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Research

Dietary intake and dietary diversity of adults and children in the North West region of Cameroon: A comparative study

Faith A. Akob[1,2,*], Kirthee Pillay[1], Nicky Wiles[1], Muthulisi Siwela[1]

[1] Dietetics and Human Nutrition, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, Pietermaritzburg, South Africa; [2]School of Tropical Agriculture and Natural Resources. Catholic University of Cameroon (CATUC), P.O. Box 782, Mankon Bamenda, Cameroon

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Background

Improving dietary intake and dietary diversity (DD) among vulnerable populations is currently a global concern. Data on the dietary intake and DD of people living in the North West Region (NWR) of Cameroon is scarce.

Objective

The objective of the present study was to assess and compare dietary intake and DD of four selected NWR communities.

Methods

A cross-sectional study design was used to assess the dietary intake and DD of a total of 156 adults (18-65 years old) and 156 children (1-5 years old) from two rural areas (Mankon and Mendakwe) and two urban areas (Mankon and Nkwen). Data were collected using a food frequency questionnaire and an individual household dietary diversity questionnaire.

Results

In both the urban and rural areas, diets consisted predominantly of refined carbohydrates, fats and oils with a low intake of dairy and fruit and vegetables. The food items that were seldom consumed in both rural and urban areas were brown bread, brown rice and millet as well as some fruits and vegetables. Adults and children from both rural and urban areas of the NWR achieved DD, as indicated by a cut-off point of 5 out of 9 food groups consumed over a 24-hour period. Nevertheless, intakes of dietary fibre and micronutrients were low.

Conclusions

Although DD was achieved, there is a need to implement strategies to improve the intake of dietary fibre and micronutrients.

INTRODUCTION

Increased urbanisation in Cameroon, shown by the fact that 56% of the population currently live in urban areas (World Bank 2018), is exposing the population to processed foods high in fat, oil, salt and sugar and increased sedentary lifestyles (Cohen et al. 2017). The habitual diet estimated with an interviewer-administered FFQ in the rural and urban West regions of Cameroon was high in starch, alcohol and fat with a low intake of dairy products, fruit and vegetables (Cohen et al 2017). The prevalence of overweight (BMI ⩾ 25 kg/m2) and obesity (BMI ⩾ 30 kg/m2) among women aged 18 years and above was 41.7% and 19.2%, respectively (Global Nutrition Report 2022). In adult men, 25.5% were overweight and 7.5% were obese, both showing an increase since the Global Nutrition Report of 2016. These reports also indicated an increase in diabetes, from 7% in 2016 to 7.5% in 2018 in adult males and from 7% in 2016 to 8.3% in 2018 among adult females (Global Nutrition Report 2022). The prevalence of hypertension was 24.6% in adult women and 24.9% in men, whilst the prevalence of hypercholesterolaemia among adult men and women was

*Corresponding author: bfaithakob@yahoo.com

20% and 24%, respectively (Non-communicable disease (NCD) Risk Factor Collaboration 2017, World Health Organization 2017). Both under-nutrition and over-nutrition co-exist in Cameroon (Global Nutrition Report 2022), a so-called double burden of malnutrition affecting many developing countries (Davis et al. 2020).

Dietary diversity (DD) (defined as "the number of different foods or food groups consumed over a given reference period" (Gonete et al. 2020)) is a serious nutrition problem among poor populations in developing regions where resources are limited (Gassara & Chen 2021). It may vary across population groups, as well as across communities living in different geographical locations.

Resource-poor communities in developing regions tend to rely heavily on monotonous diets comprised mainly of starchy staple foods such as maize and white rice, with little or no animal products, as well as very limited amounts of fruits and vegetables (Gassara & Chen 2021). These diets consumed tend to be low in several micronutrients, which results in micronutrient malnutrition (Gassara & Chen 2021.

Relevant research is largely lacking in Cameroon except in the West Region, where Cohen et al. (2017) used an interviewer-administered food frequency questionnaire in the rural and urban areas to show that the estimated habitual diet was high in starch, alcohol and fat, with a low intake of dairy products, and fruits and vegetables. They also found that physical activity levels were higher among the rural population. The lifestyle of the urban population seemed to significantly contribute to an increase in the prevalence of nutrition-related health conditions and NCDs (Cohen et al. 2017).

There is a need to assess DD among specific communities in additional regions of Cameroon and then use these data to recommend a DD-based strategy to address malnutrition. Since no such study has been done in the Northwest Region (Jackson and Cumber, 2016), the present study was conducted to assess and compare dietary intakes and DD of four selected communities in the NWR of Cameroon.

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLE SELECTION

A cross-sectional study design was employed to assess the dietary intake and DD of adults and children of selected rural and urban communities in the NWR of Cameroon. Two rural and two urban areas in Mezam Division, one of the seven divisions of the NWR were selected for the study. Mezam Division consists of seven councils in both rural and urban areas. The study areas were randomly selected using the simple random sampling procedure. An online sample size calculator (Survey Sample Size Calculator 2022) was used to calculate the sample size. To get results that reflected the target population in terms of gender and age as precisely as needed, a 95% confidence interval (1.96 confidence interval of a population of 2,180,309) in the NWR was assumed with a 5% margin of error (Survey Sample Size calculator 2022). In addition, a power analysis for a chi-square test indicated that the minimum sample size needed to yield a statistical power of at least 0.8 with an alpha of 0.5 and medium effect size of 0.5 was 601, based on the population size (Survey Sample Size calculator 2022). The calculated sample size was 1248 adults and children (which was above the minimum 601), 624 children and 624 adults for each of the two areas of the selected rural and urban areas, respectively. Therefore, 156 children and 156 adults (total of 312) per study area were required. Households that had both adults (18-65 years) and children (1-5 years) were identified and listed for each study area. Systematic probability sampling was used to recruit study participants. Households that had adults (18-65 years) and children (1-5 years) were identified and listed for each study area. Every odd numbered household that had adults and children who met the inclusion criteria were invited to participate independently of the other members of the population. Children (1-5 years) were only included in the study if their caregiver consented.

PILOT STUDY

A pilot study was conducted on 10% of the sample population (In 2017) (10% of 1248 = 125 participants), which equated to 63 adults and 63 children. The pilot study was conducted in Mbengwi, a rural area out of the municipality that was not to be used in the main study. The purpose of the pilot study was to test whether the survey questions were appropriate for the target group and to determine the time required to administer the survey questions. The results of the pilot study indicated that the survey questions were understood by both the fieldworkers and participants and the time required to administer the questions for FFQ and DD was determined to be about a total of 45 minutes. Dietary intake and diversity data were collected in the selected area of Mbengwi. A post-pilot training session was conducted to revise and correct the procedures to be followed during the main data collection.

