Background Technical Report Development of Food-Based Recommendations using Optifood - Ghana May 2017

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This report presents primary findings and analysis. A summary of the information contained within this report is presented in the GAIN Summary Report "Findings of an analysis of infant and young child feeding in Ghana using Optifood and Focused Ethnographic Studies". Geneva: GAIN, 2016.

Development of food-based dietary recommendations for children, 6-23 months old, in Karaga District and Gomoa East District, Ghana

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Abbreviations and Acronyms

EAR	Estimated Average Requirement
FBR(s)	Food-Based Recommendation(s)
FAO	Food and Agriculture Organization
FCT	Food Composition Table
FES	Focused Ethnographic Study
g/d	Grams per day
GAIN	Global Alliance for Improved Nutrition
GDHS	Ghana Demographic Health Survey
GFCT	Ghana Food Composition Table
GH¢	Ghana Cedis
GHS	Ghana Health Services
GSS	Ghana Statistical Service
HAZ	Height-for-age Z-score
HSS	Household Hunger Scale
IYCF	Infant and Young Child Feeding
IZiNCG	International Zinc Nutrition Consultative Group
Kcal	Kilocalories
MUAC	Mid Upper Arm Circumference
NMIMR	Noguchi Memorial Institute for Medical Research, Ghana
PAHO	Pan America Health Organization
RNI	Recommended Nutrient Intake
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
UDS	University for Development Studies, Ghana
UNICEF	United Nations International Children's Fund
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WAFCT	West Africa Food Composition Table
WAZ	Weight-for-age Z-score
WHO	World Health Organization
WHZ	Weight-for-Length Z-score
WUR	Wageningen University and Research Centre, Netherlands

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1 INTRODUCTION

Optimal child feeding practices are essential to growth, health and development during infancy and early childhood. Undernutrition is an underlying factor in 53% of children's deaths globally accounting for more than a third of child deaths. The immediate consequences of poor nutrition during the early formative years include significant morbidity, mortality and delayed mental and motor development. In the long term, early nutritional deficits are linked to impairment in intellectual performance, work capacity, reproductive outcome and overall health during adolescence and adulthood. It is well documented that the period from pregnancy to 23 months of age is a critical window for the promotion of optimal growth, health, behavioral and economic development (Black et al, 2013; Victora et al, 2008). Inappropriate feeding practices during this period can have profound consequences for the growth, development and survival of infants and children.

Statistics from the 2012 State of the World's Children report indicate that about 40% of children in Sub-Saharan Africa are moderately to severely stunted (UNICEF, 2012). Over the past two decades, the prevalence of childhood stunting has hovered around 30% in Ghana, leading to the country's inclusion, in 2008, in the list of 36 high-burden countries for malnutrition (Black et al, 2008). Ghana also has unacceptable rates of underweight and wasting as well as a high burden of micronutrient deficiencies among children, with a childhood anemia rate in excess of 70% (GSS et al, 2015).

Despite progress in economic growth and poverty reduction over the past decade, critical food security and nutrition problems still persist in Ghana with the three northern regions having the greatest burden. As many as 1.2 million Ghanaians are considered food insecure and chronic under-nutrition, though decreasing in the past five years, still affects about a quarter of Ghanaian children under 5 years of age (GSS et al., 2011). The recent 2014 GDHS, however, shows that there are considerable gains in efforts to reduce the rates of malnutrition although regional and urban/rural disparities still remain (GSS et al., 2015). Prevalence of stunting, underweight and wasting are down from the 2008 GDHS estimates of 28%, 14% and 8% to 19%, 11% and 5% for stunting, underweight and wasting, respectively. Significantly, of the four regions with the highest prevalence rates of stunting, the Central, Eastern and Upper East regions saw marked reductions from the 2008 estimates of 34%, 38% and 36% to 12%, 21% and 22%, respectively, while prevalences for the Northern region still remain high at 33%. Whilst anemia prevalence has also reduced from 78% to 66%, rates for the three northern regions and the Central Region remain unchanged at over 70%, with the Northern region again leading at 82%. The indications from this are that other micronutrient deficiencies are likely to be highly prevalent.

Child malnutrition and, particularly, micronutrient deficiencies primarily result from diets which do not meet energy and nutrient requirements to support the rapid growth of infants and young children. Ensuring optimal infant and young child feeding (IYCF) practices, including optimal complementary feeding practices, has been identified as one of the most effective public health interventions to improve child survival in developing countries (Bhutta et al, 2013). UNICEF and WHO recommend that children be exclusively breastfed during the first 6 months of life and not be given water, juices, other milks, or complementary foods. From age 6 months, children should be given solid or semi-solid complementary food in addition to continued breastfeeding until the child is fully weaned. The IYCF practices recommend that breastfed children be fed from three or more food

groups at least twice a day for children 6–8 months, and at least three times a day for children 9–23 months. Infants should not be given complementary foods until six months of age. For non-breastfed children, it is recommended that they receive milk or milk products and foods from four or more food groups at least four times a day. The WHO, in the Global Strategy for Infant and Young Child Feeding, also emphasizes the use of suitable locally available foods while introducing complementary foods (WHO, 2002).

The 2008 GDHS (GSS et al, 2011) indicates that the majority of infants and young children aged 6 – 23 months in Ghana are not being fed appropriately. Overall only 36% of infants and young children meet the minimum IYCF standards. The 2014 GDHS (GSS et al, 2015) paints an even more dismal picture. Using the minimum acceptable diet indicator to assess adequacy of IYCF practices, only 13% of 6 – 23 month old children meet the criteria for being fed appropriately for their age. The breakdown by age group shows that infants 6 – 11 months (i.e. 6% for the 6 – 8 month age group and 10% for the 9 – 11 month age group) are the most vulnerable. The promotion, protection and support of optimal breastfeeding together with appropriate complementary feeding are recognized as key public health strategies for child survival. Continued efforts are therefore needed to understand the myriad of social, cultural and economic influences on child feeding practices in order to develop promising and sustainable interventions to improve the feeding of infants and young children in Ghana and especially those living in rural communities.

Continued efforts are needed to develop promising and sustainable interventions to achieve optimal IYCF in Ghana. Following the re-echo of collaboration across different development sectors as a key requirement to fight malnutrition globally (Gillespie et al, 2013), there is growing interest and investment in understanding how programmatic linkages between agriculture and nutrition can contribute to improved nutritional status, especially in agrarian communities. In line with the above, USAID aims to improve IYCF through strengthening linkages between agriculture and nutrition and one of the first steps is to identify strategies to improve the nutritional quality of the diet of infants and young children based on locally available and affordable foods. USAID therefore commissioned GAIN (Global Alliance for Improved Nutrition) to conduct a Focused Ethnographic Study (FES; Pelto et al, 2013; Pelto and Armar-Klemesu, 2011) and dietary analysis using Optifood software for linear programming (Ferguson et al, 2006). The ultimate aim is to identify a set of *evidence-based, population-specific, food-based recommendations* (FBRs) that can be promoted to improve the nutritional status of infants and young children in farming communities of Ghana. This report focuses on the Optifood component of the overall study and describes results for Karaga District in Northern Ghana and Gomoa East District in Central Ghana.

2 AIM AND OBJECTIVES

The main aim of this study was to identify strategies, based on locally available foods, to improve the nutritional quality of the diet of infants and young children in selected regions in Ghana. In order to address the above aim, the objectives of the Optifood analysis were:

- To measure the usual food and nutrient intakes of infants and young children 6 – 23 months
- To identify dietary patterns of infants and young children 6 – 23 months.
- To identify the limits within which locally available foods can provide essential nutrients to infants and young children 6 – 23 months
- To generate information that can be used to identify products—fortified foods, micronutrient supplements, animal source foods, biofortified crops, etc.—that could be added to the local diet to support an adequate diet
- To identify the lowest-cost combination of local foods that meets or comes as close as possible to meeting nutrient needs of infants and young children 6 – 23 months

3 METHODOLOGY

3.1 Study areas

In the Northern Region, data collection was carried out in Karaga District. This district was carved out of the then Gushiegu-Karaga District and inaugurated in 2004. It is located in the North-East of the Northern Region of Ghana, roughly between latitudes 9°30' and 10°30' North and longitudes 0° and 45' West (**Appendix I**). Karaga is the administrative capital (Karaga District Assembly 2006). The vegetation is guinea savannah characterized by tall grasses interspersed with drought resistant trees such as the shea (*Butyrospermum parkii*) and dawadawa (*Parkia biglobosa*) and there is a typical uni-modal rainy season in May-October, peaking in August-September (Karaga District Assembly 2006). The district has a population of about 77,706 (48% male and 52% female) and an average household size of 10 (GSS 2012). The inhabitants of the district are predominantly subsistence rain-fed farmers. Major traditional crops cultivated include cereals (maize, sorghum, millet and rice), legumes (soybeans, groundnuts and cowpeas) and starchy roots (cassava and yam). About 17.8% of households in the district are food insecure with 11% severely or moderately food insecure (WFP 2012). According to the World Food Programme, 34.7% of households in the district live in the two poorest wealth quintiles with an annual income below GH ¢370 as defined by the Ghana Living Standards Survey (GSS 2008). As a relatively new district, data on nutrition is scant and thus there is a paucity of data regarding nutritional status of 6-23 month old children. Nonetheless, as a rural area and one of the poorest in Ghana, the GDHS suggests high rates of malnutrition; for this reason, Karaga District was purposively selected from the Northern Region for this study. The Ghana Health Service (GHS) has divided the district into 4 sub-districts; however, 2 districts were excluded due to inaccessibility during the rainy season.

In the Central Region, data collection was carried out in Gomoa East district, with its capital located at Gomoa Afransi, about 77 Km from Accra, the national capital. Gomoa East district is located in the south-eastern part of the Central Region and situated between latitudes 5014' North and 5035' North and longitudes 0022' West and 0054' West (**Appendix I**). The district has a total population of 207,071 (52% females and 48% males) with 52% of the population living in urban areas. Average household size is 3.8.

The district spans two ecological zones: the dry coastal savannah and the moist semi-deciduous forest zones. The district experiences two rainfall seasons: the major rainy season from March/April to June/July and the minor season, between September and November. The mean annual rainfall ranges between 70cm and 90cm in the southern coastal plains and between 90 cm and 110 cm to the north-western semi-deciduous forest cover. Agriculture is the main economic activity employing about 63% of the active population. Major crops cultivated include maize, cassava, yam, plantain, vegetables (tomatoes, pepper, garden eggs, okra) and fruits (citrus, pineapple, pawpaw, banana).

3.2 Study Population

Infants and young children between 6 –23 months are the primary target of this study and are divided into the four following groups:

- Breastfed infants between the ages of 6 – 8 months;
- Breastfed infants between the ages of 9 – 11 months;
- Breastfed young children between the ages of 12 – 23 months;
- Non-breastfed young children between the ages of 12 – 23 months.

Primary caregivers of the children 6 – 23 months were interviewed and asked to provide 24-hour recall (24hR) dietary data. Food vendors within study communities and at major markets within the study areas were interviewed as part of a market survey to determine the prices of locally available foods identified during the 24-hour recalls and seasonal influences on their availability.

3.3 Sample size and selection

The sample size estimation for the collection of dietary data, sufficient to capture the potential variability in dietary patterns of children, was based on sample sizes previously used with linear programming techniques in the literature (Santika et al, 2009). Based on the sample size calculation, 100 children per age group (4 age groups) per district (2 districts) was sufficient. This resulted in a total sample of 400 children across the district.

The sampling procedure involved a number of steps. An estimate of the total population per district was obtained from the respective district health administrations. Based on observations from the population and housing census and the demographic health survey, 8% of the total population was expected to be comprised of children younger than 2 years. The total population of children younger than 2 years was divided by the number of sub-districts in the district to obtain the number of children expected in each sub-district. The estimated number of children in a sub-district determined the number of sub-districts needed to meet the required sample size (n=400) per district. One sub-district was adequate and Karaga sub-district was randomly selected to represent Karaga district, and Buduatta sub-district was chosen to represent Gomoa East district.

A census was conducted in Karaga and Buduatta sub-districts to identify households with children 6-23 months. The census form included the sex, date of birth, the breastfeeding status of the children, and their location (community, household name and names of parents). A list of all households with children 6-23 months in the sub-district constituted the sampling frame. The sampling frame was divided into sub-frames to correspond with the four age groups of interest. Within each sub-frame, 100 eligible children were randomly selected; using Microsoft Excel each child was assigned a random number which determined whether they were selected or not. Eligibility was defined for age groups 1-3 (breastfed) as continuous breastfeeding with complementary feeding and age falling within

6-23 months with reference to the date of start of field work. For children in group 4 (non-breastfed), eligibility was defined as cessation of breastfeeding but receiving complementary foods and the age falling within 12-23 months with reference to the date of start of field work. Children who were eligible but were not selected served as potential replacements for each age group.

Eligibility for the study was cross-checked in the field prior to the start of the 24hR interviews and ineligible children were replaced with other eligible children in the same community. However, where there was no eligible child for replacement in a community, the index child was replaced with another from a nearby community within the same age group using a random order list.

One child was selected per household and where a mother or caregiver had more than one child who qualified, one of them was randomly chosen by lottery. Similarly, where there was more than one mother in a household with eligible child(ren), one of the mother-child pairs was randomly selected for the interview. A sub-sample of 20% of the selected children was selected a priori to provide a repeated recall. Communities of selected children were clustered around three geographic areas: north, central and south. Each cluster was then randomly assigned to order (1st, 2nd or 3rd) of data collection. Selected children were then randomly ordered within each cluster and weekdays were assigned to each child. Twenty-four interviews were scheduled per day.

The final study population per age group and breastfeeding status is given in **Table 3.1**. As most of the children aged 12-23 months were breastfed, it appeared to be impossible to select 100 children in the non-breastfed age group, resulting in a lower number than planned.

Table 3.1. Study population per age group and breastfeeding status participating in the dietary assessment study in Karaga District and Gomoa East District, Ghana

Dietary Survey sample groups	Karaga District	Gomoa East District
Breastfed children 6-8 months	103	87
Breastfed children 9-11 months	98	97
Breastfed children 12-23 months	108	99
Non-Breastfed children 12-23 months	29	84
Total study population	338	367

3.4 Data collection

3.4.1 Demographic and socio-economic characteristics

The demographic and socio-economic characteristics (age, sex, education, marital status, occupation, assets, landownership and housing) of the selected households were determined with a semi-structured questionnaire (**Appendix II**). The instrument also included the standardized and validated (Deitchler 2010) Household Hunger Scale (HHS). The HHS is a 3-item by 3 frequencies of occurrence scale and is used for the assessment of the food supply situation of participating households (Ballard 2011). The standard reference period of 30 days was used for the HHS assessment (Ballard 2011). The survey instrument was translated into the main local languages (*Dagbani for Karaga District and*

Twi for Gomoa East District) and was pre-tested by trained research assistants before use in this survey.

3.4.2 Anthropometry

The recumbent length, weight and mid-upper arm circumference (MUAC) of the children were measured following standard procedures (WHO 2006; Cogill 2003). Recumbent length was measured with an infantometer to the nearest 0.1 cm. Body weight was measured precisely to 0.1 kg with an electronic scale (UNIscale; Seca GmbH, Hamburg, Germany). Weight was measured by first having the mother stand on the scale; then resetting the scale to zero whilst the mother stood on it and the child given to the mother on the scale and the reading thereof recorded. A known weight was used to calibrate the scale on each measurement day. The mid-upper arm circumference (MUAC) of the infants was measured to the nearest 0.1 cm with a standard MUAC measuring tape.

All measurements were duplicated and averaged to reduce random measurement error. Where there were differences of more than 0.2 cm or 0.2 kg (length/MUAC & weight respectively) in duplicate measures, the measurement was retaken for the third time and the two closest values used. The infants were also checked for the presence of bilateral pitting edema.

The age of the infants was determined using any reliable source (birth certificate, child health record, health insurance card) and the date of collection of anthropometric data. Where there was no reliable source of birth date, the parents/caregiver was asked to estimate age based on another child's records or event on the traditional calendar (**Appendix II**).

3.4.3 24 hour recall of dietary intakes

Dietary intakes of the children were assessed using a quantitative multi-pass 24-hour recall (Gibson, 2008) repeated in a 20% subsample on a non-consecutive day (to allow modelling for day-to-day variation in dietary intake) with all days evenly distributed over the week (**Appendix II**). Primary caretakers, in the presence of the child, were asked to recall all the foods and drinks consumed in and outside the home by their child during the preceding day and to describe ingredients and cooking methods of any mixed dishes. The frequency of consumption of each food ingredient (for mixed dishes) or food item for the last seven days preceding the interview day was recorded. Duplicate amounts of all foods or beverages consumed or of ingredients used in the preparation of mixed dishes consumed were weighed to the nearest 2 g using Soehnle electronic kitchen scale (Plateau Art 65086, Germany). When duplicates were not available in the household, amounts were estimated in household units, in weight-to-weight estimates with other foods (e.g. amount of sugar estimated with refined corn flour) in volumes, as their general sizes (small, medium or large), or as their monetary value equivalents. The total volume of each (mixed) dish cooked at the respondents' household and the volume of this dish specifically consumed by the child were measured to determine the proportion of the dish consumed by the child. This proportion was multiplied by the total amount of ingredients used in the preparation of the dish to determine the amount of ingredients consumed by the child. Standard recipes were generated to estimate the grams of ingredients consumed from mixed dishes eaten outside the home by averaging 3 recipes of different vendors in the local area. Conversion factors were developed to convert household units, volumes, sizes and monetary values to their gram weight equivalents.

3.4.4 Market survey

A market survey was conducted to determine the price (GH¢) per 100g edible portion of all foods consumed by the children as identified in the 24hR. Foods were bought from food sellers within the communities and in the main markets within the respective research areas. Foods were bought (where necessary) from three different food sellers and the price per 100 g edible portion from each seller determined. For each food an average of the three prices were recorded as the price per 100 g edible portion and matched with each food item consumed as reported in the 24hR. Outlier prices of foods were excluded from the computation of average prices. The average price per 100 g edible portion was used in converting monetary values of foods given during the 24-hR to their weight equivalents (**Appendix II**).

3.5 Data quality and control measures

3.5.1 Selection and training of survey teams

Training of interviewers minimizes respondent and interviewer bias as interviewers are better able to anticipate and recognize potential sources of bias; they are also more likely to minimize the non-response rate as interviewers would better convey warmth, understanding, and trust (Gibson 2008). Consequently, a 5-day intensive training which included 2 days for supervisors and 3 days for enumerators/anthropometry data collection team was carried out by staff of Wageningen University (WUR), University for Development Studies (UDS) and The Noguchi Memorial Institute for Medical Research (NMIMR) with the aim to facilitate understanding of the rationale for the research, understand the research tools, and harmonize data collection procedures, to ensure collection of accurate data.

Two supervisors were selected based on previous experience with dietary assessment (with preference to 24-hR) and health-related research involving women and children, knowledge of the local language, English, and local foods available in the research areas including fortified foods. Additional requirements for supervisors included prior supervision of field work and training of enumerators, and most importantly knowledge of research methods and understanding of the importance of obtaining unbiased information. Graduates with first degree in nutrition (6 as enumerators, 2 for anthropometry and 5 as data entry clerks) were preferentially selected for the study. The data team was selected from UDS and one of the lead researchers from UDS coordinated the field work. Field supervision was also supported by staff and students of WUR.

3.5.2 Pretesting of instruments and procedure

Pre-testing of the research questionnaire is crucial to the quality and accuracy of the data as it provides an opportunity to test the adequacy of the questionnaire to achieve its intended goal and helps to identify problematic questions prior to the main data collection. Hence, the 24-hR questionnaire was pre-tested in a non-survey community with the same culture as the survey communities. Each enumerator assessed one child's dietary intake with supervision by field supervisors.

In order to ensure data quality, the trained supervisors observed at least 25% of all interviews and back-checked data forms for all the unobserved interviews in the field. Where there were inconsistencies and incomplete data from households, the supervisors ensured that the households were revisited.

To control instrumental errors from the measuring scales, the digital weighing scales were randomly assigned to the interviewers and each interviewer had to use her assigned weighing scale throughout the data collection. On the first time of use, each interviewer had to record the weight of her phone with her assigned scale and this was used to check the sensitivity of each digital weighing scale on each measuring occasion. Where there was a large variation between the weight of the phone on first time of use and the weight before any measuring occasion, the battery of the weighing scale was first changed and where the variation persisted, the scale was changed for the interviewer.

3.6 Data analysis

3.6.1 Food composition data base

A food composition table was specifically created for this study using nutrient values from the West African Food Composition Table (WAFCT) (Stadlmayr et al., 2012). In case of missing foods from the WAFCT, the following food composition tables were used in the order of priority: Mali food composition table (Barikmo et al, 2004), the United States Department of Agriculture National Nutrient Database for Standard Reference (USDA 2014) and the Ghana food composition table (GFCT) (Eyeson & Ankrah, 1975). Where appropriate, yield (Stadlmayr et al., 2012) and nutrient retention factors (USDA, 2007; Vásquez-Caicedo et al, 2008) were applied to account for nutrient losses during cooking. The Atwater general factors for carbohydrate, protein and fat and the recommended metabolizable energy for dietary fiber in ordinary diets (2 kcal or 8.4 kJ/g) were used in calculating energy (FAO, 2003). Total vitamin A (RAE) was calculated as the sum of retinol and 1/12 β-carotene (Stadlmayr et al., 2012).

The nutrient composition of breast milk was taken from the WHO (**Appendix III**) as the vitamin A (RE) content was reported to be more representative of developing countries (WHO/UNICEF, 1998). The value for lactose in the WHO report was assumed for carbohydrate and the water content of breast milk was estimated by subtracting the sum of protein, fat and carbohydrate from 100 (i.e. water = 100 - (protein + fat+ carbohydrate)). Energy content of breast milk was assumed to be 65 kcal per 100 g.

3.6.2 Nutrient intake analysis

Energy and nutrient intakes (total fat, total protein, iron, zinc, calcium, vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, and vitamin B12) were calculated using the nutrient calculation system COMPL-EAT (version 1.0, Wageningen University, the Netherlands). Breastmilk intake was not measured. We assumed a breastmilk intake at the lower level of the intake distribution, previously defined as the mean breastmilk intake minus two standard deviations (SD) for low-income country populations (WHO/UNICEF, 1998; Dewey and Brown, 2003), being 372 ml per day for 6-8 months; 272 ml for 9-11 months and 175 ml for 12-23 month old children; these compare to the average (mean) breastmilk intakes in low income country populations for the same age groups of 660 mL, 617 mL, and 549 mL, respectively (WHO/UNICEF, 1998). The assumption of the low breastmilk level was used, largely due to the relatively high rates of wasting (i.e., WHZ <-2 SD) in this population. While inadequate dietary intakes may be causal to wasting, the intake by children who are wasted due to other causes, such as repeated illness, will also have reduced intakes. It is likely that the true mean breastmilk intake lies between the low and average intake assumptions. An assessment was made of the consequences of different breast milk intake assumptions on the estimated energy and nutrient contribution of breast milk, and the requirements from the complementary diet. This was done to

identify nutrients for which the intake adequacy and problem nutrients may be sensitive to the different assumptions. For reference, the contribution of low and average breastmilk intake assumptions, as derived from WHO/UNICEF (1998) and Dewey and Brown (2004), are shown in Appendix VII.

Food records of children at the upper and lower ends of the distribution of energy and nutrient intakes were scrutinized for plausibility, taking into account supporting information on appetite and illness. Implausible energy and nutrient intakes were checked and adjusted when appropriate. Recommended Nutrient Intakes (RNI; FAO/WHO, 2004)[1] were used as the basis for estimating the prevalence of inadequate nutrient intakes. For children 12-23 months of age, the RNIs were adjusted to values representative of the Estimated Average Requirements (EAR)[2] using available correction factors[3] (WHO/FAO, 2006), except for iron where an adjustment factor is not available. As these adjustment factors are also not available for infants 6-11 months of age, the RNIs were used. For zinc, the EARs for low bioavailability diets from IZiNCG were applied to all age groups (IZiNCG, 2004). Intake "inadequacy" was defined as the percentage of children with intakes below the EAR/RNIs. As a result, the interpretation of inadequate intakes for infants 6-8 and 9-11 months of age and children 12-23 months of age are not equivalent - this limitation occurs regardless of the source of reference values used. As only one day of dietary intake data were analyzed for each individual, the distribution of nutrient intakes used in these estimates does not represent the usual nutrient intake distributions for the population. These distributions may thus be wider, and hence may lead to overestimation of inadequate intakes when prevalences are very low, or underestimation when prevalences are very high.

3.6.3 Costs of daily diet estimation

The child's daily diet cost from the 24hR was analyzed using SPSS and the distribution of the cost of diet per day determined. The daily diet cost for a child was determined by multiplying the amount (g) consumed of each food item by its average price/100g (GH¢/100g). The costs of each food item consumed by a child as computed were then aggregated; this represented the child's daily diet cost. The 75th percentile of the distribution of the daily diet cost for the children was arbitrarily assumed to represent the upper limit of the daily cost of an affordable diet.

3.6.4 Optifood analysis

Definition of model parameters: The 24hR dietary data were used to define the model parameters using the nutrient calculation system Compl-eat (version 1.0, Wageningen University, the Netherlands), Excel 2010 (Microsoft Corporation), IBM SPSS (v21) and MS Access 2010. These parameters included: a list of non-condiment foods consumed by ≥5% of the children per age group; the serving size of each food defined as the median serving

[1] The RNI is the age/gender/life-stage-specific daily nutrient intake amount at which 97.5% of individuals in an apparently healthy population meet their requirement (FAO/WHO 2004).
[2] The Estimated Average Requirement for a nutrient is the age/gender/life-stage-specific mean dietary requirement or dietary intake level at which 50% of individuals would meet their physiological requirement (IOM 2000).
[3] The EAR is obtained from the RNI by subtracting the equivalent of 2 SDs of the mean nutrient requirement (EAR). The SDs were obtained from the United States Food and Nutrition Board and Institute of Medicine (IOM, 2000).

size for all children who consumed the food; and the minimum and maximum number of servings per week, for each food group and sub-food group defined as the 5th and 95th percentiles, respectively, of serve counts. The maximum number of servings per individual food within a subgroup was estimated based on percentage of children consuming that food. An energy constraint was used to ensure all modeled diets provided the average energy requirement for the target group, estimated using childrens' mean body weights and the FAO/WHO/UNU algorithm for estimating energy requirements (UNU/WHO/FAO, 2004). Thirteen key nutrients are considered by the Optifood analysis: total fat, total protein, iron, zinc, calcium, vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, and vitamin B12. The FAO/WHO (2004) Recommended Nutrient Intakes (RNIs) were used for all nutrients, except zinc. For zinc, the International Zinc Nutrition Consultative Group's (IZiNCG 2004) EAR[4] for unrefined cereal based diets was used. Considering the low dietary heme iron with high phytates and fiber in the plant foods commonly consumed by the infants, 5% bioavailability was assumed for iron. For fat, the average requirement of 30% of total energy was used. **Appendix III** provides a summary of the model parameters used in the Optifood analysis.

Optifood analysis: The Optifood analysis comprises four steps (Ferguson et al, 2006; Daelmans et al, 2013): (1) to check that model parameters ensure realistic diets; (2) to identify two realistic diets that meet or come as close as possible to meeting nutrient needs (one based on current dietary patterns and one requiring dietary changes) of the target population; (3) to test alternative sets of food-based recommendations (FBRs) to select which dietary recommendations may be the best for the target population, taking into consideration nutrient needs and cost (preference was given to the recommendations with costs below the 75th percentile of the daily diet cost distribution, covering 70% of RNI or more for most nutrients); and (4) to run a cost analysis (not included in this report).

3.6.5 Socio-economic characteristics and anthropometry analysis

Demographic and socioeconomic characteristics of mothers/caregivers of the children were analyzed with IBM SPSS (version 20). Following the standard coding, each of the 3 items in the HHS were coded 0, 1 or 2, corresponding to hunger frequencies of "never", "rarely or sometimes" and "often" respectively. This results in total scores ranging from 0 – 6 based on which households will be categorized into 3 standard groups: 1= little/no household hunger (HHS ≤ 1); 2 = moderate household hunger (HHS 2 – 3); 3= severe household hunger if HHS ranges between 4 – 6 (Ballard et al, 2011).

Anthropometric Z-scores were calculated using WHO Anthro (version 3.2.2). Anthropometric indices (weight-for-age, height-for-age and weight-for-height Z-scores) were transformed into anthropometric indicators using a cut-off value of <-2 SD reflecting underweight, stunting and wasting respectively. Z-scores falling outside the WHO flags (WHZ –5 and +5; HAZ –6 and +6; WAZ – 6 and +5) were excluded from analysis (WHO 2006). For MUAC, the cut-off value of 12.5 cm was used to classify the nutritional status of infants and young children (WHO/UNICEF, 2009).

[4] While the EAR and RNI are not equivalent, the RNI for zinc was considered to be substantially overestimated (IZiNCG 2004); the IZiNCG (2004) EAR for zinc was based on more recent data on physiological requirements and bioavailability of zinc.

Body mass index (BMI) for caregivers was categorized based on WHO cut-offs (WHO, 1995): underweight (BMI <18.5), normal (BMI range <18.50-24.99>), overweight (BMI: ≥25) and obese (BMI≥ 30). Physiological status of caregivers (pregnant, lactating, non-pregnant non-lactating) were considered when analyzing BMI.

3.7 Ethical considerations

Clearance to carry out the research was granted by the Noguchi Memorial Institute for Medical Research Institutional Review Board (Ethical Clearance certificate No. NMIMR-IRB CPN 087/13-14). Approval for the study was obtained by the District Assembly, District Health Administration in both Karaga and Gomoa East District and leaders of selected communities in both districts. Participation was voluntary and written informed consent was obtained from caregivers of selected children and thumb prints used for those who were not literate. The identity of the infants and their mothers/caregivers has been kept confidential. Mothers/caregivers were compensated with a 500g sachet of iodized salt for their time.

4. RESULTS FOR KARAGA DISTRICT

4.1 Background characteristics

Background characteristics of the caregivers who participated in the dietary assessment survey are shown in **Table 4.1**. The average age of the caregiver was 27 years, living in households comprising on average 13 members. Most of the caregivers were not literate (93%), were farmers (62%), earned an income from their farm (57%), and had weekly earnings below 10 GH¢ (83%).

Table 4.1. Background characteristics of caregivers of children 6-23 months participating in the dietary survey in Karaga District

Characteristics	Number (%)
Age of caregiver, years, mean ± SD	27 ± 6
Household size, mean ± SD	13 ± 6
Physiological status, n (%)	
Lactating and Pregnant	13 (3.7)
Lactating	338 (96.3)
Education, n (%)	
Not literate	325 (92.7)
Primary	10 (2.8)
Junior high or higher	16 (4.3)
Occupation, n (%)	
Housewife/None	45 (12.8)
Farmer	216 (61.5)
Trader	57 (16.2)
Other	33 (9.5)
Religion, n (%)	
Muslim	311 (88.6)
Christian	32 (9.1)
Other	8 (2.3)
Earn money, n (%)	
Yes, on farm	200 (57.0)
Yes, off farm	79 (22.5)
No	72 (20.5)
Weekly earnings, n (%) *	
<10 GH¢	225 (82.4)
≥10 GH¢	54 (17.6)
Household Assets, n (%)	
Radio	242 (71.6)
Television	112 (33.1)
Bicycle	290 (85.8)
Motorbike	166 (49.1)
Milling machine	17 (5.0)
Vehicle (Private)	3 (0.9)
Vehicle (Commercial)	26 (7.7)
Household Hunger, n (%)	
Moderate	23 (6.8)
Severe	3 (0.9)

* USD1 = 3.5 GH¢ (Ghana Cedis)

Most caregivers were Muslim (89%). Most households of the caregivers owned a bicycle (86%), a radio (72%), and many owned a motorbike (49%) and a television (33%). More than 90% of the households had little or no hunger in the last month according to the Household Hunger Score, while only 1 percent perceived severe hunger.

