was weighed and recorded for each day. The amount eaten at each meal by the household members was weighed taking into account leftovers. All snacks eaten in between meals during the survey period by household members were also weighed and recorded. Food preparation methods were observed and recorded. The forms of foodstuffs whether they were raw, fresh, processed, or cooked were also taken into account. The nutrient contents of foods are determined by using food composition tables. The nutrient intakes were expressed as a percentage of the recommended intakes by [43].

4. Results of Nutrient Intakes

4.1. Energy and Protein Intake of Respondents

The mean energy and protein intake of respondents 6 months to 60 years is shown in **Table 1** and **Table 2**. With the exception of adolescent, lactating women in both communities and adolescent males in urban communities, all the respondents met and exceeded the [43] recommended nutrient intake (RNI) for energy. Percentage energy intake was significantly ($p < 0.05$) higher in urban females 6 - 12 months and 1 - 3 years than in rural subjects that age likewise rural males 6 - 12 months than in urban males of the same age. Lactating women 20 years and above in urban and rural communities met at least 90% - 95% of their daily energy requirements.

Protein intake of rural females 7 - 9 years, 10 - 19 years, rural males 4 - 6 years, 7 - 9 years and urban males 4 - 6 years, 7 - 9 years and 10 - 19 years was below 85.0% of FAO/WHO (2002) RNI for protein for different ages. However, both females and males 1 - 3 years in urban and rural communities and adults 20 - 60 years met and exceeded their recommended daily intake for protein while others met at least 85.0% of RNI for protein daily. Percentage protein intake was significantly ($p < 0.05$) higher in urban females 7 - 9 years and 10 - 19 years than in rural females while that of rural males 10 - 19 years was significantly ($p < 0.05$) higher than urban males.

Table 1. Energy (Kcal) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean nutrient intake	931.5 ± 18.07	1288 ± 42.35	1987 ± 42.35	2608 ± 62.33	2831 ± 121.09	2977 ± 65.64
	FAO/WHO requirement	820	1150	1800	2200	2400	2400
	Intake as % req	113.60	111.96	110.38	118.53	117.96	124.05
Number of subjects	Urban	30	25	23	27	34	55
	Mean nutrient intake	1030 ± 55.17*	1448 ± 54.03*	1874 ± 64.68	2510 ± 46.53	2700 ± 86.94	2890 ± 74.76
	FAO/WHO requirement	820	1150	1800	2200	2400	2400
	Intake as % req	125.61	125.94	104.12	114.09	112.51	120.42
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean nutrient intake	1091 ± 54.89*	1325 ± 45.18.	2189 ± 77.15	2710 ± 72.25	3310 ± 40.69	3092 ± 48.17
	FAO/WHO requirement	820	1150	2000	2600	3200	3000
	Intake as % req	133.02	115.19	109.45	104.23	103.44	103.07
Number of subjects	Urban	20	25	20	30	19	46
	Mean nutrient intake	954 ± 23.96*	1362 ± 36.89	2009 ± 36.62	2655 ± 47.27	2800 ± 49.54*	2997 ± 86.23
	FAO/WHO requirement	820	115.00	2000	2600	3200	3000
	Intake as % req	116.41	118.41	100.48	102.13	87.50	99.90
Lactating women							
Number of subjects	Rural					11	16
	Mean nutrient intake					2344 ± 33.25	2555 ± 41.37
	FAO/WHO requirement					2800	2800
	Intake as % req					83.71	91.25
Number of subjects	Urban					29	38
	Mean nutrient intake					2298 ± 47.27	2669 ± 27.47
	FAO/WHO requirement					2800	2800
	Intake as % req					82.01	95.32

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

Table 2. Protein (g) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	11.50 ± 1.41	14.20 ± 0.90	31.34 ± 1.31	35.46 ± 1.22	38.72 ± 1.03	47.28 ± 2.14
	FAO/WHO requirement	13.50	13.00	34.00	46.00	46.00	46.00
	Intake as % req	85.19	109.23	92.18	77.09	84.17	102.78
Number of subjects	Urban	30	25	23	27	34	55
	Mean	12.50 ± 0.94	13.9 0 ± 4.32	31.34 ± 1.30	45.46 ± 1.35*	43.72 ± 3.01*	44.28 ± 2.42
	FAO/WHO requirement	13.50	13.00	34.00	46.00	46.00	46.00
	Intake as % req	92.59	106.92	92.18	98.83	95.04	96.26
Male							
Number of subjects	Rural	16	14	11	8	17	41
	Mean	12.23 ± 1.25	12.19 ± 0.87	18.68 ± 1.43	30.03 ± 1.01	46.10 ± 1.14	58.06 ± 2.14
	FAO/WHO requirement	13.50	13.00	34.00	46.00	46.00	46.00
	Intake as % req	90.59	93.77	54.94	65.28	100.22	126.22
Number of subjects	Urban	20	25	20	30	19	46
	Mean	12.80 ± 0.82	13.44 ± 1.16	18.67 ± 1.96	32.74 ± 1.04	37.07 ± 1.14*	58.56 ± 2.14
	FAO/WHO requirement	13.50	13.00	34.00	46.00	46.00	46.00
	Intake as % req	94.81	103.38	54.91	71.17	80.59	127.30
Lactation							
Number of subjects	Rural					11	16
	Mean					68.87 ± 1.24	70.03 ± 1.27
	FAO/WHO requirement					71	71
	% Intake					97.00	98.63
Number of subjects	Urban					29	38
	Mean					69.9 ± 1.43	70.35 ± 1.32
	FAO/WHO Requirement					71	71
	% Intake					98.56	99.08

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

4.2. Mineral Intake of Respondents

Table 3 and Table 4 show the mean calcium and iron intake of respondents 6 months to 60 years. Females and males 6 - 12 months and males 1 - 3 years of age met and exceeded the FAO/WHO (2002) RNI for calcium while male and female children 4 - 7 years, 7 - 9 years, 4 - 6 years and lactating women in urban and rural communities met at least 85.0% of RNI for calcium though no significant difference was recorded. Both adolescent 10 - 19 years and adults 20 years and above in urban and rural communities failed to meet up to 85.0% of their RNI for calcium. All the respondents in different age groups met and exceeded their RNI for iron except adolescent males 10 - 19 years in urban communities and lactating women. Percentage iron intake of urban females 6 - 12 months, 1 - 3 years, 4 - 6 years, 7 - 9 years and urban males 1 - 3 years were significantly ($p > 0.05$) high compared to rural subjects of the same ages.