COLLECTION OF DIETARY DATA

Data were recorded by trained fieldworkers using a data collection sheet for adults and children. The data collection sheet was developed in English, as it is the language most often spoken in the chosen study area. However, in the process of administering the questionnaire, the fieldworkers could use the Cameroonian pidgin English for those who did not understand standard English. A food frequency questionnaire (FFQ) and a dietary diversity (DD) questionnaire were used to collect dietary data from adults (18-65 years) and children (1-5 years).

FOOD FREQUENCY QUESTIONNAIRE

A FFQ is a check list of foods and beverages with a frequency response section for participants to state how often they consume a specific type of food and drink per day, week, month or year (Rodrigo et al. 2015). For this study, a qualitative food frequency questionnaire was used to collect the data, administered by the field workers through an interview. In the case of children, the caregivers responded to the questions. The FFQ comprised of a list of 72 food items, subdivided into the following four groups; breads, cereals and starch; sweet and savoury snacks and meat and meat alternatives; fats and oils, milk and milk products, fruits; vegetables and drinks. Foods included in the FFQ were commonly consumed and culturally acceptable food items in the NWR of Cameroon. The frequency of consumption was indicated next to each food item listed as follows: never or less than once a month, 1-3 times a month, 2-4 times a week,

5-6 times a week, 7 times a week, 2-3 times a day, 4-5 times a day or more than 6 times a day. Using a Likert-style scale, consumption frequencies were then assigned numerical values (e.g., 1 = never or less than once a month; 9= 2-3 times a day). These values were used to calculate the mean frequency score for each food item across all respondents. Foods with mean scores greater than 3.5 were classified as commonly consumed, while those with scores less than or equal to 3.5 were considered less frequently consumed.

DIETARY DIVERSITY (DD) QUESTIONNAIRE

Food groups are used because they are more likely to be representative of a diverse diet than individual food items. Depending on the main characteristics of the diet, the dietary diversity score is intended to roughly reflect the adequacy of macro and micronutrient intake. It is recommended that a reference period of the previous 24 hours be used to obtain a simple count of food groups consumed by the individual (FAO 2013).

The DD questionnaire we used is a qualitative measure of food consumption and reflects access to the variety of foods and, indirectly, the nutrient adequacy of diets (FAO 2013), at least at for monitoring and evaluating DD at local or national levels. The current study questionnaire consisted of nine food groups namely: grains, roots and tubers; nuts, pulses and legumes; milk and milk products; meat, poultry and fish; vitamin A-rich plant foods; other fruits and vegetable; foods cooked in oil; eggs; and iron-rich plant foods (only Moringa, Egusi [melon seeds] and cow pea). The study was conducted in the raining season when most fruits and vegetables are available.

The interviewer marked a score of '1' for every food group consumed and '0' for food groups not consumed during the previous day. Although an ideal level of DD is not available, half of the food groups consumed was used as a cut-off point for DD, which is five out of nine food groups (FAO 2013). Therefore, DD was considered to be achieved if ⩾ 5 food groups were consumed and considered to be poor DD if <5 food groups were consumed. It took field workers 10-15 minutes to complete each questionnaire.

DATA ANALYSIS

Data were captured on Microsoft Excel spreadsheets and then transferred to the Statistical Package for Social Sciences (SPSS) version 25 (SPSS Inc., Chicago, IL, USA) for statistical analysis. All data on the Microsoft Excel spreadsheets were password protected and only the researcher and statistician had access to them. Means, standard deviations, chi-square tests, the Kruskal-Wallis test, Pearson's correlation, t-tests of equality of means and Pearson's correlation were used to assess and compare dietary intake and DD of four selected communities in the NWR of Cameroon using selected dietary assessment methods (FFQ and DD). A p value of <0.05 was considered to indicate statistical significance.

ETHICAL CONSIDERATIONS

Full ethical approval was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee (Reference number: BE439/19) and the Regional Hospital Institutional Review Board Cameroon (Reference number: 072/APP/RDPH/RHB/IRB). Gatekeeper's permission was obtained from the Regional Delegation of Health North West Region Cameroon (Reference number: 52/ATT/NWR/RDPH). Permission was obtained from the National Polytechnic University Institute to use some degree level nutrition students as field workers. Informed written consent was obtained from all adult participants and the caregivers of child participants. Confidentiality was maintained throughout the study. All data were safely stored with only authorised access allowed.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

The demographic characteristics (age group and gender) of the adults and children who participated in the study in each study area are presented in Table 1. Most of the adult study participants were aged between 31 and 50 years, in all study areas (Table 1). More than 50% of the child study participants were females 1-3 years of age, in all areas (Table 1).

Table 1. Age group and gender of adult study participants aged 18-65 years and child study participants aged 1-5 years by site (N=1248)

		ADULTS		
Area	**Age group (males)**	**n (%)***	**Age group (females)**	**n (%)***
Nkwen (urban) (n=156)	14-18 years	0 (0)	14-18 years	1 (0.2)
	19-30 years	14 (2.2)	19-30 years	28 (4.5)
	31-50 years	28 (4.5)	31-50 years	79 (12.7)
	51-70 years	2 (0.3)	51-70 years	4 (0.6)
Mankon (urban) (n=156)	14-18 years	0 (0)	14-18 years	0 (0)
	19-30 years	21 (3.4)	19-30 years	55 (8.8)
	31-50 years	23 (3.7)	31-50 years	56 (9.0)
	51-70 years	0 (0)	51-70 years	1 (0.2)
Mankon (rural) (n=156)	14-18 years	0 (0)	14-18 years	1 (0.2)
	19-30 years	21 (3.4)	19-30 years	18 (2.9)
	31-50 years	48 (7.7)	31-50 years	36 (5.8)
	51-70 years	13 (2.1)	51-70 years	19 (3.0)
Mendakwe (rural) (n=156)	14-18 years	0 (0)	14-18 years	1 (0.2)
	19-30 years	10 (1.6)	19-30 years	32 (5.1)
	31-50 years	22 (3.5)	31-50 years	76 (12.2)
	51-70 years	3 (0.5)	51-70 years	12 (1.9)
TOTAL		205 (32.9)		419(67.1)
		CHILDREN		
Area	**Age group (males)**	**n (%)***	**Age group (females)**	**n (%)***
Nkwen (urban) (n=156)	1-3 years	33 (5.3)	1-3 years	67 (10.7)
	4-5 years	25 (4.0)	4-5 years	31 (5.0)
Mankon (urban) (n=156)	1-3 years	48 (7.7) 5(0.8)	1-3 years	92 (14.7)
	4-5 years		4-5 years	11 (1.8)
Mankon (rural) (n=156)	1-3 years	63(10.1)	1-3 years	70 (11.2)
	4-5 years	7 (1.1)	4-5 years	16 (2.6)
Mendakwe (rural) (n=156)	1-3 years	38 (6.1)	1-3 years	44 (7.1)
	4-5 years	39 (6.3)	4-5 years	35 (5.6)

*Percentage of sub sample (n=624)

DIETARY ASSESSMENT

FOOD FREQUENCY RESULTS FOR URBAN AREAS

Food frequency data of adults and children were reported together because the objective was to compare dietary intakes between the chosen rural and urban study areas and not between adults and children. Tables 2-5 present the food items consumed by urban participants (Mankon and Nkwen)

and the frequency of consumption.