4.2 Nutritional status of children and caregivers

The mean ± SD age of the children surveyed was 12.4 ± 5 months. The prevalence of wasting was high (13.7%) with higher levels in boys (15.5%) and decreased somewhat with increasing age (**Table 4.2**). Stunting levels (39.7%) indicated a severe chronic malnutrition problem with higher levels in boys (45.3%) increasing with age to a level of 54.3% at 12-23 months. About 36.2% of the children 6-23 months were underweight, while 13.5% had a MUAC below 12.5 cm. It is noteworthy that the average age of the non-breastfed children 12-23 months was approximately 4 months greater than their breastfed counterparts. Considering this, and the smaller sample size for the latter, the results for the breastfed and non-breastfed children 12-23 mos are not directly comparable. Detailed data on average weight, height and MUAC by age group, breastfeeding status and sex are given in **Appendix IV**.

Among the caregivers of the children, 15.7% were underweight (BMI<18.5), while 8% were overweight (BMI>25 kg/m^2) and 0.9% were obese (BMI>30 kg/m^2) (data not shown).

4.3 Dietary intake analysis

4.3.1 Foods consumed: number, type and portion sizes

The total number of non-condiment foods consumed per age group and breastfeeding status ranged from 55-68 across all age groups. However, the number of commonly consumed foods (those consumed by >5% of the children) ranged only from 19-41 (**Figure 4.1**).

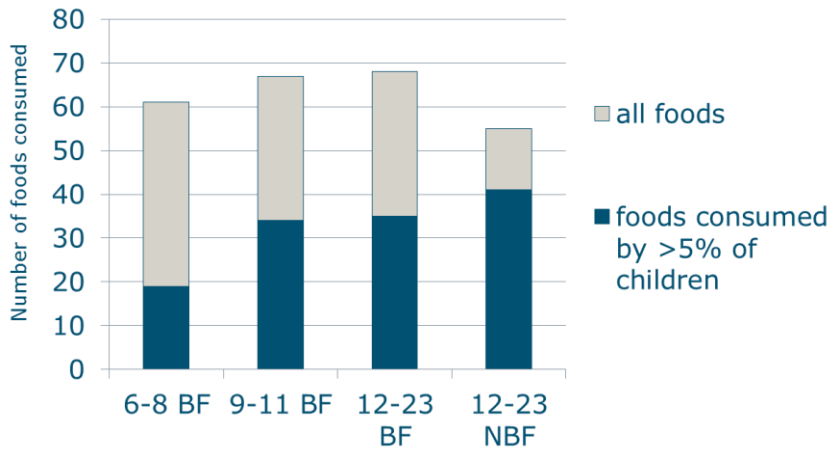

Figure 4.1. Number of different foods consumed per age group and breastfeeding state in Karaga District, Ghana

Legend: BF=breastfed; NBF=non-breastfed

Table 4.2. Nutritional status of children 6-23 months participating in the dietary assessment survey in Karaga District.

	n	Age, months	Weight-for-height			Height-for-age			Weight-for-age			MUAC		
Child characteristic		mean ±SD	*% <-3SD*	*% <-2SD*	*mean z-score*	*% <-3SD*	*% <-2SD*	*mean z-score*	*% <-3SD*	*% <-2SD*	*mean z-score*	*< 11.5 cm*	*< 12.5 cm*	*mean z-score*
All	*337*	12.4 ± 5.0	3.3	13.7	-1.0	14.8	39.7	-1.70	12.8	36.2	-1.6	3.3	13.4	-0.8
Gender														
Boys	*168*	12.7 ± 5.2	4.2	15.5	-1.1	18.5	45.3	-1.8	11.9	35.1	1.2	4.2	10.2	-0.9
Girls	*169*	12.1 ± 4.8	2.4	11.9	-1.0	11.2	34.3	-1.5	9.5	33.2	-1.5	2.4	16.6	-0.7
Age group, months														
6-8, BF	*96*	7.4 ± 0.9	4.2	14.6	-1.0	3.1	27.1	-1.2	8.3	27.1	-1.5	5.2	17.7	-0.9
9-11, BF	*97*	10.2 ± 0.9	5.2	13.4	-1.0	14.4	31.9	-1.6	15.5	34.1	-1.6	4.1	17.5	-0.7
12-23, BF	*109*	16.4 ± 3.2	0.9	13.7	-1.1	23.9	53.3	-2.2	12.8	44.9	-1.8	0.9	6.4	-0.7
12-23, NBF	*35*	20.2 ± 3.3	2.9	11.5	-0.7	20.0	54.3	-1.9	17.1	40	-1.5	2.9	11.5	-1.1

The 6-8 month old children consume cereals like maize and millet more in the form of liquid or semi-solid porridges. From 12 months onwards the children are increasingly introduced to family foods, such as vegetables, legumes, rice balls and dough from different grains, especially among those that are no longer breastfed. All foods consumed by 6-8 month old children are also consumed by older infants and children (with the exception of biscuits and fortified chocolate beverage mix). Very few children consumed nutrient-dense foods like meat, legumes, red palm oil, fruits, vegetables and dairy.

The main food items consumed from each food group by the infants and young children are summarized in **Table 4.3**. The main cereal grains consumed in all age groups were maize, millet, rice and guinea corn, and cassava was the main starchy root. From bakery and breakfast cereals, mainly bread and biscuits were consumed. Meat was not reported to be consumed in the survey by children, while egg consumption was restricted to the non-breastfed group. Small amounts of anchovies contributed most to the fish consumption by infants and young children of all age groups. Dairy was mainly consumed in the form of powdered milk. Groundnuts and cowpea were consumed, complemented with pigeon peas and soybean. A large variety of vegetables, including green leafy vegetables was consumed. The main fruit consumed was watermelon. Most of the time, vegetable oil was used for cooking. White sugar was often added to tea or porridge.

Table 4.3. Main foods consumed by children per food group in Karaga Districts, Ghana

Food groups	**Foods**
Grains	Maize, guinea corn, millet, rice
Bakery and breakfast cereals	Bread, biscuits
Starchy roots and other starchy plant foods	Cassava
Meat, fish & eggs	Dried pounded anchovies, canned mackerel
Dairy	Cow milk powder
Legumes, seeds & nuts	Groundnut, cowpea, pigeon peas, soybean
Vegetables	Green leafy vegetables (ayoyo, bra, baobab, cowpea leaves), tomato, okro
Fruits	Water melon
Added fats	Vegetable oil (vitamin A fortified and non-fortified)
Added sugar	White sugar

While some nutrient-dense foods like meat, legumes, and vegetables were consumed by a moderate to high proportion of children, they were consumed only in small quantities (**Table 4.4**). For example, among breastfed children the mean portion sizes for meat, fish & egg, legumes, and vegetables was ≤10 g, and was as little as 1 g for meat, fish & egg among 6-8 month old infants in Karaga District.

Table 4.4 Percentage of children consuming food groups and mean daily portion sizes*, per age group and breastfeeding state in Karaga District, Ghana (for additional details see Appendix V.A)

	Infants and young children consuming foods by food group in previous 24 hours (%)				Average daily portion size (g/day)			
Food groups	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
Grains	92	96	97	100	33	23	40	65
Bakery and breakfast cereals	8	10	9	28	9	0	50	73
Starchy roots and other starchy plant foods	9	17	18	17	3	6	9	34
Meat, fish & eggs	27	60	86	93	1	1	2	12
Dairy	12	11	17	21	3	2	5	274
Legumes, seeds & nuts	28	54	85	100	3	5	9	17
Vegetables	27	62	88	97	5	4	9	11
Fruits	6	9	11	17	0	72	126	118
Added fats	17	37	63	62	14	9	8	12
Added sugar	52	52	59	66	6	9	14	16

Legend: BF=breastfed; NBF=non-breastfed

* Data are presented only for food groups included in the Optifood analysis, which were those where ≥5% of children were reported to have consumed foods from that group.

For other nutrient-dense foods such as dairy and fruit, these were consumed by a relatively small proportion of children and in small quantities as well. Portion sizes did not increase consistently with age among breastfed children, but were noticeably larger among non-breastfed compared to breastfed children at 12-23 months of age. Detailed information on foods and food sub-groups consumed and their portions sizes and frequency of consumption is given in **Appendix V-A** and **Appendix V-B.**

4.3.2 Cost of foods and daily diet

Costs of each food reported in the 24hR dietary survey were assessed in the market survey (**Appendix VI**). Based on these costs, the median cost (75th percentile) of a daily diet was estimated to be 0.18 (0.39) GH₵ for 6-8 months; 0.34 (0.71) GH₵ for 9-11 months; 0.77 (1.23) GH₵ for 12-23 months and 1.51 (2.29) GH₵ for 12-23 months old non-breastfed children.

4.3.3 Energy intake and food sources of energy

The total energy and nutrient intakes reported are dependent on assumed intakes of breast milk, as the latter was not measured directly. The amounts of nutrients that would be derived from breast milk based on the average (mean) and low (mean -2 SD) levels for the 6-8, 9-11, and 12-23 month age groups (WHO/UNICEF 1998) are presented in **Appendix VII** for comparison of the two assumptions

The daily median energy intake for the children by age and breastfeeding status is shown in **Figure 4.2**. Based on the assumed conservative estimate for low breast milk intakes, the mean energy intakes of infants 6-8 and 9-11 mo of age were below the requirements (hatched line in Figure 4.2), while estimated mean energy intakes of 12-23 mo old breastfed and non-breastfed children exceeded the mean energy requirements.[5]

However, when the average breastmilk intake was assumed, estimated median energy intakes met or were higher than the average energy requirements among all groups in Karaga District(Figure 4.2). Although it is likely that the actual breast milk intakes in this population lie between the low and average breast milk intake amounts, the selection of the mean -2 SD amount is used here as the more conservative estimate and representative of nutritional status. Nonetheless, the implications of these different breastmilk intake assumptions have been considered for comparison purposes and to understand more fully their effect on energy and nutrient intake adequacy, and identification of problem nutrients, as addressed in sections 4.3.4 and 4.4.1, respectively.

[5] As noted above, the average age of non-breast-fed children 12-23 months of age was approximately 4 months greater than their non-breastfed counterparts (Table 4.2), and this age difference may result in higher average energy intakes and thus contribute to an apparently greater adequacy of energy intakes in this sub group compared to non-breastfed children in the 12-23 mo group.

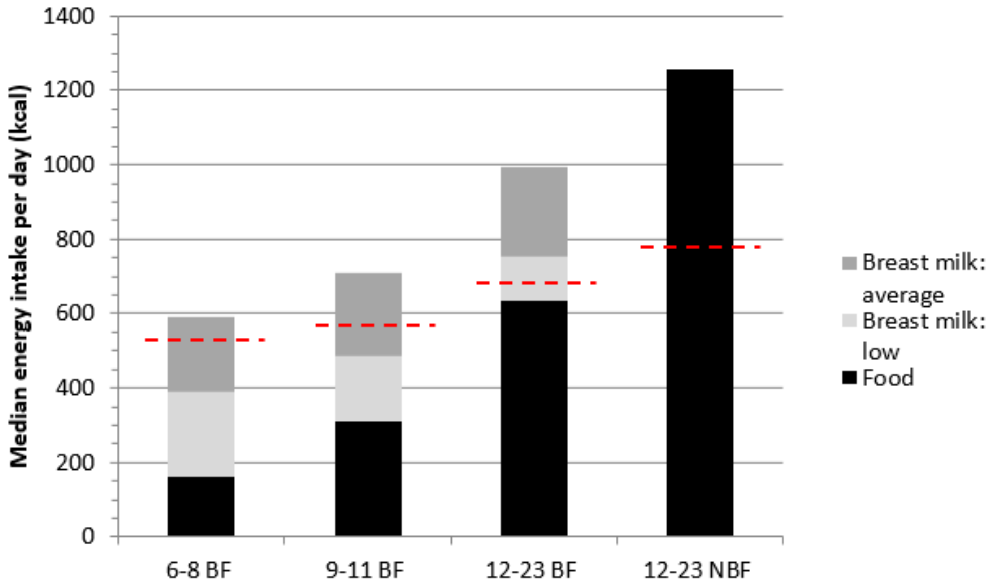

Figure 4.2. Median daily energy intake from food and breastmilk, at low (mean -2 SD) or average (mean) assumed breastmilk intakes, compared to daily energy requirements per age group and breastfeeding state in Karaga District, Ghana.

Legend: BF=breastfed; NBF=non-breastfed; red dashed line represents daily energy requirement as average of age group and sex; breastmilk intake estimated as mean intake minus 2 SD (low) or mean intake (average) as per WHO/UNICEF (1998).

Grains provide the largest contribution to the energy intake of all children, ranging from 60% in non-breastfed children to 68% in infants aged 6-8 months (**Table 4.5**). The second largest contributors to energy intake are added fat and legumes although the contribution is modest compared to that of grains.

Table 4.5 Percentage contribution of food groups to energy intake of children per age group and breastfeeding status (assuming low breast milk intake), in Karaga district, Ghana

Food groups	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
Grains	68	62	61	60
Bakery and breakfast cereals	2	2	2	3
Starchy roots and other starchy plant foods	1	2	2	1
Dairy	1	3	2	2
Legumes, seeds & nuts	7	7	10	13
Vegetables	2	2	1	2
Added fat	8	13	15	10
Added sugars	7	6	5	4
Others	4	3	2	5

Legend: BF=breastfed; NBF=non-breastfed

4.3.4 Micronutrient intake through the diet and inadequacy of intake

Using the assumption of low breastmilk intakes, a large percentage of children across all age groups do not meet the RNI for most of the 11 key micronutrients considered, although the percentage of children with intakes below the RNI tends to be lower among children who are no longer breastfed (**Table 4.6**). These very high prevalences of inadequate nutrient intakes are consistent with the low intake of nutrient-dense foods. In general, the prevalence of inadequate intakes was lower among the 12-23 month old children compared to those 6-11 months of age. While this partly reflects a greater adequacy in nutrient intakes from the diet, it is also partly attributed to the different reference values (EARs) used for the older age group.

Table 4.6 Percentage of children whose intake is below the RNI/EAR* for 11 micronutrients, by age group and breastfeeding status, assuming low breast milk intake, in Karaga district, Ghana

Micronutrients	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
		Percentage below EAR/RNI		
Calcium	99	92	94	76
Iron (low bioavailability)	100	99	83	45
Zinc (low bioavailability)	89	91	28	0
Vitamin A	95	95	91	83
Niacin	85	79	54	14
Riboflavin	90	85	60	35
Thiamin	65	55	32	0
Vitamin B6	74	55	27	3
Folate	88	85	82	62
Vitamin B12	95	91	92	83
Vitamin C	93	92	84	76

Legend: BF=breastfed; NBF=non-breastfed

*Based on RNIs from FAO/WHO (2004); for infants 6-8 and 9-11 months, the prevalence of intakes below the RNI was used, while for children 12-23 months of age, the RNI was converted to the EAR equivalent using conversion factors (WHO/FAO, 2006). Exceptions are for iron, for which no conversion factors are available, and for zinc, the EARs for low bioavailability diets from IZiNCG (2004) were used for all age groups.

When assuming average breast milk intake, the percentage of breastfed children with intakes below the RNI/EAR for respective micronutrients in general was reduced, as expected (**Table 4.7**). For nutrients such as vitamins A, B12, and C, which breastmilk supplies in relatively higher amounts in relation to the daily requirement (**Appendix VII**), larger reductions in the estimated prevalence of intakes below the RNI/EAR were observed when the average breast milk intake was assumed. However, the prevalence of inadequate

intakes for these nutrients was still very high, and the overall interpretation of results is the same. For nutrients such as iron, zinc, and vitamin B6, in particular, for which breastmilk provides only a small portion of daily requirements (**Appendix VII**), the assumption of average breast milk intake, compared to low breastmilk intake, did not result in meaningful reductions in the estimated prevalence of intakes below the RNI/EAR. For nutrients such as calcium, niacin, riboflavin, folate, some reductions in adequate intakes were observed, but again, the overall interpretation of results does not change substantially.

Table 4.7 Percentage of children by age group and breastfeeding status whose intake is below the EAR/RNI* for 11 micronutrients, assuming average breastmilk intake, in Karaga District

	6-8 BF	9-11 BF	12-23 BF	12-23 NBF
	Percentage below EAR/RNI			
Calcium	96	90	89	76
Iron (low bioavailability)	100	94	83	45
Zinc (low bioavailability)	89	87	18	0
Vitamin A	88	81	23	83
Niacin	84	75	45	14
Riboflavin	79	56	39	35
Thiamin	54	38	23	0
Vitamin B6	68	52	24	3
Folate	76	59	70	62
Vitamin B12	81	81	83	83
Vitamin C	77	62	29	76

Legend: BF=breastfed; NBF=non-breastfed

*Based on RNIs from FAO/WHO (2004); for infants 6-8 and 9-11 months, the prevalence of intakes below the RNI was used, while for children 12-23 months of age, the RNI was converted to the EAR equivalent using conversion factors (WHO/FAO, 2006). Exceptions are for iron, for which no conversion factors are available, and for zinc, the EARs for low bioavailability diets from IZiNCG (2004) were used for all age groups.

4.4 Optifood analysis

4.4.1 Problem nutrients

Problem nutrients refer to nutrients for which requirements are difficult to meet with the available local foods and dietary patterns among the target groups. A summary of problem nutrients by target group, when assuming low breast milk intakes, is given in **Table 4.8**. It is noteworthy that niacin may not require modification to the diet for most individuals as the intake of tryptophan, which may be converted to niacin, has not been accounted for.

In Karaga District, requirements for all 11 micronutrients considered for non-breastfed children 12 to 23 months of age, could be met with changes in the diet using commonly consumed local foods. However, for the breastfed children 6-8 and 9-11 months of age, requirements for calcium, iron, zinc, vitamin A, riboflavin, vitamin B12 and vitamin C could

not be met with any combination of local foods consumed within the boundaries of current dietary patterns, and therefore, either additional sources of these nutrients would need to be introduced to these children's diets, or existing sources would need to be consumed with serving sizes or frequencies greater than that observed in these populations. For the breastfed children aged 12-23 months, requirements of calcium, iron, riboflavin, vitamin B12, and vitamin C, as well as folate, cannot be met by any combination of local foods. In all three of the breastfed subgroups, requirements for vitamin B6, niacin and thiamin can be met within the local diet.

Table 4.8 Summary of problem nutrients in the diet of children by age group and breastfeeding status, assuming low breast milk intake), in Karaga District, Ghana*

Micronutrients	6-8 BF	9-11 BF	12-23 BF	12-23 NBF
Calcium				
Iron				
Zinc				
Vitamin A				
Niacin				
Riboflavin				
Thiamin				
Vitamin B6				
Folate				
Vitamin B12				
Vitamin C				

Legend: BF=breastfed, NBF=non-breastfed

*Problem nutrients will be fewer if average breastmilk intakes are assumed. See Appendix VIII for details of these differences.

Nutrient requirements cannot be met by any combination of local foods

Nutrient requirements could be met but may require changes in the diet

The intake of total fat and protein were adequate, but we did not assess adequacy of the quality and composition of fat and protein consumed due to lack of complete food composition data on the content of the subcomponents of these macronutrients.

These results are valid only for the assumption of low breast milk intakes (i.e., mean –2 SD). When assuming average breast milk intake, the number of problem nutrients in general are reduced, especially vitamin C and vitamin B12, and to a somewhat lesser extent, vitamin A (**Appendix VIII**). This is expected as breastmilk provides a large proportion of the requirements for these nutrients.

4.4.2 Food-based recommendations

To address the identified shortcomings of local diets and intake patterns, the Optifood analysis proposes recommendations that establish the quantity and frequency of consumption of available foods, expressed as recommended number of servings per week. It also indicates when such recommendations are insufficient to meet the requirements for all 11 nutrients considered and, hence, where more drastic changes to the foods or their frequency of consumption would be required to achieve adequacy for all nutrients. In each

age and breastfeeding status group, we examined the optimization of nutrient intake adequacy only using the foods reported to be consumed by these infants and young children; we did not attempt to model the potential impact of any other nutrient-dense foods, including fortified foods, micronutrient powders, or other micronutrient supplements that were not reported to be consumed.

Table 4.9 shows the foods that contribute >5% RNI for at least one of the 11 micronutrients considered. These foods were incorporated individually and in combination to meet or come as close as possible to meeting nutrient needs of individuals in the target groups. For detailed information per food and nutrient, see **Appendix IX**.

The minimum and maximum number of servings per week per food group are shown by age group and breastfeeding status in **Table 4.10**. The number of servings per week increased or remained the same with increasing age, except for meat, fish and eggs, and bakery and breakfast cereals. Numbers of servings per week for food subgroups are shown in **Appendix V-B** (**Table V-B.1**).

Table 4.9 Foods providing >5% RNI of at least one of the 11 micronutrients considered by age-group and breastfeeding status, Karaga District

6-8 BF	9-11 BF	12-23 BF	12-23 NBF
Ayoyo leaves	Ayoyo leaves	Ayoyo leaves	Ayoyo leaves
Chocolate drink powder	Bra leaves	Bra leaves	Bra leaves
Cowpea, white, dried	Cowpea, white, dried	Cowpea, white, dried	Chocolate drink powder
Groundnut paste	Fish, anchovies	Fish, anchovies	Cowpea, white, dried
Guinea corn flour	Fish, herring	Groundnut flour	Egg, guinea fowl
Maize flour	Groundnut flour	Groundnut paste	Fish, anchovies
Cow milk powder	Groundnut paste	Guinea corn flour	Maize flour
	Guinea corn flour	Mackerel, canned	Watermelon
	Mackerel, canned	Maize flour	Cow milk
	Maize flour	Watermelon	Millet dough
	Watermelon	Cow milk powder	Vegetable oil (vitamin A fortified)
	Cow milk powder	Vegetable oil (vitamin A fortified)	Okro fruit
	Vegetable oil (vitamin A fortified)	Red palm oil	Okro fruit powder
	Okro fruit	Okro fruit	Rice, brown, local
	Rice, brown, local	Pigeon peas dried	
		Rice, brown, local	

Legend: BF=breastfed; NBF=non-breastfed

Table 4.10 Minimum and maximum servings per week per food group by age group and breastfeeding status in Karaga District, Ghana

	6-8 BF (n=103)		9-11 BF (n=98)		12-23 BF (n=108)		12-23 NBF (n=29)	
Food groups[1]	**Servings per week**							
	Min[2]	Max[3]	Min[2]	Max[3]	Min[2]	Max[3]	Min[2]	Max[3]
Grains & grain products	0	21	0	28	0	28	0	35
Starchy roots & other starchy plant foods	0	7	0	7	0	7	0	7
Legumes, nuts & seeds	0	21	0	28	0	28	0	28
Meat, fish & eggs	0	7	0	21	0	14	0	14
Beverages (non-dairy or blended dairy)	0	7	0	7	0	7	0	14
Dairy products	0	7	0	7	0	7	0	7
Vegetables	0	21	0	28	0	28	0	35
Fruits	-	-	0	7	0	7	0	7
Bakery & breakfast cereals	0	7	-	-	0	7	0	7
Added fats	0	7	0	14	0	14	0	14
Added sugars	0	7	0	7	0	7	0	7
Breastmilk	6.9	7	6.9	7	6.9	7	-	-

Legend: BF=breastfed; NBF=non-breastfed

[1]Food groups are classified as it is in Optifood

[2]5th percentile of the weekly frequency was used

[3]95th percentile of the weekly frequency was used

The food-based recommendations are presented in **Table 4.11a**. Final recommendations were selected based on two criteria: (1) costing not more than the 75th percentile of the daily diet cost distribution of the target group, and (2) covering 70% of the RNI or more for the largest number of nutrients. For detailed information on the Optifood analysis and coverage of RNI per single food and combinations of food, see **Appendix X**.

In combination with other foods, incorporating the foods included in the food-based recommendations will improve the intake adequacy of micronutrients. However, even if all of the recommendations are adopted, there may still be gaps in nutrient intake adequacy (see **Table 4.11a**) and solutions must extend beyond food items already used in IYCF in these populations. Adequate breastfeeding should continue to be promoted to minimize the gaps in nutrient intake.

Table 4.11a Food based dietary recommendations for young children per age group and breastfeeding state, assuming low breast milk intake, Karaga District

Foods	**6-8BF**	**9-11BF**	**12-23 BF**	**12-23 NBF**
Breast milk	Every day	Every day	Every day	
Fortified chocolate beverage powder	1 serve			
Vegetables	3 serves	2 serves of dark green leafy vegetables		7 serves (of which 2 serves of dark green leafy vegetables
Dairy	1 serve			1 serve
Grains (preferably whole grains)		4 serves	2 serves	1 serve
Fruits		1 serve	1 serve	
Meat, fish or eggs		1 serves		
Nuts and/or seeds			3 serves	
Red palm oil			1 serve	
Beans				1 serve

Legend: BF=breastfed; NBF=non-breastfed

To improve the practical incorporation of the recommendations into complementary feeding guidelines, we made adjustments to the original, target group-specific FBRs to make these more consistent across groups where possible, and avoid having completely distinct sets of FBRs for each. These adaptations were arrived at by: (1) leaving out recommendations that were only applicable to one age group; (2) adding a recommendation to an age group if it occurred in the other groups (3) in 12-23 NBF in Karaga District, changing whole cow milk to milk powder to harmonize between groups (4) increasing servings for meat-fish-egg (Karaga) or fish and legumes (Gomoa East) to compensate for nutrient losses in the previous steps, as needed.

These adapted FBRs are given in **Table 4.11b**, and details are given in **Appendix X**. The final coverage of nutrient RNIs are reported in **Table 4.12b**. These adjustments resulted in a similar number of nutrients for which RNIs would be met.

Table 4.11b Food based dietary recommendations for young children per age group and breastfeeding state, revised to improve consistency across age groups, assuming low breast milk intake, Karaga District

Foods	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
	servings per day			
Breast milk	Every day	Every day	Every day	
Fortified chocolate beverage powder	1 serve			
Vegetables	2 serves of vitamin A rich vegetables	2 serves of green leafy vegetables	2 serves of green leafy vegetables	5 serves (of which 2 serves of green leafy vegetables)
Dairy	1 serve	1 serve	1 serve	1 serve
Grains (preferably whole grains and not including rice)		3 serves	3 serves	3 serves
Fruits		1 serve	1 serve	1 serve
Meat, fish or eggs		2 serves (of which 1 serve anchovies)	2 serves	2 serves
Beans, nuts and seeds)		3 serves	3 serves of nuts and/or seeds	3 serves (of which 1 serve of beans)

Legend: BF=breastfed; NBF=non-breastfed

Table 4.12a Nutrient composition and diet costs in the worst case scenario of the selected food based recommendations per target group in Karaga District, Ghana

	Percentage RNI												
Target group	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH₵/day**	**≠Nutrients ⩾70 % RNI**
6-8 month BF	48	70.4	73.8	72.8	47.6	75.5	52	74.6	47.7	11	20.3	0.4	5
9-11 month BF	31.2	61.6	148.2	68.3	72.8	143.7	64.2	59.8	45.4	22.9	45.3	0.4	3
12-23 month BF	17.8	52.5	107.9	48.6	80.5	118.1	36.3	21.8	109.2	41.4	93.4	0.6	5
12-23 month NBF	160.1	78.8	136.8	254	60.3	147.9	109.4	360.7	62.2	61.2	169.2	1.9	8

Legend: BF=breastfed; NBF=non-breastfed; RNI=recommend nutrient intake

Table 4.12b Nutrient composition and diet costs in the worst case scenario of the harmonized food based recommendations per target group in Karaga District, Ghana

	Percentage RNI												
Target group	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH₵/day**	**≠Nutrients ⩾70 % RNI**
6-8 month BF	47.8	69.8	73.6	72.6	47.6	75	51.7	74.6	47.7	11	20.3	0.4	5
9-11 month BF	37.1	62	142.1	74	69.8	131.6	68.8	56.2	45.4	21.7	42.8	0.4	3
12-23 month BF	39.7	74.4	116.9	79.7	85.2	130.4	47.9	52.1	44.6	47.9	105.3	0.7	6
12-23 month NBF	63.6	72.8	151.8	117.1	96.3	163	93.5	64.2	31.5	84.3	163.1	1.2	8

Legend: BF=breastfed; NBF=non-breastfed; RNI=recommend nutrient intake

5. RESULTS FOR GOMOA EAST DISTRICT

5.1 Background characteristics

Background characteristics of the caregivers who participated in the dietary assessment survey are shown in **Table 5.1**. The average age of the caregiver was 28 years, living in households comprising on average 17 members. More than half of the caregivers completed junior high or higher education (57%), were traders (37%) or housewives (26%), earned an income off farm (52%),and most had weekly earnings above 10 GH¢ (67%).

Table 5.1. Background characteristics of caregivers of children 6-23 months participating in the dietary survey in Gomoa East District

Characteristics	Number (%)
Age of caregiver, years, mean ± SD	28 ± 8
Household size, mean ± SD	6 ± 3
Physiological status, n (%)	
Lactating and Pregnant	17 (4.4)
Lactating	369 (95.6)
Education, n (%)	
Not literate	78 (20.2)
Primary	89 (23.0)
Junior high or higher	219 (56.8)
Occupation, n (%)	
Housewife/None	101 (26.1)
Farmer	62 (16.1)
Trader	141 (36.5)
Other	82 (20.4)
Religion, n (%)	
Muslim	26 (6.7)
Christian	354 (91.7)
Other	6 (1.6)
Earn money, n (%)	
Yes, on farm	54 (14.0)
Yes, off farm	202 (52.4)
No	130 (33.6)
Weekly earnings, n (%) *	
<10 GH¢	84 (33.5)
≥10 GH¢	164 (66.5)
Household Assets, n (%)	
Radio	195 (50.5)
Television	215 (55.7)
Bicycle	44 (11.4)
Motorbike	9 (2.3)
Milling machine	4 (1.0)
Vehicle (Private)	13 (3.4)
Vehicle (Commercial)	28 (7.3)
Household Hunger, n (%)	
Moderate	47 (12.8)
Severe	7 (1.3)

* USD1 = 3.5 GH¢ (Ghana Cedis)

Most caregivers were Christian (92%). More than half of the caregiver's households had a television (56%) or a radio (51%). More than 85% of the households had little or no hunger according to the Household Hunger Score, while only 1% percent perceived severe hunger.

5.2 Nutritional status of children and caregivers

Mean ± SD age of the children was 13.9 ± 5 months. The prevalence of wasting was high (11.0%) with higher levels in boys (13.2%) and reducing with age (**Table 5.2**). Stunting levels (18.7%) indicated a moderate chronic malnutrition problem with higher levels in boys (19.8%) increasing with age to 27.6% in 12-23 months. About 17.4% of the children 6-23 months were underweight, while 7.3% had a MUAC below 12.5cm. It is noteworthy that the average age of the non-breastfed children 12-23 months was approximately 4 months greater than their breastfed counterparts. Considering this, and the smaller sample size for the latter, the results for the breastfed and non-breastfed children 12-23 months are not directly comparable. Detailed data on average weight, height and MUAC by age group, breastfeeding status and sex are given in **Appendix IV**.

Among the caregivers, 11.7% were underweight (BMI<18.5), while 21.4% were overweight (BMI>25 kg/m2) and 7.3% were obese (BMI>30 kg/m^2) (data not shown).

5.3 Dietary intake analysis

5.3.1 Foods consumed: number, type and portion sizes

The total number of non-condiment foods consumed per age group and breastfeeding status ranged from 69-78 across all age groups. However, the number of commonly consumed foods (those consumed by >5% of the children) ranged from 32-41 (**Figure 5.1**).