Table 3. Calcium (mg) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	559 ± 3.75	509 ± 2.02	533 ± 2.57	679 ± 2.63	742 ± 2.20	754 ± 2.27
	FAO/WHO requirement	400.00	500.00	600.00	700.00	1300.00	1000.00
	Intake as % req	139.75	101.80	88.83	97.00	57.08	75.40
Number of subjects	Urban	30	25	23	27	34	55
	Mean	564 ± 2.14	536 ± 2.45	527 ± 2.80	690 ± 2.81	707 ± 2.59	748 ± 3.21
	FAO/WHO requirement	400.00	500.00	600.00	700.00	1300.00	1000.00
	Intake as % req	141.00	107.20	87.83	98.57	54.38	74.80
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	588 ± 2.06	554 ± 1.72	569 ± 1.44	693 ± 2.15	728 ± 1.69	758 ± 1.71
	FAO/WHO requirement	400.00	500.00	600.00	700.00	1300.00	1000.00
	Intake as % req	147.00	110.80	94.83	99.00	56.00	75.80
Number of subjects	Urban	20	25	20	30	19	46
	Mean	587 ± 1.08	554 ± 2.92	526 ± 3.08	657 ± 1.11	691 ± 1.15	754 ± 2.11
	FAO/WHO requirement	400.00	500.00	600.00	700.00	1300.00	1000.00
	Intake as % req	146.75	110.80	87.67	93.86	53.15	75.40
Lactation							
Number of subjects	Rural					11	16
	Mean					865 ± 2.22	890 ± 1.90
	FAO/WHO requirement					1000	1000
	% Intake					86.50	89.00
Number of subjects	Urban					29	38
	Mean					880 ± 2.31	900 ± 2.02
	FAO/WHO requirement					1000	1000
	% Intake					88.00	90.00

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

Table 4. Iron (mg) intake of respondents.

Gender	Subjects	6 - 12 mnths	1 - 3 ys	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	8.55 ± 1.17	5.37 ± 1.02	9.22 ± 1.42	6.87 ± 1.27	13.93 ± 1.11	16.66 ± 0.88
	FAO/WHO requirement	6.2	3.9	4.2	5.9	12.7	9.1
	Intake as % req	138	138	220	116	164	185
Number of subjects	Urban	30	25	23	27	34	55
	Mean	10.16 ± 0.83*	8.56 ± 1.09*	10.2 ± 1.70*	8.84 ± 1.12*	14.29 ± 1.22	16.73 ± 1.34
	FAO/WHO requirement	6.2	3.9	4.2	5.9	12.7	9.1
	Intake as % req	164	219	243	150	166	185
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	9.7 1 ± 0.73	6.38 ± 0.53	8.54 ± 1.46	7.84 ± 1.02	9.66 ± 1.82	10.76 ± 0.90
	FAO/WHO requirement	6.2	3.9	4.2	5.9	12.7	9.1
	Intake as % req	157	164	203	133	76	118
Number of subjects	Urban	20	25	20	30	19	46
	Mean	10.41 ± 0.88	8.35 ± 1.14*	8.7 ± 1.59	8.66 ± 1.66	10.16 ± 1.61	10.37 ± 0.78
	FAO/WHO requirement	6.2	3.9	4.2	5.9	12.7	9.1
	Intake as % req	168	214	207	147	80	114
Lactation							
Number of subjects	Rural					11	16
	Mean					7.94 ± 0.68	8.78 ± 1.86
	FAO/WHO requirement					10	10
	% Intake					79	88
Number of subjects	Urban					29	38
	Mean					8.56 ± 1.08	8.07 ± 1.10
	FAO/WHO requirement					10	10
	% Intake					86	87

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

4.3. Vitamin Intake of Respondents

Mean vitamin intake of respondents 6 months to 60 years are presented in Table 5, Table 6. From Table 6, most respondents in both rural and urban communities met and exceeded the RNI for vitamin A. Female children 4 - 6 years, male adolescent 10 - 19 years, female and male adults 20 years and above in both in rural and urban communities met at least 90% of the FAO/WHO (2002) RNI for vitamin A but lactating mothers in both communities failed to meet at least 85.0% of the RNI for vitamin A. Male IYC 6 - 23 months in rural communities had significantly ($p < 0.05$) higher values of RNI vitamin A compared to those in urban communities likewise female children 1 - 3 years in urban communities compared to those in rural communities. While females 1 - 3 years and 4 - 6 years in rural communities failed to meet their daily thiamine RNI, rural female 6 - 12 months, urban female 1 - 3 years, urban and rural males 6 - 12 months, 1 - 3 years and 4 - 6 years met at least 85.0% of the RNI for thiamine (B^1) the others met and exceeded the RNI for thiamine. The percentage of thiamine intake in females 1 - 3 years and 4 - 6 years in rural communities was significantly ($p < 0.05$) lower compared to children the same age in urban communities while the percentage of thiamine intake of adolescent males 10 - 19 years in rural communities was significantly ($p < 0.05$) higher compared to those in the urban as seen in Table 6.