The mean frequency scores for commonly consumed food items were determined and used to identify which food items were consumed the most and the least (Table 6). The mean frequency scores are for frequencies per day up to a month and are based on data from Tables 2-5.

The mean frequency scores for commonly consumed food items were determined and used to describe the trends identified (Table 2 and Table 3). Tables 2 and 3 show that refined carbohydrates were consumed more frequently than whole grains, fruit and vegetables.

Table 2. Frequency of consumption of bread, cereals and starch in urban sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Bread, white	0	0.0	0	0.0	0	0.0	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bread, brown	1223	98.0	0	0.0	25	2.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cassava	0	0.0	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
*Calabar yam	186	14.9	664	53.2	398	31.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cocoyam	0	0.0	0	0.0	936	75.0	312	25.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cornflakes	1109	88.9	124	9.9	15	1.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Corn fufu flour	0	0.0	6	0.5	1156	92.6	86	6.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Irish potatoes	89	7.1	104	8.3	699	56.0	356	28.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Millet	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pancakes	840	67.3	271	21.7	137	11.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Plantain, green	56	4.5	538	43.1	464	37.2	190	15.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Plantain, ripe	54	4.3	429	34.4	389	31.2	376	30.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rice, brown	1228	98.4	9	0.7	11	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rice, white	0	0.0	0	0.0	194	15.5	1054	84.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spaghetti	776	62.2	339	27.2	90	7.2	43	3.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sweet potatoes	118	9.5	111	8.9	617	49.4	402	32.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
#Sweet yams	340	27.2	908	72.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

*Calabar yam is an edible tuber that belongs to the Dioscorea plant species; #Sweet yams are an edible tuber similar to sweet potatoes.

Table 3. Frequency of consumption of sweet and savoury snacks and meat and meat alternatives in urban sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sweet and savoury snacks																		
Biscuits	471	37.7	235	18.8	326	26.1	106	8.5	0	0.0	71	5.7	39	3.1	0	0.0	0	0.0
Cakes	318	25.5	832	66.7	98	7.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Doughnuts	89	7.1	1006	80.6	153	12.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Popcorn	608	48.7	640	51.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
*Puff puff	28	2.2	231	18.5	144	11.5	845	67.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sweets	397	31.8	632	50.6	74	5.9	107	8.6	0	0.0	38	3.0	0	0.0	0	0.0	0	0.0
Meat and meat alternatives																		
Beans	64	5.1	238	19.1	232	18.6	714	57.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Beef	62	5.0	328	26.3	475	38.1	383	30.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Caterpillar	1070	85.7	176	14.1	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Chicken	126	10.1	763	61.1	283	22.7	76	6.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Crickets	1192	95.5	22	1.8	34	2.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Eggs	45	3.6	169	13.5	525	42.1	397	31.8	0	0.0	112	9.0	0	0.0	0	0.0	0	0.0
Fish	32	2.6	458	36.7	586	47.0	167	13.4	0	0.0	5	0.4	0	0.0	0	0.0	0	0.0
Groundnuts	0	0.0	70	5.6	715	57.3	463	37.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Guinea pigs	1060	84.9	158	12.7	30	2.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pork	439	35.2	590	47.3	197	15.8	22	1.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rabbit	1067	85.5	181	14.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

*Puff puff is a fried dough product made with refined wheat flour, yeast, sugar and salt.

Table 4. Frequency of consumption of fats and oils, milk and milk products and fruit in urban sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Fats and oils																		
Coconut oil	984	78.8	210	16.8	54	4.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Butter, hard	1092	87.5	156	12.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Margarine, soft	61	4.9	384	30.8	491	39.3	272	21.8	0	0.0	40	3.2	0	0.0	0	0.0	0	0.0
Mayonnaise	775	62.1	161	12.9	192	15.4	120	9.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Palm oil	35	2.8	27	2.2	393	31.5	750	60.1	0	0.0	43	3.4	0	0.0	0	0.0	0	0.0
Vegetable oil	184	14.7	54	4.3	74	5.9	785	62.9	0	0.0	151	12.1	0	0.0	0	0.0	0	0.0
Milk and milk products																		
Cheese	1231	98.6	17	1.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Milk	312	25.0	105	8.4	160	12.8	406	32.5	0	0.0	265	21.2	0	0.0	0	0.0	0	0.0
Yoghurt	449	36.0	507	40.6	73	5.8	219	17.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fruit																		
Apple	851	68.2	288	23.1	77	6.2	32	2.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Avocado pear	114	9.1	988	79.2	124	9.9	22	1.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Banana	152	12.2	194	15.5	679	54.4	0	0.0	55	4.4	0	0.0	0	0.0	0	0.0	0	0.0
Coconut fresh	567	45.4	654	52.4	27	2.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Grape fruit	1226	98.2	22	1.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mango	1196	95.8	52	4.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Orange	106	8.5	330	26.4	663	53.1	149	11.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Watermelon	278	22.3	320	25.6	586	47.0	49	3.9	0	0.0	15	1.2	0	0.0	0	0.0	0	0.0
pawpaw	241	19.3	380	30.4	627	50.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pear	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pineapple	193	15.5	534	42.8	472	37.8	49	3.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tangerine	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 5. Frequency of consumption of vegetables and beverages in urban sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Vegetables																		
[a]Bitter leaves	111	8.9	157	12.6	768	61.5	212	17.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cabbage	238	19.1	648	51.9	325	26.0	37	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carrots	172	13.8	866	69.4	210	16.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cucumber	1075	86.1	117	9.4	43	3.4	13	1.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
[b]Eru	111	8.9	1039	83.3	98	7.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
[c]Green	449	36.0	504	40.4	295	23.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Green beans	581	46.6	614	49.2	53	4.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Huckleberry	270	21.6	370	29.6	432	34.6	176	14.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Lettuce	1037	83.1	93	7.5	118	9.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Okra	52	4.2	291	23.3	671	53.8	192	15.4	0	0.0	42	3.4	0	0.0	0	0.0	0	0.0
Onions	0	0.0	0	0.0	0	0.0	780	62.5	0	0.0	187	15.0	281	22.5	0	0.0	0	0.0
Pumpkin leaves	519	41.6	589	47.2	109	8.7	31	2.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sweet potato leaves	802	64.3	377	30.2	69	5.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tomatoes	0	0.0	0	0.0	0	0.0	1192	95.5	0	0.0	0	0.0	56	4.5	0	0.0	0	0.0
Beverages																		
Fizzy drinks	180	14.4	538	43.1	288	23.1	242	19.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fruit juices natural	962	77.1	170	13.6	66	5.3	0	0.0	0	0.0	0	0.0	50	4.0	0	0.0	0	0.0
Fruit juices concentrate	662	53.0	303	24.3	240	19.2	0	0.0	0	0.0	43	3.4	0	0.0	0	0.0	0	0.0
Water	0	0.0	0	0.0	48	3.8	156	12.5	0	0.0	384	30.8	660	52.9	0	0.0	0	0.0

[a]Bitter leaves (*Vernonia amygdalina*) is a type of green leafy vegetable; [b]Eru (*Gnetum afrianum*) is a vegetable soup made up of finely shredded eru leaves; [c]*Green (Amaranthus spinosus*) is a type of leafy vegetable.

