

# Food Profiles and Exposure to Acute Malnutrition among Children Under-five in the Department of Mayo-Danay, Cameroon

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**Abstract** Malnutrition is a major public health issue in Cameroon. **Objective.** Measure the food profile association with the nutritional status of children of the Mayo-Danay Division. **Material and methods:** A cross-sectional, descriptive and analytical study based on 433 children aged 6-59 months from a stratified two-level random sampling design was used. The nutritional status of children was evaluated according to WHO standards (2006). Food profile was estimated from the dietary diversity score (DDS) using the 24-hour recall method. Anthropometric data were analyzed using ENA for SMART and statistical tests were performed using Epi Info 7. A confidence interval of 95% and a P-value <5% were considered significant. **Results:** Out of 433 children recruited, 50.8% were female and 49.2% male. The Global Acute Malnutrition (GAM) was at 4.2% with 3.0% being the moderate form and 1.2% the severe form. One hundred (23.2%) children were chronic malnourished, with 7.0% as moderate chronic undernourished form and 16.2% as severe chronic undernourished. Sixty out of 432 (13.9%) were underweight, of which 11.1% as moderate form and 2.8% as severe form. Cereals-roots-tubers consumption was at 98.9% and 48.8% of the children had received three meals during the past 24 hours. According to the DDS, 48.4% against 51.6% had a diet not diversified and twice exposed to the GAM than those with a diversified diet (OR = 2.891; P - value = 0 .0386). **Conclusion** This study confirms the impact of food diversification on acute malnutrition among children under-five years. We recommend the promotion of diversification of foods available in the Mayo-Danay Division.

**Keywords:** dietary diversity, food profile, malnutrition, children under-five, Cameroon

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## 1. Introduction

The Demographic and Health Surveys, 2011 (DHS, 2011) [1] and Standardize Monitoring and Assessment of Relief and Transition (SMART) Surveys of 2013 and 2014 [2,3] showed the highest prevalence of malnutrition among children less than five years in the Far North for 2011; with 45% (2011) and 46.6% (2014) of chronic malnutrition and 8.6% (2013) and 9% (2014) global acute malnutrition (GAM), the Far North is one of the regions most affected in Cameroon by malnutrition among children within six to 59 months.

Diet is a key factor in the development and growth of the child. Indeed, the diet should be appropriate in quantity and quality, and nutrients should be combined so

that the body can assimilate them. At the level of the household, the decision on the food served (demand) and those that consume them (intra-household distribution) determine the composition of meals for individuals. Knowledge and habits affect the composition, but also the biological use of food. [4].

The World Health Organization (WHO) recommends that infants be breastfed within one hour of birth, and continue to exclusive breastfeeding for six months, and later on introduce adequate and safe complementary foods in a timely manner. It is advised to continue breast feeding until two years of age or older, even while giving complementary food [5]. The first 1000 days between conception and the age of two years have a decisive impact on the development and growth of an individual [6]. The nutritional status of a child under two years of age as well as their survival ultimately depends directly

on feeding practices [7]. Longitudinal studies have consistently shown that it is the age at which growth is slowed down, nutrient deficiencies occur and common childhood illnesses such as diarrhea are the most common. After the age of two, it is very difficult for a child to reverse stunting [8].

Complementary feeding has been shown to be the most effective intervention for improving child growth. Complementary foods should be introduced into infant feeding in the period between 6 and 18 months to 24 months. It is the transition from exclusive breastfeeding to a diversified family diet. This diet should be introduced in a timely and appropriate manner, considering the quantity, the frequency of intake, the consistency, and including variety in order to meet the nutritional needs of the child [9]. Also, according to the same source, it is during this period that we see malnutrition appear in many infants, which contributes significantly to the high prevalence of malnutrition among children under five around the world. Several studies (SMART surveys and DHS) assess the nutritional status of children in the regions of Cameroon, but contextual determinants are less explored. Data on children's eating habits and behaviors are almost non-existent, particularly in the Far-North region, which has the highest prevalence of malnutrition in Cameroon. We therefore found it necessary to describe and evaluate the nutritional profiles of children in the Mayo-Danay Department in Far North Cameroon, then measure the association of the food profile with the nutritional status of the latter.