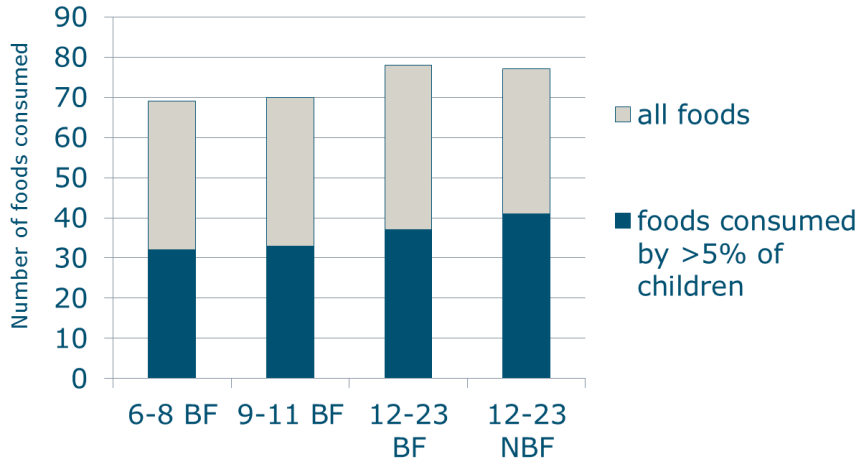

Figure 5.1. Number of different foods consumed per age group and breastfeeding status in Gomoa East District, Ghana

Legend: BF=breastfed; NBF=non-breastfed

Table 5.2 Nutritional status of children 6-23 months participating in the dietary assessment survey in Gomoa East District.

	N	***Age, months***	**Weight-for-height**			**Height-for-age**			**Weight-for-age**			**MUAC**		
Child characteristic		*Mean ± SD*	*% <-3 SD*	*% <-2 SD*	*mean z-score*	*% <-3 SD*	*% <-2 SD*	*mean z-score*	*% <-3 SD*	*% <-2 SD*	*mean z-score*	*< 11.5 cm*	*< 12.5 cm*	*mean z-score*
All	*384*	13.9 ± 5.2	1.6	11.0	-0.7	3.6	18.7	-1.0	5.2	17.4	-1.1	0.8	7.3	-0.4
Gender														
Boys	*197*	14.1 ± 5.3	2.5	13.2	-0.8	3.6	19.8	-1.1	6.6	20.8	-1.1	0.5	7.6	-0.5
Girls	*187*	13.8 ± 5.2	0.5	8.5	-0.6	3.7	17.6	-1.0	3.7	13.9	-1.0	1.1	7.0	-0.3
Age group, months														
6-8, BF	*80*	7.7 ± 1.2	1.3	12.6	-0.5	1.3	8.8	-0.6	5.0	15.0	-0.8	0.0	10.0	-0.2
9-11, BF	*98*	10.2 ± 1.1	2.0	9.1	-0.8	2.0	12.2	-0.8	4.1	15.3	-1.1	1.0	9.2	-0.3
12-23, BF	*119*	16.4 ± 2.7	0.8	10.9	-0.8	4.2	24.4	-1.3	5.9	20.2	-1.2	0.0	5.0	-0.4
12-23, NBF	*87*	20.4 ± 2.6	2.3	11.5	-0.6	6.9	27.6	-1.4	5.7	18.3	-1.2	2.3	5.7	-0.6

The 6-8 month old children consume cereals like maize and millet more in the form of liquid or semi-solid porridges. From 12 months onwards the children are increasingly introduced to family foods, such as beef, tuna, cowpeas, vegetables, rice balls and cassava dough, especially among those that are no longer breastfed. All foods consumed by 6-8 month old children are also consumed by older infants and children (with the exception of infant cereals). Very few children consumed nutrient-dense foods like meat, legumes, fruits and dairy.

The main food items consumed from each food group by the infants and young children are summarized in **Table 5.3**. The main cereal grains consumed in all age groups were maize, millet and rice, and cassava was the main starchy root. From bakery and breakfast cereals, mainly bread and biscuits were consumed. The variety of fish types was greater in the older age groups than in the younger ones. Meat consumption, as well as consumption of bread, was restricted to the children above 1-year of age. Dairy was mainly consumed in the form of powdered milk or evaporated milk. Groundnuts and cowpea were consumed, complemented with melon seeds. A large variety of vegetables, including green leafy vegetables, was consumed. Fruit was rarely consumed. Most of the time, red palm oil was used for cooking. White sugar was often added to tea or porridge.

Table 5.3. Main foods consumed by children per food group in Gomoa East Districts, Ghana

Food groups	**Foods**
Grains	Maize, millet, rice
Bakery and breakfast cereals	Bread, biscuits, infant cereals
Starchy roots and other starchy plant foods	Cassava, plantain
Meat, fish & eggs	Egg, smoked herrings, dried lean fish, smoked mackerel
Dairy	Cow milk evaporated and powdered
Legumes, seeds & nuts	Groundnut, cowpea, melon seeds
Vegetables	Vitamin A rich vegetables (cocoyam leaves, tomato paste, palm nuts pulp) onion, eggplant, turkey berries
Added fats	Red palm oil
Added sugar	White sugar

For nutrient-dense foods like meat, fish and eggs, and vegetables, a moderate to high proportion of children reportedly consumed these foods in the previous 24-hours. However, they were consumed in only small quantities (**Table 5.4**). For example, among breastfed children the mean portion sizes for meat, fish & egg, dairy, legumes, and vegetables were ≤10 g. Only a small or moderate proportion of children reportedly consumed nutrient-dense foods such as dairy and legumes and these foods were also consumed in very small portions. Fruit was only consumed by a few children. Portion sizes did not increase consistently with age among breastfed children, but were noticeably larger among non-breastfed compared to breastfed children at 12-23 months

of age. For more detailed information on foods and food sub-groups consumed, and their portion sizes, and frequency of consumption, refer to **Appendix V-A.** and **V-B.**

Table 5.4 Percentage of children consuming food groups and mean daily portion sizes*, per age group and breastfeeding state in Gomoa East District, Ghana (for additional details see Appendix V.A)

	Infants and young children consuming foods by food group in previous 24 hours (%)				Mean daily portion size (g/day)			
Food groups	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
Grains	87	86	95	93	35	56	56	93
Bakery and breakfast cereals	24	22	22	35	46	26	14	72
Starchy roots and other starchy plant foods	32	46	54	65	57	62	36	70
Meat, fish & eggs	48	63	70	90	5	8	5	10
Dairy	37	36	33	26	4	5	3	4
Legumes, seeds & nuts	16	18	23	35	4	4	6	11
Vegetables	48	68	78	89	6	7	10	16
Added fats	29	44	44	45	4	7	5	6
Added sugar	60	43	34	29	7	9	15	19

Legend: BF=breastfed; NBF=non-breastfed

* Data are presented only for food groups included in the Optifood analysis, which were those where at least one individual food item in that food group was consumed by >5% of children.

5.3.2 Cost of foods and daily diet

Costs of each food reported in the 24hR dietary survey was assessed in the market survey (**Appendix VI**). Based on these costs, the median cost (75th percentile) of a daily diet was estimated to be 0.71 (1.44) GH₵ for 6-8 months; 0.80 (1.42) GH₵ for 9-11 months; 0.81 (1.51) GH₵ for 12-23 months and 1.50 (2.62) GH₵ for 12-23 months old non-breastfed children.

5.3.3 Energy intake and food sources of energy

As noted in results presented for Karaga District (4.3.3), the total energy and nutrient intakes reported here are dependent on assumed intakes of breast milk. The amounts of nutrients that would be derived from breast milk based on the average (mean) and low (mean -2 SD) amounts for the 6-8, 9-11, and 12-23 month age groups (WHO/UNICEF, 1998) are presented in **Appendix VII** for comparison.

The daily median energy intake for the children by age and breastfeeding status is shown in **Figure 5.2**. Based on the assumed low breast milk intake estimate, the energy intakes of children less than one year of age are equivalent to the estimated energy requirements (hatched line in Figure 5.2) while the mean energy intakes for the breastfed children 12-23 mo of age was below the estimated energy requirement for this group. For children that were fully weaned, energy intakes were above the requirements[6]. When average breastmilk intake is assumed, mean energy intake of all children was higher than the estimated mean energy requirements in Gomoa East District (Figure 5.2).

As for Karaga District, the assumption of low breast milk intakes was considered realistic for this population given the relatively high rates of WHZ <-2 SD (i.e., 11.0%). To understand the implications of using different assumptions, energy and nutrient intake adequacy, and identification of problem nutrients are compared for both levels of breast milk intake, as addressed in sections 5.3.4 and 5.4.1, respectively.

Grains provide the largest contribution to the energy intake of all children, ranging from 38% in non-breastfed children to 49% in infants aged 6-8 months (**Table 5.5**). The second largest contributors to energy intake are added fat and starchy roots although the contribution is modest compared to that of grains.

[6] As noted above, the average age of non-breast fed children 12-23 months of age was approximately 4 months greater than their non-breastfed counterparts (Table 5.2); this age difference may result in higher average energy intakes and thus contribute to an apparently greater adequacy of energy intakes in this sub group compared to breastfed children 12-23 mo.

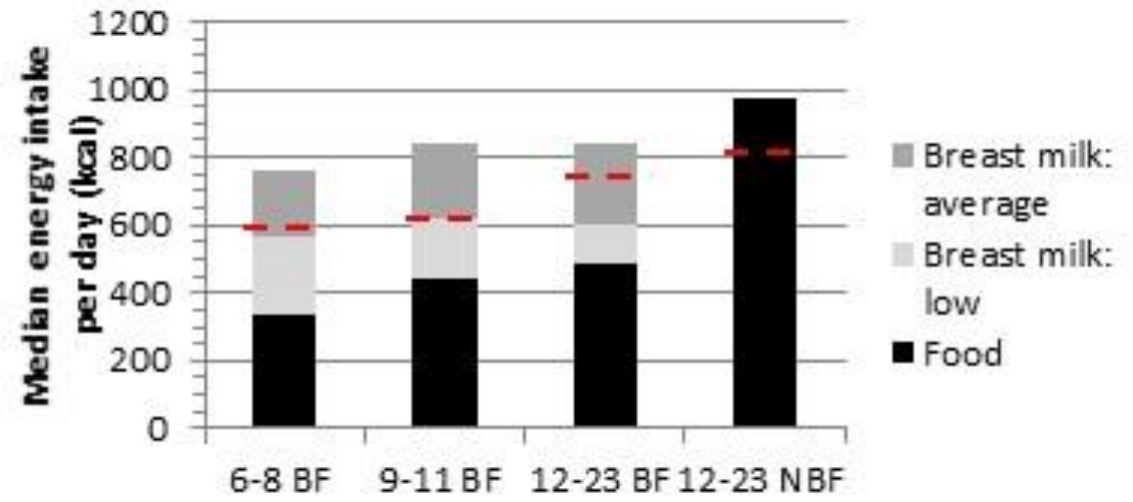

Figure 5.2. Median daily energy intake from food and breastmilk, at low (mean -2 SD) or average (mean) assumed breastmilk intakes, compared to daily energy requirements per age group and breastfeeding state in Gomoa East District, Ghana

Legend: BF=breastfed; NBF=non-breastfed; red dashed line represents daily energy requirement as average of age group and sex; breastmilk intake estimated as mean intake minus 2 SD (low) or mean intake (average) as per WHO/UNICEF (1998).

Table 5.5 Contribution of food groups to energy intake of children per age group and breastfeeding status in Gomoa East District, Ghana

Food groups	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
Grains	49	41	47	38
Bakery and breakfast cereals	13	6	8	11
Starchy roots and other starchy plant foods	13	22	15	17
Dairy	3	1	1	1
Legumes, seeds & nuts	3	1	3	4
Vegetables	3	5	4	6
Added fat	7	12	12	10
Added sugars	6	6	4	4
Others	3	6	6	9

Legend: BF=breastfed; NBF=non-breastfed

5.3.4 Micronutrient intake through the diet and inadequacy of intake

A large percentage of children across all age groups did not meet the RNI of most of the 11 key micronutrients considered, when using the assumption of low breastmilk intake. The percentage of children with intakes below the RNI tend to be lower among children who are no longer breastfed (**Table 5.6**). These very high prevalences of inadequate nutrient intakes are consistent with the low intake of nutrient-dense foods. When assuming average breast milk intake (see also 5.3.3), the percentage of children with intakes below the RNI for respective micronutrients was, in general, reduced in all age groups, with the largest differences occurring in the younger age groups, and for vitamins A, B12, and C (**Table 5.7**). Breast milk provides a relatively high proportion of the daily requirement for these nutrients and therefore increases in breastmilk intake will decrease the amount required from food (Appendix VII). However, for nutrients such as iron, zinc, calcium, niacin and vitamin B6, breast milk provides a relatively low proportion of the daily requirement (Appendix VII). Even if nutrient bioavailability is significantly higher from breastmilk than from food, an average breast milk intake does not substantially decrease the amounts required from the diet compared to low breast milk intake. As a result, for these latter nutrients, the difference in breastmilk intake assumption does not substantially decrease the nutritional risk.

Table 5.6 Percentage of children whose intake is below the EAR/RNI* for 11 micronutrients, by age group and breastfeeding status, assuming low breastmilk intake, in Gomoa East District, Ghana

Micronutrients	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
		Percentage below EAR/RNI		
Calcium	94	94	98	96
Iron (low bioavailability)	100	100	95	85
Zinc (low bioavailability)	88	89	54	27
Vitamin A	78	66	61	57
Niacin	82	78	78	50
Riboflavin	83	79	78	63
Thiamin	54	59	74	56
Vitamin B6	54	45	57	21
Folate	85	78	86	77
Vitamin B12	63	53	46	30
Vitamin C	69	59	61	45

Legend: BF=breastfed; NBF=non-breastfed

*Based on RNIs from FAO/WHO (2004); for infants 6-8 and 9-11 months, the prevalence of intakes below the RNI was used, while for children 12-23 months of age, the RNI was converted to the EAR equivalent using conversion factors (WHO/FAO, 2006). Exceptions are for iron, for which no conversion factors are available, and for zinc, the EARs for low bioavailability diets from IZiNCG (2004) were used for all age groups.

Table 5.7 Percentage of children by age group and breastfeeding status whose intake is below the EAR/RNI* for 11 micronutrients, assuming average breastmilk intake, in Gomoa East District

	6-8 BF	9-11 BF	12-23 BF	12-23 NBF
	Percentage below EAR/RNI			
Calcium	81	86	94	96
Iron (low bioavailability)	100	100	94	85
Zinc (low bioavailability)	83	83	42	27
Vitamin A	54	47	20	57
Niacin	78	67	72	50
Riboflavin	67	58	56	63
Thiamin	38	42	66	56
Vitamin B6	53	43	50	21
Folate	60	50	83	79
Vitamin B12	43	36	31	30
Vitamin C	36	28	18	45

Legend: BF=breastfed; NBF=non-breastfed

*Based on RNIs from FAO/WHO (2004); for infants 6-8 and 9-11 months, the prevalence of intakes below the RNI was used, while for children 12-23 months of age, the RNI was converted to the EAR equivalent using conversion factors (WHO/FAO, 2006). Exceptions are for iron, for which no conversion factors are available, and for zinc, the EARs for low bioavailability diets from IZiNCG (2004) were used for all age groups.

5.4 Optifood analysis

5.4.1 Problem nutrients

Problem nutrients refer to nutrients for which requirements are difficult to meet with the available local foods and dietary patterns among the target groups. A summary of problem nutrients by target groups with the assumption of low breastmilk intake is given in **Table 5.8**. The extent of inadequacy of niacin in the diet may be overestimated as only sources of preformed niacin were considered; intake of tryptophan, which may be converted to niacin, has not been accounted for.

In Gomoa East District there is a range of realistic recommendations to current diets that would improve nutrient intake adequacy using local foods that are already part of the infant and young child diet. Among breastfed children 6-23 months of age, iron and zinc (all children), niacin (6-8 months) and calcium (12-23 months) are problem nutrients and requirements for these nutrients could not be met with any combination of local foods. Also, among the non-breastfed children 12-23 months of age, only the requirement for calcium could not be met. For all other micronutrients considered, requirements could be met with the local infant and young child foods when consumed within the boundaries of the current dietary intake patterns, although changes to the number of servings per week for many individuals may be necessary.

Table 5.8 Summary of problem nutrients in the diet of children by age group and breastfeeding status, assuming low breast milk intake, in Gomoa East District, Ghana*

Micronutrients	6-8 BF	9-11 BF	12-23 BF	12-23 NBF
Calcium				
Iron				
Zinc				
Vitamin A				
Niacin				
Riboflavin				
Thiamin				
Vitamin B6				
Folate				
Vitamin B12				
Vitamin C				

Legend: : BF=breastfed, NBF=non-breastfed

*Problem nutrients will be fewer if average breastmilk intakes are assumed. See Appendix VIII for details of these differences.

Nutrient requirements cannot be met by any combination of local foods

Nutrient requirements could be met but may require changes in the diet

The intake of total fat and protein were adequate, but we did not assess adequacy of the quality and composition of fat and protein consumed due to lack of complete food composition data on the content of the subcomponents of these macronutrients.

These results are valid only for the assumption of low breast milk intakes (i.e., mean – 2 SD). When assuming average breast milk intake, the number of problem nutrients in general was reduced, especially for vitamins A, B12, and C (**Appendix VII**).

5.4.2 Food-based recommendations

To address the identified shortcomings of local diets and intake patterns, the Optifood analysis proposes recommendations that establish the quantity and frequency of consumption of available foods, expressed as recommended number of servings per week. It also indicates when such recommendations are insufficient to meet the requirements for all 11 nutrients considered and, hence, where more drastic changes to the foods or their frequency of consumption would be required to achieve adequacy for all nutrients. In each age and breastfeeding status group, we examined the optimization of nutrient intake adequacy only using the foods reported to be consumed by these infants and young children; we did not attempt to model the potential impact of any other nutrient-dense foods, including fortified foods, micronutrient powders, or other micronutrient supplements that were not reported to be consumed.

Table 5.9 shows the foods that contribute >5% RNI for at least one of the 11 micronutrients considered. These foods were incorporated individually and in combination to meet or come as close as possible to meeting nutrient needs of individuals in the target groups. For detailed information per food and nutrient, see **Appendix IX**.

Table 5.9 Foods providing > 5% RNI of at least one of the 11 micronutrients considered by age-group and breastfeeding status

6-8 BF	9-11 BF	12-23 BF	12-23 NBF
Cassava tuber	Fortified infant cereal	Biscuit, sweet	Biscuit, sweet
Fortified infant cereal	Cocoyam leaves	Cassava tuber	Cassava tuber
Cocoyam leaves	Fish (anchovies, herrings, salmon)	Chocolate drink powder	Chocolate drink powder
Cowpea, white, flour	Melon seeds	Cocoyam leaves	Cocoyam leaves
Fish (herrings, general lean, salmon)	Cow milk powder	Cowpea, white, dried	Cowpea white dried
Groundnut flour with fat	Millet flour	Fish (anchovies, herrings, general lean)	Fish (herrings, general lean, tuna)
Groundnut paste	Okro fruit	Groundnut paste	Groundnut paste
Cow milk powder	Tomatoes	Maize dough, whole grain	Meat, beef
Millet flour	Tomato paste	Melon seeds	Millet flour
Tomato paste		Millet flour	Red palm oil
		Red palm oil	Vegetable oil (vitamin A fortified)
		Okro fruit	Palm nuts pulp
		Palm nuts pulp	Tomatoes
		Tomatoes	Tomato paste

Legend: BF=breastfed; NBF=non-breastfed

Table 5.10 Minimum and maximum servings per week per food group by target group in Gomoa East District, Ghana

	6-8 BF (n=87)		9-11 BF (n=97)		12-23 BF (n=100)		12-23 NBF (n=84)	
Food groups[1]	**Servings per week**							
	Min[2]	Max[3]	Min[2]	Max[3]	Min[2]	Max[3]	Min[2]	Max[3]
Grains & grain products	0	14	0	21	0	21	0	21
Starchy roots & other starchy plant foods	0	14	0	21	0	14	0	21
Legumes, nuts & seeds	0	14	0	7	0	14	0	14
Meat, fish & eggs	0	28	0	28	0	28	0	35
Beverages (non-dairy or blended dairy)	-	-	-	-	0	7	0	7
Dairy products	0	7	0	7	0	7	0	7
Vegetables	0	35	0	42	0	42	0	49
Bakery & breakfast cereals	0	7	0	7	0	7	0	7
Added fats	0	14	0	14	0	21	0	21
Added sugars	0	7	0	7	0	7	0	7
Breastmilk	*6.9*	*7*	*6.9*	*7*	*6.9*	*7*	-	-

Legend: BF=breastfed; NBF=non-breastfed

[1]Food groups are classified as it is in Optifood

[2]5th percentile of the weekly frequency

[3]95th percentile of the weekly frequency

The minimum and maximum number of servings per week per food group are shown by age group and breastfeeding status in **Table 5.10**. The number of servings per week increased or remained the same with increasing age, except for meat, fish, eggs and bakery and breakfast cereals. Numbers of servings per week for sub food groups are shown in **Appendix V-B** (Table V-B.2).

The food-based recommendations are presented in **Table 5.11a**. Final recommendations were selected based on two criteria: (1) costing not more than the 75th percentile of the daily diet cost distribution of the target group, and (2) covering 70% RNI or more for the largest number of nutrients. For detailed information on the Optifood analysis and coverage of RNI per single food and combinations of food, see **Appendix X** (Table X.5-X.8).

In combination with other foods, consuming at least the foods included in the modification will improve the nutrient adequacy of micronutrients. However, even if all of the food-based recommendations are adopted, there would still be gaps in nutrient intake adequacy, particularly for iron and zinc (see **Table 5.12a**). Solutions must extend beyond the use of food items already used in IYCF in these populations.

Table 5.11a Food based dietary recommendations for young children per age group and breastfeeding state, assuming low breastmilk intake, Gomoa East District, Ghana

Foods	**6-8BF**	**9-11BF**	**12-23 BF**	**12-23NBF**
Breast milk	Every day	Every day	Every day	
Fats			1 serve (red palm oil)	3 serves (of which 1 red palm oil)
Legumes			2 serves	
Starchy foods	1 serve of cassava		2 serves	2 serves
Dark green leafy vegetables	1 serve	1 serve	1 serve	1 serve
Fish	1 serve (small whole fish)	2 serves (small whole fish)	1 serve (small whole fish)	3 serves (fish without bones)
Fortified chocolate beverage powder			1 serve	
Grains (preferably whole grains)	1 serve	3 serves	2 serves	2 serves

Legend: BF=breastfed; NBF=non-breastfed

To improve the practical incorporation of the recommendations into complementary feeding guidelines, we made adjustments to the original, target group-specific FBRs to make these more consistent across groups where possible, and avoid having completely distinct sets of FBRs for each. These adapted FBRs are given in **Table 5.11b**, and details are given in Appendix X. The final coverage of nutrient RNIs are reported in **Table 5.12b**. These adjustments resulted in a similar number of nutrients for which the RNI would be met.

Table 5.11b Food based dietary recommendations for infants and young children per age group and breastfeeding state, revised to improve consistency across age groups, assuming low breast milk intake, Gomoa East District, Ghana

Foods	**6-8 BF**	**9-11 BF**	**12-23 BF**	**12-23 NBF**
	servings per day			
Breast milk	Every day	Every day	Every day	
Red palm oil			1 serve	1 serve
Legumes		1 serve	1 serve (beans and peas)	1 serve
Starchy roots (preferably vit C rich)	1 serve of cassava	1 serve	2 serves	2 serves
Green leafy vegetables	1 serve	1 serve	1 serve	1 serve
Fish	1 serve (small whole fish)	2 serves (small whole fish)	3 serves (1 small whole fish and 2 fish with bones)	3 serves (fish without bones)
Grains (preferably whole grains and not including rice)	1 serve	2 serves	2 serves	2 serves

Legend: BF=breastfed; NBF=non-breastfed

Table 5.12a Nutrient composition and diet costs in the worst case scenario of the selected food based recommendations per target group in Gomoa East District, Ghana

	Percentage RNI												
Target group	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH₵/day**	**≠Nutrients ⩾70 % RNI**
6-8 month BF	44	161.2	67.6	76.2	54.3	88.4	97.9	193.1	62.1	12	28.2	0.2	5
9-11 month BF	31.7	51.5	138	80.7	98.5	165.2	78.3	240.9	50.5	35.2	47.8	0.7	6
12-23 month BF	27.3	113.2	72	66.9	53	103.1	58.2	143.2	149.3	56.2	78.7	0.7	6
12-23 month NBF	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	124.3	65.8	78.5	0.9	8

Legend: BF=breastfed; NBF=non-breastfed; RNI=recommend nutrient intake

Table 5.12b Nutrient composition and diet costs in the worst case scenario of the harmonized food based recommendations per target group in Gomoa East District, Ghana

	Percentage RNI												
Target group	**Ca**	**Vitamin C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vitamin B_6**	**Folate**	**Vitamin B_{12}**	**Vitamin A (RAE)**	**Fe**	**Zn**	**GH₵/day**	**≠Nutrients ⩾ 70 % RNI**
6-8 month BF	44	161.2	67.6	76.2	54.3	88.4	97.9	193.1	62.1	12	28.2	0.2	5
9-11 month BF	31.4	62.4	125.2	79	100.6	156.8	77.8	240.5	51.9	30.1	44.1	0.6	6
12-23 month BF	26.9	113.4	71	68.4	54	107.6	55.8	195.3	150	54.1	70.5	0.8	6
12-23 month NBF	28.5	184.4	82.6	73.3	74.7	149	64.9	116.7	124.3	68.8	87	1.0	8

Legend: BF=breastfed; NBF=non-breastfed; RNI=recommend nutrient intake

6. SUMMARY, RECOMMENDATIONS AND NEXT STEPS

Summary

The results of these analyses show that stunting is a problem of high public health concern with higher prevalence in Karaga District compared to Gomoa District. The current micronutrient adequacy of the diet is poor for all age groups, especially in Karaga District. The modelling of the diets indicates that dietary diversity and nutrient adequacy can be improved significantly in both districts using foods that are currently consumed.

However, even the best modelled diets could not meet all requirements, so that even if the FBRs were fully adopted, there would still be large gaps in intake adequacy for some nutrients. In Karaga District among the breastfed target groups, inadequate intakes of iron, calcium, and folate (all 3 breastfed target groups) and zinc, vitamin A, riboflavin and vitamin C (for at least 2 breastfed target groups) would remain, assuming low breastmilk intake. In Gomoa East District, intakes of iron and calcium in particular will remain inadequate (all 3 breastfed target groups) and zinc, vitamin A, and niacin (for at least 2 breastfed target groups). For the non-breastfed 12-23 month old children, nutrient requirements that could not be met even if the FBRs were fully adopted are iron, vitamin A, and possibly niacin (Karaga District) and iron, folate and calcium (Gomoa East District) but may require significant changes in the diet. As a result, additional interventions and solutions are required to enable consumption of nutrient-dense foods beyond those that are already consumed by infants and young children in the districts, especially in the rural northern Ghanaian District of Karaga.

The inability to cover requirements for all 11 nutrients reflects the limited number, frequency, and amounts of foods consumed by the infant and young children in the local diet, that are good sources of nutrients. Nutrient dense foods like meat, legumes, red palm oil, vegetables and dairy were consumed in low quantities with average daily portion sizes between 1-10 g. Cow milk in the form of powder (in both districts) and small dried fish (in Karaga District), which are good sources of iron and zinc, were the only animal source foods consumed, although in Gomoa East District a wider variety of animal source foods are consumed including eggs and different fish varieties. Whereas dark green leafy vegetables are consumed daily by infants and young children, consumption of fruits is far less common. As the linear modelling approach used in Optifood for the present analysis was intentionally limited to the selected foods and the frequencies and portion sizes that are currently being consumed by the target groups, the inclusion of these foods was limited in the food-based recommendations. Before modelling these infrequently consumed nutrient-dense foods, it is recommended to consider whether adopting the more frequent use of animal source foods and fruits for infants and young children is feasible, culturally acceptable, and realistic in these districts.

The results indicate that, within the constraints of the local dietary pattern, it is more difficult to meet nutrient requirements in the 12-23 month old breastfed child age group compared to their non-breastfed counterparts and this may have several explanations. First, the estimated level of energy intake from the IYC diet is one of the main constraints for the food based recommendations and their ability to fill nutrient intake gaps in the Optifood analysis, and thus a greater energy requirement from non-breastmilk foods increases the food options the programme has to select from to fill nutrient intake gaps, as is the case for the non-breastfed children. This points to the importance of consumption of nutrient-dense foods especially in this age group. Concurrently, the diversity of the diet,

and the frequency and average portion sizes of foods consumed by the non-breastfed children tended to be higher in the non-breastfed groups (in part attributed to the older age of non-breastfed children), and thus the options for food-based recommendations were less constrained. As consumption of nutrient-dense foods is low in these districts, it confirms the above recommendation to strengthen promotion of nutrient-dense foods for young children. The promotion of increased breastmilk through breastfeeding on demand should always be a priority.

Limitations of the study results

The dietary and Optifood analysis has some limitations that need to be acknowledged and are important for the interpretation of results:

- The analysis is dependent on the quality of the dietary recall data, the food composition table used, the assumed bioavailability of nutrients and the proposed RNIs. However, the analysis and results are based on the best available information at this time.
- Data collection took place during the rainy season before the harvest, and results cannot necessarily be extrapolated to other seasons. Given that food is more abundant in the post-harvest season, it is possible that nutrient intake gaps in that season would be smaller and that those gaps could be filled with a smaller number of modifications. It is also possible that since food is more abundant and tends to be more accessible in the post-harvest season, the food-based recommendations derived in the pre-harvest season would be more feasible to implement by more households. Comparative analyses using dietary intake data from different seasons would be required to understand how food-based recommendations might change.
- Foods reported by <5% of the children in the 24hR were not included in the analysis and may have limited the options the Optifood analysis had for selection of foods. On the other hand, including these foods may decrease the feasibility of implementing recommendations that might include those foods.
- Breastmilk intakes were not measured directly and assumed intakes were based on estimated energy intakes from breast milk for populations in low income countries (WHO/UNICEF, 1998; Dewey and Brown, 2003). We assumed a low intake of breastmilk (i.e., average intake -2 SD) based on field observations concerning breastfeeding practices with frequent but very short breastfeeding episodes and the high level of stunted and wasted infants and young children in the districts. This implied that a larger contribution of energy and nutrients would need to be derived from complementary foods to meet requirements. For the purpose of deriving FBRs to fill nutrient intake gaps, the larger requirement from complementary foods increased the scope and options for those FBRs.

  Differences in the modeled and actual breastmilk intakes will modify our findings, and the selection of different breastmilk intake assumptions will affect identification of problem nutrients and the resultant FBRs. Our assumption of low breastmilk intake may underestimate the total energy and nutrient intakes by these children, and overestimate the nutrient intakes gaps that need to be filled. Our analysis shows that nutrients that may be affected by this are vitamins A, B12, and C as breastmilk provides a relatively high proportion of the nutrient requirements. Nonetheless, even with the assumption of average breast milk intake, the prevalence of inadequate intakes of the latter nutrients is still elevated, indicating only very small amounts are derived from the complementary diet. Further, given

that the FBRs presented do not fully cover the nutrient requirements, their adoption would still leave gaps to be filled. Even with some underestimation of actual intakes, it is unlikely that the FBRs as presented would pose an unnecessary burden for improving the adequacy of infant and young child diets or lead to unnecessary interventions.

- It is important to emphasize that the data used to set the model parameters in Optifood originated from limited areas in the northern and the southern part of Ghana, and the agro-ecological zones in which the two study areas were located are not representative of the whole of Ghana. Therefore, the extent to which the recommendations derived in this analysis also apply to other areas in Ghana needs to be further assessed. Results from this study may not apply to areas that are not similar to our study areas.