Table 6. The mean daily frequency scores of commonly consumed food items in the urban study areas

Food items	Mean ± SD	Food items	Mean ± SD	Food items	Mean ± SD
Bread white	4.00 ± 0.00	Beans	3.28 ± 0.94	Cucumber	1.19 ± 0.54
Bread brown	1.04 ± 0.28	Beef	2.94 ± 0.88	Eru leaves	1.99 ± 0.41
Cassava	2.00 ± 0.00	Caterpillar	1.14 ± 0.36	Green	1.88 ± 0.76
Calabar yams	2.17 ± 0.66	Chicken	2.25 ± 0.71	Green beans	1.58 ± 0.57
Cocoyam	3.25 ± 0.43	Crickets	1.07 ± 0.35	Huckleberry	2.41 ± 0.98
Cornflakes	1.12 ± 0.36	Eggs	3.40 ± 1.18	Lettuce	1.26 ± 0.62
Corn fufu	3.06 ± 0.26	Fish	2.73 ± 0.75	Okra	2.94 ± 0.92
Irish potatoes	3.06 ± 0.81	Groundnuts	3.31 ± 0.57	Onions	4.98 ± 1.29
Millet	1.00 ± 0.00	Guinea pigs	1.17 ± 0.44	Pumpkin leaves	1.72 ± 0.72
Pancakes	1.44 ± 0.68	Pork	1.84 ± 0.75	Sweet potato leaves	1.41 ± 0.59
Plantain green	2.63 ± 0.79	Rabbit	1.15 ± 0.35	Tomatoes	4.13 ± 0.62
Plantain ripe sweet potatoes	2.87 ± 0.89	Cheese	1.01 ± 0.12	Fizzy drinks	2.47 ± 0.96
Rice brown	1.02 ± 0.20	Milk	3.38 ± 1.78	Fruit juices natural	1.48 ± 1.25
Rice white	3.84 ± 0.36	Yoghurt	2.05 ± 1.06	Fruit juices concentrate	1.80 ± 1.11
Spaghetti	1.57 ± 0.89	Apple	1.43 ± 0.72	Water	4.16 ± 1.16
Sweet potatoes	3.04 ± 0.89	Avocado pear	2.04 ± 0.51		
Sweet yams	1.73 ± 0.45	Banana	2.87 ± 1.08		
Biscuits	2.44 ± 1.57	Coconut fresh	1.57 ± 0.54		
Cakes	1.82 ± 0.55	Grape fruit	1.02 ± 0.13		
Doughnuts	2.05 ± 0.44	Mango	1.04 ± 0.20		
Popcorn	1.51 ± 0.50	Orange	2.69 ± 0.79		
Puff puff	3.45 ± 0.87	Watermelon	2.37 ±0.95		
Sweets	2.03 ± 1.09	Pawpaw	2.31 ± 0.77		
Coconut oil	1.25 ± 0.53	Pear	1.00 ± 0.00		
Butter hard	1.13 ± 0.33	Pineapple	2.30 ± 0.77		
Margarine soft	2.91 ± 1.00	Tangerine	1.00 ± 0.00		
Mayonnaise	1.73 ± 1.04	Bitter leaves	2.87± 0.79		
Palm oil	3.63 ± 0.81	Cabbage	2.13 ± 0.74		
Vegetable oil	3.65 ± 1.39	Carrots	2.03 ± 0.55		

Using a Likert-style scale, consumption frequencies were then assigned numerical values (e.g., 1 = never or less than once a month; 9= 2-3 times a day). These values were used to calculate the mean frequency score for each food item across all respondents. Food items were rated most commonly consumed based on a mean frequency score ⩾3.5

See footnotes to tables above for explanations of local food items.

FOOD FREQUENCY RESULTS FOR RURAL SITES (MANKON RURAL AND MENDAKWE)

The food items consumed by rural participants and the frequency of consumption are shown in Tables 7-10. The mean frequency scores for commonly consumed food items was determined and used to identify which food items were consumed the most and the least (Table 11).

Table 7. Frequency of consumption of bread, cereals and starch in rural sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Bread, cereals and starch																		
Bread white	0	0.0	0	0.0	973	77.9	275	22.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bread brown	809	64.8	439	35.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cassava	0	0.0	0	0.0	321	25.7	672	53.9	255	20.4	0	0.0	0	0.0	0	0.0	0	0.0
*Calabar yams	749	60.0	499	39.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cocoyam	0	0.0	5	0.4	813	65.1	430	34.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cornflakes	1024	82.1	224	17.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Corn fufu flour	0	0.0	0	0.0	0	0.0	0	0.0	69	5.5	800	64.1	379	30.4	0	0.0	0	0.0
Irish potatoes	0	0.0	321	25.7	458	36.7	469	37.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Millet	1248	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pancakes	991	79.41	257	20.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Plantain green	0	0.0	253	20.3	300	24.0	695	55.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Plantain ripe	0	0.0	601	49.2	647	51.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rice brown	575	46.7	379	30.4	294	23.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rice white	0	0.0	601	48.2	372	29.8	275	22.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spaghetti	962	77.0	286	22.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sweet potatoes	0	0.0	0	0.0	431	34.6	817	65.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
#Sweet yams	0	0.0	927	74.3	321	25.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

*Calabar yam is an edible tuber that belongs to the Dioscorea plant species; #Sweet yams are an edible tuber similar to sweet potatoes.