## 2. Materials and Methods

### 2.1. Study Design

We conducted a cross-sectional, descriptive and analytical study of a sample of 433 children, regardless of gender. The respondents were from households randomly drawn from the Mayo-Danay Department. The main objective of this study was to evaluate the food profiles consumption of children from six to fifty-nine months by recalling food consumption of 24 hours and compared these to the nutritional status of children. Data were collected during the post-harvest period in the dry season, from February 26, 2015 to March 8, 2015.

### 2.2. Area and Study Population

According to the Ministry of Public Health of Cameroon, in May 2014 the Mayo-Danay Divisions had five health districts, including Maga, Velé, Kar-Hay, Yagoua and Guéré; 41 health areas and 714 villages / neighborhoods. For a population of 739,268 inhabitants in 2014, including 124,936 children from 0 to 59 months constituting, or 16.9% of the general population of the Division. Several ethnic groups live and share the Division, among others, the Massas, the Toupouris, the Musgums, the Mousey, the Peuls, the Kanuris, and the Kéras. The main activities carried out in this Division are: agriculture, breeding, fishing and trade etc... The study population for anthropometric data and food consumption practices during the 24 hours prior to collection was made up of children under five years of age in households in the

Mayo-Danay Division. Only children aged 6 to 59 months whose parents or legal guardians had spent at least one (1) month in the study area and who freely consented were included in the study. Children not belonging to selected household were excluded from the study.

### 2.3. Sampling

It was a two-stage cluster survey. This procedure ran in a random fashion from the selection of clusters to the households to be interviewed. This was done to optimize representativeness and thus limit selection bias. The first level of sampling was the village and the household was the second level or unit of survey. In a household, all target children meeting the inclusion criteria were included in the sample. Regarding anthropometric measures and 24-hour dietary data prior to the survey, only one parent, legal guardian or baby-sitter was interviewed in the household.

### 2.4. Sample Size

The calculation of the sample size (n) was done using the ENA version of November 24, 2012, used in SMART nutrition surveys. An estimated prevalence of 12%, which corresponded to the prevalence of wasting among children under five in the Far North region (DHS, 2011). To estimate the minimum sample size, we used a desired precision of 5% and a cluster effect of 1.5. The calculation by this software gave us a minimum sample size (n) of 265 children. The frame unit was the household (m), the number of households to be surveyed was estimated using the ENA 2012 software. For a sample size (n) of 265 children and an average household size (the Far North) of 5.7 people (SMART Survey 2013) [2]. With 5% of possible refusals (and absence) of participation in surveys and a proportion of 19.6% of children under 5 in 2015 in the Far North [10]. In doing so we obtained a minimum size  $m = 277$  households to investigate in the Mayo-Danay Division. The number of households per village (u) was simply the number of households to be surveyed in total on the number of clusters ( $u = m / 30$ ). That is, a number of households per village, equal to 9.23 households (10 households were therefore surveyed in clusters). All eleven districts in the Division consisted of one stratum and each village / district was a cluster. Thirty (30) clusters were randomly drawn from an exhaustive list of 714 villages / neighborhoods (clusters) of the Division using ENA Version 2014. Households were randomly drawn by systematic random sampling using a probing step calculated by teams of investigators trained and following pre-established applied procedures. The sampling rate (p) was the total number of households in the cluster to be surveyed ( $m_i$ ) on number of households to be surveyed (u), (i.e.  $p = m_i / u$ ). In the household, children meeting the inclusion criteria were included in the study.

### 2.5. Data Collection Procedure

The interview of participants took place during the day or in the evening depending on the availability of target populations. After obtaining the consent of the head of the family or a legal representative, a questionnaire

was administered in a face-to-face interview with the respondent. To ensure the quality of the data collected, investigators and supervisors were trained on the sampling method and anthropometric measurements for two days.

## 2.6. Anthropometric Measurement and Classification of Nutritional Status

The tools and collection technique used were those often used in the methodology of SMART surveys in Cameroon. All members of the survey teams had received theoretical and practical training on anthropometric measurement in children under five years of age. Malnourished children were classified into three broad classes and two subclasses (moderate and severe) by class defined as follows:

### Class 1. Acute Malnutrition

a). Acute severe malnutrition: Weight-for-height index at less than -3 Z-scores, and / or presence of bilateral edema or mid-upper arm circumference <115 mm

b). Moderate acute malnutrition: Weight-for-height index between -2 and -3 Z-scores or MUAC  $\geq$  115 mm and <125 mm

### Class 2. Chronic malnutrition (stunting)

a). Severe growth retardation: Size-for-age index at less than -3 Z-scores

b). Moderate growth retardation: Size-for-age index between -2 and -3 Z-scores

### Class 3. Insufficient weight

a) Severe underweight: Weight-for-age index at less than -3 Z-scores

b) Moderate underweight: weight-for-age index between -2 and -3 Z.