Recommendations

While to some extent, promotion of the food-based recommendations through nutrition education or behavior change communications activities may lead to improvements in infant and young child dietary adequacy, cost and poor access to nutrient-dense foods are likely major barriers to their use. Clearly, additional strategies are required to help overcome these barriers and improve access to low cost nutrient-dense foods. Agricultural- and market-based strategies in combination with nutrition specific interventions including food fortification, and home fortification options, may offer opportunities to further facilitate adoption of recommendations and provide additional support to improve nutrient adequacy.

Agriculture-based interventions may support the adoption of the recommendations, when focusing on increasing the local production and marketing of the nutrient-dense foods identified in the Optifood analysis, such as (green leafy) vegetables, legumes, or milk. The following agronomic opportunities appropriate for the context of Karaga and Gomoa East Districts that could be considered to help support the feasibility of adopting the food-based recommendations are suggested:

- Maize and millet are the main cereals used for porridge preparation and are among the cultural core foods in the infant and young child diet. In view of the identification of vitamin A intakes as inadequate in both districts, the introduction of dark orange maize biofortified with pro-vitamin A might be considered. To contribute to the iron and zinc adequacy, iron and zinc biofortified millet could offer a solution, especially in Gomoa East District. However, these nutritionally-improved crops have not yet been introduced in Ghana and hence this may represent a longer term strategy. Introduction and local adaptation of biofortified millet and maize varieties may be considered and may provide information on the feasibility and acceptability of these improved crops for infants and young children. As a first step, the impact of these foods on the adequacy of vitamin A, iron and zinc could be modelled using Optifood.
- In addition, it may be considered to promote the production and use of soybean milk to fortify grain and millet based porridges. Soybean milk is nutrient dense and provides several micronutrients. Small scale processes to produce fortified soy milk are developed, for example by Malnutrition Matters (Canada), which could be a nutritionally attractive and affordable alternative for cow's milk as an additive to porridges among non-breastfed children.

- Vegetables, and especially green leafy vegetables, are prominently included in the food based recommendations for both districts. Although vegetables are generally available in both districts, the limited amounts and the seasonal absence of fresh vegetables were noted as important limitations to the use of these in infant and young child diets. Promoting horticulture activities may contribute to increased access to vegetables, and specific messages to increase the frequency of feeding these among the youngest age groups, should be included. Home production of vegetables may also support access, but feasibility of this in terms of quantities of foods that need to be produced, the time burden or opportunity cost required to produce them, current levels of production, seasonality, and input requirements for production (e.g., seeds, water, etc.) should be evaluated. Ensuring the local availability of quality seed and introduction of water-management practices may also support year-round availability of vegetables.
- In Karaga, the use of dried green leaves and dried okro is already practiced; introducing improved drying and storage practices to reduce post-harvest losses of those vegetables would help extend their availability outside the main growing season. Ensuring the local availability of quality seed and introduction of water-management practices may also support year-round availability of vegetables. Worth mentioning is the RING and SPRING program efforts to interlink dry season farming with nutrition, which is key in improving the narrow dietary choices available especially during the lean/dry seasons, and in Karaga District in particular.

Despite the high value given to self-sufficiency in food production, infant and young child foods cannot be provided with on-farm produce alone, and market purchases are indispensable when adopting the food based recommendations. This provides an opportunity to strengthen markets for nutritious food products:

- Milk in the form of milk powder (in Karaga district) and small anchovies fish (in Gomoa East) need to be purchased at informal and formal markets. However, costs are constraining the incorporation of sufficient amounts of milk powder and/or fish in the family food and in infant and young child diets in particular. Value chains for milk powder and small fish should be examined to identify opportunities to strengthen them, improve efficiencies with the aim of reducing their cost, and hence to improve accessibility to these foods.
- Although meat is absent in the current IYC diet and therefore does not appear among the FBRs identified by this analysis, interventions on small ruminants and poultry production and consumption (such as USAID/Ghana RING projects) may offer an opportunity to introduce meat production and consumption as 'external' solutions that reach beyond the currently available foods.
- The consumption of chocolate drink powder, fortified infant cereal, and milk powder, indicates the availability of these products at the market, but accessibility is constrained by the cost of these foods. This might indicate that there is room for low-cost (locally produced) fortified beverage or porridge mixes specifically formulated for infants and young children. These could provide great nutritional benefit if offered at a low cost. Public-private partnerships already exist in Ghana to provide low-cost fortified products for these age groups, but these products are not yet available at the public markets.

Next steps

The Optifood analysis provided technical information regarding problem nutrients, best food sources for nutrients, and food-based recommendations that could meet or come as close as possible to meeting, the nutrient needs for infants and young children in the different target groups. However, the extent to which the developed food-based recommendations are feasible and affordable to implement by the target population remains to be determined. The modelling was based on the local dietary pattern reflecting the foods that are consumed by at least some (i.e. >5%) of the children in the study areas. The recommendations may therefore be considered as realistic and achievable by some, but may ask for substantial changes for others.

The feasibility of successfully promoting the recommendations should be evaluated by household trials taking into account, amongst others, food availability on-farm and in the market, prices of foods and their fluctuations, time needed for preparation, individual preferences, and caregiver's other time commitments for child care, food production, water and fuel collection. These trials, using program tools like ProPAN (PAHO, 2013) or Trials in Improved Practices (Dickin et al, 1997; Dickin and Seim, 2013), will identify barriers and supporting factors that could encourage the adoption of the recommendations. This may lead to adaptation of the suggested food-based recommendations to facilitate their adoption, while the information obtained can also assist in formulating appropriate messages to be used in behaviour change strategies to promote the recommendations.

A next step in the modelling process is to optimize diets by including promising nutrient dense foods that address, in particular, the problem nutrients identified. These include foods that are available in the local settings but were not consumed by >5% of infants and young children, and those that represent new potential product formulations not yet introduced (eg, fortified complementary foods), or home fortification products, consumed at different frequencies. This step of analysis would also be useful to conduct after determining the feasibility of the food-based recommendations; if some are determined to be infeasible for many caregivers to adopt, these novel food items may need to fill additional nutrient intake gaps.

The local and regional value chains for small fish, milk powder and fruits and vegetables should be further assessed to understand both the constraints and opportunities to improve the accessibility of these foods to households in these areas. It is also important to understand potential (environmental) trade-offs for expanding fruit and vegetable production. A principal dilemma in development of value chains for nutrient-dense foods is the tension between assuring their affordability for low-income consumers, and ensuring sufficient price incentives for smallholder farmers to produce quality raw materials or produce. The assessment should look into infrastructural and logistical aspects of the specific agri-food value chains, as well as options for increased efficiencies. Results should inform what types of interventions in the specific value chains would lead to more affordable, available, or more preferred (in terms of quality characteristics) small fish, milk, and fruits and vegetables for the target populations.

Lastly**,** the potential for a low-cost fortified beverage mix or porridge mix targeted for children 6-23 months should be assessed. Although these types of products are available in the market, these products may at the moment be inaccessible for many, or caregivers may not be aware of their nutritional value. Understanding the barriers and potential opportunities to increase awareness and accessibility of appropriate fortified foods should be determined both for the northern as well as the southern part of Ghana. Micronutrient

powders, although acceptance by caregivers was not studied here, may offer another opportunity to complement food-based recommendations to achieve nutrient intake adequacy among infants and young children.

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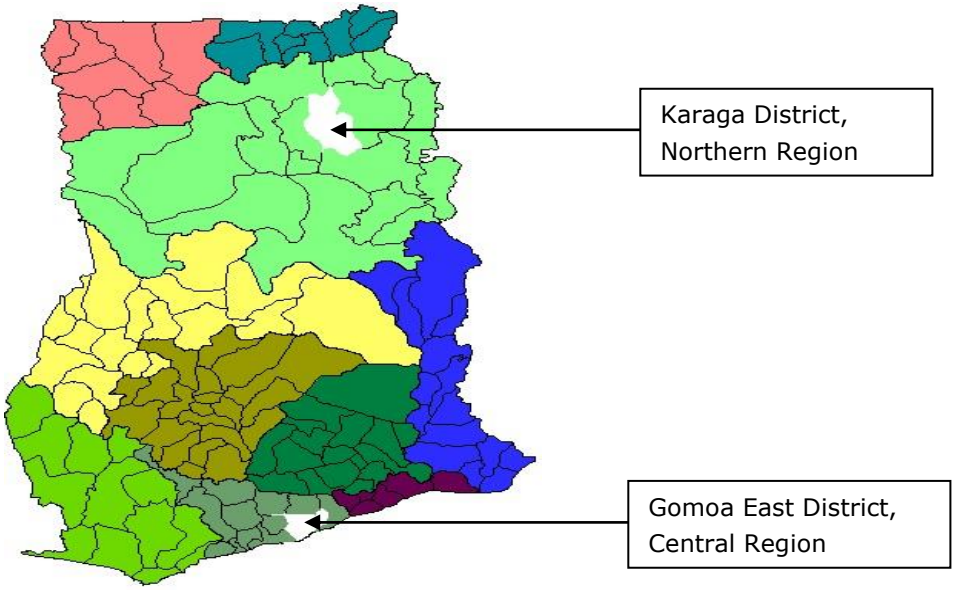
APPENDIX I: MAP OF LOCATION OF KARAGA DISTRICT AND GOMOA EAST DISTRICT IN GHANA



APPENDIX II: SURVEY INSTRUMENTS

GAIN FES/Optifood Research, Ghana

Food Consumption Survey of Infants and Young Children 6-23 months

Karaga and Gomoa East Districts, 2014

NMIMR/UDS/WU

A. General Information

1. District Name:	2. Sub-district Name:	3. Community Name:
4. Household name:	5. Household number:	10. Date of 1st visit (dd/mm/yy): Time Started: Time Ended:
6. Name of index child:	7. Index child ID:	11. Date of 2nd visit (dd/mm/yy): Time Started: Time Ended:
8.Interviewer's name:	9. Interviewer's number:	12. Date of 3rd visit (dd/mm/yy): Time Started: Time Ended:
13. Supervisor name & No:	14. Date Supervisor check: Signature:	15. GPS coordinates household North/South: __ __ . __ __ __ __ __ East/West: __ __ __ . __ __ __ __ __ Altitude (meter): _____
16. Supervisor2 name & No:	17. Date Supervisor2 check: Signature:	18. Data entry (dd/mm/yy): Signature:

Appendix II-A: Household Questionnaire (Demographic and Socioeconomic Characteristics)

Household Survey

Respondent: 1 Head of household 2 Mother of index child (circle)

1. Household Roster (*if there are remarks, these should be numbered and written at empty page)*

								IF FEMALE AND ≥ 14 YEARS								
NO.	**USUAL RESIDENTS**	**RESIDENCE**		**AGE**			**SEX**	**PERIODS**	**PREGNANCY**		**LACTATING**	**RELIGION**	**EDUCATION**	**OCCUPATION**	**WEEKLY EARNINGS**	
	Names of persons who eat from the same cooking pot as the index child	Does NAME usually live here?	Did NAME stay here last night?	How old is NAME? **0 – 6 months**	**6 – 11 months**	**> 12 months**	Is NAME male or female?	Does NAME has her periods?	Is NAME pregnant?	If yes, in which trimester?	Is (NAME) breastfeeding?	Religion of NAME?	1=S.H.S or higher 2=J.H.S. or higher 3=primary school 4=literate (Arabic) 5=none, 6=other*	1=office work 2=trader 3=farmer 4=housewife 5=none 6=other*	Does NAME earn money?	If yes, how much per week?
		N=no Y=yes	N=no Y=yes	N=no Y=yes	N=no Y=yes	Completed years	M=male F=female	N=no Y=yes	N=no Y=yes	1=1-12 wks 2=13-28 wks 3=29-40 wks	N=no Y=yes	1=Christian 2=Muslim 3=Others	Code: 1 to 6 *specify	Code: 1 to 5 *specify	0=no** 1=yes, F 2=yes, OF	1=1-3 GH₵ 2=3-7 GH₵ 3=>7 GH₵
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
1	Head of household															
2	Mother of index child															
3																

4																
5																
6																
7																
8																
9																

***[1=yes, F] = yes, mainly farm income; [2=yes, OF] = yes, mainly off-farm income (includes working on other people's farm)*

Appendix II-B: 24hR form

Interview Date:	**Date of assessed food intake:**	**Recall number:** 1 2 (circle)
Enumerator Name:	**Childs Name:**	**Child ID Number:**
Breastfed: Yes No (circle)	**Caregiver's Name:**	**Respondent: 1 <u>Mother</u> 2 Caregiver** (circle)
Scale number:	**Weight of mobile: .....**	

Yesterday: (Circle)

1. Did the child take medicine yesterday?	Yes	No	If yes, name:
2. Was yesterday a celebration/feast day where the child ate unusual foods:	Yes	No	
3. Did the child feel unwell yesterday:	Yes	No	If yes, symptoms:

Quick list	**Logbook**

Meal code*	Place of preparation**	Dish name	Ingredients				Amounts per ingredient				Total volume cooked		Consumers	Total volume served to the child		Left over (of food served to the child)	
			Description	Origin ***	Method of preparation - *What did you do with the ingredient?* (condition consumed, eg. boiled, raw, peeled, fried etc)	No. of days in last 7 days	Quantity	Unit (eg. g, kg, ml, GH₵, pieces)	Measured with	Condition measured (eg. raw, (un)cleaned, (un)peeled, **brandname** etc)	Quantity	Unit	No. who eat the food	Quantity	Unit	Quantity	Unit
A	B	C	D		E	F	H	I		G	J	K		L	M	N	O

* Meal code: 1=before breakfast, 2=breakfast, 3= mid-morning, 4= lunch, 5=afternoon, 6=dinner/supper, 7=before sleep, 8=during night

** Place: 1= inside, 2= outside

*** Origin: 1=own production, 2=purchase, 3=gift, 4=in kind, 5=from wild

Appendix II-C: Household Food Access

In answering each of the following questions, please respond according to your situation in the past 4 weeks or 30 days

QNo.	Question	Response Option	Code (do not fill)
1	***In the past 4 weeks/30 days***, was there ever no food at all in your household because there were not enough resources to get more? *A daa bi toi nya, bee a sulinsi maa so daa bi nya bindiri payapaya yiko kalinsi øuêu?*	0 = No (skip to Q2a) 1 = Yes 0 = Aayi 1 = Iii	....|_____|
1a	How often did this happen ***in the past 4 weeks/30 days***? *Bu la ka lala daa niå?*	1 = Di bi yoli (yim bee buyi biâê'30 maa puuni) 2 = Chirigili (but 3 øaå cheni 10 biâê'30 maa puuni) 3 = Di niåda (Di gari bu 10)	....|_____|
2	***In the past 4 weeks/30 days***, did you or any household member go to sleep at night hungry because there was not enough food? *A daa min gbe kum, bee a sulinsi maa so daa min gbe kum bindirigu kalinsi zuêu?*	0 = No (skip to Q3a) 1 = Yes 0 = Aayi 1 = Iii	....|_____|
2a	How often did this happen ***in the past 4 weeks/30 days***? *Bu la ka lala daa niå?*	1 = Di bi yoli (yim bee buyi biâê'30 maa puuni) 2 = Chirigili (but 3 øaå cheni 10 biâê'30 maa puuni) 3 = Di niåda (Di gari bu 10)	....|_____|
3	***In the past 4 weeks/30 days***, did you or any member of your household go a whole day without eating anything because there was not enough food? *A daa min be di dabsili pulni bee a sulinsi maa so daa min be di dabsili pulni domin bindirpooli zuêu?*	0 = No (end questionnaire) 1 = Yes 0 = Aayi 1 = Iii	....|_____|
3a	How often did this happen ***in the past 4 weeks/30 days***?	1 = Di bi yoli (yim bee buyi biâê'30 maa puuni)	....|_____|

	Bu la ka lala daa niå?	2 = Chirigili (but 3 øaå cheni 10 biâê'30 maa puuni) 3 = Di niåda (Di gari bu 10)	

Appendix II-D: Anthropometry Form

1. Interview date: _____/_____/2014
2. District name: _____ 3. District number: _____
4. Sub-district name: _____ 5. Sub-district number: _____
6. Community name: _____ 7. Community number: _____
8. Household name: _____

Index child (6 – 23 months)

9. Name of index child: _____

10. Sex of child: 1 Male 2 Female (circle)

11. Date of birth of child: _____/_____/_____ (dd/mm/yyyy)

12. Date of birth verified from: 0 Not verified
1 Birth certificate
2 Health records booklet
3 Community register
4 Other document, specify: _____

13. Age of child: |_____|_____| (in completed months)

14. Weight child: A. __ __.__(kg) 15. Length child: A. __ __ __ .__ (cm)
B. __ __.__(kg) B. __ __ __ .__ (cm)

16. MUAC child: A. _____ (mm)
B. _____ (mm)

17. Presence of bilateral pitting edema: 0 No 1 Yes (circle)

Mother of index child

18. Weight mother: A. __ __ __.__(kg) 19. Height mother: A. __ __ __ .__ (cm)
B. __ __ __.__(kg) B. __ __ __ .__ (cm)

Number of scale used: _____

Appendix II-E: Market survey form

Date: _____/_____/2014 District: _____ Name of market: _____
Name of interviewer:_____

Food Item	Unit of sale	Commercial Food Source*			Months Available	Price (Gh₵)			Price/100 g edible portion (GH₵)
		Market	Store	Other (specify)		Seller 1	Seller 2	Seller 3	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

*Tick (√) as appropriate

APPENDIX III: SUMMARY OF THE MODEL PARAMETERS USED IN THE OPTIFOOD ANALYSIS

	Data source	**Specification**
Model parameters[1]		
List of foods	24hr recalls	Non-condiment foods consumed by >5% of the children
Serving size per food	24hr recalls	Median serving size (g/day)
Cost per food	Market survey	GHC/100g edible portion
Min and max number of servings per week per food	24hr recalls	Estimated within subgroup based on % of children consuming the food
Min and max number of servings per week per food group	24hr recalls	5th and 95th percentile
Min and max number of servings per week per sub-food group	24hr recalls	5th and 95th percentile
Nutrient composition per food	Ghana FCT	Energy, protein, fat, carbohydrate, calcium, iron, zinc, vitamin A, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C
Breast milk, intake amount and energy and nutrient content	WHO/UNICEF (1998))	Low intake (Mean –2 SD), being 372 ml per day for 6-8 mo; 272 ml for 9-11 mo, and 175 ml for 12-23 mo old children Nutrient content of breast milk: Nutrient – Units – Content per 100 g Energy – kcal – 65 Protein – g – 1.1 Fat – g – 3.9 Calcium – mg – 28 Iron – mg – 0.03 Zinc – mg – 0.12 Vitamin A, RE – µg – 50 Niacin – mg – 0.15 Riboflavin – mg – 0.035 Thiamin – mg – 0.021 Vitamin B6 – mg – 0.009 Folate – µg – 8.5 Vitamin B12 – µg – 0.097 Vitamin C – mg – 4
Constraints		
Energy requirement	Anthropometry and FAO/WHO/UNU	Estimated using average bodyweight and algorithm for estimating energy requirement (FAO, 2004)
Costs daily diet	24hr recalls and market survey	75th percentile of costs for daily diet on first recall days
Requirement per nutrient		
Protein	FAO	Estimated using average body weight and algorithm for estimating protein requirement (FAO, 2007)
Fat	FAO	30% of energy, estimated using energy requirement as calculated for constraint (FAO, 2010)

Recommended Nutrient Intakes (Optifood analysis)	FAO	

FAO/WHO, 2004		
	7-11 months	12-23 months
Calcium, mg/d	400	700
Iron, mg/d; low (5%) bioavailability	18.6	11.6
Vitamin A, µg RE	400	400
Thiamin, mg/d	0.3	0.5
Riboflavin, mg/d	0.4	0.5
Niacin, mg/d	4	6
Vitamin B6, mg/d	0.3	0.5
Folate, µg DFE/d	80	150
Vitamin B12, µg/d	0.7	0.9
Vitamin C, mg/d	50	15
IZiNCG, 2004		
Zinc, mg/d; low (23%) bioavailability	4	2

APPENDIX IV: ANTHROPOMETRIC CHARACTERISTICS OF CHILDREN 6-23 MONTHS IN KARAGA DISTRICT AND GOMOA EAST DISTRICT

	All children	**Boys**	**Girls**	**6 – 8 months**	**9 – 11 months**	**12 – 23 months**	**12 – 23 months NBF**
Karaga District							
	n=337	n=168	n=169	n=96	n=97	n=109	n=35
Age, *mos*	12.4 ± 5.0	12.7 ± 5.2	12.1 ± 4.8	7.4 ± 0.9	10.2 ± 0.9	16.4 ± 3.2	20.2 ± 3.3
Weight, *kg*	7.9 ± 1.4	8.2 ± 1.5	7.6 ± 1.2	6.9 ± 0.8	7.6 ± 1.2	8.4 ± 1.1	9.6 ± 1.6
Height, *cm*	71.2 ± 5.3	72.1 ± 5.3	70.3 ± 5.1	66.7 ± 2.3	69.6 ± 3.3	74.3 ± 4.2	78.5 ± 4.6
MUAC[7], *cm*	13.6 ± 1.1	13.8 ± 1.2	13.5 ± 0.9	13.3 ± 1.0	13.7 ± 1.2	13.8 ± 0.9	13.7 ± 1.2
Gomoa East District							
	n=384	n=197	n=187	n=80	n=98	n=119	n=87
Age, *mos*	13.9 ± 5.2	14.1 ± 5.3	13.8 ± 5.2	7.7 ± 1.2	10.2 ± 1.1	16.4 ± 2.7	20.4 ± 2.6
Weight, *kg*	8.7 ± 1.4	9.0 ± 1.5	8.4 ± 1.3	7.7 ± 1.1	8.1 ± 1.2	9.1 ± 1.2	9.8 ± 1.3
Height, *cm*	74.4 ± 5.6	75.5 ± 4.3	73.3 ± 4.1	68.5 ± 2.9	71.3 ± 3.1	76.8 ± 4.0	80.0 ± 3.9
MUAC, *cm*	14.1 ± 1.1	14.2 ± 1.1	14.0 ± 1.1	14.0 ± 1.3	14.1 ± 1.1	14.2 ± 1.0	14.2 ± 1.2

[7] Mid-Upper Arm Circumference

APPENDIX V: DETAILED TABLES OF FOODS CONSUMED AND FOOD GROUP AND FOOD SUBGROUP CONSUMPTION PATTERNS IN KARAGA DISTRICT AND GOMOA EAST DISTRICT

Appendix V-A: All foods consumed by target group: types, portion size, percentage consumed and whether food is a snack or staple

***Table V-A.1**: All foods consumed by target group in Karaga district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food*

	6-8mo (n=103)	9-11mo (n=98)	12-23mo BF[1] (n=108)	12-23mo NBF[2] (n=29)
Food	**Median amount consumed, g/day (% of children consumed)**			
Grains & grain products				
Guinea corn dough whole grain RT[3] boiled	20.00 (16.7)[4]	21.56 (20.4)[4]	47.94 (14.8)[4]	66.44 (17.2)[4]
Guinea corn flour whole grain RTboiled	40.13 (18.6)[4]	33.10 (20.4)[4]	27.49 (14.8)[4]	90.95 (13.8)[4]
Maize dough whole grain white RTboiled	27.14 (44.1)[4]	36.25 (42.9)[4]	50.20 (37.0)[4]	38.39 (31.0)[4]
Maize flour refined white RTboiled	65.40 (1.0)	50.30 (1.0)	-	74.08 (6.9)[4]
Maize flour whole grain white RTboiled	39.70 (30.4)[4]	37.98 (55.1)[4]	65.05 (75.9)[4]	123.36 (89.7)[4]
Maize flour whole grain white RTfried	53.96 (1.0)	17.99 (2.0)	-	-
Maize grain dried white RTboiled	38.40 (1.0)	10.70 (8.2)[4]	53.08 (10.2)[4]	11.03 (20.7)[4]
Millet dough whole grain RTboiled	29.45 (4.9)	10.25 (6.1)[4]	32.78 (9.3)[4]	53.16 (13.8)[4]
Millet flour whole grain RTboiled	21.44 (4.9)	13.18 (8.2)[4]	15.25 (8.3)[4]	18.77 (6.9)[4]
Noodles instant RTboiled	24.89 (1.0)	3.28 (7.1)[4]	9.08 (5.6)[4]	12.87 (3.5)
Rice dough local brown unpolished RTboiled	-	-	-	31.52 (3.5)
Rice flour local brown unpolished RTboiled	108.86 (1.0)	-	-	-
Rice local brown unpolished raw RTboiled	40.28 (10.8)[4]	20.52 (28.6)[4]	56.07 (49.1)[4]	102.71 (48.3)[4]
Rice white polished raw RTboiled	31.62 (1.0)	41.25 (5.1)[4]	57.71 (1.9)	-
Starchy roots & other starchy plant foods				
Cassava dough roasted	13.83 (1.0)	2.81 (5.1)[4]	8.29 (7.4)[4]	40.58 (6.9)[4]
Cassava flour RTboiled	3.04 (6.9)[4]	8.93 (8.2)[4]	8.74 (9.3)[4]	26.73 (10.3)[4]
Cassava flour RTfried	7.10 (1.0)	2.37 (2.0)	-	-
Yam tuber flour RTboiled	-	25.06 (1.0)	124.55 (1.9)	-
Yam tuber raw RTroasted	-	103.36 (1.0)	85.85 (0.9)	-
Legumes, nuts & seeds				
Bambara groundnut flour RTboiled	4.27 (1.0)	-	10.72 (1.9)	74.88 (3.5)
Beans soya dried raw RTboiled	0.75 (2.9)	0.20 (2.0)	0.88 (7.4)[4]	1.76 (10.3)[4]
Beans soya flour whole RTboiled	14.13 (3.9)	3.78 (3.1)	14.78 (2.8)	13.24 (6.9)[4]
Bongu roasted RTboiled	1.96 (1.0)	15.13 (1.0)	54.39 (0.9)	3.81 (3.5)
Cowpea red dried whole RTboiled	-	11.94 (1.0)	-	-
Cowpea white dried whole RTboiled	24.39 (7.8)[4]	10.09 (11.2)[4]	23.03 (16.7)[4]	41.62 (24.1)[4]
Cowpea white flour RTboiled	1.99 (1.0)	4.34 (2.0)	10.61 (2.8)	-
Groundnut flour defatted RTroasted	-	-	6.45 (0.9)	5.76 (6.9)[4]
Groundnut flour with fat RTboiled	2.90 (4.9)	3.52 (9.2)[4]	4.61 (11.1)[4]	12.51 (20.7)[4]
Groundnut roasted paste RTboiled	6.64 (5.9)[4]	4.24 (21.4)[4]	7.87 (44.4)[4]	25.24 (44.8)[4]
Groundnut shelled dried raw RTboiled	0.27 (18.6)[4]	0.40 (42.9)[4]	0.48 (75.0)[4]	0.98 (75.9)[4]
Kapok seeds RTboiled	2.30 (1.0)	30.12 (4.1)	83.25 (0.9)	-
Koose fried	-	27.52 (1.0)	6.88 (0.9)	-
Neri roasted RTboiled	4.45 (2.0)	3.36 (4.1)	3.65 (8.3)[4]	14.55 (24.1)[4]

Pigeon peas dried RTboiled	-	11.89 (2.0)	23.15 (9.3)[4]	40.76 (13.8)[4]

Table V-A.1: All foods consumed by target group in Karaga district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food - continued

	6-8mo (n=103)	9-11mo (n=98)	12-23mo BF[1] (n=108)	12-23mo NBF[2] (n=29)
Food	**Median amount consumed, g/day (% of children consumed)**			
Meat, fish & eggs				
Egg chicken RT[3]boiled	11.10 (1.0)	57.56 (1.0)	-	88.55 (3.5)
Egg guinea fowl RTboiled	-	11.00 (1.0)	13.64 (0.9)	28.80 (10.3)[4]
Fish anchovies smoked dried RTboiled	0.89 (27.5)[4]	1.71 (56.1)[4]	2.34 (84.3)[4]	4.29 (82.8)[4]
Fish herrings smoked dried RTboiled	-	0.67 (5.1)[4]	3.76 (1.9)	43.20 (3.5)
Fish ice fish raw RTboiled	0.57 (1.0)	0.12 (6.1)[4]	0.21 (2.8)	18.36 (3.5)
Fish tilapia raw RTsmoked/boiled	-	-	3.61 (0.9)	-
Fish sardines in oil canned	3.18 (1.0)	-	-	-
Fish salmon raw RTsmoked/boiled	-	-	-	0.04 (3.5)
Mackerel canned in tomato sauce RTboiled	0.71 (1.0)	0.91 (6.1)[4]	0.91 (6.5)[4]	1.30 (6.9)[4]
Meat beef raw RTboiled	7.70 (1.0)	-	-	-
Beverages (non-dairy or blended dairy)				
Barley malt canned	-	-	-	415.00 (3.5)
Chocolate drink powder	6.12 (10.8)[4]	0.99 (7.1)[4]	2.75 (3.7)	10.06 (10.3)[4]
Creamer non diary powder	3.51 (4.9)	2.28 (8.2)[4]	6.50 (12.0)[4]	6.24 (24.1)[4]
Dairy products				
Cheese raw RTfried	-	80.00 (1.0)	26.13 (0.9)	-
Milk cow canned evaporated	16.42 (2.0)	31.90 (1.0)	13.18 (0.9)	-
Milk cow powder skimmed	2.95 (6.9)[4]	2.02 (6.1)[4]	4.53 (7.4)[4]	10.00 (10.3)[4]
Milk cow whole raw	95.12 (1.0)	273.00 (3.1)	151.20 (4.6)	538.26 (6.9)[4]
Milk cow whole raw RTboiled	38.85 (2.0)	268.95 (2.0)	326.77 (3.7)	73.54 (3.5)
Vegetables				
Amaranthus leaves raw RTboiled	30.27 (1.0)	8.77 (2.0)	20.40 (0.9)	-
Ayoyo leaves dried RTboiled	-	-	2.02 (1.9)	-
Ayoyo leaves raw RTboiled	4.68 (13.7)[4]	2.83 (28.6)[4]	6.96 (45.4)[4]	18.30 (31.0)[4]
Baobab leaves dried RTboiled	-	9.93 (1.0)	3.74 (2.8)	8.18 (6.9)[4]
Baobab leaves raw RTboiled	-	26.04 (1.0)	7.90 (1.9)	-
Bra leaves raw RTboiled	7.47 (6.9)[4]	8.43 (17.4)[4]	17.39 (26.9)[4]	18.86 (58.6)[4]
Okro fruit dried powder RTboiled	0.56 (2.9)	0.95 (7.1)	3.32 (13.9)[4]	4.22 (27.6)[4]
Okro fruit raw RTboiled	15.33 (4.9)	12.35 (14.3)[4]	24.87 (11.1)[4]	27.47 (24.1)[4]
Onion bulb raw RTboiled	2.38 (8.8)[4]	1.56 (31.6)[4]	2.36 (50.0)[4]	5.70 (31.0)[4]
Onion bulb raw RTfried	2.40 (1.0)	-	1.77 (2.8)	-
Onion leaves fermented dried RTboiled	0.30 (4.9)	0.19 (9.2)	0.19 (18.5)[4]	0.44 (13.8)[4]
Palm nut pulp raw RTboiled	43.14 (1.0)	-	1.82 (0.9)	-
Tomato paste concentrated RTboiled	4.02 (6.9)[4]	3.46 (23.5)[4]	5.17 (37.0)[4]	9.70 (27.6)[4]
Tomato powder dried RTboiled	1.86 (1.0)	15.32 (1.0)	0.94 (4.6)	1.65 (10.3)[4]
Tomato raw RTboiled	15.19 (2.9)	22.48 (2.0)	13.59 (3.7)	14.22 (3.5)
Fruits				
Blackberries fresh	-	8.00 (1.0)	20.00 (0.9)	-
Melon water raw	31.50 (1.0)	72.00 (5.1)[4]	126.00 (6.5)[4]	117.86 (13.8)[4]
Melon yellow fresh	-	-	55.06 (0.9)	-
Orange raw	115.50 (1.0)	-	46.20 (0.9)	-
Shea fruit pulp raw	15.00 (3.9)	15.00 (4.1)	30.00 (1.9)	80.00 (3.5)

***Table V-A.1**: All foods consumed by target group in Karaga district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food - continued*

	6-8mo (n=103)	9-11mo (n=98)	12-23mo BF[1] (n=108)	12-23mo NBF[2] (n=29)
Food	**Median amount consumed, g/day (% of children consumed)**			
Bakery & breakfast cereals				
Biscuit sweet	8.80 (5.9)[4]	6.37 (1.0)	22.50 (0.9)	41.25 (3.5)
Bread sugar	-	10.00 (3.1)	50.00 (5.6)[4]	73.00 (20.7)[4]
Bread tea	12.00 (1.0)	23.60 (1.0)	29.50 (2.8)	26.22 (3.5)
Cerelac maize/wheat/rice cereal Nestle	46.00 (1.0)	14.78 (4.1)	-	-
Doughnut	-	23.56 (1.0)	-	-
Added fats				
Oil palm	11.26 (3.9)	5.22 (2.0)	5.20 (6.5)[4]	-
Oil vegetable frytol	5.35 (4.9)	3.32 (14.3)[4]	6.44 (16.7)[4]	6.44 (20.7)[4]
Vegetable Oil	14.20 (10.8)[4]	15.42 (30.6)[4]	13.35 (51.9)[4]	17.28 (48.3)[4]
Added sugar				
Sugar white refined	6.30 (52.0)[4]	8.66 (52.0)[4]	14.00 (59.3)[4]	16.40 (65.5)[4]
Miscellaneous[5]				
Dawa dawa[6] dried RTboiled	0.64 (20.6)	0.82 (41.8)	0.91 (73.2)	1.99 (69.0)
Garlic raw RTboiled	-	-	0.12 (0.9)	-
Ginger fresh RTboiled	0.19 (5.9)	0.17 (10.2)	0.37 (12.0)	3.99 (3.5)
Maggi cube	0.90 (17.7)	0.55 (55.1)	0.88 (85.2)	1.73 (86.2)
Monosodium Glutamate	0.16 (2.0)	1.83 (2.0)	0.42 (0.9)	-
Pepper red dried	0.00 (2.0)	0.00 (1.0)	0.00 (1.9)	0.00 (3.5)

[1]BF=Breastfed, [2]NBF=Not breastfed, [3]RT=retention factor, [4]Food is consumed by more than 5% of the target group and is selected for modelling,[5]Foods used as condiments are not selected for modelling, [6]Dawadawa consists of legumes but is classified as miscellaneous because it is consumed as a condiment.