Table 8. Frequency of consumption of sweet and savoury snacks and meat and meat alternatives in rural sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Sweet and savoury snacks																		
Biscuits	0	0.0	0	0.0	982	79.7	266	21.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cakes	1002	80.3	246	19.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Doughnuts	994	79.7	254	20.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Popcorn	0	0.0	379	30.37	869	69.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
*Puff puff	0	0.0	0	0.0	485	38.9	763	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sweets	0	0.0	0	0.0	0	0.0	815	65.3	433	34.7	0	0.0	0	0.0	0	0.0	0	0.0
Meat and meat alternatives																		
Beans	0	0.0	0	0.0	300	24.0	16	1.3	932	74.7	0	0.0	0	0.0	0	0.0	0	0.0
Beef	0	0.0	794	63.6	454	36.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Caterpillar	0	0.0	0	0.0	300	24.0	633	50.7	315	25.2	0	0.0	0	0.0	0	0.0	0	0.0
Chicken	142	11.4	1106	88.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Crickets	0	0.0	751	60.2	497	39.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Eggs	0	0.0	964	77.2	228	22.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fish	0	0.0	786	62.9	462	37.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Groundnuts	0	0.0	0	0.0	294	23.6	873	69.9	81	6.5	0	0.0	0	0.0	0	0.0	0	0.0
Guinea pigs	0	0.0	752	60.3	397	31.8	99	7.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pork	1248	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rabbit	751	60.2	497	39.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 9. Frequency of consumption of fats and oils, milk and milk products and fruit in rural sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Fats and oils																		
Coconut oil	906	72.6	342	27.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Butter hard	1017	81.5	231	18.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Margarine soft	1248	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mayonnaise	1153	92.4	95	7.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Palm oil	0	0.0	0	0.0	0	0.0	0	0.0	194	15.5	261	20.9	795	63.7	0	0.0	0	0.0
Vegetable oil	431	34.5	694	55.6	123	9.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Milk and milk products																		
Cheese	1248	100	0.0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Milk	1099	88.1	149	11.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Yoghurt	911	73.0	337	27.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fruit																		
Apple	821	65.8	395	31.7	32	2.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Avocado pear	0	0.0	0	0.0	300	24.0	45	3.6	0	0.0	706	56.6	361	28.9	0	0.0	0	0.0
Banana	0	0.0	0	0.0	308	24.7	0	0.0	649	52.0	261	20.9	0	0.0	0	0.0	0	0.0
Coconut fresh	0	0.0	701	56.2	247	19.8	300	24.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Grape fruit	0	0.0	724	58.0	382	30.6	142	11.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mango	0	0.0	0	0.0	221	17.7	929	74.4	101	8.1	0	0.0	0	0.0	0	0.0	0	0.0
Orange	0	0.0	0	0.0	56	4.5	794	63.6	176	14.1	222	17.8	0	0.0	0	0.0	0	0.0
Watermelon	642	51.4	269	21.6	183	14.7	154	12.3	0	0	0.0	0	0	0.0	0	0.0	0	0.0
Pawpaw	0	0.0	0	0.0	0	0.0	696	55.8	269	21.6	115	9.2	168	13.5	0	0.0	0	0.0
Pear	0	0.0	0	0.0	179	14.3	715	57.3	155	12.4	99	7.9	100	8.0	0	0.0	0	0.0
Pineapple	0	0.0	261	20.9	725	58.1	265	21.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tangerine	709	56.8	331	26.5	0	0.0	208	16.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Table 10. Frequency of consumption of vegetables and beverages in rural sites

Food items	Never or less than once a month		1-3 times per month		Once a week		2-4 times per week		5-6 times per week		Once a day		2-3 times per day		4-5 times per day		>6 times per day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Vegetables																		
[a]Bitter leaves	0	0.0	0	0.0	58	4.7	0	0.0	200	16.0	990	79.3	0	0.0	0	0.0	0	0.0
Cabbage	0	0.0	395	31.7	827	66.3	26	2.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Carrots	0	0.0	0	0.0	721	57.8	300	24.0	227	18.2	0	0.0	0	0.0	0	0.0	0	0.0
Cucumber	300	24.0	672	53.9	276	22.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
[b]Eru leaves	0	0.0	833	66.8	415	33.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
[c]Green	0	0.0	0	0.0	0	0.0	785	62.9	463	37.1	0	0.0	0	0.0	0	0.0	0	0.0
Green beans	0	0.0	256	20.5	691	55.4	0	0.0	301	24.1	0	0.0	0	0.0	0	0.0	0	0.0
Huckleberry	0	0.0	14	1.1	593	47.5	341	27.3	300	24.0	0	0.0	0	0.0	0	0.0	0	0.0
Lettuce	941	75.4	307	24.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Okra	0	0.0	0	0.0	75	6.0	200	16.0	973	77.9	0	0.0	0	0.0	0	0.0	0	0.0
Onions	0	0.0	0	0.0	653	52.3	299	23.9	296	23.7	0	0.0	0	0.0	0	0.0	0	0.0
Pumpkin leaves	0	0.0	0	0.0	421	33.7	682	54.7	145	11.6	0	0.0	0	0.0	0	0.0	0	0.0
Sweet potatoes leaves	0	0.0	0	0.0	116	9.3	0	0.0	241	19.3	891	71.4	0	0.0	0	0.0	0	0.0
Tomatoes	0	0.0	0	0.0	34	2.7	0	0.0	714	57.2	500	40.1	0	0.0	0	0.0	0	0.0
Beverages																		
Fizzy drinks	993	79.6	255	20.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fruit juices natural	1248	100	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fruit juices concentrate	1099	88.1	149	11.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Water	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	527	42.2	481	38.5	240	19.2	0	0.0

[a]Bitter leaves (*Vernonia amygdalina*) is a type of green leafy vegetable; [b]Eru (*Gnetum afrianum*) is a vegetable soup made up of finely shredded eru leaves; [c]Green (*Amaranthus spinosus*) is a type of leafy vegetable.

Table 11. The mean frequency scores for commonly consumed food items in the rural study areas

Food items	Mean ± SD	Food items	Mean ± SD	Food items	Mean ± SD
Bread white	3.20 ± 0.76	Beans	3.58 ± 0.94	Cucumber	2.14 ± 0.11
Bread brown	1.04 ± 0.14	Beef	2.94 ± 0.88	Eru okazi leaves	2.99 ± 0.36
Cassava	4.00 ± 0.16	Caterpillar	3.14 ± 0.36	Green	3.58 ± 0.64
Calabar yams	2.17 ± 0.84	Chicken	1.25 ± 0.71	Green beans	3.53 ± 0.84
Cocoyam	3.25 ± 0.17	Crickets	1.07 ± 0.35	Huckleberry	3.92 ± 0.88
Cornflakes	1.12 ± 0.85	Eggs	3.40 ± 1.18	Lettuce	2.26 ± 0.43
Corn fufu	4.00 ± 0.83	Fish	2.73 ± 0.75	Okra	4.00 ± 0.73
Irish potatoes	3.06 ± 0.16	Groundnuts	3.51 ± 0.57	Onions	3.65 ± 0.34
Millet	1.60 ± 0.53	Guinea pigs	1.17 ± 0.44	Pumpkin leaves	3.72 ± 0.93
Pancakes	1.04 ± 0.84	Pork	1.84 ± 0.75	Sweet potato leaves	3.82 ± 0.28
Plantain green	3.80 ± 0.38	Rabbit	1.15 ± 0.35	Tomatoes	3.52 ± 0.99
Plantain ripe	3.87 ± 0.19	Cheese	1.01 ± 0.12	Fizzy drinks	2.01 ±0.48
Rice brown	2.12 ± 0.52	Milk	1.38 ± 1.78	Fruit juices natural	0.23 ± 0.71
Rice white	3.74 ± 0.72	Yoghurt	1.05 ± 1.06	Fruit juices concentrate	0.49 ± 0.57
Spaghetti	1.07 ± 0.53	Apple	1.43 ± 0.72	Water	4.00 ± 0.01
Sweet potatoes	3.97 ± 0.64	Avocado pear	3.84 ± 0.51		
Sweet yams	2.83 ± 0.17	Banana	3.87 ± 1.08		
Biscuits	3.84 ± 1.84	Coconut fresh	1.57 ± 0.54		
Cakes	1.01 ± 0.83	Grape fruit	1.02 ± 0.13		
Doughnuts	2.00 ± 0.42	Mango	3.54 ± 0.20		
Popcorn	2.71 ± 0.57	Orange	3.69 ± 0.79		
Puff puff	3.68 ± 0.42	Watermelon	2.37 ± 0.95		
Sweets	4.00 ± 0.09	Pawpaw	3.51 ± 0.77		
Coconut oil	1.02 ± 0.50	Pear	3.20 ± 0.00		
Butter hard	1.09 ± 0.64	Pineapple	2.30 ± 0.77		
Margarine soft	1.61 ± 1.73	Tangerine	1.00 ± 0.00		
Mayonnaise	0.74 ± 0.04	Bitter leaves	3.87 ± 0.79		
Palm oil	3.83 ± 0.73	Cabbage	3.53 ± 0.74		
Vegetable oil	2.05 ± 0.92	Carrots	2.03 ± 0.55		