Table 5. Vitamin A (μgRE) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 ys	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	440 ± 1.47	437 ± 1.41	420 ± 2.49	550 ± 2.48	596 ± 2.43	510 ± 2.20
	FAO/WHO requirement	400	400	450	500	600	500
	Intake as % req	110	109	93	110	99	102
Number of subjects	Urban	30	25	23	27	34	55
	Mean	449 ± 1.51	488 ± 1.76*	404 ± 1.62	516 ± 1.96	640 ± 2.12	490 ± 1.04
	FAO/WHO requirement	400	400	450	500	600	500
	Intake as % req	112	122	90	103	107	98
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	488 ± 2.51	420 ± 4.35	500 ± 2.37	551 ± 2.06	590 ± 2.97	545 ± 2.20
	FAO/WHO requirement	400	400	450	500	600	600
	Intake as % req	122	105	111	110	98	91
Number of subjects	Urban	20	25	20	30	19	46
	Mean	417 ± 3.22*	431 ± 1.44	505 ± 3.88	519 ± 1.03	569 ± 5.04	589 ± 3.33
	FAO/WHO requirement	400	400	450	500	600	600
	Intake as % req	104	108	112	104	95	98
Lactation							
Number of subjects	Rural					11	16
	Mean					870 ± 1.55	910 ± 1.45
	FAO/WHO requirement					1300	1300
	Intake as % req					66.92	70.00
Number of subjects	Urban					29	38
	Mean					900 ± 1.10	980 ± 1.09
	FAO/WHO requirement					1300	1300
	Intake as % req					69.23	75.38

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

DOI: 10.4236/fns.2024.151001

Table 6. Vitamin B_1 (mg) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	0.2 9 ± 0.06	0.3 4 ± 0.06	0.4 1 ± 0.08	1 ± 0.18	1.3 ± 0.12	1.46 ± 0.09
	FAO/WHO requirement	0.3	0.5	0.6	0.9	1.1	1.1
	Intake as % req	96.67	68.00	68.33	111.11	118.18	131.82
Number of subjects	Urban	30	25	23	27	34	55
	Mean	0.3 ± 0.05	0.4 6 ± 0.05*	0.4 9 ± 0.32*	1.1 ± 0.12	1.34 ± 0.17	1.58 ± 0.08
	FAO/WHO requirement	0.3	0.5	0.6	0.9	1.1	1.1
	Intake as % req	100.00	92.00	81.67	122.22	121.82	146.36
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	0.26 ± 0.03	0.44 ± 0.06	0.53 ± 0.14	1.15 ± 0.09	1.49 ± 0.14	1.67 ± 0.05
	FAO/WHO requirement	0.3	0.5	0.6	0.9	1.2	1.2
	Intake as % req	86.67	88.00	88.33	127.78	124.17	139.17
Number of subjects	Urban	20	25	20	30	19	46
	Mean	0.29 ± 0.04	0.4 6 ± 0.04	0.55 ± 0.08	1.19 ± 0.03	1.2 ± 0.14*	1.49 ± 0.05
	FAO/WHO requirement	0.3	0.5	0.6	0.9	1.2	1.2
	Intake as % req	96.67	92.00	91.67	132.22	100.00	124.17
Lactation							
Number of subjects	Rural					11	16
	Mean					1.67 ± 0.08	1.69 ± 0.05
	FAO/WHO requirement					1.5	1.5
	Intake as % req					111.33	112.67
Number of subjects	Urban					29	38
	Mean					1.5 ± 0.11	1.63 ± 0.14
	FAO/WHO requirement					1.5	1.5
	Intake as % req					100.00	108.67

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

Table 7 presents percentage Riboflavin (B^2) intake. Though no significant difference was recorded, respondents in different ages met at least 90% of the RNI for Riboflavin except rural females 6 - 12 months and males 1 - 3 years and 4 - 6 years in rural and urban communities. Percentage Niacin (B^3) intake is presented in Table 8. Adults 20 years and above and lactating women met and exceeded the RNI for Niacin while others met at least 85% except IYC 6 - 12 months in rural and urban communities, females 4 - 6 years, 7 - 9 years and 10 - 19 years in rural communities and males 1 - 3 years in rural communities. Females 4 - 7 years and 7 - 9 years had significantly ($p < 0.05$) higher values in urban compared to rural communities likewise males 1 - 3 years and 7 - 9 years in urban communities compared to those that age in rural communities. The percentage of vitamin C is presented in Table 9. Female IYC 6 - 12 months in rural and males that age in urban communities failed to meet at least 85% of the RNI for vitamin C. Females 6 - 12 months and 4 - 6 years and 7 - 9 years had significantly ($p < 0.05$) higher values in urban compared to rural communities likewise females 20 years and above in urban compared to rural communities while males 7 years and above had significantly ($p < 0.05$) higher values in urban compared to those that age in rural communities.

Table 7. Vitamin B_2 (mg) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	0.3 3 ± 0.63	0.4 5 ± 0.95	0.54 ± 1.05	1.33 ± 1.12	1.41 ± 1.44	1.43 ± 1.39
	FAO/WHO requirement	0.4	0.5	0.6	0.9	1	1.1
	Intake as % req	82.50	90.00	90.00	147.78	141.00	130.00
Number of subjects	Urban	30	25	23	27	34	55
	Mean	0.3 8 ± 0.92	0.4 7 ± 1.07	0.5 5 ± 1.11	1.33 ± 1.22	1.34 ± 1.42	1.32 ± 1.36
	FAO/WHO requirement	0.4	0.5	0.6	0.9	1	1.1
	Intake as % req	95.00	94.00	91.67	147.78	134.00	120.00
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	0.3 7 ± 0.81	0.39 ± 1.33	0..4 7 ± 1.14	1.34 ± 1.05	1.38 ± 1.24	1.33 ± 1.32
	FAO/WHO requirement	0.4	0.5	0.6	0.9	1.3	1.3
	Intake as % req	92.50	78.00	78.33	148.89	106.15	102.31
Number of subjects	Urban	20	25	20	30	19	46
	Mean	0.3 6 ± 0.05	0.4 7 ± 0.06*	0.4 7 ± 0.04	1.38 ± 0.05	1.43 ± 1.02	1.45 ± 0.05
	FAO/WHO requirement	0.4	0.5	0.6	0.9	1.3	1.3
	Intake as % req	90.00	94.00	78.33	153.33	111.54	110.00
Lactation							
Number of subjects	Rural					11	16
	Mean					1.56 ± 0.12	1.6 ± 0.04
	FAO/WHO requirement					1.6	1.6
	Intake as % req					97.5	100
Number of subjects	Urban					29	38
	Mean					1.6 ± 0.05	1.6 ± 0.06
	FAO/WHO requirement					1.6	1.6
	Intake as % req					100.00	100.00