Table V-A.2: All foods consumed by target group in Gomoa East district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food

	6-8mo (n=87)	9-11mo (n=97)	12-23mo BF[1] (n=100)	12-23mo NBF[2] (n=84)
Food	**Median amount consumed, g/day (% of children consumed)**			
Grains & grain products				
Maize dough whole grain white RT[3]boiled	33.1 (52.9) [4]	40.6 (45.4) [4]	38.0 (38.2) [4]	52.7 (41.7) [4]
Maize flour whole grain white RTboiled	21.5 (11.5) [4]	20.8 (4.1)	21.6 (3.9)	27.6 (2.4)
Maize grain dried white RTboiled	37.8 (6.9) [4]	68.9 (6.2) [4]	38.0 (2.0)	24.4 (2.4)
Maize grain dried yellow RTboiled	-	-	-	22.5 (1.2)
Millet dough whole grain RTboiled	43.9 (2.3)	0.4 (1.0)	-	-
Millet flour whole grain RTboiled	35.6 (27.6) [4]	36.1 (28.9) [4]	45.9 (27.5) [4]	68.2 (29.8) [4]
Noodles instant RTboiled	-	11.9 (2.1)	53.0 (6.9) [4]	16.0 (3.6)
Oats RT boiled	-	13.3 (1.0)	-	-
Rice local brown unpolished raw RTboiled	-	34.5 (1.0)	-	-
Rice white polished boiled	40.4 (2.3)	95.1 (11.3) [4]	85.6 (12.8) [4]	170.3 (23.8) [4]
Rice white polished raw RTboiled	47.6 (24.1) [4]	37.9 (34.0) [4]	57.9 (55.9) [4]	82.4 (56.0) [4]
Wheat flour white raw RTfried	4.5 (1.2)	14 (1.0)	21.0 (2.9)	14.0 (3.6)
Starchy roots & other starchy plant foods				
Cassava dough RTboiled	17.0 (19.5) [4]	12.1 (21.7) [4]	22.2 (27.5) [4]	16.4 (29.8) [4]
Cassava dough RTroasted	18.4 (1.1)	40.3 (1.0)	30.0 (6.9) [4]	69.8 (3.6)
Cassava tuber, raw RTboiled	132.8 (16.1) [4]	147.8 (32.0) [4]	82.4 (28.4) [4]	176.0 (44.1) [4]
Plantain, raw RTboiled	22.6 (12.6) [4]	25.1 (27.8) [4]	9.4 (24.5) [4]	16.8 (36.9) [4]
Plantain, raw RTfried	-	11.8 (1.0)	-	-
Yam tuber raw RTboiled	-	601.9 (1.0)	257.5 (2.0)	-
Legumes, nuts & seeds				
Beans soya dried raw RTboiled	-	-	-	27.5 (1.2)
Beans soya flour whole RTboiled	8.0 (1.1)	-	-	-
Cowpea white boiled	-	-	85.1 (2.9)	153.4 (1.2)
Cowpea white dried whole RTboiled	12.4 (1.1)	7.3 (2.1)	7.5 (8.8) [4]	20.8 (15.5) [4]
Cowpea white flour RTboiled	6.5 (6.9) [4]	5.1 (1.0)	4.6 (2.9)	-
Cowpea white flour RTfried	3.1 (1.1)	-	4.7 (2.0)	6.3 (10.7) [4]
Groundnut flour with fat RTboiled	5.0 (6.9) [4]	3.9 (1.0)	3.5 (2.9)	71.6 (1.2)
Groundnut paste RTboiled	4.1 (8.0) [4]	2.1 (5.2) [4]	5.6 (6.9) [4]	11.6 (10.7) [4]
Groundnut shelled dried raw RTboiled	-	-	28.8 (1.0)	-
Melon seeds, raw RTboiled	1.1 (5.7) [4]	5.3 (8.3) [4]	6.3 (7.8) [4]	4.3 (8.3) [4]
Milk soy fresh	71.0 (1.1)	3.9 (3.1)	-	69.2 (2.4)
Pigeon peas dried RTboiled	-	-	2.0 (1.0)	51.8 (1.2)
Meat, fish & eggs				
Beef leg/feet, raw RTboiled	11.0 (4.6)	-	16.6 (1.0)	18.9 (2.4)
Chicken, raw RTboiled	24.2 (1.1)	1.7 (2.1)	10.2 (3.9)	29.0 (3.6)
Chicken, raw RTfried	-	-	-	44.5 (1.2)
Cow skin raw RTboiled	10.0 (1.1)	-	10.0 (1.0)	10.0 (1.2)
Crab, raw RTboiled	-	-	-	23.2 (1.2)
Egg chicken RTboiled	3.4 (17.2) [4]	4.0 (25.8) [4]	3.5 (32.4) [4]	3.3 (38.1) [4]
Egg chicken RTfried	0.1 (1.1)	0.3 (1.0)	0.4 (2.9)	0.3 (3.6)
Fish African threadfin raw RTsmoked/boiled	1.4 (1.1)	-	-	-

Table V-A.2: All foods consumed by target group in Gomoa East district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food- *continued*

	6-8mo (n=87)	9-11mo (n=97)	12-23mo BF[1] (n=100)	12-23mo NBF[2] (n=84)
Food	**Median amount consumed, g/day (% of children consumed)**			
Meat, fish & eggs - *continued*				
Fish anchovies smoked RT[3]boiled	6.6 (4.4)	8.4 (14.4) [4]	6.3 (11.8) [4]	9.6 (10.7) [4]
Fish eel, raw RTfried	-	8.5 (1.0)	-	-
Fish eel, raw RTsmoked/boiled	3.7 (1.1)	-	-	-
Fish fat, dried RTsmoked/boiled	-	1.3 (1.0)	0.9 (5.9) [4]	3.0 (14.3) [4]
Fish herrings smoked RTboiled	5.6 (28.7)	7.7 (38.1) [4]	8.6 (41.2) [4]	14.2 (52.4) [4]
Fish herrings, raw RTboiled	0.9 (1.1)	8.9 (2.1)	8.1 (2.9)	-
Fish herrings, raw RTfried	27.9 (2.3)	18.7 (5.2) [4]	15.7 (3.9)	16.0 (4.8)
Fish Horse mackerel raw RTsmoked/boiled	7.5 (1.1)	1.7 (1.0)	18.8 (1.0)	-
Fish lean, dried salted RTboiled	1.7 (18.4) [4]	1.4 (15.5) [4]	2.5 (25.5) [4]	2.8 (39.3) [4]
Fish mackerel raw RTsmoked/boiled	6.0 (1.1)	14.6 (2.1)	13.8 (2.0)	9.6 (4.8)
Fish mud, raw RTboiled	6.4 (1.1)	-	-	-
Fish red snapper, raw RTboiled	-	5.3 (2.1)	4.3 (2.0)	26.7 (6.0) [4]
Fish salmon raw RTsmoked/boiled	7.7 (17.2) [4]	7.0 (14.4) [4]	10.2 (23.5) [4]	11.4 (31.0) [4]
Fish sardines in oil canned	1.8 (1.1)	-	-	-
Fish tilapia raw RTsmoked/boiled	-	30.8 (1.0)	-	10.3 (1.2)
Fish tuna raw RTboiled	7.4 (1.1)	7.2 (4.1)	10.6 (2.9)	13.7 (6.0) [4]
Fish tuna, raw RTsmoked	-		3.8 (2.9)	11.6 (8.3) [4]
Mackerel canned in tomato sauce RTboiled	-	11.8 (1.0)	4.5 (1.0)	-
Meat beef raw RTboiled	2.0 (4.6)	2.3 (4.1)	2.4 (6.9) [4]	7.4 (9.5) [4]
Periwinkle raw RTboiled	-	1.1 (1.0)	2.2 (1.0)	0.8 (1.2)
Pork leg/feet, raw RTboiled	-	-	4.5 (1.0)	-
shrimp, raw RTboiled	5.7 (1.1)	-	-	7.2 (1.2)
Beverages (non-dairy or blended dairy)				
Barley malt canned	-	-	330.0 (1.0)	-
Chocolate drink powder	12.1 (2.3)	25.3 (1.0)	6.3 (8.8)	15.8 (7.1)
Creamer non-dairy powder	3.0 (1.1)	-	-	-
Fruit drink mixed fruits	-	-	-	250.0 (1.2)
Soda (Coca, Fanta etc.)	-	146.0 (1.0)	159.3 (1.0)	-
Dairy products				
Lactogen growing up milk powder	41.8 (2.3)	-	-	-
Milk cow canned evaporated	4.4 (19.5) [4]	5.4 (32.0) [4]	5.8 (28.4) [4]	8.2 (23.8) [4]
Milk cow powder skimmed	3.8 (13.8) [4]	5.2 (10.3) [4]	0.9 (7.8) [4]	0.6 (14.3) [4]
Milk cow powder skimmed, Cowbell	21.8 (2.3)	8.0 (2.1)	9.6 (4.9)	5.4 (3.6)
Yoghurt, fan milk	-	-	-	160.0 (1.2)
Vegetables				
Ayoyo leaves raw RTboiled	-	-	9.9 (2.9)	-
Beans green French, raw RTboiled	-	-	9.6 (1.0)	3.0 (1.2)
Cabbage raw RTboiled	-	-	15.2 (2.0)	-
Carrot, raw RTboiled	0.4 (1.1)	0.8 (2.1)	1.5 (6.9) [4]	1.5 (4.8)
Cocoyam leaves, raw RTboiled	19.6 (13.8) [4]	17.9 (19.6) [4]	29.1 (21.6) [4]	34.6 (26.2) [4]
Dandelion leaves, raw RTboiled	-	-	-	5.4 (1.2)
Eggplant leaves, raw RTboiled	-	-	4.9 (1.0)	-

***Table V-A.2**: All foods consumed by target group in Gomoa East district from 24hour recalls, median serving size (g/day) and percentage of children consuming each food - continued*

	6-8mo (n=87)	9-11mo (n=97)	12-23mo BF[1] (n=100)	12-23mo NBF[2] (n=84)
Food	**Median amount consumed, g/day (% of children consumed)**			
Vegetables - *continued*				
Eggplant, raw RT[3]boiled	1.2 (14.9) [4]	2.7 (32.0) [4]	9.4 (25.5) [4]	24.3 (42.9) [4]
Mushrooms canned RTboiled	-	-	-	10.0 (1.2)
Okro fruit raw RTboiled	2.8 (6.9) [4]	4.9 (12.4) [4]	14.1 (16.7) [4]	10.1 (16.7) [4]
Onion bulb raw RTboiled	2.3 (32.2) [4]	3.4 (56.7) [4]	4.6 (75.5) [4]	9.8 (79.8) [4]
Onion bulb raw RTfried	1.4 (19.5) [4]	2.8 (18.6) [4]	3.9 (7.8) [4]	-
Palm nuts pulp raw RTboiled	6.4 (13.8) [4]	4.4 (21.7) [4]	8.9 (22.6) [4]	11.5 (27.4) [4]
Tomato paste concentrated RTboiled	4.4 (35.6) [4]	7.4 (51.6) [4]	6.5 (65.7) [4]	11.8 (73.8) [4]
Tomato raw	67.1 (1.1)	4.5 (1.0)	-	37.3 (1.2)
Tomato raw RTboiled	11.3 (18.4) [4]	11.3 (41.2) [4]	10.5 (55.9) [4]	14.8 (63.1) [4]
Turkey berries raw RTboiled	7.5 (9.2) [4]	5.7 (15.5) [4]	10.5 (19.6) [4]	14.6 (27.4) [4]
Fruits				
Banana raw	-	-	25.1 (1.0)	-
Coconut, water RTboiled	-	-	-	48.0 (1.2)
Juice orange unsweetened	19.6 (1.1)	256.0 (1.0)	46.1 (2.0)	174.1 (1.2)
Orange raw	-	34.4 (4.1)	35.7 (2.0)	-
Papaya fruit, raw	-	2.0 (1.0)	-	-
Bakery & breakfast cereals				
Biscuit sweet	9.0 (4.6)	7.0 (10.3) [4]	13.7 (8.8) [4]	13.7 (8.3) [4]
biscuit, not sweet	22.7 (2.3)	-	18.9 (2.9)	40.2 (4.8)
Bread butter	91.3 (1.1)	-	228.2 (2.9)	274.0 (3.6)
Bread sugar	32.3 (1.1)	15.1 (2.1)	90.5 (3.9)	109.1 (9.5) [4]
Bread tea	-	-	74.5 (2.0)	91.7 (7.1) [4]
Cerelac maize/wheat/rice cereal Nestle	46.0 (17.2) [4]	46.2 (9.3) [4]	19.7 (2.0)	36.5 (2.4)
Added fats				
Margarine fortified	0.4 (1.1)	1.3 (1.0)	1.9 (2.9)	1.3 (3.6)
Oil palm	6.0 (23.0) [4]	6.8 (37.1) [4]	7.0 (47.1) [4]	6.3 (51.2) [4]
Oil vegetable frytol	3.5 (6.9) [4]	4.4 (23.7) [4]	3.7 (25.5) [4]	7.0 (44.1) [4]
Oil vegetable refined	1.3 (6.9) [4]	9.2 (10.3) [4]	4.8 (19.6) [4]	3.4 (31.0) [4]
Added sugar				
Honey	15.8 (1.1)	-	-	-
Sugar cane immature	-	26.6 (1.0)	106.3 (1.0)	-
Sugar white/brown	6.5 (59.8) [4]	8.7 (42.3) [4]	15.3 (35.3) [4]	18.7 (33.3) [4]
Miscellaneous[5]				
Garlic raw RTboiled	1.1 (3.4)	0.7 (1.0)	0.7 (3.9)	2.0 (4.8)
Ginger fresh RTboiled	1.3 (4.6)	1.2 (5.2) [4]	0.4 (10.8) [4]	0.5 (19.1) [4]
Maggi cube	0.4 (25.3) [4]	0.6 (41.2) [4]	0.9 (54.9) [4]	0.8 (61.9) [4]
Pepper chilli, raw RTboiled	0.9 (25.3) [4]	0.8 (39.2) [4]	1.2 (45.1) [4]	1.4 (41.7) [4]
Pepper red dried	0.4 (19.5) [4]	0.5 (24.7) [4]	0.6 (24.5) [4]	1.1 (26.2) [4]
Sweetened snacks & desserts				
Candy	-	-	-	6.0 (2.4)
Chewing gum	-	-	-	6.0 (1.2)

[1]BF=Breastfed, [2]NBF=Not breastfed, [3]RT=retention factor, [4]Food is consumed by more than 5% of the target group and is selected for modelling [5]Foods used as condiments are not selected for modelling

Appendix V-B Dietary pattern with minimum and maximum servings per week by target group in Karaga and Gomoa East districts

***Table V-B.1**:Dietary pattern with minimum and maximum servings per week by target group in Karaga district*

	6-8mo (n=103)		**9-11mo (n=98)**		**12-23mo BF[1] (n=108)**		**12-23mo NBF[2] (n=29)**	
Food groups & Sub food groups[3]	**Servings per week**							
	Min[4]	Max[5]	Min	Max	Min	Max	Min	Max
Grains & grain products	**0**	**21**	**0**	**28**	**0**	**28**	**0**	**35**
Whole grains and products, unenriched/unfortified	0	21	0	28	7	28	7	35
Refined grains and products, unenriched/unfortified	-	-	0	7	0	7	0	7
Starchy roots & other starchy plant foods	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Other starchy plant foods	0	7	0	7	0	7	0	7
Legumes, nuts & seeds	**0**	**21**	**0**	**28**	**0**	**28**	**0**	**28**
Cooked beans, lentils, peas	0	7	0	7	0	7	0	7
Nuts, seeds, and unsweetened products	0	14	0	21	0	21	0	21
Soybeans and products	-	-	-	-	0	7	0	7
Meat, fish & eggs	**0**	**7**	**0**	**21**	**0**	**14**	**0**	**14**
Small, whole fish, with bones	0	7	0	21	0	14	0	14
Eggs	-	-	-	-	-	-	0	7
Beverages (non-dairy or blended dairy)	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**14**
Chocolate beverage or powder mix (non-dairy)	0	7	0	7	-	-	0	7
Other beverages	-	-	0	7	0	7	0	7
Dairy products	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Fluid or powdered milk (fortified)	0	7	0	7	0	7	0	7
Fluid or powdered milk (unfortified)	-	-	-	-	-	-	0	7
Vegetables	**0**	**21**	**0**	**28**	**0**	**28**	**0**	**35**
Vitamin A source dark green leafy vegetables	0	7	0	14	0	14	0	14
Vitamin A source other vegetables	0	7	0	7	0	7	0	7
Other vegetables	0	7	0	7	0	14	0	14
Vitamin C-rich vegetables	-	-	0	7	0	7	0	7
Fruits	**-**	**-**	**0**	**7**	**0**	**7**	**0**	**7**
Other fruit	-	-	0	7	0	7	0	7
Bakery & breakfast cereals	**0**	**7**	**-**	**-**	**0**	**7**	**0**	**7**
Sweetened bakery products, unenriched/unfortified	0	7	-	-	0	7	0	7
Added fats	**0**	**7**	**0**	**14**	**0**	**14**	**0**	**14**
Vegetable oil (unfortified)	0	7	0	7	0	7	0	7
Vegetable oil (fortified)	-	-	0	7	0	7	0	7
Red palm oil	-	-	-	-	0	7	-	-
Added sugars	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Sugar (non-fortified)	0	7	0	7	0	7	0	7
Breastmilk	*6.9*	*7*	*6.9*	*7*	*6.9*	*7*	-	-

[1] BF=breastfed, [2]NBF=Not breastfed, [3]Food groups and sub food groups are classified as it is in Optifood, [4]5th percentile of the weekly frequency was used, [5]95th percentile of the weekly frequency was used

Table V-B.2:Dietary pattern with minimum and maximum servings per week by target group in Gomoa East district

	6-8mo (n=87)		**9-11mo (n=97)**		**12-23mo BF[1] (n=100)**		**12-23mo NBF[2] (n=84)**	
Food groups & Sub food groups[3]	**Servings per week**							
	Min[4]	Max[5]	Min	Max	Min	Max	Min	Max
Grains & grain products	**0**	**14**	**0**	**21**	**0**	**21**	**0**	**21**
Whole grains and products, unenriched/unfortified	0	14	0	21	0	14	0	14
Refined grains and products, unenriched/unfortified	0	7	0	7	0	14	0	7
Starchy roots & other starchy plant foods	**0**	**14**	**0**	**21**	**0**	**14**	**0**	**21**
Vitamin C-rich starchy plant foods	0	14	0	14	0	14	0	14
Other starchy plant foods	0	7	0	7	0	7	0	7
Legumes, nuts & seeds	**0**	**14**	**0**	**7**	**0**	**14**	**0**	**14**
Cooked beans, lentils, peas	0	7	-	-	0	7	0	7
Nuts, seeds, and unsweetened products	0	7	0	7	0	7	0	7
Meat, fish & eggs	**0**	**28**	**0**	**28**	**0**	**28**	**0**	**35**
Small, whole fish, with bones	0	7	0	14	0	7	0	7
Eggs	0	7	0	7	0	7	0	7
Fish without bones	0	14	0	14	0	14	0	21
Red meats	-	-	-	-	0	7	0	7
Beverages (non-dairy/blended dairy)	**-**	**-**	**-**	**-**	**0**	**7**	**0**	**7**
Chocolate beverage or powder mix (non-dairy)	-	-	-	-	0	7	0	7
Dairy products	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Fluid or powdered milk (fortified)	0	7	0	7	0	7	0	7
Vegetables	**0**	**35**	**0**	**42**	**0**	**42**	**0**	**49**
Vitamin A source dark green leafy vegetables	0	7	0	7	0	7	0	7
Vitamin A source other vegetables	0	14	0	14	0	14	0	14
Other vegetables	0	14	0	21	0	21	0	21
Vitamin C-rich vegetables	0	7	0	14	0	14	0	14
Bakery & breakfast cereals	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Ready-to-eat (RTE) cereals, fortified	0	7	0	7	-	-	-	-
Sweetened bakery products, unenriched/unfortified	-	-	0	7	0	7	0	7
Refined grain bread, unfortified	-	-	-	-	-	-	0	7
Added fats	**0**	**14**	**0**	**14**	**0**	**21**	**0**	**21**
Vegetable oil (unfortified)	0	7	0	7	0	7	0	7
Vegetable oil (fortified)	0	7	0	7	0	7	0	7
Red palm oil	0	7	0	7	0	7	0	7
Added sugars	**0**	**7**	**0**	**7**	**0**	**7**	**0**	**7**
Sugar (non-fortified)	0	7	0	7	0	7	0	7
Breastmilk	*6.9*	*7*	*6.9*	*7*	*6.9*	*7*	-	-

[1] BF=breastfed, [2]NBF=Not breastfed, [3]Food groups and sub food groups are classified as in Optifood [4]5th percentile of the weekly frequency was used, [5]95th percentile of the weekly frequency was used

Appendix VI: Prices per 100 g of food and mean weight per GH₵ of all foods reported in the 24h recall in Karaga and Gomoa East Districts

Table VI-1: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Karaga District, Ghana

Food code	Food item	Price/100g	mean weight(g)/GH₵
112	Amaranthus leaves raw RTboiled	0,21	470
167	Ayoyo leaves dried RTboiled	0[1]	0[1]
113	Ayoyo leaves raw RTboiled	0,43	233
49	Bambara groundnut flour RTboiled	0,27	376
130	Bambara groundnuts dried RTboiled	0,54	186
117	Baobab leaves dried RTboiled	0,49	203
116	Baobab leaves raw RTboiled	0,09	1090
171	Barley malt canned	0,76	132
59	Beans soya dried raw RTboiled	0,23	444
60	Beans soya flour whole RTboiled	0,26	466
156	Beans white dried RTboiled	0,48	212
160	Beans white flour RTboiled	0,56	179
158	Biscuit sweet	1,83	66
165	Blackberries fresh	0[1]	0[1]
157	Bongu roasted RTboiled	0,71	140
114	Bra leaves raw RTboiled	0,09	1147
96	Bread sugar	0,68	146
97	Bread tea	0,42	236
83	Butter sheabutter	0,47	211
22	Cassava dough roasted	0,18	568
21	Cassava flour Rtboiled	0,11	899
162	Cassava flour RTfried	0,11	899
150	Cerelac maize/wheat/rice cereal Nestle	3,00	33
163	Cheese raw RTfried	0,77	131
101	Chocolate drink powder	2,17	63
51	Cowpea red dried whole RTboiled	0,36	276
50	Cowpea white dried whole RTboiled	0,48	212
148	Creamer non diary powder	1,20	83
88	Dawa dawa dried RTboiled	0,94	106
108	Doughnut	0,85	118
61	Egg chicken RTboiled	0,85	119
62	Egg guinea fowl RTboiled	1,51	66
63	Fish anchovies smoked dried RTboiled	1,26	80
135	Fish herrings smoked dried RTboiled	3,29	30
146	Fish ice fish raw RTboiled	2,16	46
175	Fish mackerel raw RTboiled	2,16	46
66	Fish salmon raw RTsmoked/boiled	2,16	46
168	Fish sardines in oil canned	1,73	58
67	Fish tilapia raw RTsmoked/boiled	1,79	56
164	Garlic raw RTboiled	2,12	47
35	Ginger fresh RTboiled	0,42	240
57	Groundnut flour defatted RTroasted	0,83	120
55	Groundnut flour with fat RTboiled	0,91	109
58	Groundnut roasted paste RTboiled	0,85	118

Table VI-1: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Karaga District, Ghana

Food code	Food item	Price/100g	mean weight(g)/GH₵
54	Groundnut shelled dried raw RTboiled	0,50	200
56	Groundnut whole RTroasted	0,71	140
4	Guinea corn dough whole grain brow RTboiled	0,45	224
3	Guinea corn dough whole grain red RTboiled	0,45	224
9001	Guinea corn dough whole grain Rtboiled	0,45	222
6	Guinea corn flour whole grain brown RTboiled	0,27	372
5	Guinea corn flour whole grain red RTboiled	0,27	372
9002	Guinea corn flour whole grain Rtboiled	0,27	370
155	Kapok seeds RTboiled	0,00[1]	0[1]
109	Koose Fried	0,35	287
68	Mackerel canned in tomato sauce RTboiled	0,59	169
86	Maggi cube	1,71	40
11	Maize dough whole grain white RTboiled	0,13	750
159	Maize flour refined white RTboiled	0,30	330
9	Maize flour whole grain white RTboiled	0,27	373
161	Maize flour whole grain white RTfried	0,27	373
8	Maize grain dried white Rtboiled	0,24	424
69	Meat beef raw RTboiled	1,43	70
144	Melon water raw	0,05	2141
166	Melon yellow fresh	0,16	626
99	Milk cow canned evaporated	1,63	67
100	Milk cow powder skimmed	2,15	57
140	Milk cow whole raw	0,25	400
141	Milk cow whole raw RTboiled	0,25	400
14	Millet dough whole grain RTboiled	0,48	208
13	Millet flour whole grain Rtboiled	0,40	250
176	Monosodium Glutamate	6,40	16
149	Neri roasted RTboiled	0,39	256
147	Noodles instant RTboiled	0,56	177
81	Oil groundnut	0,74	135
82	Oil palm	0,96	104
84	Oil vegetable frytol	0,95	105
85	Oil vegetable refined	0,85	120
38	Okro fruit dried powder RTboiled	1,53	69
37	Okro fruit raw RTboiled	0,15	658
39	Onion bulb rawRTboiled	0,54	192
151	Onion bulb rawRTfried	0,54	192
122	Onion leaves fermented dried RTboiled	0,59	168
47	Orange raw	0,13	791
152	Palm nut seeds dried Rtboiled	0,16	643
139	Pigeon peas dried RTboiled	0,17	594
153	Plumpy nut peanut paste	0,00[2]	0[2]
170	Rice dough local brown unpolished RTboiled	0,50	200
169	Rice flour local brown unpolished RTboiled	0,35	286
18	Rice local brown unpolished raw RTboiled	0,30	331

Table VI-1: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Karaga District, Ghana

Food code	Food item	Price/100g	mean weight(g)/GH₵
17	Rice white polished raw Rtboiled	0,31	323
145	Shea fruit pulp raw	0,00[3]	0[3]
105	Sugar white refined	0,44	228
45	Tomato paste concentrated RTboiled	0,87	137
143	Tomato powder dried RTboiled	1,43	70
44	Tomato raw RTboiled	0,33	316
9000	Vegetable oil	0,61	164
138	Yam tuber flour RTboiled	0,59	170
32	Yam tuber raw RTboiled	0,19	537
33	Yam tuber raw RTfried	0,19	537
34	Yam tuber raw Rtroasted	0,19	537

Table VI-2: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Gomoa East District, Ghana

food code	food name	Price/100g	mean weight(g)/ GH₵
113	Ayoyo leaves raw RTboiled	0,43	233
225	Banana raw	0,39	256
171	Barley malt canned	0,76	132
59	Bean soya dried raw RTboiled	0,48	209
215	Beans green French, raw RTboiled	1,02	98
60	Beans soya flour whole RTboiled	0,86	116
269	Beef leg/feet, raw RTboiled	0,93	107
158	Biscuit sweet	0,94	106
209	biscuit, not sweet	0,76	132
262	Bread butter	0,07	1370
96	Bread sugar	0,39	259
97	Bread tea	0,44	229
172	Cabbage raw RTboiled	0,64	155
226	Candy	1,25	80
196	Carrot, raw RTboiled	0,42	236
197	Cassava dough RTboiled	0,10	1020
22	Cassava dough RTroasted	0,95	105
263	Cassava tuber, raw RTboiled	0,04	2727
150	Cerelac maize/wheat/rice cereal Nestle	3,00	33
205	Chewing gum	1,67	60
198	Chicken, raw RTboiled	1,17	85
199	Chicken, raw RTfried	1,17	85
101	Chocolate drink powder	1,84	170
202	Coconut, water RTboiled	0,53	188
190	Cocoyam leaves, raw RTboiled	0,12	820
268	Cow skin raw RTboiled	0,93	107
250	Cowpea white boiled	0,16	641
50	Cowpea white dried whole RTboiled	0,38	260
52	Cowpea white flour RTboiled	0,50	200
187	Cowpea white flour RTfried	0,50	200