Using a Likert-style scale, consumption frequencies were then assigned numerical values (e.g., 1 = never or less than once a month; 9= 2-3 times a day). These values were used to calculate the mean frequency score for each food item across all respondents. Food items were rated most commonly consumed based on a mean frequency score ⩾3.5

See footnotes to tables above for explanations of local food items.

DIETARY DIVERSITY

Figure 1 presents the mean number of food groups consumed per day per study site for adults and children separately. Figure 2 presents the proportion of adults who consumed food groups consumed by study site and Figure 3 shows this for children. The food groups that were consumed most across all age groups (adults and children) in all the study areas were grains, roots and tubers, fats and oils. The least consumed food groups across all age groups in all the study areas were fruits and vegetables, especially vitamin A-rich plant foods, and milk and milk products. Children did not consume meat, poultry, and fish in all the study areas.

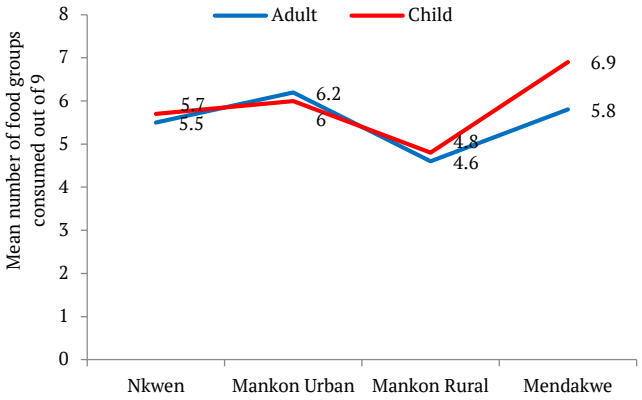

Figure 1. Mean number of food groups consumed per day per study site

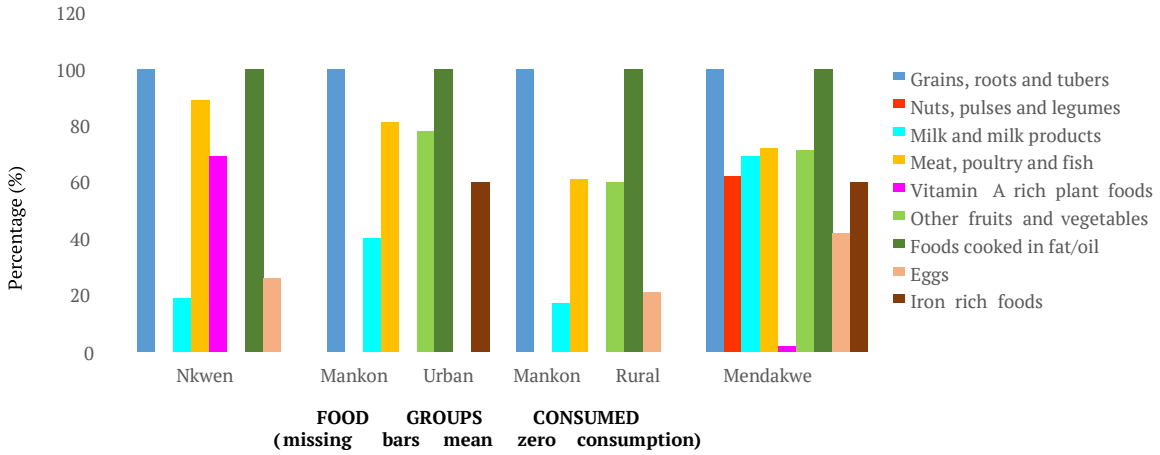

Figure 2. Food group types consumed by adults at all four study sites

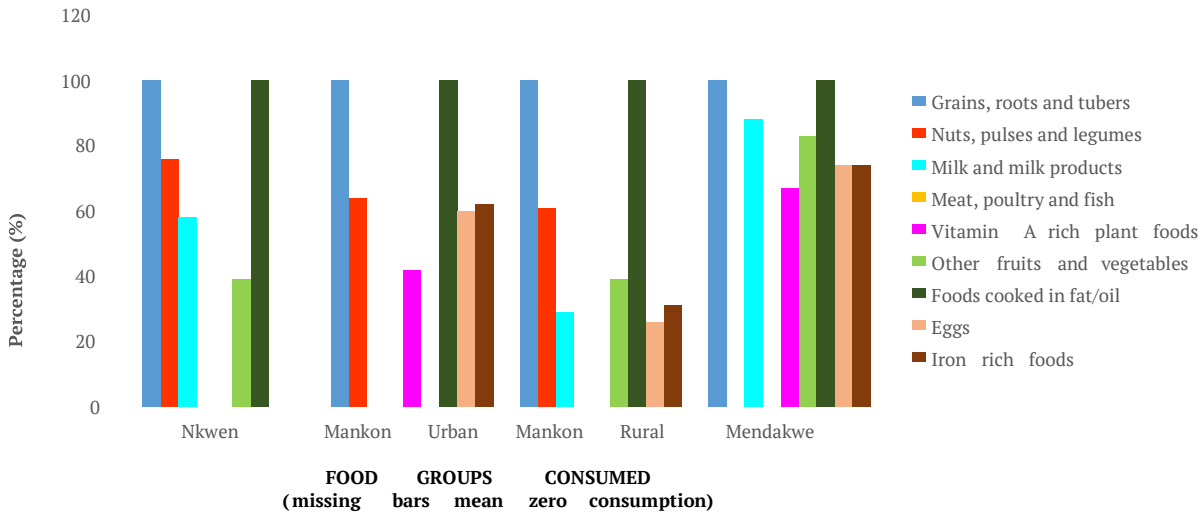

Figure 3. Food group types consumed by children (1-5 years) for all four study sites (N=624)

Figure 4 shows the difference in DD across all the study areas for adults and children. The results showed that there was generally good DD among adults and children, with rural Mankon having by far the poorest DD.