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

Table 8. Vitamin B_3 (mg) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	41
	Mean	3.27 ± 0.55	5.32 ± 0.5	6.55 ± 0.47	10.03 ± 0.78	14.45 ± 0.56	16.99 ± 0.45
	FAO/WHO requirement	4	6	8	12	14	14
	Intake as % req	81.75	88.67	81.88	83.58	84.06	121.36
Number of subjects	Urban	30	25	23	27	34	55
	Mean	3.3 8 ± 0.41	5.85 ± 0.47	7.49 ± 0.48*	11.67 ± 0.83*	14.00 ± 0.82	17.00 ± 0.48
	FAO/WHO requirement	4	6	8	12	14	14
	Intake as % req	84.50	97.50	93.63	97.25	87.50	121.43
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	3.26 ± 0.91	4.46 ± 0.61	7.36 ± 0.72	12.67 ± 0.56	14.75 ± 0.78	17.67 ± 0.50
	FAO/WHO requirement	4	6	8	12	16	16
	Intake as % req	81.50	74.33	92.00	105.58	92.19	109.19
Number of subjects	Urban	20	25	20	30	19	46
	Mean	3.36 ± 0.87	5.37 ± 2.06*	7.60 ± 0.55	14.90 ± 1.17*	16.03 ± 0.41	17.26 ± 0.46
	FAO/WHO requirement	4	6	8	12	16	16
	Intake as % req	84.00	89.50	95.00	124.17	100.19	107.88
Lactation							
Number of subjects	Rural					11	16
	Mean					17 ± 0.55	18.08 ± 0.47
	FAO/WHO requirement					17	17
	Intake as % req					100.00	106.35
Number of subjects	Urban					29	38
	Mean					17.45 ± 0.40	18.98 ± 0.41
	FAO/WHO requirement					17	17
	Intake as % req					102.65	111.65

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

Table 9. Vitamin C (mg) intake of respondents.

Gender	Subjects	6 - 12 mths	1 - 3 yrs	4 - 6 yrs	7 - 9 yrs	10 - 19 yrs	20 - 60 yrs
Female							
Number of subjects	Rural	20	18	11	9	31	49
	Mean	30.4 ± 2.53	25.79 ± 1.91	42.70 ± 1.12	48.50 ± 1.44	76.99 ± 3.19	91.42 ± 3.36
	FAO/WHO requirement	30	30	30	35	40	45
	Intake as % req	101.33	85.97	142.33	138.57	192.48	203.16

Continued

Number of subjects	Urban	30	25	23	27	34	55
	Mean	39.19 ± 1.70*	24.28 ± 1.41	46.29 ± 1.53*	53.61 ± 1.25*	74.29 ± 2.33	79.93 ± 1.79*
	FAO/WHO requirement	30	30	30	35	40	45
	Intake as % req	130.63	80.93	154.30	153.17	185.73	177.62
Male							
Number of subjects	Rural	16	14	12	8	17	41
	Mean	33.53 ± 3.26	26.58 ± 2.00	42.18 ± 2.65	52.45 ± 0.84	78.98 ± 2.94	94.93 ± 1.65
	FAO/WHO requirement	30	30	30	35	40	45
	Intake as % req	111.77	88.60	140.60	149.86	197.45	210.96
Number of subjects	Urban	20	25	20	30	19	46
	Mean	36.2 ± 1.9	25.79 ± 0.99	45.23 ± 1.04	45.2 ± 1.37*	45.68 ± 3.41*	78.68 ± 1.25*
	FAO/WHO requirement	30	30	30	35	40	45
	Intake as % req	120.67	83.33	150.77	129.14	114.20	174.84
Lactation							
Number of subjects	Rural					11	16
	Mean					101 ± 1.90	116 ± 1.99
	FAO/WHO requirement					70	70
	Intake as % req					144.29	165.7
Number of subjects	Urban					29	38
	Mean					109.01 ± 1.04	120 ± 1.25
	FAO/WHO requirement					70	70
	Intake as % req					155.73	171.43

Values are expressed and mean ± SEM. * = Significant at $p < 0.05$. Source for RNI = FAO/WHO (2002).

4.4. Discussion

The study observed indigenous grains, legumes and leafy vegetables, starchy roots, tubers and oils were the major foods consumed by the majority of households in urban and rural areas at least three times a week. Carbohydrate availability was uniformly high in both rural and urban communities. Regular and frequent consumption of foods like corn fufu, pottage potato, pounded cocoyam and pap for infants might have contributed to the high energy levels recorded. All age groups met and exceeded the recommended values for energy except for adolescent lactating women. This probably could be due to inequalities in household meal distribution where priority is given to some family members in terms of portion sizes not considering the health implications. This practice can be detrimental to the health of those not receiving adequate energy-dense foods as observed in this study. The high demands of pregnancy and lactation put adolescent women in developing countries at high risk of nutrient deficiency. Reduced intake of energy by adolescent lactating women can leads to wasting, increased vulnerability to disease, and thuslow levels of physical activity. It can also result in low agricultural and economic productivity. Low carbohydrate intake and poor glycogen stores can also cause a breakdown in central nervous system and cardiac problems such as angina [12]. Availability and accessibility of foods rich in carbohydrates was not a problem in both communities especially as more than 50% of households used both home-produced and purchased foods. This helped respondents in the different age groups to meet their energy requirements. Carbohydrates, protein and fats play vital roles in the human body and are needed daily for healthy growth and normal functioning of the system. About 50 - 60 percent of the total kcal in a well-balanced diet should come from carbohydrates. A constant supply of carbohydrates is necessary for the proper functioning of the central nervous system [12].

The staples are traditionally not prepared with any form of flesh foods and it is consumed daily in most households. This shows that most households consume foods from plant sources on a daily basis which includes legumes, leafy vegetables and cereals. Plant proteins are known to be deficient in lysine and methionine making it a second-class protein and insufficient to promote growth and attain optimal health. Low intakes of macronutrients as suggested by various studies have been shown to cause protein energy malnutrition (PEM). PEM is associated with stunting, wasting and underweight and sometimes permanent impairment of the physical and mental growth of children [22]. It impairs immunity and metabolism of fats, carbohydrates and protein thus, affecting energy levels, physical stamina, mood, memory, mental clarity, emotional and mental wellbeing. PEM is associated with an increased risk of morbidity and mortality [36].