## 2.7. Food Profile of Children under Five (24h Recall)

The diet was assessed primarily through dietary diversity defined as the number of different food groups consumed over a given reference period [11]. It was a measure of children's access to food in households, defined as the ability to provide the child with sufficient quality and quantity of food to meet the nutritional needs that lead to a productive life. This refers to the number of different food groups consumed 24 hours prior to the interview. WHO recommends evaluating seven food groups for children. The seven food groups used to assess dietary diversity were: (1) cereals, roots and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) meat products (meat, poultry, slaughter) and fish; (5) eggs; (6) fruits and vegetables rich in vitamin A; (7) other fruits and vegetables [7,12]. A food item was "considered" in each group regardless of the amount consumed. That is, there was no minimum quantity, unless the food in question was used as a spice. Each group of foods consumed then counted for a score of "1", when a food group was not consumed, its score was then zero (0).

## 2.8. Statistical Analysis

The anthropometric data collected during this survey were compared to WHO standards published in 2006 as an international reference for identifying malnourished

children. We used the ENA version 2014 software to classify children according to their nutritional status. Epi-Info 7 allowed us to perform the various statistical tests at a 95% confidence interval and a 5% random error. The charts and tables were designed from Excel 2013.

We set the threshold for at least four of the seven food groups because it is associated with a better diet, whether the child is breastfed or not. In most populations, eating foods from at least four groups the day before meant that the child had a high probability of eating at least one animal food and one fruit or vegetable that day, in addition to a staple [13]. A child therefore had access to a dietary diversity, if he had in his diet 24 hours before at least 4 of the 7 food groups mentioned above. When the sum of food groups in the child's diet (for the 24 hours preceding the survey) was  $\geq 4$  then, dietary diversity was validated (yes) and when  $< 4$ , dietary diversity was rejected (no). Data analysis excluded children whose anthropometric data gave z-scores with (baseline mean) Flags WHO (2006) [14]: Weight-for-Height Z-score -5 to 5; Size-for-age Z-score -6 to 6; Weight-for-age Z-score -6 to 5. After this exclusion, anthropometric data from 431 children were analyzed for acute malnutrition; chronic malnutrition and 432 children for underweight.

## 2.9. Ethical Considerations

Parental written consent was obtained. We obtained the agreement of the health authorities of the Far North Regional Health Delegation. Data collection and electronic data files were anonymous.

## 3. Results

### 3.1. Sociodemographic

Of 433 children surveyed, 50.8% (220) were female and 49.2% (213) male. The average age of the children was 30 months ( $Z = 14.7$ ), more than 75% (324) of the children were 42 months old. The age of the mother ranged between 15 and 87 years, with an average of 30 years. Among heads of household, the age ranged from 18 to 85 years with an average of 40 years. The majority of children's households (92.6%) were in single households (marriage, cohabitation), 7.4% were separated households (1.0% single, 1.3% separated, 5.0% widowed).

### 3.2. Nutritional Status of Children

After exclusion of the z-score with flag WHO (2006), the anthropometric data of the children were analyzed in 431 children for the research of the acute malnutrition and in 432 for the research of the underweight (Table 1). Global Acute Malnutrition (GAM) was 4.2% (18/431), including 3.0% (13/431) Moderate Malnutrition (MAM) and 1.2% (5/431) Severely Acute Malnourished (SAM), with 1.4% SAM in male children versus 0.9% in females ( $P$ -value = 0.944,  $OR = 1.034$ ). Children aged 6 to 17 months were the most affected group by SAM (1.7%) and MAM (6.9%), this age group (6-17 months) had a significant correlation with GAM compared to 18-29 months ( $P$ -value = 0.0479). Marasmus malnutrition represented 1.2% of case and Kwashiorkor, 0.2%.