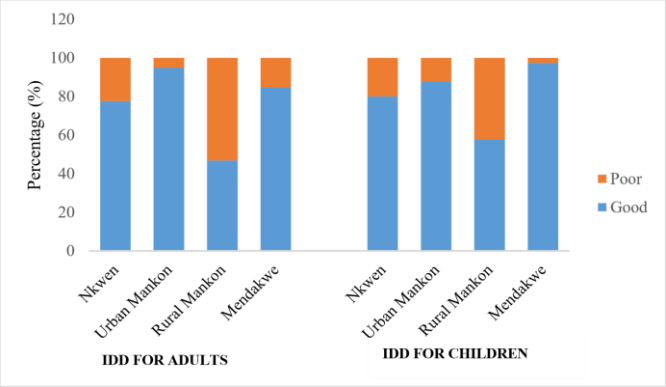

Figure 4. Differences in dietary diversity (DD) across all study areas for adults and children

Nkwen isurban and *Mendakwe* is rural.
Poor DD (<5 food groups); good DD (≥5 food groups)

DISCUSSION

FOOD FREQUENCY

For the urban areas, white bread, cocoyams (white yams), white rice, puffpuff (yeast dough deep fat fried), palm oil, beans, eggs, onions and tomatoes were the most commonly consumed food items. The food items that were seldom consumed in both rural and urban areas were brown bread, brown rice and millet as well as some fruits and vegetables. However, these foods are all accessible and available in the food markets in the NWR. The taste of whole grain foods is different from refined carbohydrates as they contain bran, which makes them grainy and difficult to chew (Cohen et al. 2017). High fibre foods are priced the same as refined carbohydrates (Cohen et al. 2017). It is possible that the nutritional value and benefits of high fibre foods are not known by the communities studied. Indeed, Nkengfack et al. (2011) stated that brown rice, brown bread, millet, fruits and vegetables were not often consumed in the Western part of Cameroon, because the population lacked nutritional knowledge on the benefits of these foods for their health. Another study conducted in urban Cameroon found the same commonly consumed foods as found in the current study (Cohen et al. 2017). Thus, there is a need to educate Cameroonians on the importance of consuming high fibre foods.

Gassara & Chen (2021) also found that increased urbanisation in Cameroon is exposing the population to refined carbohydrates and processed foods high in fat, oil, salt and sugar, pointing out that high intakes of refined carbohydrates and processed foods has been associated with increased risk of obesity, type 2 diabetes, cardiovascular disease and hypertension. According to the 2022 Global Nutrition report (Global Nutrition Report 2022), the prevalence of overweight, obesity, type 2 diabetes and hypertension among adults in Cameroon has increased. The prevalence of NCDs could be reduced by reducing the intake of carbohydrates and fats and oils, while increasing fruit and vegetable portions, coupled with use of cooking methods that do not require the use of fats and oils like baking, steaming and boiling (Hyseni et al. 2017). Among the factors that affect eating habits of different populations, climate change can affect crop yields, making certain foods less available and more expensive (Masipa 2017). If household income is small, often unhealthy choices are cheaper e.g. refined carbohydrates (Cohen et al. 2017).

DIETARY DIVERSITY

Mekuria et al. (2017) suggested that DD among individuals and communities can be achieved by promoting the consumption of diverse diets rather than monotonous diets, but since factors such as availability, climate, and poverty are involved, this remains to be proven. Overall, this study showed that reasonably good DD was practiced in the four areas we studied, though there may have been problems in rural Mankon. The urban adult and children's populations achieved better DD compared to their rural counterparts. These results are similar to the findings of a study conducted in urban and rural Cameroon and Ghana, which also showed that the urban areas enjoyed better DD compared to the rural areas (Bahadur et al. 2018). Possible reasons for this include the higher income level in the urban areas, more educated individuals residing in the urban areas, greater food varieties being available and access to global markets (Mekuria et al. 2017).

Although good DD was practised, results showed that the food groups that were consumed the least or not consumed at all were fruits and vegetables, including vitamin A-rich plant foods and milk and milk products. It was also observed that children consumed more nuts, pulses and legumes as compared to adults, who consumed more meat, poultry and fish. One possible reason for this is culture and tradition, as some cultures do not allow children to eat meat until a certain age with punishment implemented if these cultural rules are violated (Asi et al. 2018).

Although we did not study alcohol consumption, our results are in line with those from a study which showed that the habitual diet in the rural and urban centre regions of Cameroon consisted predominantly of fat, starch and alcohol, with a low intake of dairy products, fruits and vegetables (Mennen et al. 2000). Another study found that most of the study participants complained of a lack of time to prepare vegetables and cook them as well as no time to consume fruits, thus providing a possible reason for the low consumption of vegetables and fruits (Cohen et al. 2017). Many studies have shown that diets high in refined starch and low in fruit and vegetables lead to NCDs (Wanjohi et al. 2021, Guleria 2021, Olatona et al. 2018, Chohen et al. 2017); therefore, the communities of the current study are at risk of developing NCDs.

STUDY LIMITATIONS

The limitation of using a FFQ is that it does not always provide the most accurate information, as participants can under- or over-report consumption frequency of a specific food item (Steinemann et al. 2017). In addition, it does not report on amounts of food consumed, so any conclusions drawn about dietary quality are rather speculative. In addition, we did not ask about consumption based on individuals, but requested that respondents try to estimate for all adults and all children under five in the family respectively.

The lack of similar earlier studies in Cameroon made it difficult for the authors to compare the results of the current study to many other studies. The FAO guideline for measuring DD only considers the previous 24-hours, which is a short time period. A particular problem this causes is that some foods are either highly available or hardly available at all during certain seasons. The study was conducted in the raining season when most fruits and vegetables are available. Using Anglophone study sites where English is universally spoken and understood favoured participants with English proficiency and excluded those less fluent in either English or pidgin English.

CONCLUSION

The results of the current study indicate that there was diversity in the diets of communities of the urban and rural areas of the NWR that we studied. However, the diets were high in refined carbohydrates, with low intakes of dietary fibre, fruit and vegetables and high intakes of fats and oils. The observed poor dietary intake characterised by a high intake of refined carbohydrates and foods high in salt, sugar, fats and oils is a likely contributor to the high prevalence of malnutrition, NCDs and micronutrient deficiencies in this region. The findings of the current study suggest a need to formulate a strategy to promote balanced diets, improve the intake of dietary fibre and micronutrients, and reduce the consumption of refined carbohydrates and foods high in salt, sugar, fats and oils.