Adolescents 10 - 19 years and adults 20 years and above failed to meet at least 85% of RNI for calcium. The reason for this could be linked to the low consumption of calcium-rich foods and probably the eating habits of respondents that age. Poor eating habits including skipping meals, eating lots of processed foods and following food fads are an important nutritional risk in childhood that promotes inadequate calcium intake and consequently growth problems in children and adolescents. Calcium is required for all tissues and in conjunction with phosphorus contributes to the hardness of bones and teeth. The low dietary calcium intake of adolescents as seen in the study may negatively affect growth and bone development in children and expose them to osteoporosis (soft bones) in adult life. Calcium intake during childhood and adolescence is critical and adequate calcium intake during this period of the life cycle is of great interest to have a positive calcium balance, and good bone density necessary for skeletal consolidation. Milk is consumed mostly by IYC 6 - 59 months in both communities but not on a regular basis. It appears that calcium from this source was for only IYC leaving respondents in other age groups to derive their calcium from beans, dry fish and green leafy vegetables.

With the exception of adolescent males in both urban and rural households and adolescent lactating women from the rural households, all age groups met and exceeded 85% the recommended values for iron. Iron intake of respondents who met their RNI was significantly ($p > 0.05$) high in urban compared to rural subjects of the same age group. Although food distribution was not governed by gender norms and nutritional needs, it appears there were some inequalities in food distribution within families. Foods rich in iron like meat, fish, legumes, green leafy vegetables and whole cereals were consumed. Regular consumption of these foods may have contributed to the general levels of iron intake in the different age groups in both the urban and rural communities. However, adolescent males and female may not have received adequate iron-rich foods like flesh foods to enhance adequate iron absorption from plant sources (legumes and leafy green vegetables). This could be the reason for their inability to meet the RNI for iron. The inability of adolescents and lactating women to meet their iron RNI could lead to low serum haemoglobin levels resulting in iron deficiency anaemia. Iron deficiency anaemia, the most common spread of all micronutrient deficiencies globally is the leading cause of infant and maternal mortality in developing countries. This is because the low iron status of reproductive women exposes them to an increased risk for infections thus affecting their iron stores. Iron from plant origin (non-haem iron) is not as readily absorbed as that from animal foods. Increasing the number of dietary animal proteins (meat, poultry, fish and other seafoods), ascorbic acid and other organic acids (citric, lactic, malic and tartaric acid) in adolescent and lactating women will enhance their absorption from the plant iron sources.

Adolescent and adult lactating women did not meet at least 85% of their RNI for vitamin A, an essential micronutrient required by these group and their infants. Poor vitamin A intake in lactating adult women as observed in this study can diminish the amount present in human milk reducing intake adequacy in their infants. Low vitamin A intake in adolescents can lead Vitamin A deficiency (VAD) resulting in negative health outcomes during their developmental stage and later in life especially the girl child. VAD can diminish the body's ability to fight against diseases and infections. The continuous consumption of diet insufficient in vitamin A and B-carotene can reduce body stores thus, preventing the body from meeting basic physiological needs such as supporting tissue growth, normal metabolism and resistance to infection and contribute to maternal mortality, poor pregnancy and lactation outcome. The adequacy of vitamin A for most age groups in both communities could be attributed to high intakes of their precursors, red palm oil, dark-green vegetables, carrots, fresh tomatoes and fruits in the diet and from breast milk for (infant and young children) IYC. Majority of households in both communities used palm oil and dark green leafy vegetables which are very rich source of Beta-carotene on daily basis. Vitamin A deficiency occurs when there is low intake of animal foods, inadequate intake of non-animal sources of carotenoids that are converted to vitamin A, and inadequate intake of fat which facilitates the absorption of carotenoids. Vitamin A deficiency is a major public health problem in many developing countries and has been identified as one of the factors responsible for high infant and maternal morbidity and mortality in these countries. It is considered to be the main cause of childhood blindness in low-income countries [5]. Previous studies in Cameroon identified the prevalence of vitamin A deficiency amongst children less than five years old [5]. The results of this study show improvement in Vitamin A Generally, thiamine intake of most male and female respondents 6 months to 6 years of age in rural and urban households was less than 100%. This was observed in females 1 - 3 years of age in rural and 4 - 6 years in rural and urban communities whose RNI of thiamine was lower than 85%. Percentage intake was significantly ($p < 0.05$) lower in rural compared to children the same age in urban communities. Frequent consumption of legumes, groundnuts, whole grains, vegetables, dried fish and locally produced rice is an added advantage as this could be the reason why most respondents met and exceeded their RNI for thiamine. However, the low intake observed in children below seven years of age could be due to inadequate intake of foods rich in this vitamin coupled with the prevalence of helminths infestations and intestinal infections which could rapidly deplete body stores, especially in poor settings in developing countries were proper sanitation and hygiene is a problem [5]. Thiamin deficiency has been observed in Russian school children (in Moscow), Southeast Asian school children and Thai rural elderly, who were infected with hookworm. Respondents in different age groups in both communities met at least 90% of the RNI for Riboflavin except females 6 - 12 months and males 1 - 3 years in rural and 4 - 6 years in rural and urban communities. This may be due to poor eating behavior and the absence of surveillance during meals. Studies have shown that eating habits vary with age groups. [37], noted poor eating behaviours and absence of surveillance as factors contributing to malnutrition among children under five years. Inadequate dietary intake of riboflavin may occur as a result of limited food supply, sometimes exacerbated by poor dietary practices [24]. Deficiency almost invariably occurs in combination with other B-complex vitamins, so some of these signs and symptoms may reflect these other deficiencies of Stroke. Amongst children in developing countries deficiency is primarily due to prevalent gastrointestinal infections.