Table VI-2: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Gomoa East District, Ghana

food code	food name	Price/100g	mean weight(g)/ GH₵
208	Crab, raw RTboiled	1,32	76
148	Creamer non dairy powder	1,20	83
212	Dandelion leaves, raw RTboiled	0,28	360
61	Egg chicken RTboiled	1,05	95
274	Egg chicken RTfried	1,05	95
282	Eggplant leaves, raw RTboiled	0,43	233
193	Eggplant, raw RTboiled	0,10	1032
280	Fish African threadfin raw RTsmoked/boiled	1,32	76
63	Fish anchovies smoked RTboiled	1,46	69
278	Fish eel, raw RTfried	1,32	76
236	Fish eel, raw RTsmoked/boiled	1,32	76
279	Fish fat, dried RTsmoked/boiled	1,32	76
135	Fish herrings smoked RTboiled	1,32	76
217	Fish herrings, raw RTboiled	1,32	76
220	Fish herrings, raw RTfried	1,32	76
281	Fish Horse mackerel raw RTsmoked/boiled	1,28	78
261	Fish lean, dried salted RTboiled	1,74	57
175	Fish mackerel raw RTsmoked/boiled	1,43	70
229	Fish mud, raw RTboiled	1,32	76
218	Fish red snapper, raw RTboiled	0,75	133
66	Fish salmon raw RTsmoked/boiled	1,16	86
168	Fish sardines in oil canned	3,11	32
67	Fish tilapia raw RTsmoked/boiled	1,79	56
174	Fish tuna raw RTboiled	1,18	85
233	Fish tuna, raw RTsmoked	1,18	85
264	Fruit drink mixed fruits	0,30	332
164	Garlic raw RTboiled	1,41	71
35	Ginger fresh RTboiled	0,58	172
55	Groundnut flour with fat RTboiled	0,91	110
222	Groundnut paste	1,02	98
54	Groundnut shelled dried raw RTboiled	0,50	200
223	Honey	0,67	148
224	Juice orange unsweetend	0,07	1528
270	Lactogen growing up milk powder	3,33	30
68	Mackerel canned in tomato sauce RTboiled	1,33	75
86	Maggi cube	1,75	57
11	Maize dough whole grain white RTboiled	0,15	649
9	Maize flour whole grain white RTboiled	0,27	373
8	Maize grain dried white RTboiled	0,27	376
7	Maize grain dried yellow RTboiled	0,27	376
195	Margarine fortified	1,33	75
69	Meat beef raw RTboiled	1,35	74
258	Melon seeds, raw RTboiled	1,11	90
99	Milk cow canned evaporated	1,81	55
100	Milk cow powder skimmed	3,33	30

Table VI-2: Prices per 100 g food and mean weight per GH₵ of all foods reported in 24h recalls in Gomoa East District, Ghana

food code	food name	Price/100g	mean weight(g)/ GH₵
207	Milk cow powder skimmed, Cowbell	3,70	27
267	Milk soy fresh	0,77	130
14	Millet dough whole grain RTboiled	0,48	208
13	Millet flour whole grain RTboiled	0,40	250
228	Mushrooms canned RTboiled	0,93	108
147	Noodles instant RTboiled	1,43	70
230	Oats RTboiled	0,40	250
82	Oil palm	0,59	170
84	Oil vegetable frytol	0,98	102
85	Oil vegetable refined	0,98	102
37	Okro fruit raw RTboiled	0,29	340
39	Onion bulb raw RTboiled	0,33	307
151	Onion bulb raw RTfried	0,33	307
47	Orange raw	0,07	1528
152	Palm nuts pulp raw RTboiled	0,14	738
191	Papaya fruit, raw	0,39	256
216	Pepper chilli, raw RTboiled	1,19	84
40	Pepper red dried	2,05	49
232	Periwinkle raw RTboiled	1,32	76
192	Plantain, raw RTboiled	0,27	372
265	Plantain, raw RTfried	0,27	372
277	Pork leg/feet, raw RTboiled	0,93	107
18	Rice local brown unpolished raw RTboiled	0,32	311
285	Rice white polished boiled	0,28	353
17	Rice white polished raw RTboiled	0,52	216
235	shrimp, raw RTboiled	1,32	76
194	Soda (coca, fanta etc.)	0,30	332
266	Sugar cane immature	0,12	844
105	Sugar white/brown	0,67	148
45	Tomato paste concentrated RTboiled	0,93	108
219	Tomato raw	0,23	435
44	Tomato raw RTboiled	0,23	435
257	Turkey berries raw RTboiled	0,13	788
284	Wheat flour white raw RTfried	0,80	125
32	Yam tuber raw RTboiled	0,22	460
214	Yoghurt, fan milk	0,63	160

RT=retention factor

APPENDIX VII: SUMMARY OF ENERGY AND NUTRIENT INTAKES AND ADEQUACY FROM BREAST MILK

Table VII-1. Energy and nutrient contribution of human breast milk at low and average assumed intake amounts: 6-8 months of age

Nutrient		Estimated intake from breastmilk/day*		RNI*	Estimated percent RNI (%)	
		Low (Mean -2 SD)	Average (Mean)		Low (Mean -2 SD)	Average (Mean)
Nutrient	Units					
Breast milk amount	g/d	354	660			
Energy	kcal/d	217	413	678	32	63
Calcium	mg/d	99	185	400	25	46
Iron (low bioavailability) **	mg/d	0.1	0.2	18.6	1	1
Zinc (low bioavailability) **	mg/d	0.4	0.8	4	11	20
Vitamin A, RE	µg/d	177	330	400	44	83
Niacin	µg/d	0.531	0.990	4	13	25
Riboflavin	mg/d	0.124	0.231	0.4	31	58
Thiamin	mg/d	0.074	0.139	0.3	25	46
Vitamin B6	mg/d	0.033	0.061	0.3	11	20
Folate	mg/d	30	56	80	38	70
Vitamin B12	mg/d	0.3	0.6	0.7	49	91
Vitamin C	mg/d	14	26	30	47	88

*The nutrient composition of breastmilk and energy requirement were derived from WHO/UNICEF, 1998. RNIs derived from FAO/WHO (2004), except for zinc (IZiNCG, 2004).

**Iron bioavailability in breast milk among infants >7 months has been estimated at 14.8% (Abrams et al., 1997). However, as breast milk provides only a small percentage of the iron requirement after 6 months of age, the assumption of low iron bioavailability pertaining to the diet is used.

Table VII-2. Energy and nutrient contribution of human breast milk at low and average assumed intake amounts: 9-11 months of age

Nutrient	Units	Estimated intake from breastmilk/day*		RNI*	Estimated percent RNI (%)*	
		Low (Mean -2 SD)	Average (Mean)		Low (Mean -2 SD)	Average (Mean)
Breast milk intake	g/d	272	616			
Energy	kcal/d	157	379	764	21	50
Calcium	mg/d	76	172	400	19	43
Iron (low bioavailability) **	mg/d	0.1	0.2	18.6	0	1
Zinc (low bioavailability) **	mg/d	0.3	0.7	4	8	18
Vitamin A, RE	µg/d	136	308	400	34	77
Niacin	µg/d	0.408	0.924	4	10	23
Riboflavin	mg/d	0.095	0.216	0.4	24	54
Thiamin	mg/d	0.057	0.129	0.3	19	43
Vitamin B6	mg/d	0.025	0.057	0.3	8	19
Folate	mg/d	23	52	80	29	65
Vitamin B12	mg/d	0.3	0.6	0.7	38	85
Vitamin C	mg/d	11	25	30	36	82

*The nutrient composition of breastmilk and energy requirement were derived from WHO/UNICEF, 1998. RNIs derived from FAO/WHO (2004), except for zinc (IZiNCG, 2004).

**Iron bioavailability in breast milk among infants >7 months has been estimated at 14.8% (Abrams et al., 1997). However, as breast milk provides only a small percentage of the iron requirement after 6 months of age, the assumption of low iron bioavailability pertaining to the diet is used.

Table VII-3. Energy and nutrient contribution of human breast milk at low and average assumed intake amounts: 12-23 months of age

Nutrient	Units	Estimated intake from breastmilk/day*		EAR (from RNI)*	Estimated percent EAR	
		Low (Mean -2 SD)	Average (Mean)		Low (Mean -2 SD)	Average (Mean)
Breast milk intake	g/d	175	549			
Energy	kcal/d	90	346	1092	8	32
Calcium	mg/d	49	154	417	12	37
Iron (low bioavailability) **	mg/d	0.1	0.2	13	0	1
Zinc (low bioavailability) **	mg/d	0.2	0.7	2	11	33
Vitamin A, RE	µg/d	88	275	286	31	96
Niacin	µg/d	0.263	0.824	5	5	16
Riboflavin	mg/d	0.061	0.192	0.4	15	48
Thiamin	mg/d	0.037	0.115	0.4	9	29
Vitamin B6	mg/d	0.016	0.051	0.4	4	13
Folate	mg/d	15	47	128	12	36
Vitamin B12	mg/d	0.2	0.5	0.7	24	76
Vitamin C	mg/d	7	22	25	28	88

*The nutrient composition of breastmilk and energy requirement was derived from WHO/UNICEF, 1998 and the zinc requirement was derived from IZiNCG (2004). The RNI (FAO/WHO, 2004) was converted to the EAR equivalent using conversion factors (WHO/FAO, 2006), except for iron as no conversion factor is available.

**Iron bioavailability in breast milk among infants >7 months has been estimated at 14.8% (Abrams et al., 1997). However, as breast milk provides only a small percentage of the iron requirement after 6 months of age, the assumption of low iron bioavailability pertaining to the diet is used.

APPENDIX VIII: SUMMARY OF PROBLEM NUTRIENTS WHEN ASSUMING AVERAGE BREASTMILK INTAKE

Table VIII-1 Summary of problem nutrients in the diet of children by age group and breastfeeding status in Karaga and Gomoa East Districts, assuming average breast milk intake.

Micro-nutrients	Karaga District				Gomoa East District			
	6-8 BF	9-11 BF	12-23 BF	12-23 NBF	6-8 BF	9-11 BF	12-23 BF	12-23 NBF
Calcium								
Iron								
Zinc								
Vitamin A								
Niacin								
Riboflavin								
Thiamin								
Vitamin B6								
Folate								
Vitamin B12								
Vitamin C								

Legend: BF=breastfed, NBF=non-breastfed

Nutrient requirements cannot be met by any combination of local foods

Nutrient requirements could be met but may require changes in the diet

Table VIII-2 Changes in problem nutrients in the diet of children by age group when assuming average breastmilk intake compared to low breastmilk intake.

Age-group	Changes in problem nutrients in Karaga District	Changes in problem nutrients in Gomoa District
6-8 mo	- vitamin C and vitamin B12 are not problem nutrients anymore - riboflavin is above 100% RNI in best-case scenario (which was not the case for low BM intake) - niacin and vitamin B6 are in best-case scenario not above 100% RNI (which was the case for low BM intake) - vitamin A is in worst-case scenario above 70% RNI (which was not the case for low BM intake) but in best-case also not above 100% RNI	- protein, vitamin C, vitamin B12 and vitamin A are not problem nutrients anymore
9-11 mo	- fat, vitamin C and vitamin B12 are not problem nutrients anymore - niacin is in best-case scenario not above 100% RNI (which was the case for low BM intake) - vitamin A is in worst-case scenario above 70% RNI (which was not the case for low BM intake) but in best-case also not above 100% RNI	- protein, fat, vitamin C, vitamin B12 and vitamin A are not problem nutrients anymore - niacin is in best-case scenario not above 100% RNI (which was the case for low BM intake)
12-23 mo	- fat and vitamin C are not problem nutrients anymore - riboflavin is in best-case scenario above 100% RNI (which is not the case for low BM intake)	- fat and vitamin C are not problem nutrients anymore

Appendix IX: FOODS CONTRIBUTING MORE THAN 5% TO MICRONUTRIENT INTAKE IN KARAGA AND GOMOA EAST DISTRICTS

Table IX-1 *Foods contributing ≥5% to nutrient intake in draft optimized diet in Karaga district by target group*

Target group: 6-8 months old		
Food	**#nutrients[1] ⩾5%**	**Nutrients**
Chocolate drink powder	8	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B-6, Vitamin B-12, Iron
Cowpea white dried whole	8	Calcium, Thiamin, Riboflavin, Niacin, Vitamin B-6, Folate, Iron, Zinc
Guinea corn flour whole	6	Thiamin, Riboflavin, Niacin, Vitamin B-6, Iron, Zinc
Maize flour whole white	6	Thiamin, Riboflavin, Niacin, Vitamin B-6, Iron, Zinc
Groundnut roasted paste	5	Thiamin, Niacin, Vitamin B-6, Folate, Zinc
Milk cow powder skimmed	3	Calcium, Riboflavin, Vitamin B-12
Ayoyo leaves raw	2	Calcium, Vitamin C
Target group: 9-11 months old		
Food	**#nutrients[1] ⩾5%**	**Nutrients**
Maize flour whole grain white	7	Thiamin, Riboflavin, Niacin, Vitamin B-6, Folate, Iron, Zinc
Guinea corn flour whole	6	Thiamin, Riboflavin, Niacin, Vitamin B-6, Iron, Zinc
Cowpea white dried whole	4	Thiamin, Folate, Iron, Zinc
Melon water raw	4	Vitamin C, Riboflavin, Vitamin B-6, Vitamin A
Okro fruit raw	4	Calcium, Vitamin C, Vitamin B-6, Folate
Rice local brown unpolished	4	Thiamin, Niacin, Vitamin B-6, Zinc
Bra leaves raw	3	Calcium, Riboflavin, Folate
Milk cow powder skimmed	3	Calcium, Riboflavin, Vitamin B-12
Ayoyo leaves raw	2	Calcium, Vitamin C
Groundnut flour with fat	2	Thiamin, Niacin
Groundnut roasted paste	2	Niacin, Vitamin B-6
Fish anchovies smoked dried	1	Niacin
Fish herrings smoked dried	1	Vitamin B-12
Mackerel canned in tomato sauce	1	Vitamin B-12
Oil vegetable frytol	1	Vitamin A
Target group: 12-23 months old, breastfed		
Food	**#nutrients[1] ⩾5%**	**Nutrients**
Melon water raw	6	Vitamin C, Thiamin, Riboflavin, Vitamin B-6, Vitamin A, Iron
Rice local brown unpolished raw	6	Thiamin, Niacin, Vitamin B-6, Folate, Iron, Zinc
Bra leaves raw	5	Calcium, Vitamin C, Riboflavin, Folate, Iron
Groundnut roasted paste	5	Thiamin, Niacin, Vitamin B-6, Folate, Iron
Ayoyo leaves raw	4	Calcium, Vitamin C, Riboflavin, Folate
Cowpea white dried whole	4	Thiamin, Folate, Iron, Zinc
Maize flour whole white	4	Thiamin, Vitamin B-6, Iron, Zinc
Milk cow powder skimmed	4	Calcium, Riboflavin, Vitamin B-12, Zinc
Okro fruit raw	4	Calcium, Vitamin C, Vitamin B-6, Folate
Guinea corn dough whole	3	Thiamin, Iron, Zinc
Groundnut flour with fat	2	Thiamin, Niacin
Fish anchovies smoked dried	1	Niacin
Mackerel canned in tomato sauce	1	Vitamin B-12
Oil palm	1	Vitamin A

Pigeon peas dried	1	Folate

Table C.1 *Foods contributing ≥5% to nutrient intake in draft optimized diet in Karaga district by target group - continued*

Target group: 12-23 months old, non-breastfed

Food	#nutrients[1] ⩾5%	Nutrients
Milk cow whole raw	9	Calcium, Vitamin C, Thiamin, Riboflavin, Vitamin B-6, Folate, Vitamin B-12, Vitamin A, Zinc
Bra leaves raw	7	Calcium, Vitamin C, Riboflavin, Vitamin B-6, Folate, Vitamin A, Iron
Chocolate drink powder	7	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B-6, Iron
Maize flour whole grain white	7	Thiamin, Riboflavin, Niacin, Vitamin B-6, Folate, Iron, Zinc
Egg guinea fowl	6	Riboflavin, Folate, Vitamin B-12, Vitamin A, Iron, Zinc
Cowpea white dried whole	5	Thiamin, Niacin, Folate, Iron, Zinc
Ayoyo leaves raw	4	Calcium, Vitamin C, Folate, Vitamin A
Rice local brown unpolished raw	4	Thiamin, Niacin, Vitamin B-6, Zinc
Melon water raw	3	Vitamin C, Vitamin B-6, Vitamin A
Okro fruit raw	3	Vitamin C, Vitamin B-6, Folate
Fish anchovies smoked dried	1	Niacin
Millet dough whole grain	1	Iron
Oil vegetable frytol	1	Vitamin A
Okro fruit dried powder	1	Niacin

[1]*#Nutrients ≥5%=number of nutrients to which a specific food contributes more than 5% of nutrient intake*

Table IX-2 Foods contributing ≥5% to nutrient intake in draft optimized diet in Gomoa East district by target group

Target group: 6-8 months old

Food	#nutrients[1] ⩾5%	Nutrients
Cocoyam leaves, raw	8	Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin A. Iron
Millet flour whole grain	7	Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Cerelac maize/wheat/rice cereal Nestle	6	Calcium, Vitamin C, Thiamin, Vitamin A, Iron, Zinc
Fish herrings smoked	4	Riboflavin, Niacin, Vitamin B6, Vitamin B12
Fish salmon raw	3	Niacin, Vitamin B6, Vitamin B12
Cassava tuber, raw	3	Vitamin C, Niacin, Folate
Cowpea white flour	3	Folate, Iron, Zinc
Milk cow powder skimmed	2	Calcium, Riboflavin
Fish lean, dried salted	1	Vitamin B12
Groundnut flour with fat	1	Niacin
Groundnut paste	1	Niacin
Tomato paste concentrated	1	Niacin

Target group: 9-11 months old

Food	#nutrients[1] ⩾5%	Nutrients
Millet flour whole grain	7	Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Cerelac maize/wheat/rice cereal Nestle	6	Calcium, Vitamin C, Thiamin, Vitamin A, Iron, Zinc
Cocoyam leaves, raw	6	Vitamin C, Thiamin, Riboflavin, Vitamin B6, Folate, Vitamin A
Fish herrings smoked	4	Riboflavin, Niacin, Vitamin B6, Vitamin B12
Fish anchovies smoked	2	Riboflavin, Niacin
Fish salmon raw	2	Niacin, Vitamin B12
Fish herrings, raw	1	Vitamin B12
Milk cow powder skimmed	1	Riboflavin
Okro fruit raw	1	Folate
Tomato paste concentrated	1	Niacin
Tomato raw	1	Vitamin C

Target group: 12-23 months old, breastfed

Food	#nutrients[1] ⩾5%	Nutrients
Cassava tuber, raw	9	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Cocoyam leaves, raw	9	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin A, Iron
Millet flour whole grain	7	Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Chocolate drink powder	7	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Iron
Maize dough whole grain white	6	Thiamin, Riboflavin, Niacin, Vitamin B6, Iron, Zinc
Cowpea white dried whole	3	Folate, Iron, Zinc
Fish herrings smoked	2	Niacin, Vitamin B12
Okro fruit raw	2	Vitamin C, Folate
Melon seeds, raw	1	Zinc
Biscuit sweet	1	Calcium
Oil palm	1	Vitamin A
Palm nuts pulp raw	1	Vitamin A

Fish anchovies smoked	1	Niacin
Fish lean, dried salted	1	Vitamin B12
Groundnut paste	1	Niacin
Tomato raw	1	Vitamin C

Target group: 12-23 months old, non-breastfed

Food	**#nutrients[1] ⩾5%**	**Nutrients**
Cassava tuber, raw	9	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Chocolate drink powder	8	Calcium, Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B6, Iron, Zinc
Millet flour whole grain	7	Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Iron, Zinc
Cocoyam leaves, raw	7	Calcium, Vitamin C, Thiamin, Riboflavin, Folate, Vitamin A, Iron
Cowpea white dried whole	4	Thiamin, Folate, Iron, Zinc
Fish herrings smoked	3	Riboflavin, Niacin, Vitamin B12
Groundnut paste	2	Niacin, Folate
Meat beef raw	1	Zinc
Oil palm	1	Vitamin A
Oil vegetable frytol	1	Vitamin A
Palm nuts pulp raw	1	Vitamin A
Biscuit sweet	1	Calcium
Fish lean, dried salted	1	Vitamin B12
Fish tuna, raw	1	Vitamin B12
Tomato paste concentrated	1	Niacin
Tomato raw	1	Vitamin A

[1]*#Nutrients ≥5%=number of nutrients to which a specific food contributes more than 5% of nutrient intake*

Appendix X: FOOD BASED RECOMMENDATIONS FOR EACH TARGET GROUP FOR KARAGA AND GOMOA EAST DISTRICTS

Table X-1*Food based recommendations for6-8 months old infants in Karaga district*

	Percentage RNI												
Food-Based Recommendation (FBR)	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B6**	**Folate**	**Vit. B12**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH¢/day[1]**	**≠Nutrients ⩾70 % RNI[2]**
Best-case scenario without FBR[3]	59.6	72.2	152.4	92.8	111.8	147.8	111.3	76.7	48.4	28.1	55.3	NA[5]	7
Worst-case scenario without FBR[4]	26.5	46.5	55.6	38.7	26.4	37.7	44.3	49.2	43.6	5.6	18.5	0.2	0
Worst-case scenario for FBR, not combined													
A	31.3	57.5	57.6	46.4	30.4	44.9	50.8	49.3	47.5	7.1	18.9	0.3	0
B	35.8	47.2	56.8	49.5	26.4	38.9	45.5	66.4	43.7	5.6	19.9	0.3	0
C	33.8	58.7	70.5	54.2	43.6	66.8	44.3	57.3	43.6	9.3	18.5	0.3	1
D	29.7	47.4	62.1	41.5	52.2	42.6	89.2	49.2	43.6	11.8	32.3	0.3	1
E	28.7	46.6	127.4	54.5	60.6	103.7	57.9	49.8	43.6	16.4	39.9	0.2	2
Worst-case scenario for FBR, combined													
A + B	40.7	58.2	58.9	57.2	30.4	46.2	52	66.6	47.7	7.1	20.3	0.3	0
A + C	38.6	69.7	72.5	61.9	47.6	74.1	50.8	57.4	47.6	11	18.9	0.4	2
A + D	34.6	58.3	65.2	49.6	56.4	51	96	49.4	47.5	13.5	33.3	0.4	1
A + E	33.7	57.5	131.2	62.8	65.3	112.5	64.8	49.9	47.6	18.3	41	0.3	2
B + C	43.1	59.4	71.7	65	43.6	68.2	45.5	74.5	43.8	9.3	19.9	0.4	2
B + D	39	48.1	65.2	52.9	52.2	45.6	90.9	66.5	43.7	11.8	34.5	0.4	1
B + E	38.2	47.3	131.6	66.1	61.3	107.3	59.8	67	43.7	16.5	42.3	0.3	2
C +D	37	59.5	81.4	58.4	69.8	75.8	89.2	57.3	43.6	16.1	33.5	0.4	3
A + B + C	48	70.4	73.8	72.8	47.6	75.5	52	74.6	47.7	11	20.3	0.4	5
A + B + D	43.9	59	68.4	61	56.4	54	97.7	66.6	47.7	13.5	35.5	0.4	1
A + C + D	41.9	70.5	84.5	66.5	74	84.2	96	57.5	47.6	17.9	34.5	0.5	5
B + C + D	46.3	60.2	84.7	69.9	69.8	78.7	90.9	74.6	43.8	16.1	35.7	0.5	4
A + B + C + D	51.2	71.2	88.1	78	74.1	87.2	97.7	74.7	47.7	17.9	36.7	0.5	7
Best and worst-case scenario, selected FBR													
Best-case scenario, A + B + C	59.6	72.2	152.2	92.8	111.6	147.8	110.2	76.7	48.4	27.6	54.6	NA[5]	7
Worst-case scenario, A + B + C	48	70.4	73.8	72.8	47.6	75.5	52	74.6	47.7	11	20.3	0.4	5
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario, B + C + F	59.6	72.2	152.2	92.8	111.6	147.8	110.2	76.7	48.4	27.6	54.6	NA[5]	7
Worst-case scenario, B + C + F	47.8	69.8	73.6	72.6	47.6	75	51.7	74.6	47.7	11	20.3	0.4	4

A=21 serves/week of vegetables, B=7 serves/week of dairy products, C=7 serve/week of chocolate drink powder, D=21 serves/week of legumes, E=21 serves/week of whole grains unfortified and F=14 serves/week of vitamin A rich vegetables.[1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their

RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient, [5]NA=not available

Table X-2 *Food based recommendations for9-11 months old infants in Karaga district*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Best-case scenario without FBR[3]	45.5	77.6	167.1	85.9	105.6	170.5	102.7	73.4	53.6	28.5	56.2	NA[5]	7
Worst-case scenario without FBR[4]	20.9	35.8	49.1	33.1	26	45.1	39.1	38.3	33.5	5.3	20	0.3	0
Worst-case scenario for FBR, not combined													
A	21.9	52.6	50.5	38.8	26	57.3	41.2	39.2	41.1	5.7	20	0.3	0
B	27.1	36.2	49.9	40.4	26	45.9	39.9	49.8	33.6	5.3	20.9	0.3	0
C	21.7	35.8	49.1	34.7	33.8	45.8	39.2	58	33.7	5.5	20.4	0.3	0
D	22.5	36.1	54.3	33.8	48.6	49.9	61.2	38.3	33.5	8.1	25.3	0.3	0
E	26.2	44.7	51.8	41.6	27.8	51.5	47.3	38.4	37.7	7	20.8	0.3	0
F	23.7	35.8	136.9	50.7	60.8	118.2	52	38.9	33.5	19.6	41.8	0.3	2
Worst-case scenario for FBR, 2 FBR combined													
A + B	28.1	53	51.4	46	26	58.2	42	50.7	41.1	5.7	20.9	0.3	0
A + C	22.7	52.6	50.5	40.3	33.8	58	41.4	59	41.2	5.9	20.4	0.3	0
A + D	23.5	52.9	56.9	40.1	48.6	62.4	63.3	39.2	41.1	8.7	25.3	0.4	0
A + E	27.2	61.5	53.3	47.2	27.8	63.8	49.4	39.3	45.3	7.4	20.8	0.3	0
A + F	25	52.6	144	57.8	62.6	134.9	55.4	39.9	41.1	20.7	43.3	0.3	2
B + C	27.9	36.3	49.9	41.9	33.8	46.6	40	69.5	33.7	5.5	21.3	0.4	0
B + D	28.7	36.6	55.3	41.2	48.6	50.8	62	49.8	33.6	8.1	26.4	0.4	0
B + E	32.4	45.2	52.6	48.8	27.8	52.4	48.1	49.9	37.8	7	21.8	0.3	0
B + F	30	36.3	139.6	58.4	61.3	120.5	53.2	50.4	33.6	19.6	43.5	0.4	2
C + D	23.3	36.1	54.3	35.4	56.4	50.6	61.3	58.1	33.7	8.4	25.8	0.4	0
C + E	27	44.7	51.8	43.1	35.6	52.2	47.4	58.1	37.9	7.2	21.2	0.3	0
C + F	24.6	35.8	137.4	52.5	68.9	119.7	52.4	58.7	33.7	19.9	42.6	0.4	2
D + E	27.8	45	57	42.3	50.4	56.4	69.4	38.4	37.7	9.8	26.3	0.4	0
E + F	29.1	44.7	140.6	59.3	62.9	125.4	60.4	39	37.7	21.4	43.1	0.3	2

A=7 serves/week of fruits, B=7 serves/week of dairy products, C=7 serves/week of meat, fish, eggs, D=28 serves/week of legumes, E=13 serves/week of dark green leafy vegetables and F=27 serves/week of whole grains unfortified, [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-2 Food based recommendations for9-11 months old infants in Karaga district- continued

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	20.9	35.8	49.1	33.1	26	45.1	39.1	38.3	33.5	5.3	20	0.3	0
Worst-case scenario for FBR, 3 FBR combined													
A + B + C	28.9	53.1	51.4	47.6	33.8	58.9	42.2	70.5	41.3	5.9	21.3	0.4	1
A + B + D	29.7	53.4	59	47.5	48.6	63.6	64.1	50.7	41.1	8.7	26.4	0.4	0
A + B + E	33.4	62	54.1	54.4	27.8	64.6	50.2	50.8	45.3	7.4	21.8	0.4	0
A + B + F	31.3	53.1	146.7	65.5	63.1	137.3	56.7	51.4	41.2	20.8	44.9	0.4	2
A + C + D	24.3	52.9	57.1	41.7	56.4	63.3	63.5	59	41.2	9	25.8	0.4	0
A + C + E	28	61.5	53.3	48.7	35.6	64.5	49.5	59.1	45.4	7.6	21.2	0.4	0
A + C + F	25.8	52.6	144.5	59.6	70.7	136.4	55.8	59.7	41.2	21.1	44	0.4	3
A + D + E	28.8	61.8	60.2	48.6	50.4	69	71.5	39.3	45.3	10.5	26.3	0.4	1
A + E + F	30.3	61.5	147.7	66.5	64.7	142.1	63.8	40	45.3	22.6	44.5	0.4	2
B + C + D	29.5	36.6	55.3	42.9	56.4	51.5	62.1	69.5	33.7	8.4	26.9	0.4	0
B + C + E	33.2	45.2	52.6	50.3	35.6	53.1	48.2	69.6	37.9	7.2	22.1	0.4	0
B + C + F	30.9	36.3	140.2	60.2	69.4	122.1	53.7	70.2	33.8	20	44.2	0.4	3
B + D +E	34	45.5	58.2	49.7	50.4	57.2	70.2	49.9	37.8	9.8	27.4	0.4	1
B + E + F	35.4	45.2	143.3	67.1	63.4	127.8	61.7	50.5	37.8	21.4	44.7	0.4	2
C + D + E	28.6	45.1	57	43.9	58.2	57.1	69.5	58.1	37.9	10.1	26.7	0.4	0
C + E + F	29.9	44.8	141.1	61.1	71	126.9	60.8	58.8	37.9	21.7	43.8	0.4	3
Worst-case scenario for FBR, 4 FBR combined													
A + B + C + D	30.5	53.4	59.2	49.2	56.4	64.5	64.3	70.5	41.3	9	26.9	0.4	1
A + B + C + E	34.2	62	54.1	56	35.6	65.3	50.4	70.6	45.5	7.6	22.1	0.4	1
A + B + C + F	32.1	53.1	147.3	67.3	71.2	138.8	57.1	71.2	41.3	21.1	45.7	0.4	4
A + B + D + E	35	62.3	62.4	56	50.4	70.2	72.3	50.8	45.3	10.5	27.4	0.4	2
A + B + E + F	36.6	62	150.4	74.2	65.2	144.5	65.1	51.5	45.4	22.6	46.1	0.4	3
A + C + D +E	29.6	61.9	60.4	50.3	58.2	69.9	71.6	59.1	45.4	10.7	26.7	0.4	1
A + C + E + F	31.2	61.6	148.2	68.3	72.8	143.7	64.2	59.8	45.4	22.9	45.3	0.4	3
B + C + D + E	34.8	45.5	58.2	51.4	58.2	57.9	70.3	69.6	37.9	10.1	27.9	0.4	1
B + C + E + F	36.2	45.2	143.9	68.9	71.5	129.3	62.1	70.3	38	21.8	45.5	0.4	4

A=7 serves/week of fruits, B=7 serves/week of dairy products, C=7 serves/week of meat, fish, eggs, D=28 serves/week of legumes, E=13 serves/week of dark green leafy vegetables and F=27 serves/week of whole grains unfortified, [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-2 *Food based recommendations for9-11 months old infants in Karaga district- continued*

	Percentage RNI												
Food-Based Recommendation (FBR)	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH¢/day[1]**	**≠ Nutrients[2] ⩾70 % RNI**
Worst-case scenario without FBR	20.9	35.8	49.1	33.1	26	45.1	39.1	38.3	33.5	5.3	20	0.3	0
Worst-case scenario for FBR, 5 FBR combined													
A + B + C + D + E	35.8	62.3	62.7	57.7	58.2	71.1	72.4	70.6	45.5	10.7	27.9	0.4	3
A + B + C + E + F	37.5	62	151	76	73.3	146	65.5	71.3	45.5	22.9	46.9	0.4	5
Best and worst-case scenario, selected FBR													
Best-case scenario, A + C + E + F	43.3	77	163.7	84.1	94.2	166.7	91.7	73.4	52.2	27.2	54	NA[5]	7
Worst-case scenario, A + C + E + F	31.2	61.6	148.2	68.3	72.8	143.7	64.2	59.8	45.4	22.9	45.3	0.4	3
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario, A + B + E + G + H + I	45.3	77.5	166.3	85.5	102.7	166.6	101	73.4	53.6	28.3	55.3	NA[5]	7
Worst-case scenario, A + B + E + G + H + I	37.1	62	142.1	74	69.8	131.6	68.8	56.2	45.4	21.7	42.8	0.4	2