**Table 1. Distribution of malnutrition by type and sex in children**

	Total (n) [%IC]	Male (n) [%IC]	female (n) [%IC]
N <sup>0</sup>	n= 431	n= 212	n=219
GAM	(18) 4,2 % [2,5-6,8]	(9) 4,2 % [2,4-7,5]	(9) 4,1 % [2,2-7,4]
MAM	(13) 3,0 % [1,8-4,9]	(6) 2,8 % [1,3-5,9]	(7) 3,2 % [1,6-6,4]
SAM	(5) 1,2 % [0,5-2,7]	(3) 1,4 % [0,4-4,4]	(2) 0,9 % [0,2-3,8]
CM	<b>n = 431</b>	<b>n = 212</b>	<b>n = 219</b>
GCM	(100) 23,2% [18,8-28,3]	(52) 24,5 % [18,9-31,1]	(48) 21,9 % [16,4-28,6]
MCM	(70) 16,2 % [12,6-20,7]	(39) 18,4 % [13,4-24,8]	(31) 14,2 % [9,9-19,9]
SCM	(30) 7,0 % [4,8-10,0]	(13) 6,1 % [3,5-10,6]	(17) 7,8 % [4,5-13,2]
UW	<b>n = 432</b>	<b>n = 213</b>	<b>n = 219</b>
GUW	(60) 13,9 % [10,0-19,0]	(29) 13,6 % [9,3-19,4]	(31) 14,2 % [9,4-20,7]
MUW	(48) 11,1 % [7,7-15,7]	(20) 9,4 % [5,9-14,7]	(28) 12,8 % [8,3-19,1]
SUW	(12) 2,8 % [1,5-5,1]	(9) 4,2 % [2,2-8,0]	(3) 1,4 % [0,4-4,2]

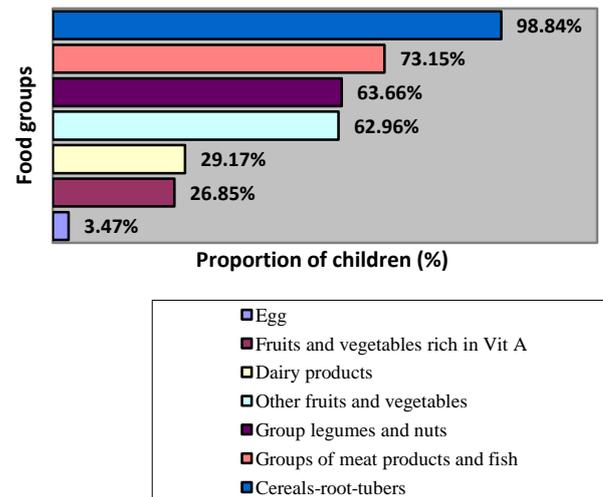
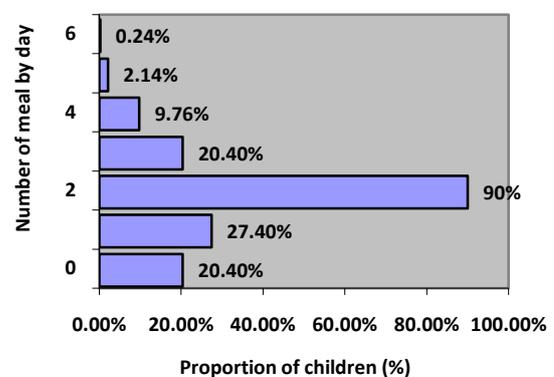
Nearly 23.2% (100/431) children were chronically malnourished (CM) including 16.2% (70/431) severe chronic malnutrition (SCM) and 7.0% (30/431) chronic malnourished moderate (CMM). According to the sexes, male children (24.5%) were the most affected by the MCM form, while female children (7.8%) were more exposed to the MCS form (Table I). We did not find a significant correlation between the two sexes and the CM (P-value  $\geq 0.05$ ). Concerning underweight, 432 children (Table I), 13.9% (60/432) had global underweight (GUW), of which 11.1% (48/432) had Moderate underweight (MUW) and 2.8% (12/432) severe underweight (SUW). Female children (14.2%) were the most affected by overall low birth weight (13.6%), but not significantly (P-value = 0.891).

### 3.3. Dietary Habits of Children under Five in Households

Concerning the most consumed food groups in households, Figure 1 below shows a high consumption of cereals-root-tubers (98.89%) followed by groups of meat products and fish (73.15%), group legumes and nuts (63.66%), and other fruits and vegetables (62.96%). Low consumption of eggs (3.47%), fruits and vegetables rich in vitamin A (26.85%) and dairy products (29.17%).