Majority of IYC, children and adolescents in urban and rural communities had percentage niacin intake below 100%. This was observed most in IYC 6 - 12 months in both communities, males 1 - 3 years and females 4 - 6 years, 7 - 9 years and 10 - 19 years in rural communities who failed to meet at least 85% of the RNI for niacin. The frequent consumption of foods rich in niacin was similar in both rural and urban households. Urban and rural households consumed legumes, potatoes, groundnuts, brown rice, maize and green peas. Considering the anomalies in food tables and losses due to preparation and cooking which were not taken into account in this study, intakes of several nutrients may be considerably lower or higher than have been reported in this study. For instance, it was observed that most households cooked their lima beans with "akanwu" (potassium carbonate). The use of "akanwu" in the cooking of legumes especially lima beans often results in substantial losses of B vitamin. Also maize a popular food consumed in most households contains niacinin which is not available for absorption in the body except when the maize is treated with limewater to release the bound niacin. Most households may handle these foods such that the B nutrients may not be available to the body. Reduced vitamin B intake in children and adolescents as observed in this study, can result in deficiency of these vitamins and affect the metabolism of other nutrients like carbohydrate and branched chain -amino acids [10], affect growth and increase their risk for infections and result in nervous breakdown.

Vitamin C functions as an antioxidant, boosts the immune system, improves the formation of connective tissues and facilitates absorption of iron in the gastrointestinal tract [14]. Most age groups in both communities met and exceeded the RNI for vitamin C except male and female children 1 - 3 years in urban households who met less than 85% of the RNI for vitamin C. Though the consumption of fresh leafy vegetables and fresh fruits was encouraging in households in urban and rural communities, the percentage intake was high in urban compared to rural households. It is possible that some households in rural communities sell their fruit and vegetable produce for more income resulting in low consumption of these foods in those areas. The finding in this study is in accordance with a previous study done in Cameroon by [38]. They reported very high intake of ascorbic acid in parts of Cameroon that have tropical climates with long periods of rain. They attributed the high level of ascorbic acid recorded to high consumption of fresh leafy vegetables and fresh fruits by the subjects.

In Cameroon, studies have shown that iron deficiency is the main cause of anaemia. Low intake of foods rich in bioavailable iron and regular consumption of foods rich in iron inhibitors and dietary fibre could be the reason why high prevalence of anaemia among respondents in different age groups was observed in the study. Poor infant feeding practices also had adverse effects on iron status of IYC as most of them were fed with "*pap*" and traditional home foods with little or no flesh foods rich in iron. Though not detected in the study, malaria and helminthes infection could also be responsible for the prevalence of anaemia in respondents. As reported from previous studies, besides insufficient iron intake from foods, malaria parasite is also a leading cause of iron deficiency amongst Cameroonians. This is because malaria causes massive destruction of red blood cells especially in pregnant women. This anaemia leads to low birth weight, high maternal morbidity and mortality rates [13]. Malaria also contributes to chronic undernutrition responsible for high stunting rates particularly amongst the under-five children in Sub-Sahara Africa [23]. Chronic infection and infestation such as HIV, bloody diarrhoeal diseases, helminthiasis (worms) may also be responsible. Blood loss from hookworm and schistosomasis and at childbirth plays a major role to aggravate iron deficiency. Anemia is estimated to be three to four times higher in developing countries than in industrialized countries [13].

Vitamin A deficiency (VAD) constitute one of the major public health problems in developing countries. An estimated 2.8 million preschool-age children are at risk of blindness from VAD and the health and survival of 251 million others are seriously compromised [13]. Previous studies in Cameroon indicate that the national prevalence rates of VAD amongst children less than five years old, and women of childbearing age are 40% and 45% respectively [5]. VAD in IYC 6 - 59 months old and other age groups in this study were lower than the 39.00% National average for IYC 12 - 59 months in Cameroon [13]. The high intake of red palm oil, Carrots, mangoes and dark green leafy vegetables could be the reason for the reduced VAD prevalence in the study area. These foods contain high in carotenoids (precursors of vitamin A) which can be synthesized to vitamin A within the body and improve vitamin A status. Children five and below receive Vitamin A supplementation as part of the public health program in Cameroon. It appears from the result that even without supplementation vitamin A intake from food alone would have been adequate for the under-five. Liver, milk, and egg yolks are rich dietary sources of preformed vitamin A. Vegetables (pumpkins, squash, carrots), yellow and orange non-citrus fruits (mangoes, apricots, papayas) and dark green leafy vegetables such as spinach, are common sources of carotenoids. Calcium intake was significantly ($p < 0.05$) higher in males 6 - 9 and 10 - 14 years in rural compared to urban households. Calcium intake from food generally met the [43] requirements for the majority of the population. The intake of animal sources of calcium was limited. However, in both communities, the diet was high in dark leafy vegetables, dried fish and cereal grains. Calcium intake from food was generally low but the blood calcium levels for the majority of subjects were normal. This seems to suggest that the FAO/WHO requirements and RDA used as levels of nutrient requirements were higher than the needs of the majority of the population. Food consumption patterns among this age group may have been hampered by their frequent consumption of refined carbohydrates, high sugar and saturated fats as snack consumption was more frequent amongst these age groups. This could adversely affect the growth and development of respondents in their formative age. Micronutrient deficiency may cause devastating consequences on health, productivity, and mental impairment. Lack of dietary micronutrients has resulted in anemia, cretinism and xerophthalmia on tens of millions of people. Severe deficiency of micronutrients may affect intellectual development, weaken immune systems, provoke birth defects, and cause individuals to live below their physical and mental potential which ultimately impairs their capabilities and the prospects of nations.

5. Summary, Conclusion and Recommendations

5.1. Summary

Available local foods, culture and market prices were the main determinants of food consumption patterns and dietary practices. This explains why corn fufu and huckleberry featured predominantly in the diets of both urban and rural communities.

Foods consumed by the households were generally starchy roots or tubers, proteins from plant sources (particularly lima beans), vegetables and fruits with very minimal animal source foods. In the rural communities, farm animals were reared for income and not primarily for consumption. It was observed that preference was given to fathers in most households during food shortages and in the consumption of nutritious animal foods.