A=7 serves/week of fruits, B=7 serves/week of dairy products, C=21 serves/week of meat, fish, eggs, D=28 serves/week of legumes, E=13 serves/week of dark green leafy vegetables, F=27serves/week of whole grains unfortified, G=21serves/week of whole grains unfortified and no rice, H=14 serves/week of meat, fish, eggs of which 7 serves of anchovies and I=21 serves/week of nuts and/or seeds. [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario. [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-3 Food based recommendations for12-23 months old breastfed infants in Karaga district

Food-Based Recommendation (FBR)	Percentage RNI												≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn	GH¢/day[1]	
Best-case scenario without FBR[3]	50.6	99.3	138.1	94.4	119.5	159.5	89.6	53.1	133.9	67.4	134.8	NA[5]	8
Worst-case scenario without FBR[4]	13	23	53.6	25.8	31.6	45.4	20.7	20	21.6	16.8	46.7	0.4	0
Worst-case scenario for FBR, not combined													
A	14.4	52.4	56.4	34.4	31.6	61.1	22.7	21.3	34.8	18.5	47.6	0.4	0
B	24.2	24.1	55.3	39.1	31.6	47.7	21.7	40.1	21.7	16.8	51.1	0.5	0
C	16	23.6	58.6	28.9	34.3	50.1	41.1	20	21.6	25.6	66.9	0.4	0
D	13.7	23	57	26.3	54	55.6	25.7	20	21.6	18.2	50.5	0.5	0
E	14.6	23.1	88.6	35.4	45.4	85.3	25.5	20.4	21.6	33	79	0.4	3
F	13.1	23	54.9	26.2	32.2	46.1	21.1	20	96	17.2	47.9	0.4	1
Worst-case scenario for FBR, 2 FBR combined													
A + B	25.6	53.5	58.2	47.8	31.6	63.5	23.7	41.4	35	18.5	52.4	0.5	0
A + C	17.3	53	62.6	38	34.5	66	43	21.3	34.8	28.1	68.2	0.5	0
A + D	15.1	52.4	60.6	35.4	54.2	71.5	27.6	21.3	34.8	20.8	51.8	0.5	1
A + E	16.4	52.5	96.1	45.4	47.5	102.9	28.7	21.7	34.8	36.2	83.1	0.5	3
A + F	14.5	52.4	57.8	34.8	32.2	61.6	23.1	21.3	109.2	19	48.4	0.5	1
B + C	27.1	24.6	60.5	42.3	34.3	52.5	42	40.1	21.8	25.6	71.8	0.5	1
B + D	24.9	24.1	58.7	39.7	54	58	26.6	40.1	21.7	18.2	55.4	0.5	0
B + E	26	24.1	92.3	49.3	46.2	88.5	27	40.5	21.8	33.1	85.1	0.5	3
B + F	24.3	24.1	56.6	39.5	32.2	48.3	22.1	40.1	96.1	17.2	52.2	0.5	1
C + D	16.6	23.6	65.1	30.7	57.5	60.5	46.3	20	21.6	29.2	71.2	0.5	1
C + E	18.3	23.6	102.3	41	52.2	93.5	48.2	20.5	21.6	44.7	105.4	0.5	3
C + F	16.1	23.6	59.7	29.3	34.9	50.6	41.4	20	96	26	67.8	0.5	1
D + E	16.1	23.1	100.4	38.5	72.1	99.1	32.9	20.4	21.6	37.5	89.3	0.5	4
D + F	13.8	23	58.3	26.7	54.6	56.1	26	20	96	18.6	51.4	0.5	1
E + F	14.6	23.1	88.6	35.4	45.4	85.3	25.5	20.4	96	33	79	0.4	4

A=7 serves/week of fruits, B=7 serves/week of dairy products, C=7 serves/week of cooked beans, D=21 serves/week of nuts, seeds, E=13 serves/week of whole grains unfortified and F=7serves/week of red palm oil, [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-3 *Food based recommendations for12-23 months old breastfed infants in Karaga district– continued*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	13	23	53.6	25.8	31.6	45.4	20.7	20	21.6	16.8	46.7	0.4	0
Worst-case scenario for FBR, 3 FBR combined													
A + B + C	28.5	54	65.5	51.7	34.5	68.4	44.1	41.4	35	28.1	73	0.6	1
A + B + D	26.3	53.5	63.5	49.2	54.3	73.9	28.7	41.4	35	20.8	56.6	0.6	1
A + B + E	27.7	53.5	99.8	59.3	48.3	106.1	30.2	41.9	35	36.3	89.3	0.5	3
A + B + F	25.7	53.5	59.5	48.2	32.2	64	24	41.4	109.4	19	53.2	0.5	1
A + C + D	18.4	53	72	40.4	59.1	77.7	49.2	21.3	34.8	32.4	74.4	0.5	3
A + C + E	20.1	53	109.8	51	54.3	111.1	51.4	21.9	34.8	48	109.5	0.5	3
A + C + F	17.5	53	63.2	38.2	35	66.5	43.4	21.3	109.2	28.3	69.1	0.5	1
A + D + E	17.8	52.5	107.9	48.5	74.2	116.7	36.1	21.8	34.8	40.7	93.4	0.5	4
A + D + F	15.2	52.4	61.3	35.6	54.7	72	28	21.3	109.2	20.9	52.7	0.5	2
A + E + F	16.4	52.5	96.1	45.4	47.5	102.9	28.7	21.7	109.2	36.2	83.1	0.5	4
B + C + D	28	24.6	68.3	44.5	57.8	63.4	47.5	40.1	21.8	29.3	76.3	0.6	1
B + C + E	29.6	24.7	106	54.9	53	96.7	49.7	40.7	21.8	44.9	111.5	0.5	3
B + C + F	27.2	24.6	61.7	42.7	34.9	53	42.4	40.1	96.2	26	72.6	0.5	2
B + D +E	27.4	24.1	104.2	52.4	72.9	102.4	34.4	40.6	21.8	37.6	95.4	0.6	4
B + D + F	25	24.1	60	40.1	54.6	58.5	27	40.1	96.1	18.6	56.2	0.6	1
B + E + F	26	24.1	92.3	49.3	46.2	88.5	27	40.5	96.2	33.1	85.1	0.5	4
C + D + E	19.7	23.6	114.2	44.2	79.6	107.4	55.7	20.6	21.6	49.4	115.7	0.6	4
C + D + F	16.7	23.6	65.5	30.8	57.9	61	46.5	20	96	29.2	72	0.5	2
C + E + F	18.3	23.6	102.3	41	52.2	93.5	48.2	20.5	96	44.7	105.4	0.5	4
D + E + F	16.1	23.1	100.4	38.5	72.1	99.1	32.9	20.4	96	37.5	89.3	0.5	5
Worst-case scenario for FBR, 4 FBR combined													
A + B + C + D	29.7	54	75.7	54.2	59.9	80.9	50.7	41.4	35	32.5	80.5	0.6	3
A + B + C + E	31.4	54	113.5	64.9	55.1	114.3	52.9	42	35	48.1	115.7	0.6	3
A + B + C + F	28.6	54	66.1	51.8	35	68.9	44.4	41.4	109.4	28.3	73.9	0.6	2
A + B + D + E	29.2	53.5	111.7	62.4	75.1	119.9	37.6	41.9	35	40.8	99.6	0.6	4
A + B + D + F	26.4	53.5	64.1	49.3	54.7	74.4	29	41.4	109.4	20.9	57.5	0.6	2
A + B + E + F	27.7	53.5	99.8	59.3	48.3	106.1	30.2	41.9	109.4	36.3	89.3	0.6	4

Table X-3 *Food based recommendations for12-23 months old breastfed infants in Karaga district– continued*

Food-Based Recommendation (FBR)	Percentage RNI												
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH¢/day[1]**	**≠Nutrients ⩾70 % RNI[2]**
Worst-case scenario without FBR[4]	13	23	53.6	25.8	31.6	45.4	20.7	20	21.6	16.8	46.7	0.4	0
Worst-case scenario for FBR, 4 FBR combined													
A + C + D + E	18.4	53	72	40.5	59.1	77.8	49.2	21.3	109.2	32.4	74.4	0.5	4
A + C + E + F	20.1	53	109.8	51	57.1	111.6	51.5	21.9	109.2	48.5	109.5	0.6	4
A + D + E + F	17.8	52.5	107.9	48.6	80.5	118.1	36.3	21.8	109.2	41.4	93.4	0.6	5
B + C + D + F	28	24.6	68.6	44.6	58.1	63.5	47.7	40.1	96.2	29.3	76.9	0.6	2
B + C + E + F	29.6	24.7	106	54.9	53.1	96.7	49.7	40.7	96.2	44.9	111.5	0.6	4
B + D + E + F	27.4	24.1	104.2	52.4	73.1	102.4	34.4	40.6	96.2	37.6	95.4	0.6	5
Worst-case scenario for FBR, 5 FBR combined													
A + B + C + D + F	29.7	54	75.7	54.3	59.9	80.9	50.7	41.4	109.4	32.5	80.5	0.6	4
Best and worst-case scenario, selected FBR													
Best-case scenario, A + D + E + F	22.4	64.2	110.8	57.6	93	128.6	42.1	33	114.1	46.3	96.4	NA[5]	5
Worst-case scenario, A + D + E + F	17.8	52.5	107.9	48.6	80.5	118.1	36.3	21.8	109.2	41.4	93.4	0.6	5
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario, A + B + D + G + H + I	45.3	98.1	129	89.4	111.2	155.2	65.6	52.8	79.4	56.9	117.1	NA[5]	7
Worst-case scenario, A + B + D + G + H + I	39.7	74.4	116.9	79.7	85.2	130.4	47.9	52.1	44.6	47.9	105.3	0.7	5

A=7 serves/week of fruits, B=7 serves/week of dairy products, C=7 serves/week of cooked beans, D=21 serves/week of nuts, seeds, E=13 serves/week of whole grains unfortified, F=7serves/week of red palm oil, G=2 serves/week of dark green leafy vegetables, H=21 serves/week of whole grains unfortified, I=2 serves/week of meat, fish and/or eggs. [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ≥70% RNI=the number of nutrients that are ≥70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-4 *Food based recommendations for12-23 months old not breastfed infants in Karaga district*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Best-case scenario without FBR[3]	175.7	149.4	192.6	308.2	206.7	248.1	128.6	409.1	100	108	194.2	NA[5]	11
Worst-case scenario without FBR[4]	3.8	0.1	67.6	22.3	30.6	63.8	15.8	1.7	0	24.8	60.8	0.5	3.8
Worst-case scenario for FBR, not combined													
A	16.2	35.1	73.8	42.8	43.6	87.2	37	2.2	10.2	34.4	69	0.7	2
B	28.9	2.4	72.6	52.2	31.1	69.3	18	46.4	0.4	24.8	71.5	0.7	2
C	3.8	0.1	67.6	22.3	30.6	63.8	15.8	1.7	0	24.8	60.8	0.5	0
D	22.4	34.6	74.6	48.5	36.6	81.5	34.4	2	16.5	36.9	68	0.6	2
E	10.6	0.8	84.2	29.1	38.7	71.6	52.5	1.9	0.1	42.4	93	0.6	3
F	132.4	35.9	101.2	209.7	35.5	108.8	46.3	360	43.8	26.8	115.4	1.6	6
G	9.4	0.1	141.6	38.7	87.4	156.8	29.7	2.7	0	57.9	130.6	0.7	4
Worst-case scenario for FBR, 2 FBR combined													
A + B	41.3	37.5	80.4	72.8	44.1	92.6	39.1	46.9	10.5	34.4	79.8	0.9	4
A + C	16.2	35.1	73.8	42.8	43.6	87.2	37	2.2	10.2	34.4	69	0.7	2
A + D	24.3	42.1	77	55.6	43.7	88.2	37.1	2.2	18.5	39.4	69.7	0.7	2
A + E	23	35.9	92.5	49.7	51.7	95	73.7	2.4	10.2	52	101.4	0.7	4
A + F	144.8	71	110.7	231.1	49.3	133.8	68.5	360.4	53.9	36.9	126.5	1.8	7
B + C	28.9	2.4	72.6	52.2	31.1	69.3	18	46.4	0.4	24.8	71.5	0.7	2
B + D	47.5	36.9	80.3	78.5	37.1	87	36.5	46.7	16.9	36.9	78.7	0.8	4
B + E	35.7	3.2	91.3	59.1	39.5	77.1	54.8	46.6	0.4	42.4	103.8	0.8	3
B + F	132.4	35.9	101.2	209.7	35.5	108.8	46.3	360	43.8	26.8	115.4	1.6	6
C + D	22.4	34.6	74.6	48.5	36.6	81.5	34.4	2	16.5	36.9	68	0.6	2
C + E	10.6	0.8	84.2	29.1	38.7	71.6	52.5	1.9	0.1	42.4	93	0.6	3
C + F	132.4	35.9	101.2	209.7	35.5	108.8	46.3	360	43.8	26.8	115.4	1.7	6
D + E	29.2	35.4	92.1	55.4	44.7	89.4	71.1	2.2	16.6	54.5	100.2	0.6	4
D + F	28.1	34.6	150	67.2	104.7	177.4	49.1	3	16.5	72	139.1	0.7	5
D + G	151	70.5	109.6	236.3	41.9	127.2	65.3	360.3	60.3	39.1	123.8	1.7	7
E + F	139.6	36.7	124.2	219.7	46.3	121.9	87	360.2	43.8	46.1	157.4	1.7	7

A=35 serves/week of vegetables, B=7 serves/week of dairy products, C=7 serves/week of fats, D=14 serves/week of dark green leafy vegetables, E=7 serves/week of cooked beans, F=7 serves/week of milk cow whole raw and G=28 serves/week of whole grains unfortified. [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ≥70% RNI=the number of nutrients that are ≥70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-4 *Food based recommendations for12-23 months old not breastfed infants in Karaga district - continued*

Food-Based Recommendation (FBR)	Percentage RNI												≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn	GH¢/day[1]	
Worst-case scenario without FBR[4]	3.8	0.1	67.6	22.3	30.6	63.8	15.8	1.7	0	24.8	60.8	0.5	3.8
Worst-case scenario for FBR, 3 FBR combined													
A + B + C	41.3	37.5	80.4	72.8	44.1	92.6	39.1	46.9	10.5	34.4	79.8	0.9	4
A + B + D	49.4	44.4	83.6	85.6	44.3	93.6	39.2	46.9	18.9	39.4	80.5	0.9	4
A + B + E	48.1	38.3	100	79.7	52.9	101.2	76.7	47.1	10.6	52	112.3	0.9	5
A + B + F	144.8	71	110.7	231.1	49.3	133.8	68.5	360.4	53.9	36.9	126.5	1.8	7
A + C + D	24.3	42.1	77	55.6	43.7	88.2	37.1	2.2	18.5	39.4	69.7	0.7	2
A + C + E	23	35.9	92.5	49.7	51.7	95	73.7	2.4	10.2	52	101.4	0.7	4
A + C + F	144.8	71	110.7	231.1	49.3	133.8	68.5	360.4	57.4	36.9	126.5	1.8	7
A + D + E	31.1	42.9	95.6	62.5	51.9	96	73.9	2.4	18.5	56.9	102.1	0.7	4
A + D + F	152.9	78	113.8	243.9	49.5	134.8	68.6	360.4	62.2	41.8	127.2	1.8	7
A + E + F	152	71.8	133.7	241.2	60.1	146.9	109.2	360.7	53.9	56.2	168.5	1.9	8
B + C + D	47.5	36.9	80.3	78.5	37.1	87	36.5	46.7	16.9	36.9	78.7	0.8	4
B + C + E	35.7	3.2	91.3	59.1	39.5	77.1	54.8	46.6	0.4	42.4	103.8	0.8	3
B + C + F	132.4	35.9	101.2	209.7	35.5	108.8	46.3	360	43.8	26.8	115.4	1.7	6
B + D + E	54.3	37.7	99.3	85.4	45.7	95.1	73.7	46.9	17	54.5	111.2	0.8	5
B + D + F	151	70.5	109.6	236.3	41.9	127.2	65.3	360.3	60.3	39.1	123.8	1.7	7
B + E + F	139.6	36.7	124.2	219.7	46.3	121.9	87	360.2	43.8	46.1	157.4	1.7	7
C + D + E	29.2	35.4	92.1	55.4	44.7	89.4	71.1	2.2	16.6	54.5	100.2	0.6	4
C + D + F	151	70.5	109.6	236.3	41.9	127.2	65.3	360.3	61.3	39.1	123.8	1.7	7
D + E + F	158.2	71.3	132.6	246.4	52.7	140.3	106	360.5	60.3	58.4	165.9	1.8	8
Worst-case scenario for FBR, 4 FBR combined													
A + B + C + D	49.4	44.4	83.6	85.6	44.3	93.6	39.2	46.9	18.9	39.4	80.5	0.9	4
A + B + C + E	48.1	38.3	100	79.7	52.9	101.2	76.7	47.1	10.6	52	112.3	0.9	5
A + B + C + F	144.8	71	110.7	231.1	49.3	133.8	68.5	360.4	57.4	36.9	126.5	1.8	7
A + B + D + E	56.1	45.2	103.1	92.5	53.1	102.2	76.8	47.1	18.9	56.9	113	0.9	5
A + B + D + F	152.9	78	113.8	243.9	49.5	134.8	68.6	360.4	62.2	41.8	127.2	1.8	7
A + B + E + F	152	71.8	133.7	241.2	60.1	146.9	109.2	360.7	53.9	56.2	168.5	1.9	8

Table X-4 *Food based recommendations for12-23 months old not breastfed infants in Karaga district - continued*

Food-Based Recommendation (FBR)	Percentage RNI												
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn	GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
Worst-case scenario without FBR[4]	3.8	0.1	67.6	22.3	30.6	63.8	15.8	1.7	0	24.8	60.8	0.5	3.8
Worst-case scenario for FBR, 4 FBR combined													
A + C + D + E	31.1	42.9	95.6	62.5	51.9	96	73.9	2.4	18.5	56.9	102.1	0.7	4
A + C + D + F	152.9	78	113.8	243.9	49.5	134.8	68.6	360.4	65.9	41.8	127.2	1.8	7
A + D + E + F	160.1	78.8	136.8	254	60.3	147.9	109.4	360.7	62.2	61.2	169.2	1.9	8
B + C + D + E	54.3	37.7	99.3	85.4	45.7	95.1	73.7	46.9	17	54.5	111.2	0.8	5
B + C + D + F	151	70.5	109.6	236.3	41.9	127.2	65.3	360.3	61.3	39.1	123.8	1.7	7
B + D + E + F	158.2	71.3	132.6	246.4	52.7	140.3	106	360.5	60.3	58.4	165.9	1.8	8
Worst-case scenario for FBR, 5 FBR combined													
A + B + C + D + E	56.1	45.2	103.1	92.5	53.1	102.2	76.8	47.1	18.9	56.9	113	0.9	5
A + B + C + D + F	152.9	78	113.8	243.9	49.5	134.8	68.6	360.4	65.9	41.8	127.2	1.8	7
A + B + D + E + F	160.1	78.8	136.8	254	60.3	147.9	109.4	360.7	62.2	61.2	169.2	1.9	8
Best and worst-case scenario, selected FBR													
Best-case scenario, A + D + E + F	165.6	105.2	140	257.8	73.7	159.9	123	375.3	66.3	64.8	175.4	NA[5]	9
Worst-case scenario, A + D + E + F	160.1	78.8	136.8	254	60.3	147.9	109.4	360.7	62.2	61.2	169.2	1.9	8
Best and worst-case scenario, selected harmonizedFBR													
Best-case scenario, A + B + D + H +I + J + K	73.9	103.7	162.2	130.3	119.7	189.7	109.8	82.9	39.5	95.6	178	NA[5]	10
Worst-case scenario, A + B + D + H + I + J +K	63.6	72.8	151.8	117.1	96.3	163	93.5	64.2	31.5	84.3	163.1	1.2	8

A=35 serves/week of vegetables, B=7 serves/week of dairy products, C=7 serves/week of fats, D=14 serves/week of dark green leafy vegetables, E=7 serves/week of cooked beans,F=7 serves/week of milk cow whole raw, G=28 serves/week of whole grains unfortified, H=21 serves/week of whole grains unfortified, I=21 serves/week of legumes of which 7 serves of cooked beans, J=7 serves/week of fruits and K=2 serves/week of meat, fish and/or eggs. [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ≥70% RNI=the number of nutrients that are ≥70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-5 *Food based recommendations for 6-8 months old infants in Gomoa East district*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B6	Folate	Vit. B12	Vit. A (RAE)	Fe	Zn		
Best-case scenario without FBR[3]	108	235.2	192	100.3	88.4	171.5	125.7	265.2	0	212.6	43.3	NA[5]	7
Worst-case scenario without FBR[4]	27	46.6	41	34.3	17.8	19.5	39.1	49.4	43.6	6.1	17.9	0.1	27
Worst-case scenario for FBR, not combined													
A	27	46.6	41	36.3	19.9	36.9	41.9	49.5	43.6	6.1	21	0.1	0
B	30	63.6	52.9	53.8	22.7	27.5	62	49.7	61.2	8.5	19.2	0.2	0
C	39.2	143.9	45.6	47.9	36.4	49	69	50.6	44	6.6	18	0.1	1
D	28	46.7	42.3	38.4	22.7	24.4	39.4	191.5	44.2	6.2	18.9	0.2	1
E	85.4	123.2	120.3	34.3	17.8	19.5	39.1	49.4	88.5	23.6	64.5	1.4	4
Worst-case scenario for, 2 FBR combined													
A + B	30	63.6	52.9	55.9	25.3	46	65.2	49.8	61.2	8.5	22.4	0.2	0
A + C	39.7	143.9	50.1	51.9	43	72.5	73.8	50.8	44	8.9	25	0.1	3
A + D	28	46.7	42.3	40.7	25.7	43.7	42.8	191.6	44.2	6.2	22	0.2	1
A + E	85.8	123.2	124.4	36.5	19.9	36.9	41.9	49.6	88.5	25.7	71.2	1.5	5
B + C	42.2	161	57.7	67.5	41.8	58.1	92.2	50.9	61.6	9	19.5	0.2	2
B + D	31	63.8	54.1	57.9	27.5	32.4	62.4	191.7	61.7	8.6	20.2	0.2	1
B + E	88.4	140.3	132.5	53.8	22.7	27.5	62	49.7	106.1	26	65.9	1.4	4
C + D	40.3	144.1	47.3	52.3	42.3	55.9	69.8	192.7	44.5	6.8	19.4	0.2	2
D + E	86.4	123.4	122	38.4	22.7	24.4	39.4	191.5	89	23.8	65.7	1.5	5
Worst-case scenario for, 3 FBR combined													
A + B + C	42.8	161	62.6	71.6	48.4	81.5	97.1	51.1	61.6	11.4	26.7	0.2	4
A + B + D	31	63.8	54.1	60.3	31.1	52.8	66.1	191.8	61.7	8.6	23.4	0.2	1
A + B + E	88.9	140.3	136.9	56.2	25.3	46	65.2	49.9	106.1	28.2	72.8	1.5	5
A + C + D	40.9	144.1	53.5	56.4	48.8	79.3	74.7	192.9	44.5	9.4	26.6	0.2	4
A + D + E	87	123.4	126.6	40.9	25.7	43.7	42.8	191.6	89	26.1	72.7	1.5	6
B + C + D	43.3	161.2	59.4	72	47.7	64.9	93.1	192.9	62.1	9.2	20.9	0.2	4
B + D + E	89.5	140.5	134.2	57.9	27.5	32.4	62.4	191.7	106.6	26.2	67.2	1.5	5

Table X-5 *Food based recommendations for 6-8 months old infants in Gomoa East district …continued*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B6	Folate	Vit. B12	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	27	46.6	41	34.3	17.8	19.5	39.1	49.4	43.6	6.1	17.9	0.1	27
Worst-case scenario for, 4 FBR combined													
A + B + C + D	44	161.2	67.6	76.2	54.3	88.4	97.9	193.1	62.1	12	28.2	0.2	5
A + B +D + E	90.1	140.5	139.6	60.6	31.1	52.8	66.1	191.9	106.6	28.7	74.3	1.5	6
Best and worst-case scenario, selected FBR													
Best-case scenario, A + B + C + D	71.8	200.4	123.5	99.8	87.5	157.2	123.2	265.2	154.1	26.9	50.6	NA	9
Worst-case scenario, A + B + C + D	44	161.2	67.6	76.2	54.3	88.4	97.9	193.1	62.1	12	28.2	0.2	5
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario,													
Worst-case scenario													

A=7 serves/week of grains, B=7 serves/week of dark green leafy vegetables, C=7 serves/week of cassava tuber, D=7serves/week of small whole fish and E=7 serves/week of bakery foods,[1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-6 *Food based recommendations for 9-11 months old infants in Gomoa East district*

Food-Based Recommendation (FBR)	Percentage RNI												≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn	GH¢/day[1]	
Best-case scenario without FBR[3]	110.5	260.7	204.2	108.1	129.9	214.5	116.2	373.6	214.9	52.2	95.2	NA[5]	10
Worst-case scenario without FBR[4]	21.3	35.8	33.8	27.2	12.4	14.1	31.2	38.4	33.5	5.7	16	0.2	0
Worst-case scenario for FBR, not combined													
A	24.1	36	35.6	40.3	32.3	29.4	32.6	148.3	35.3	6.3	19	0.4	1
B	79.9	112.7	114.4	27.2	12.4	14.1	31.2	38.4	78.5	23.3	63.5	1.5	4
C	24.1	51.3	44.5	44.8	16.9	22.1	52	38.6	49.4	7.8	17.2	0.2	0
D	24.4	36	36	38.1	53.4	26	32.1	239.5	34.5	6.8	19.3	0.4	1
E	25.4	35.8	122.4	51.4	51.4	144	55.1	39.5	33.5	31.1	41.9	0.4	2
Worst-case scenario for FBR, 2 FBR combined													
A + B	82.9	112.9	117.2	40.3	32.3	29.4	32.6	148.3	80.3	24.3	66.8	1.7	5
A + C	26.8	51.4	46.4	58	37.1	37.3	53.4	148.5	51.3	8.5	20.2	0.5	1
A + D	25	36.1	36.2	41.4	56.7	31.7	32.6	264.8	35.3	7	19.8	0.5	1
A + E	28.6	36	126.3	65.2	72.7	160.5	58.2	149.4	35.4	32.7	46.4	0.7	4
B + C	82.7	128.1	125.4	44.8	16.9	22.1	52	38.6	94.4	25.4	64.7	1.5	4
B + D	83.2	112.9	117.7	38.1	53.4	26	32.1	239.5	79.5	24.6	66.9	1.7	5
C + D	27.2	51.5	46.8	55.8	58.2	34	53	239.8	50.5	8.9	20.5	0.4	1
C + E	28.2	51.3	133.7	69.2	56.3	152.2	76.2	39.7	49.5	33.4	43.4	0.5	3
D + E	28.9	36.1	126.8	62.9	93.6	157	57.2	240.6	34.5	32.9	46.3	0.7	4
Worst-case scenario for, 3 FBR combined													
A + B + C	85.6	128.3	128.4	58	37.1	37.3	53.4	148.5	96.3	26.6	68.2	1.7	5
A + B + D	83.8	113	118.3	41.4	56.7	31.7	32.6	264.8	80.3	24.9	67.7	1.7	5
A + C + D	27.7	51.5	46.9	59.1	61.5	39.7	53.4	265	51.3	9.1	21	0.5	1
A + C + E	31.4	51.5	137.6	83	82.6	168.8	79.4	149.6	51.6	35	47.9	0.7	6
A + D + E	29.5	36.1	127.7	66.4	97	163.1	58.2	265.9	35.4	33.3	47.3	0.7	4
B + C + D	85.9	128.4	128.8	55.8	58.2	34	53	239.8	95.5	26.9	68.3	1.7	5
B + D + E	86.2	112.9	167.2	50.6	69.3	97.5	44.3	240.1	79.5	39.9	85	1.8	7
C + D + E	31.7	51.5	138	80.7	98.5	165.2	78.3	240.9	50.5	35.2	47.8	0.7	6

Table X-6 Food based recommendations for 9-11 months old infants in Gomoa East district - continued

	Percentage RNI												
Food-Based Recommendation (FBR)	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B6**	**Folate**	**Vit. B12**	**Vit. A (RAE)**	**Fe**	**Zn**	**GH¢/day[1]**	**≠ Nutrients ⩾70 % RNI[2]**
Worst-case scenario without FBR[4]	21.3	35.8	33.8	27.2	12.4	14.1	31.2	38.4	33.5	5.7	16	0.2	0
Worst-case scenario for, 4 FBR combined													
A + B + C + D	86.5	128.4	129.5	59.1	61.5	39.7	53.4	265	96.3	27.1	69.1	1.8	5
Best and worst-case scenario, selected FBR													
Best-case scenario, C + D + E	38.1	69.1	143.2	88.9	106.9	176.4	87.4	321.1	63.9	36.6	51.2	NA[5]	6
Worst-case scenario, C + D + E	31.7	51.5	138	80.7	98.5	165.2	78.3	240.9	50.5	35.2	47.8	0.7	6
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario, C + D + F + G + H	57.2	111.2	158.7	104.4	127.3	206.6	97.8	372.1	152.7	39.7	64.6	1.2	8
Worst-case scenario, C + D + F + G + H	31.4	62.4	125.2	79	100.6	156.8	77.8	240.5	51.9	30.1	44.1	0.6	6

A=28 serves/week of meat, fish and eggs, B=7 serves/week of RTE cereals fortified (Cerelac), C=7 serves/week of dark green leafy vegetables, D=14 serves/week of small fish with bones, E=21 serves/week of grains, F=14 serves/week of whole grains (maize/millet), G=7 serves/week of legumes and H=serves/week of vitamin A rich starchy foods,[1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-7 *Food based recommendations for 12-23 months old breastfed infants in Gomoa East district*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Best-case scenario without FBR[3]	49.7	155.6	100.6	101.1	93.2	161.3	76	212.2	170.2	76.7	116.1	NA[5]	10
Worst-case scenario without FBR[4]	13.3	23	23.2	19.7	22.3	28.6	18	20.2	21.6	11.8	39.7	0.5	0
Worst-case scenario for FBR, not combined													
A	19.3	35.6	35.3	33.7	34.3	47.4	18	26.7	21.6	19.1	40	0.6	0
B	14.6	23.3	27.7	22.2	29.1	30.5	26.6	20.2	21.6	17	53.8	0.5	0
C	18.9	87.6	24	25.7	25.2	35.5	25.9	20.7	22.6	13	40	0.6	1
D	16.8	48.2	33.7	42.9	27.1	35.7	36	20.5	47.5	17.5	42.6	0.5	0
E	14.5	23.3	24.1	24.4	30.6	32.2	18.2	141.9	22.2	12.5	41.7	0.6	1
F	14.3	23.1	50.2	28.9	25.1	72.9	20.8	20.5	21.6	40.4	50.7	0.5	1
G	13.3	23	23.2	19.7	22.3	28.6	18	20.2	121.7	11.8	39.7	0.5	1
Worst-case scenario for FBR, 2 FBR combined													
A + B	20.6	35.9	39.8	36.3	41.2	49.7	26.6	26.7	21.6	24.4	54.2	0.6	0
A + C	24.9	100.1	36.2	39.6	37.4	55.3	25.9	27.2	22.6	20.3	40.4	0.6	1
A + D	22.8	60.8	45.8	56.9	39	54.5	36	27	47.5	24.8	42.9	0.6	0
A + E	20.4	35.8	36.2	38.4	42.5	50.9	18.2	148.4	22.2	19.8	42.1	0.7	1
A + F	20.4	35.6	62.9	42.9	37.6	92.8	20.8	27	21.6	48	51.8	0.6	1
A + G	19.3	35.6	35.3	33.7	34.3	47.4	18	26.7	121.7	19.1	40	0.6	1
B + C	20.3	87.8	28.9	28.1	32.5	39	34.6	20.8	22.6	18.2	54.2	0.6	1
B + D	18.1	48.5	38.2	45.4	33.9	37.6	44.7	20.5	47.5	22.7	56.7	0.5	0
B + E	15.7	23.5	28.6	26.9	37.4	34.1	26.9	142	22.2	17.7	55.9	0.6	1
B + F	15.9	23.3	55.6	31.4	32.9	76.4	29.5	20.5	21.6	46.2	66.7	0.5	1
B + G	14.6	23.3	27.7	22.2	29.1	30.5	26.6	20.2	121.7	17	53.8	0.5	1
C + D	22.5	112.8	34.5	48.8	30.1	42.9	44	21	48.5	18.7	43	0.6	1
C + E	20.1	87.8	24.9	30.3	33.6	39.6	26.2	142.5	23.2	13.7	42.1	0.6	2
C + F	20.6	87.6	53.9	36.5	30.5	85.1	29.8	21.1	22.6	43.1	52	0.6	2
C + G	18.9	87.6	24	25.7	25.2	35.5	25.9	20.7	122.7	13	40	0.6	2
D + E	18	48.4	34.6	47.5	35.3	39.2	36.3	142.2	48.2	18.2	44.6	0.6	1
D + F	17.9	48.3	60.9	52	30.1	80.4	38.9	20.8	47.5	46.2	53.9	0.5	1
D + G	16.8	48.2	33.7	42.9	27.1	35.7	36	20.5	147.7	17.5	42.6	0.5	1
E + F	15.5	23.3	51.4	33.5	33.7	77	21.1	142.3	22.2	41.2	53.2	0.6	2