### 3.4. Frequency of Food Consumption

According to the number of meals received by children in the 24 hours' recall, Figure 2 shows that, 0.48% of mothers declared that their offspring had received no meals. Less than half of the children (48.81%) had three meals. Nearly 95.95% of children had received at least two meals within 24 hours.

**Figure 1.** Distribution of consumption of food groups**Figure 2.** Proportion of the number of meals consumed in the 24 hours' recall

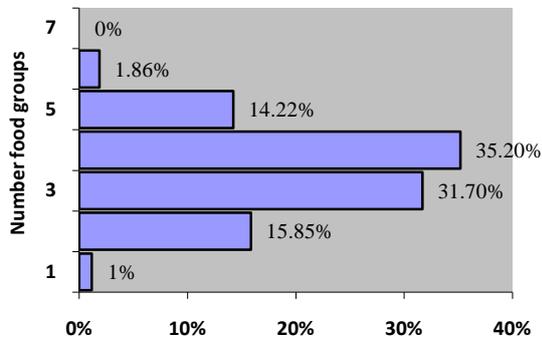
### 3.5. Diets

Nearly half of children 51.62% (223/432) had diversified diet in the 24 hours preceding the survey, while 48.38% (209/432) had received an undiversified diet. Among children with a diversified meal, 1.34% (3/209) continued breastfeeding (although above six months of age). Regarding the number of food groups consumed by the children during the 24 hours preceding the survey, results are visible in Figure 3. Of the 429 children who had consumed solid foods during the 24 hours preceding the survey, 35.20% (151/429) had consumed four food groups, the minimum score of dietary diversity, 31.70% (136 / 429) for three food groups. We observed a change in the number of food groups consumed in the 24 hours preceding the survey, ranging from 0% (for seven groups consumed) to 35.20% (for four groups). Only about 16.8% of children had consumed more than four food groups in the past 24 hours.

### 3.6. Diet and Nutritional Status

The comparison between the quality of the diet through the diversity of foods consumed and the nutritional status of children in the household (Table 2) shows that out of 209 children exposed to a non-diversified diet in the past 24 hours, 6.22% were acutely malnourished.; 22.49%

chronically malnourished and 15.79% underweight. In children who had a diversified diet in the past 24 hours, 2.24% of these were acutely malnourished; 23.32% chronically malnourished and 13.00% were underweight. Exposure to an undiversified diet was significantly associated with acute malnutrition in children from six to fifty-nine months (OR = 2.891, P-value = 0.0386).



**Figure 3.** Frequency of the number of food groups consumed in the previous 24 hours

**Table 2. Comparison diet to nutritional status**

Diversified meals	Malnourished	Normal status	Odd Ratio	P-value
<b>Global acute malnutrition</b>				
no	13 (6,22%)	196 (93,78%)	2,891	0,0386
yes	5 (2,24%)	218 (97,76%)		
Total	18 (4,17%)	414 (95,83%)		
<b>Chronic malnutrition</b>				
no	47 (22,49%)	162 (77,51%)	0,954	0,8374
yes	52 (23,32%)	171 (76,68%)		
Total	99 (22,92%)	333 (77,08%)		
<b>Underweight</b>				
no	33 (15,79%)	176 (84,21%)	1,254	0,4093
yes	29 (13,00)	194 (87,00%)		
Total	62 (14,35)	370 (85,65)		

## 4. Discussion

The present study confirms the relatively high prevalence of malnutrition in the Far North Cameroon. It highlighted the association between nutritional profile and malnutrition in children under five in the Division of Mayo-Danay in Far North Cameroon.

The nutritional status was assessed using anthropometric measurement techniques, whose classification of children according to their nutritional status was in line with the standards defined by WHO in 2006. The World Health Organization had undertaken a study of international scale between 1977 and 2003 to establish new curves to assess the growth and development of children around the world, the WHO Multicenter Growth Reference Study (MGRS). The MGRS was designed specifically to produce a standard rather than a reference. Allowing to establish new standards published in 2006 [14]. The ENA version 2012 software used in this survey during data analysis is widely used by UNICEF, in the SMART Nutrition Surveys [2,3], this software meets the criteria for assessing

the nutritional status of children under five according to WHO standards (2006).