5.2. Conclusion

The study was conducted to determine food consumption patterns and nutritional status of urban and rural households in the North West region of Cameroon. Daily energy, protein, calcium, iron, vitamin A, C, B_1, B_2 and B_3 intake of respondents of each household in both communities were estimated and compared with the [43] RNI for different age groups. The region has sufficient quantity and diversity of food resources but culture and lack of good nutritional knowledge influenced food choices, frequency of food consumption and preparation pattern. The diets in both urban and rural households were almost monotonous and were rich in carbohydrates, fats, legumes, fruits and vegetables. The consumption of meat of all types, milk and milk products, eggs and fresh fish was low. The low consumption of these food items indicates that, the diets of household members in both communities are generally of poor quality and therefore the occurrence of both over nutrition (obesity and overweight) and under-nutrition is not unexpected. The food choice was greatly influenced by culture, availability and price. There is need to modify some traditional dietary practices such as cooking of garden eggs, cabbage and huckleberry without crayfish, meat and fish, boiling of lima beans with potash, excessive soaking and blanching of vegetables. This will reduce nutrient loss and increase their contribution to a better nutritional status of the consumers.

5.3. Recommendation

The following recommendations may help food policymakers to determine the areas of priority:

To parents of the households:

Men, as well as women, should be educated on the peculiar nutritional needs of the family members to avoid improper distribution of food. The women should be taught the foods needed for good health, and nutritional values of various locally-produced foods. They need to attend and participate in nutrition seminars and other nutrition education programs put at their locality by either the government or NGOs.

There is need for households to modify some traditional nutrition practices such as cooking of garden eggs and huckleberries without meat, fish, and crayfish. Diversification of foods consumed in both communities should be encouraged.

To the government and policymakers:

The government should ensure that nutrition and health education are taught at all levels.

Conflicts of Interest

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

References

[1] Ake-Tano, O., Ekou, K., Tetchi, E.O., Koffi, K.B., Oussou, K.R., Kpebo, D. and Coulibaly, T.I. (2011) Détermination de la national de santé publique Côte d'Ivoire. *Medicine African Noir*, **58**, 93-99.

[2] Spolidoro, J., Pitrez, M., Vasgas, H., Santana, J., Pitrez, E. and Hauschild, J. (2012) Waist Circumference in Children and Adolescents Correlate with Metabolic Syndrome and Fat Deposits. *Clinical Nutrition*, **30**, 1-5.

[3] Shubhangini, A. (2012) Nutrition and Dietetics with Indian Case Studies. Tata Private Ltd., New Delhi.

[4] Srilakshmi, A. (2016) Nutrition and Dietetics. Tata New Age International Publishers, New Delhi.

[5] Nolla, N.P., Marie-Modestine, K., Marlyne, J.M., Tetanye, E. and Innocent, G. (2014) Assessment of Nutritional Status of Preschool Children in the Bangang Rural Community, Cameroon. *International Journal of Biotechnology and Food Science*, **2**, 44-52.

[6] Reinsma, K.R. (2008) Chop Fayne: Nutritional Realities in Cameroon and Interventions. University Fort Collins, Fort Collins.

[7] Labadarios, T.R., Steyn, N.P. and Nel, D.T. (2011) How Diverse Is the Diet of Adult South Africans? *Nutrition Journal*, **11**, 77-83. https://doi.org/10.1186/1475-2891-10-33

[8] Kotut, J., Wafula, S., Ettyang, G. and Mbagaya, G. (2014) Protein-Energy Malnutrition among Women of Child Bearing Age in Semi Arid Areas of Keiyo District, Kenya. *Advances in Life Science and Technology*, **24**, 80-91.

[9] Nutrition Initiative (2017) Global Nutrition Report. Cameroon, Nutrition Country Profile. http://globalnutritionreport.org

[10] Kanasop, M.M., Gouado, I., Mananga, M., Djeukeu, W.A., AmvamZollo, P.H., Oberleas, D. and Tetanye, E. (2014) Feeding Practices and Nutritional Parameters of Adolescents from Cameroon. *Global Journal of Medical Research Interdisciplinary*, **13**, 110-115.

[11] UNICEF/WHO/WB (2017) Global File Cameroon.

[12] Ponka, R., Fokou, E., Leke, R., Fotso, M., Souopgui, J., Achu, B. and Mbiapo, T.F. (2005) Methods of Preparation and Nutritional Evaluation of Dishes Consumed in Malaria Endemic Zone in Cameroon (Ngali II). *African Journal Biotechnology*, **4**, 273-278.

[13] UNICEF Cameroon (2017) Humanitarian Action Update: Silent Emergency Affecting Children in Cameroon. UNICEF, Yaounde.

[14] Nolla, N.P., Kana, S.M., Djeukeu, W.A., Tetanye, E. and Gouado, I. (2013) Assess-

ment of Nutritional Status and Food Consumption in Makepe Missoke, Douala, Cameroon. *Journal of Medicine and Medical Sciences*, **4**, 1-7.

[15] Nutrition Initiative (2019) Global Nutrition Report. Cameroon. Nutrition Profile. Overlapping, Stunting, Wasting and Overweight. https://www.globalnutritionreport.org

[16] Cameoon Baptist Convection Health Board CBCHB (2017) Nutrition Improvement Program (NIP) NIP Meeting Kumbo.

[17] Demographic and Health Survey Multiple Indicator Cluster Survey (2016) Rapport préliminaire Institut national de lastatistique.

[18] Kennedy, G., Berardo, A., Papavero, C., Horjus, P., Ballard, T. and Dop, M.C. (2010) Proxy Measures of Household Food Consumption for Food Security Assessment and Surveillance: Comparison of the Household Dietary Diversity and Food Consumption Scores. *Public Health Nutrition*, **13**, 2010-2018. https://doi.org/10.1017/S136898001000145X

[19] World Health Organization (WHO) (2010) Global Database on Child Growth and Malnutrition World Health Organization/Department of Nutrition for Health and Development. WHO, Geneva.

[20] Asres, G. and Eidelman, A. (2011) L'évaluation nutritionnelle des enfant éthiopiens bêta-Israël: Une enquête transversale. *College Medical Health Science*, **6**, 171-176.

[21] Soha, R. (2009) Assessment of Nutritional Status. http://www.slideshare.net/soharashed/assessment-of-nutritional-status

[22] Kinge, J.M. and Morris, S. (2010) Socioeconomic Variation in the Impact of Obesity on Health-Related Quality of Life. *Social Science & Medicine*, **71**, 1864-1871.