AUTHOR CONTRIBUTIONS

Conceptualisation and methodology by FA, KP, NW and MS; collection of data by FA; data analysis by research statistician; manuscript preparation by FA with input from KP, NW and MS; review and editing of manuscript by FA, K.P, NW, MS; supervision of study by KP, NW and MS. All the authors approved the final version of the manuscript and consent for the publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN SCIENTIFIC WRITING

Nothing to disclose.

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AVAILABILITY OF DATA AND MATERIALS

The data will be made available upon request.

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REFERENCES

Asi, L.N., Teri, D.T., and Meyer-Rochow, V.B. 2018. "Influence of Food Taboos on Nutritional Patterns in Rural Communities in Cameroon." *International Review of Social Research* 8(1):2–6. https://doi.org/10.2478/irsr-2018-0013.

Bahadur, K., Legwegoh, A.F., Therien, A., Fraser, E. D.G., & Antwi-Agyei, P. 2018. "Food Price, Food Security and Dietary Diversity: A Comparative Study of Urban Cameroon and Ghana." *Journal of International Development* 30:42–60. https://doi.org/10.1002/jid.3291

Cohen, E., Amougou, N., Ponty, A., Loinger-Beck, Nkuintchua, T., Monteillet, N., Bernard, J.Y., Said-Mohamed, R., Holdsworth, M., Pasquet, P. 2017. "Nutrition Transition and Biocultural Determinants of Obesity Among Cameroonian Migrants in Urban Cameroon and France." *International Journal of Environmental Research and Public Health* 14(7):696–714. https://www.mdpi.com/1660-4601/14/7/696/pdf.

Davis, J.N., Oaks, B.M., and Engle-Stone, R. 2020. "The Double Burden of Malnutrition: A Systematic Review of Operational Definitions." *Current Developments in Nutrition* 4(9). https://doi.org/10.1093/cdn/naa127.

Food and Agricultural Organization (FAO). 2013. *Guidelines for Measuring Household and Individual Dietary Diversity*. https://www.fao.org/3/i1983e/i1983e.pdf.

Gassara, G., and Chen, J. 2021. "Household Food Insecurity, Dietary Diversity and Stunting in Sub-Saharan Africa: A Systematic Review." *Nutrients* 13(12). https://doi.org/10.3390/nu13124401.

Global Nutrition Report. 2022. *Nutrition Country Profile: Cameroon*. Available at: **full text here**

Gonete, K.A., Tariku, A., Wami, S. D., Akalu, T.Y. 2020. "Dietary Diversity Practice and Associated Factors Among Adolescent Girls in Dembia District, Northwest Ethiopia, 2017." *Public Health Reviews* 41. https://doi.org/10.1186/s40985-020-00137-2.

Guleria, S. 2021. "Food, Obesity and Noncommunicable Diseases." *Journal of Postgraduate Medicine Education and Research* 55(1):8–11. https://www.jpmer.com/doi/10.5005/jp-journals-10028-1368

Hyseni, L., Atkinson, M., Bromley, H., Orton, L., Lloyd-Williams, F., McGill, R., Capewell, S. 2017. "The Effects of Policy Actions to Improve Population Dietary Patterns and Prevent Diet-Related Non-Communicable Diseases: Scoping Review." *European Journal of Clinical Nutrition* 71(6):694–711. https://doi.org/10.1038/ejcn.2016.234

In, J. 2017. "Introduction of a Pilot Study." *Korean Journal of Anesthesiology* 70(6):601–605. https://doi.org/10.4097/kjae.2017.70.6.601

Jackson, N.N. Jr., and Cumber, S.N. 2016. "Eradicating Malnutrition in Cameroon." *South African Journal of Clinical Nutrition* 29(4):172–173. https://doi.org/10.1080/16070658.2016.1217649

Masipa, T.S. 2017. "The impact of climate change on food security in South Africa: Current realities and challenges ahead." *Journal of Disaster Risk Studies* 9(1):411. https://doi.org/10.4102/jamba.v9i1.411

Mekuria, G., Wubneh, Y., and Tewabe, T. 2017. "Household Dietary Diversity and Associated Factors Among Residents of Finote Selam Town, Northwest Ethiopia: A Cross-Sectional Study." *BMC Nutrition* 3:28. https://doi.org/10.1186/s40795-017-0148-0

Mennen, L.I., Mbanya, J.C., Cade, J., Balkau, B., Sharma, S., Chungong, S., Cruickshank,. J.K. 2000. "The Habitual Diet in Rural and Urban Cameroon." *European Journal of Clinical Nutrition* 54(2):150–154. https://www.nature.com/articles/1600909

Nkengfack, G.N., Torimiro, J.N., Ngogang, J., Ngogang. J., Englert, H. 2011. "A Review of Nutrition in Cameroon: Food Supply, Factors Influencing Nutritional Habit and Impact on Micronutrient (Vitamin A, Iodine, Iron) Status." *Health Sciences and Disease* 12(1). **Full text here**

Non-communicable Disease (NCD) Risk Factor Collaboration. 2017. "Worldwide Trends in Blood Pressure from 1975 to 2015: A Pooled Analysis of 1479 Population-Based Measurement Studies with 19.1 Million Participants." *Lancet* 389:37–55. https://doi.org/10.1016/S0140-6736(16)31919-5

Olatona, F.A., Onabanjo, O.O., Ugbaja, R.N., Nnoaham, K.E., Adelekan, D.A. 2018. "Dietary Habits and Metabolic Risk Factors for Non-Communicable Diseases in a University Undergraduate Population." *Journal of Health, Population and Nutrition* 37(21). https://doi.org/10.1186/s41043-018-0152-2.

Rodrigo, C.P., Aranceta, J., Salvador, G., Valera-Moreiras, G. 2015. "Food Frequency Questionnaires." *Nutrición Hospitalaria* 31(3):49–56. https://doi.org10.3305/nh.2015.31.sup3.8751

Steinemann, N., Grize, L., Ziesemer, K., Kauf, P., Probst-Hensch, N., Brombach, C. 2017. "Relative Validation of a Food Frequency Questionnaire to Estimate Food Intake in an Adult Population." *Food & Nutrition Research* 61(1). https://doi.org/10.1080/16546628.2017.1305193.

Survey Sample Size Calculator. 2022. Statistics Kingdom. Available at: https://www.statskingdom.com/50_ci_sample_size.html.

Wanjohi, M.N., Thow, A.M., Karim, S.A., Asiki, G., Erzse, A., Mohamed, S.F., Donfouet, H.P.P., Juma, P.A., Hofman, K.J. 2021. "Nutrition-Related Non-Communicable Disease and Sugar-Sweetened Beverage Policies: A Landscape Analysis in Kenya." *Global Health Action* 14(1). https://doi.org/10.1080/16549716.2021.1902659.

World Bank. 2018. *Cameroon City Competitiveness Diagnostic*. Available at: https://openknowledge.worldbank.org.

World Health Organization (WHO). 2017. *Nutrition in the WHO African Region*. Available at: **Full text here**