Prevalences of global acute malnutrition (4.2%); chronic malnutrition (23.2%) and underweight (13.9%) differ from those found in the 2014 SMART Cameroon surveys for the Far North Region, whose prevalence was 9%; 46.6% respectively for global acute malnutrition and chronic malnutrition [3]. This difference could be explained by the different data collection periods, in the post-harvest period for this survey and during the lean season for SMART 2014. The results showed that boys are more affected by MAG (4, 2%) and chronic malnutrition (24.5%) than girls, 4.1% and 21.9% respectively. These trends are similar to those reported by Bloss E and coll., (2004) [15], that boys (29%) are more vulnerable to malnutrition than girls (20%). Several other authors like Engebretsen and coll., [16], Wamani and coll., [17] and Semba and coll., [18] reported an association between malnutrition (stunting) and male sex. This association between male sex and nutritional status could, be linked to a greater vulnerability in boys [17] than in girls in a socio-economically disadvantaged environment such as Far North Cameroon where our study was conducted.

Investigation on food consumption showed that cereals root-tubers were mainly consumed (98.89%), followed by meat products and fish (73.15%) and legumes and nuts (63.66%), and other fruits and vegetables at 62.96%. This result could be explained by the production of different food groups in the Mayo Danay Division in Cameroon. Indeed, the work of Fofiri, (2010) [19], already showed this uneven distribution in the production of different foods in the region of North Cameroon. According to the same source, the Far north region produces a good quantity of cereals, mainly millet, maize, and sorghum although seasonal production of tubers such as yams and potatoes is also strongly represented. Watered by the Logone and the Maga and Guéré rivers, the Division of Mayo Danay is one of the ideal fishing areas in the Far North region. Generally, in the Far North, including Mayo Danay Division, livestock is practiced and could, explain the large proportions of children fed with the cereals-roots-tubers groups; meat products and fish. The contrast of a low consumption of dairy products (29.17%) in the Department of Mayo Danay could be due to the fact that the milk produced in the household is primarily intended for sale to meet other household needs.

Less than half (48.38%) of children in households had a diversified daily diet. These results are not far from those found in a study conducted in Yaoundé by Um-Sap and coll., (2013) [20], showing that 50% of children aged 6 to 24 months had a diversified diet. The 2014 SMART surveys in Cameroon had already shown a smaller proportion (26.6%) of children with a diversified diet in the Far North region [21]. This difference could be explained by the period of data collection. The present study collected data in the post-harvest period when households still have food reserves. The proportion of 6- to 59-months-old children with a diversified diet (48.38%) is well above the 28.2% of children 6-23 months old, found by White and coll., (2017) [22]. According to Salomon and coll., (2017) [23], nearly 59.9% of children aged 6-23 months had a diversified diet. The fact that this proportion is above that found in this study could be

explained by the mother's level of education in the study area. In fact, mothers' knowledge of dietary diversity and children's diets is positively associated (OR = 1.98) with the practice of dietary diversity of children in households [23]. According to Bitá (2015), more than 54.24% of mothers never went to school, 35.25% of mothers continued primary education in the Mayo Danay Division [24].

Analysis of the association between food ration quality across dietary diversity score and nutritional status confirmed the results of Um-Sap and coll., (2013) [23], who also observed a positive association between the dietary diversity score and the nutritional status of children. Our study showed a significant and specific association between acute malnutrition and a dietary diversity score of less than four (undiversified diet). This association also confirms the results of other authors [25,26] that already showed that higher dietary diversity scores are associated with a lower probability of malnutrition among children under five.

## 5. Conclusion

Malnutrition is a public health concern in Cameroon which particularly affects children under five in the East, Adamaoua and the Far north. This study aimed to describe children's eating behaviors, and to measure the association between quality of dietary rations across the dietary diversity score and the nutritional status of children in Mayo Danay households. The study showed a proportion of 4.2% MAG; 23.2% GCM and 13.9% IPG. Cereals-roots-tubers are the most consumed foods in the study area (98.84%) and eggs (3.47%); fruit-root vegetables rich in vitamin A (26.85%) and dairy products (29.7%) are the least consumed. Only 35.20% of children had a diversified diet and 39.53% of children receive less than three meals over 24 hours. We recommend promoting the diversification of foods available in the communities of Mayo Danay Division.

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## Conflicts of Interest

The authors declare no conflict of interest.

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