[23] Sharma, S., Mbanya, J.C., Cruickshank, K., Cade, J., Tanya, K.N., Cao, X., Hurbos, M. and Wong, M.R. (2007) Nutritional Composition of Commonly Consumed Composite Dishes from the Central Province of Cameroon. *International Journal Food Science Nutrition*, **58**, 475-485. https://doi.org/10.1080/09637480701288454

[24] Jahangir, M., Kim, H.K., Choi, Y.H. and Verpoorte, R. (2009) Health-Affecting Compounds in Brassicaceae. *Comprehensive Review in Food Science and Food Safety*, **8**, 31-43. https://doi.org/10.1111/j.1541-4337.2008.00065.x

[25] Burkert, N.T., Großschädl, F., Muckenhuber, J., Rásky, É. and Stronegger, W.J. (2012) Gastro-Intestinal Complaints Related to Various Eating Behaviours. *Journal Nutrition Therapeutics*, **1**, 19-23. https://doi.org/10.6000/1929-5634.2012.01.01.3

[26] Shoeps, D.O., de Abreu, C.L., Valentine, V.E., Nascimento, V.G., de Oliveira, A.G. and Gallo, P.R. (2011) Nutritional Status of Pre-Schoolchildren from Low Income Families. *Nutrition Journal*, **10**, 43-57. https://doi.org/10.1186/1475-2891-10-43

[27] Ponce, X., Ramirez, E. and Delisle, H. (2006) A More Diversified Diet among Mexican Men May Also Be More Atherogenic. *The Journal of Nutrition*, **136**, 2921-2927. https://doi.org/10.1093/jn/136.11.2921

[28] Amsala, S. and Tigabu, Z. (2008) Risk Factors for Severe Acute Malnutrition in Children under the Age of Five: A Case-Control Study. *Ethiopian Journal Health Development*, **22**, 21-25. https://doi.org/10.4314/ejhd.v22i1.10058

[29] Turyashemererwa, F.M., Kikafunda, J.K. and Agaba, E. (2009) Prevalence of Early Childhood Malnutrition and Influencing Factors in Peri-Urban Areas of Kabarole District, Western Uganda. *African Journal of Food Agriculture*, *Nutrition and Development*, **9**, 974-989. https://doi.org/10.4314/ajfand.v9i4.43872

[30] Van de Poel, E., Hosseinpoor, A.R., Speybroeck, N., Ourti, T.V. and Vega, J. (2009) Socioeconomic Inequality in Malnutrition in Developing Countries. *Bulletin of the*

World Health Organization, **86**, 282-291. https://doi.org/10.2471/BLT.07.044800

[31] Adeladza, T.A. (2009) The Influence of Socio-Economic and Nutritional Characteristics on Child Growth in Kwale District of Kenya. *African Journal of Food Agriculture, Nutrition and Development*, **9**, 1570-1590. https://doi.org/10.4314/ajfand.v9i7.47686

[32] Kimani-Murage, E.W., Schofield, L., Wekesah, F., Mohamed, S., Mberu, B. and Ettarh, R. (2014) Vulnerability to Food Insecurity in Urban Slums: Experiences from Nairobi, Kenya. *Journal Urban Health*, **91**, 1098-1113. https://doi.org/10.1007/s11524-014-9894-3

[33] Sumati, R., Mudambi, M. and Rajagopal, V. (2010) Fundamentals of Foods, Nutrition and Diet Therapy. New International (P) Limited Publishers, New Delhi.

[34] Tchientche, R.C., Kouamé, A.R., Atangana, T., Chagomoka, R. and Ndango, T. (2013) Nutritional Evaluation of Five African Indigenous Vegetables. *Journal of Horticultural Research*, **21**, 99-106.

[35] Mahogoub, O.E.S., Nnyepi, M. and Bandeke, T. (2006) Factors Affecting Prevalence of Malnutrition among Children under Three Years of Age in Botswana. *African Journal of Food Agriculture Nutrition and Development*, **6**, 1-9. https://doi.org/10.4314/ajfand.v6i1.19171

[36] Saloojee, H., Maayer De, T., Garenne, L.M. and Kahn, K. (2007) What Is New? Investigating Risk Factors for Severe Childhood Malnutrition in a High HIV Prevalence South African Setting. *Scandinavian Journal of Public Health*, **35**, 96-106. https://doi.org/10.1080/14034950701356435

[37] Ngum, E. and Besong, A. (2015) Dietary Habits and the Nutritional Status of Children Aged 1-5 Years in Mambu, Bafut, North West Region, Cameroon. *Merit Research Journal of Medicine and Medical Science*, **3**, 301-305.

[38] Germaine, N.S., Nkengfack, J., Torimiro, N., Jeanne, N. and Heike, E. (2013) A Review of Nutrition in Cameroon: Food Supply, Factors Influencing Nutritional Habit and Impact on Micronutrient (Vitamin A, Iodine, Iron) Status. *Health Science Discovery*, **12**, 112-119.

[39] Janevic, T., Petrovic, O., Bjelic, I. and Kubera, A. (2010) Risk Factors for Childhood Malnutrition in Roma Settlements in Serbia. *Public Health*, **10**, 509-521. https://doi.org/10.1186/1471-2458-10-509

[40] Alom, J., Mohammad, A., Islam, M.D. and Abdul, Q. (2009) Socio Economic Factors Influencing Nutritional Status of Under-Five Children of Agrarian Families in Bangladesh: A Multilevel Analysis. *Bangladesh Journal of Agricultural Economics*, **32**, 63-74.

[41] Swindale, A. and Bilinsky, P. (2005) Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide, Food and Nutrition Technical Assistance. *The Journal of Nutrition*, **138**, 2448-2453.

[42] Humphrey, J. (2009) Child under Nutrition, Tropical Enteropathy, Toilets, and Hand Washing. *The Lancet*, **374**, 1032-1035. https://doi.org/10.1016/S0140-6736(09)60950-8

[43] FAO/WHO (2002) Vitamin A: Human Vitamin and Mineral Requirements. Report of a Joint FAO/WHO Expert Consultation. FAO, Rome, 87-107.