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	13.3	23	23.2	19.7	22.3	28.6	18	20.2	21.6	11.8	39.7	0.5	0
Worst-case scenario for FBR, 2 FBR combined – *continued*													
E + G	14.5	23.3	24.1	24.4	30.6	32.2	18.2	141.9	122.4	12.5	41.7	0.6	2
F + G	14.3	23.1	50.2	28.9	25.1	72.9	20.8	20.5	121.7	40.4	50.7	0.5	2
Worst-case scenario for, 3 FBR combined													
A + B + C	26.5	100.4	41.6	42.1	45	58.9	34.6	27.2	22.6	25.8	54.6	0.6	1
A + B + D	24.1	61.1	50.3	59.4	46	57.2	44.7	27	47.5	30.1	57.1	0.6	0
A + B + E	21.7	36.1	40.7	41	49.6	53.8	26.9	148.4	22.2	25.1	56.2	0.7	1
A + B + F	22.1	35.9	68.3	45.5	45.4	96.3	29.5	27	21.6	53.8	67.9	0.6	1
A + B + G	20.6	35.9	39.8	36.3	41.2	49.7	26.6	26.7	121.7	24.4	54.2	0.6	1
A + C + D	28.5	125.3	46.9	62.7	42.2	62.8	44	27.5	48.5	26	43.3	0.6	1
A + C + E	26.1	100.3	37.4	44.3	45.8	59.5	26.2	149	23.2	21	42.4	0.7	2
A + C + F	26.8	100.2	66.6	50.5	42.9	105.7	29.8	27.6	22.6	50.6	54.1	0.6	2
A + C + G	24.9	100.1	36.2	39.6	37.4	55.3	25.9	27.2	122.7	20.3	40.4	0.6	2
A + D + E	24	61	46.7	61.5	47.4	58	36.3	148.7	48.2	25.5	45	0.7	1
A + D + F	24	60.8	73.6	66	42.5	100.3	38.9	27.3	47.5	53.8	55.1	0.6	2
A + D + G	22.8	60.8	45.8	56.9	39	54.5	36	27	147.7	24.8	42.9	0.6	1
A + E + F	21.7	35.8	64.1	47.6	46.1	96.9	21.1	148.8	22.2	48.8	54.4	0.7	2
A + E + G	20.4	35.8	36.2	38.4	42.5	50.9	18.2	148.4	122.4	19.8	42.1	0.7	2
A + F + G	20.4	35.6	62.9	42.9	37.6	92.8	20.8	27	121.7	48	51.8	0.6	2
B + C + D	23.9	113	39.6	51.2	37.5	46.5	52.7	21	48.5	24	57.1	0.6	1
B + C + E	21.6	88	30.1	32.8	41.1	43.1	34.9	142.5	23.2	19.1	56.3	0.6	2
B + C + F	22.3	87.8	59.4	39.1	38.6	90.1	39.3	21.1	22.6	49.1	71.2	0.6	3
B + C + G	20.3	87.8	28.9	28.1	32.5	39	34.6	20.8	122.7	18.2	54.2	0.6	2
B + D + E	19.3	48.7	39.1	50	42.3	41.4	45	142.2	48.2	23.5	58.8	0.6	1
B + D + F	19.5	48.5	66.3	54.6	37.8	83.9	47.7	20.8	47.5	52	70	0.6	1
B + D + G	18.1	48.5	38.2	45.4	33.9	37.6	44.7	20.5	147.7	22.7	56.7	0.5	1
B + E + F	17.2	23.5	56.8	36.1	41.4	80.6	29.9	142.3	22.2	47.1	69.2	0.6	2
B + E + G	15.7	23.5	28.6	26.9	37.4	34.1	26.9	142	122.4	17.7	55.9	0.6	2
B + F + G	15.9	23.3	55.6	31.4	32.9	76.4	29.5	20.5	121.7	46.2	66.7	0.5	2
C + D + E	23.7	113	35.5	53.4	38.4	47.1	44.3	142.8	49.2	19.4	45	0.7	2

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	13.3	23	23.2	19.7	22.3	28.6	18	20.2	21.6	11.8	39.7	0.5	0
Worst-case scenario for, 3 FBR combined – *continued*													
C + D + F	24.2	112.8	64.6	59.6	35.4	92.8	48	21.4	48.5	48.9	55.6	0.6	2
C + D + G	22.5	112.8	34.5	48.8	30.1	42.9	44	21	148.7	18.7	43	0.6	2
C + E + F	21.9	87.8	55.1	41.2	39	89.6	30.2	142.9	23.2	43.9	55	0.7	3
C + E + G	20.1	87.8	24.9	30.3	33.6	39.6	26.2	142.5	123.4	13.7	42.1	0.6	3
C + F + G	20.6	87.6	53.9	36.5	30.5	85.1	29.8	21.1	122.7	43.1	52	0.6	3
D + E + F	19.1	48.5	62.1	56.7	38.6	84.5	39.2	142.6	48.2	47	56.4	0.6	2
D + E + G	18	48.4	34.6	47.5	35.3	39.2	36.3	142.2	148.3	18.2	44.6	0.6	2
D + F + G	17.9	48.3	60.9	52	30.1	80.4	38.9	20.8	147.7	46.2	53.9	0.5	2
E + F + G	15.5	23.3	51.4	33.5	33.7	77	21.1	142.3	122.4	41.2	53.2	0.6	3
Worst-case scenario for, 4 FBR combined													
A + B + C + D	30.1	125.6	52.3	65.2	50	66.4	52.7	27.5	48.5	31.6	57.5	0.7	1
A + B + C + E	27.7	100.6	42.8	46.8	53.6	63	34.9	149	23.2	26.7	56.6	0.7	2
A + B + C + F	28.6	100.4	72.7	53.2	52	111.3	39.5	27.6	22.6	57.1	74.2	0.7	4
A + B + C + G	26.5	100.4	41.6	42.1	45	58.9	34.6	27.2	122.7	25.8	54.6	0.6	2
A + B + D + E	25.3	61.3	51.2	64.1	54.4	61.3	45	148.7	48.2	30.8	59.1	0.7	1
A + B + D + F	25.7	61.1	79.1	68.6	50.3	103.8	47.7	27.3	47.5	59.6	71.3	0.6	3
A + B + D + G	24.1	61.1	50.3	59.4	46	57.2	44.7	27	147.7	30.1	57.1	0.6	1
A + B + E + F	23.3	36.1	69.5	50.2	53.9	100.5	29.9	148.8	22.2	54.6	70.8	0.7	3
A + B + E + G	21.7	36.1	40.7	41	49.6	53.8	26.9	148.4	122.4	25.1	56.2	0.7	2
A + B + F + G	22.1	35.9	68.3	45.5	45.4	96.3	29.5	27	121.7	53.8	67.9	0.6	2
A + C + D + E	29.7	125.5	48.2	67.4	50.7	67	44.3	149.3	49.2	26.7	45.3	0.7	2
A + C + D + F	30.4	125.3	77.4	73.7	47.9	113.6	48	27.9	48.5	56.4	57.9	0.7	4
A + C + D + G	28.5	125.3	46.9	62.7	42.2	62.8	44	27.5	148.7	26	43.3	0.6	2
A + C + E + F	28	100.4	67.8	55.2	51.5	110.4	30.3	149.4	23.2	51.5	57.5	0.7	3
A + C + E + G	26.1	100.3	37.4	44.3	45.8	59.5	26.2	149	123.4	21	42.4	0.7	3
A + C + F + G	26.8	100.2	66.6	50.5	42.9	105.7	29.8	27.6	122.7	50.6	54.1	0.6	3
A + D + E + F	25.3	61	74.9	70.7	51.1	104.4	39.2	149	48.2	54.6	57.6	0.7	4
A + D + E + G	24	61	46.7	61.5	47.4	58	36.3	148.7	148.3	25.5	45	0.7	2

A + D + F + G	24	60.8	73.6	66	42.5	100.3	38.9	27.3	147.7	53.8	55.1	0.6	3

	Percentage RNI												
Food-Based Recommendation (FBR)	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
Worst-case scenario without FBR[4]	13.3	23	23.2	19.7	22.3	28.6	18	20.2	21.6	11.8	39.7	0.5	0
Worst-case scenario for, 4 FBR combined - *continued*													
A + E + F + G	21.7	35.8	64.1	47.6	46.1	96.9	21.1	148.8	122.4	48.8	54.4	0.7	3
B + C + D + E	25.2	113.2	40.8	55.9	46	50.6	53	142.8	49.2	24.9	59.2	0.7	2
B + C + D + F	26	113	70.4	62.2	43.9	98.1	57.6	21.4	48.5	55	75.1	0.6	4
B + C + D + G	23.9	113	39.6	51.2	37.5	46.5	52.7	21	148.7	24	57.1	0.6	2
B + C + E + F	23.6	88	61	43.8	47.7	95	39.9	142.9	23.2	50.2	74.8	0.7	4
B + C + E + G	21.6	88	30.1	32.8	41.1	43.1	34.9	142.5	123.4	19.1	56.3	0.6	3
B + C + F + G	22.3	87.8	59.4	39.1	38.6	90.1	39.3	21.1	122.7	49.1	71.2	0.6	4
B + D + E + F	20.8	48.7	67.6	59.3	46.4	88.1	48.1	142.6	48.2	52.9	72.5	0.7	3
B + D + E + G	19.3	48.7	39.1	50	42.3	41.4	45	142.2	148.3	23.5	58.8	0.6	2
B + D + F + G	19.5	48.5	66.3	54.6	37.8	83.9	47.7	20.8	147.7	52	70	0.6	2
B + E + F + G	17.2	23.5	56.8	36.1	41.4	80.6	29.9	142.3	122.4	47.1	69.2	0.6	3
C + D + E + F	25.5	113	65.9	64.3	44	97.4	48.5	143.2	49.2	49.7	58.6	0.7	3
C + D + E + G	23.7	113	35.5	53.4	38.4	47.1	44.3	142.8	149.3	19.4	45	0.7	3
C + D + F + G	24.2	112.8	64.6	59.6	35.4	92.8	48	21.4	148.7	48.9	55.6	0.6	3
C + E + F + G	21.9	87.8	55.1	41.2	39	89.6	30.2	142.9	123.4	43.9	55	0.7	4
D + E + F + G	19.1	48.5	62.1	56.7	38.6	84.5	39.2	142.6	148.3	47	56.4	0.6	3
Worst-case scenario for, 5 FBR combined													
A + B + C + D + E	31.3	125.8	53.6	69.9	58.5	70.5	53	149.3	49.2	32.5	59.5	0.7	3
A + B + C + D + F	32.2	125.6	83.7	76.3	57.3	119.4	57.8	27.9	48.5	63.1	78.2	0.7	5
A + B + C + D + G	30.1	125.6	52.3	65.2	50	66.4	52.7	27.5	148.7	31.6	57.5	0.7	2
A + B + C + E + F	29.9	100.6	74.3	57.9	61.1	116.3	40.1	149.4	23.2	58.3	77.8	0.7	5
A + B + C + E + G	27.7	100.6	42.8	46.8	53.6	63	34.9	149	123.4	26.7	56.6	0.7	3
A + B + C + F + G	28.6	100.4	72.7	53.2	52	111.3	39.5	27.6	122.7	57.1	74.2	0.7	5
A + B + D + E + F	26.9	61.3	80.3	73.3	58.9	108.1	48.1	149.1	48.2	60.4	74.4	0.7	5
A + B + D + E + G	25.3	61.3	51.2	64.1	54.4	61.3	45	148.7	148.3	30.8	59.1	0.7	2
A + B + D + F + G	25.7	61.1	79.1	68.6	50.3	103.8	47.7	27.3	147.7	59.6	71.3	0.6	4
A + B + E + F + G	23.3	36.1	69.5	50.2	53.9	100.5	29.9	148.8	122.4	54.6	70.8	0.7	4
A + C + D + E + F	31.6	125.5	78.6	78.3	56.5	118.3	48.5	149.7	49.2	57.3	61.4	0.8	5

A + C + D + E + G	29.7	125.5	48.2	67.4	50.7	67	44.3	149.3	149.3	26.7	45.3	0.7	3

	Percentage RNI												
Food-Based Recommendation (FBR)	**Ca**	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**	GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
Worst-case scenario without FBR[4]	13.3	23	23.2	19.7	22.3	28.6	18	20.2	21.6	11.8	39.7	0.5	0
Worst-case scenario for, 5 FBR combined - *continued*													
A + C + D + F + G	30.4	125.3	77.4	73.7	47.9	113.6	48	27.9	148.7	56.4	57.9	0.7	5
A + C + E + F + G	28	100.4	67.8	55.2	51.5	110.4	30.3	149.4	123.4	51.5	57.5	0.7	4
A + D + E + F + G	25.3	61	74.9	70.7	51.1	104.4	39.2	149	148.3	54.6	57.6	0.7	5
B + C + D + E + F	27.3	113.2	72	66.9	53	103.1	58.2	143.2	49.2	56.2	78.7	0.7	5
B + C + D + E + G	25.2	113.2	40.8	55.9	46	50.6	53	142.8	149.3	24.9	59.2	0.7	3
B + C + D + F + G	26	113	70.4	62.2	43.9	98.1	57.6	21.4	148.7	55	75.1	0.6	5
B + C + E + F + G	23.6	88	61	43.8	47.7	95	39.9	142.9	123.4	50.2	74.8	0.7	5
B + D + E + F + G	20.8	48.7	67.6	59.3	46.4	88.1	48.1	142.6	148.3	52.9	72.5	0.7	4
C + D + E + F + G	25.5	113	65.9	64.3	44	97.4	48.5	143.2	149.3	49.7	58.6	0.7	4
Worst-case scenario for, 6 FBR combined													
A + B + C + D + E + F	33.6	125.8	85.3	81	66.4	124.3	58.4	149.7	49.2	64.3	81.8	0.8	6
A + B + C + D + E + G	31.3	125.8	53.6	69.9	58.5	70.5	53	149.3	149.3	32.5	59.5	0.7	4
A + B + C + D + F + G	32.2	125.6	83.7	76.3	57.3	119.4	57.8	27.9	148.7	63.1	78.2	0.7	6
A + B + C + E + F + G	29.9	100.6	74.3	57.9	61.1	116.3	40.1	149.4	123.4	58.3	77.8	0.7	6
A + B + D + E + F + G	26.9	61.3	80.3	73.3	58.9	108.1	48.1	149.1	148.3	60.4	74.4	0.7	6
A + C + D + E + F + G	31.6	125.5	78.6	78.3	56.5	118.3	48.5	149.7	149.3	57.3	61.4	0.8	6
B + C + D + E + F + G	27.3	113.2	72	66.9	53	103.1	58.2	143.2	149.3	56.2	78.7	0.7	6
Worst-case scenario for, 7 FBR combined													
A + B + C + D + E + F + G	33.6	125.8	85.3	81	66.4	124.3	58.4	149.7	149.3	64.3	81.8	0.8	7
Best and worst-case scenario, selected FBR													
Best-case scenario, B + C + D + E + F + G	46.4	155.5	94.8	98	87.9	150.9	71.9	212	170.2	73.2	101.5	NA[5]	10
Worst-case scenario, B + C + D + E + F + G	27.3	113.2	72	66.9	53	103.1	58.2	143.2	149.3	56.2	78.7	0.7	6
Best and worst-case scenario, selected harmonized FBR													
Best-case scenario, C + D + E + F + G + H + I	47.3	155.5	95.3	97.7	87.9	152.5	71.8	212.1	170.2	72.7	100.6	1.4	10
Worst-case scenario, C + D + E + F + G + H + I	26.9	113.4	71	68.4	54	107.6	55.8	195.3	150	54.1	70.5	0.8	6

A=7 serves/week of fortified chocolate beverage powder, B=14 serves/week of legumes, C=14 serves/week of vitamin C starchy plants, D=7 serves/week of dark green leafy vegetables, E=7 serves/week of small fish with bones and F=14 serves/week of whole grains, G=7 serves/week of red palm oil, H=14 serves/week of fish without bones and I=7 serves/week beans and peas,[1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ⩾70% RNI=the number of nutrients that are ⩾70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available

Table X-8 *Food based recommendations for 12-23 months old not breastfed infants in Gomoa East district*

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Best-case scenario without FBR[3]	59.5	262.4	157.3	139.7	166.1	238.8	104.8	384	155.2	109.4	138.9	NA[5]	10
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for FBR, not combined													
A fats 14	4.9	0.1	19.8	16.8	28	36.3	12	4.9	13.3	18.7	40.5	0.5	0
B beverages 7	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	0.2	36.6	42.9	0.8	1
C bakery cereals 7	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	0.2	36.6	42.9	0.8	1
D vitamin C starchy plants 14	19.1	153.8	24.5	28.1	33.9	51.9	30.7	6.2	1.9	20.1	40.5	0.6	1
E fish without bones 21	5.6	0.6	22.4	20.3	50.1	53.6	12.7	114	1.5	19.4	41.8	0.8	1
F whole grains 13	5.9	0.1	52.3	24.3	29.8	86	14.9	5.6	0.2	51.3	60.4	0.6	1
G red palm oil 7	4.9	0.1	19.8	16.8	28	36.3	12	4.9	90.3	18.7	40.5	0.5	1
H DGLV 7	9	30.1	32.4	44	33.5	44.7	33.4	5.3	31	25.4	44.2	0.6	0
Worst-case scenario for FBR, 2 FBR combined													
A + B	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	13.3	36.6	42.9	0.8	1
A + C	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	13.3	36.6	42.9	0.8	1
A + D	19.1	153.8	24.5	28.1	33.9	51.9	30.7	6.2	15	20.1	40.5	0.6	1
A + E	5.6	0.6	22.4	20.3	50.1	53.6	12.7	114	14.7	19.4	41.8	0.8	1
A + F	5.9	0.1	52.3	24.3	29.8	86	14.9	5.6	13.3	51.3	60.4	0.6	1
A + G	4.9	0.1	19.8	16.8	28	36.3	12	4.9	90.3	18.7	40.5	0.5	1
A + H	9	30.1	32.4	44	33.5	44.7	33.4	5.3	44.1	25.4	44.2	0.6	0
B + C	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	0.2	36.6	42.9	0.8	1
B + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	1.9	38.5	42.9	0.8	2
B + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	1.6	37.3	44.3	1	3
B + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	0.2	69.7	63.4	0.9	2
B + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
B + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	31.1	43.3	46.7	0.8	2
C + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	1.9	38.5	42.9	0.8	2
C + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	1.6	37.3	44.3	1	3
C + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	0.2	69.7	63.4	0.9	2
C + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
C + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	31.1	43.3	46.7	0.8	2

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for FBR, 2 FBR combined *-continued*													
D + E	20.2	154.4	27.6	32	56.1	70.6	31.5	115.4	3.3	21	41.8	0.8	3
D + F	22	153.8	62.9	39.9	42	117.2	38.2	7.1	1.9	56.9	70.9	0.7	3
D + G	19.1	153.8	24.5	28.1	33.9	51.9	30.7	6.2	92	20.1	40.5	0.6	2
D + H	23.4	183.8	37.3	55.5	39.5	60.9	52.2	6.6	32.8	26.9	44.2	0.6	1
E + F	7.1	0.7	55.4	28.1	52	104.6	15.7	114.7	1.5	52.2	62	0.9	2
E + G	5.6	0.6	22.4	20.3	50.1	53.6	12.7	114	91.7	19.4	41.8	0.8	2
E + H	9.7	30.6	34.9	47.5	55.7	61.9	34.1	114.4	32.4	26.1	45.6	0.8	1
F + G	5.9	0.1	52.3	24.3	29.8	86	14.9	5.6	90.3	51.3	60.4	0.6	2
F + H	10.2	30.1	65.1	51.7	35.5	94.9	36.4	5.9	31	58.1	64.3	0.7	1
G + H	9	30.1	32.4	44	33.5	44.7	33.4	5.3	121.2	25.4	44.2	0.6	1
Worst-case scenario for, 3 FBR combined													
A + B + C	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	13.3	36.6	42.9	0.8	1
A + B + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	15.1	38.5	42.9	0.8	2
A + B + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	14.7	37.3	44.3	1	3
A + B + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	13.3	69.7	63.4	0.9	2
A + B + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
A + B + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	44.2	43.3	46.7	0.8	2
A + C + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	15.1	38.5	42.9	0.8	2
A + C + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	14.7	37.3	44.3	1	3
A + C + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	13.3	69.7	63.4	0.9	2
A + C + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
A + C + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	44.2	43.3	46.7	0.8	2
A + D + E	20.2	154.4	27.6	32	56.1	70.6	31.5	115.4	16.4	21	41.8	0.8	3
A + D + F	22	153.8	62.9	39.9	42	117.2	38.2	7.1	15	56.9	70.9	0.7	3
A + D + G	19.1	153.8	24.5	28.1	33.9	51.9	30.7	6.2	92	20.1	40.5	0.6	2

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
A + D + H	23.4	183.8	37.3	55.5	39.5	60.9	52.2	6.6	45.9	26.9	44.2	0.6	1
A + E + F	7.1	0.7	55.4	28.1	52	104.6	15.7	114.7	14.7	52.2	62	0.9	2
A + E + G	5.6	0.6	22.4	20.3	50.1	53.6	12.7	114	91.7	19.4	41.8	0.8	2
A + E + H	9.7	30.6	34.9	47.5	55.7	61.9	34.1	114.4	45.5	26.1	45.6	0.8	1

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 3 FBR combined - *continued*													
A + F + G	5.9	0.1	52.3	24.3	29.8	86	14.9	5.6	90.3	51.3	60.4	0.6	2
A + F + H	10.2	30.1	65.1	51.7	35.5	94.9	36.4	5.9	44.2	58.1	64.3	0.7	1
A + G + H	9	30.1	32.4	44	33.5	44.7	33.4	5.3	121.2	25.4	44.2	0.6	1
B + C + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	1.9	38.5	42.9	0.8	2
B + C + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	1.6	37.3	44.3	1	3
B + C + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	0.2	69.7	63.4	0.9	2
B + C + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
B + C + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	31.1	43.3	46.7	0.8	2
B + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	3.3	39.3	44.3	1	4
B + D + F	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	1.9	77.4	78.6	0.9	7
B + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3
B + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	32.8	45.2	46.7	0.8	3
B + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	1.6	70.5	64.9	1.1	5
B + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
B + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	32.4	44	48.1	1	4
B + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
B + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	31.1	76.5	67.2	0.9	4
B + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
C + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	3.3	39.3	44.3	1	4
C + D + F	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	1.9	77.4	78.6	0.9	7
C + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
C + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	32.8	45.2	46.7	0.8	3
C + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	1.6	70.5	64.9	1.1	5
C + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
C + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	32.4	44	48.1	1	4
C + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
C + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	31.1	76.5	67.2	0.9	4
C + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
D + E + F	23.2	154.4	66.6	44.3	65.9	137.1	39.5	116.3	3.3	58.6	73.8	0.9	4

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 3 FBR combined - *continued*													
D + E + G	20.2	154.4	27.6	32	56.1	70.6	31.5	115.4	93.4	21	41.8	0.8	4
D + E + H	24.5	184.3	40.4	59.4	61.8	79.6	53	115.7	34.2	27.7	45.6	0.8	3
D + F + G	22	153.8	62.9	39.9	42	117.2	38.2	7.1	92	56.9	70.9	0.7	4
D + F + H	26.4	183.8	76	67.6	48.3	126.8	60	7.5	32.8	64.1	75.6	0.7	4
D + H + G	23.4	183.8	37.3	55.5	39.5	60.9	52.2	6.6	122.9	26.9	44.2	0.6	2
E + F + G	7.1	0.7	55.4	28.1	52	104.6	15.7	114.7	91.7	52.2	62	0.9	3
E + F + H	11.3	30.6	68.2	55.5	57.7	113.6	37.2	115	32.4	59	65.8	0.9	2
E + G + H	9.7	30.6	34.9	47.5	55.7	61.9	34.1	114.4	122.5	26.1	45.6	0.8	2
F + G + H	10.2	30.1	65.1	51.7	35.5	94.9	36.4	5.9	121.2	58.1	64.3	0.7	2
Worst-case scenario for, 4 FBR combined													
A + B + C + D	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	15.1	38.5	42.9	0.8	2
A + B + C + E	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	14.7	37.3	44.3	1	3
A + B + C + F	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	13.3	69.7	63.4	0.9	2
A + B + C + G	19.5	31.7	50.3	50.2	57.8	83.4	12	21.2	90.3	36.6	42.9	0.8	2
A + B + C + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	44.2	43.3	46.7	0.8	2
A + B + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	16.4	39.3	44.3	1	4
A + B + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3
A + B + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	45.9	45.2	46.7	0.8	3

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
A + B + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	14.7	70.5	64.9	1.1	5
A + B + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
A + B + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	45.6	44	48.1	1	4
A + B + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
A + B + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	44.2	76.5	67.2	0.9	4
A + B + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
A + C + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	16.4	39.3	44.3	1	4
A + C + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3
A + C + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	45.9	45.2	46.7	0.8	3
A + C + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	14.7	70.5	64.9	1.1	5
A + C + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	**Vit. C**	**Thiamin**	**Riboflavin**	**Niacin**	**Vit. B_6**	**Folate**	**Vit. B_{12}**	**Vit. A (RAE)**	**Fe**	**Zn**		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 4 FBR combined - *continued*													
A + C + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	45.6	44	48.1	1	4
A + C + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
A + C + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	44.2	76.5	67.2	0.9	4
A + C + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
A + D + E + F	23.2	154.4	66.6	44.3	65.9	137.1	39.5	116.3	16.4	58.6	73.8	0.9	4
A + D + E + G	20.2	154.4	27.6	32	56.1	70.6	31.5	115.4	93.4	21	41.8	0.8	4
A + D + E + H	24.5	184.3	40.4	59.4	61.8	79.6	53	115.7	47.3	27.7	45.6	0.8	3
A + D + F + G	22	153.8	62.9	39.9	42	117.2	38.2	7.1	92	56.9	70.9	0.7	4
A + D + F + H	26.4	183.8	76	67.6	48.3	126.8	60	7.5	45.9	64.1	75.6	0.7	4
A + D + G + H	23.4	183.8	37.3	55.5	39.5	60.9	52.2	6.6	122.9	26.9	44.2	0.6	2
A + E + F + G	7.1	0.7	55.4	28.1	52	104.6	15.7	114.7	91.7	52.2	62	0.9	3
A + E + F + H	11.3	30.6	68.2	55.5	57.7	113.6	37.2	115	45.5	59	65.8	0.9	2
A + E + G + H	9.7	30.6	34.9	47.5	55.7	61.9	34.1	114.4	122.5	26.1	45.6	0.8	2
A + F + G + H	10.2	30.1	65.1	51.7	35.5	94.9	36.4	5.9	121.2	58.1	64.3	0.7	2
B + C + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	3.3	39.3	44.3	1	4

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
B + C + D + F	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	1.9	77.4	78.6	0.9	7
B + C + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3
B + C + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	32.8	45.2	46.7	0.8	3
B + C + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	1.6	70.5	64.9	1.1	5
B + C + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
B + C + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	32.4	44	48.1	1	4
B + C + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
B + C + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	31.1	76.5	67.2	0.9	4
B + C + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
B + D + E + F	39	186	100.3	80.1	99.6	190.7	40.2	132.7	3.3	79	81.5	1.1	8
B + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
B + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	34.2	46.1	48.1	1	6
B + D + F + G	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	92.1	77.4	78.6	0.9	8
B + D + F + H	42.2	215.4	109.7	103.4	82	180.4	60.6	23.9	32.8	84.5	83.3	0.9	7

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 4 FBR combined - *continued*													
B + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4
B + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
B + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	32.5	77.3	68.7	1.1	6
B + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5
B + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
C + D + E + F	39	186	100.3	80.1	99.6	190.7	40.2	132.7	3.3	79	81.5	1.1	8
C + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
C + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	34.2	46.1	48.1	1	6
C + D + F + G	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	92.1	77.4	78.6	0.9	8
C + D + F + H	42.2	215.4	109.7	103.4	82	180.4	60.6	23.9	32.8	84.5	83.3	0.9	7
C + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
C + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
C + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	32.5	77.3	68.7	1.1	6
C + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5
C + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
D + E + F + G	23.2	154.4	66.6	44.3	65.9	137.1	39.5	116.3	93.4	58.6	73.8	0.9	5
D + E + F + H	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	34.2	65.8	78.5	0.9	7
D + E + G + H	24.5	184.3	40.4	59.4	61.8	79.6	53	115.7	124.3	27.7	45.6	0.8	4
D + F + G + H	26.4	183.8	76	67.6	48.3	126.8	60	7.5	122.9	64.1	75.6	0.7	5
E + F + G + H	11.3	30.6	68.2	55.5	57.7	113.6	37.2	115	122.6	59	65.8	0.9	3
Worst-case scenario for, 5 FBR combined													
A + B + C + D + E	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	16.4	39.3	44.3	1	4
A + B + C + D + G	34.5	185.4	56.5	62.7	63.9	102.5	30.7	22.5	92.1	38.5	42.9	0.8	3
A + B + C + D + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	45.9	45.2	46.7	0.8	3
A + B + C + E + F	22.5	32.3	87.3	62.7	82	155.2	15.7	131	14.7	70.5	64.9	1.1	5
A + B + C + E + G	20.5	32.2	52.8	53.7	80.1	100.6	12.7	130.3	91.7	37.3	44.3	1	4
A + B + C + E + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	45.6	44	48.1	1	4
A + B + C + F + G	21.3	31.7	84.3	58.8	59.8	136.5	14.9	21.9	90.3	69.7	63.4	0.9	3
A + B + C + F + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	44.2	76.5	67.2	0.9	4

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 5 FBR combined - *continued*													
A + B + C + G + H	23.7	61.6	62.8	77.4	63.5	91.8	33.4	21.5	121.2	43.3	46.7	0.8	3
A + B + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
A + B + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	47.3	46.1	48.1	1	6
A + B + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4
A + B + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
A + B + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	45.6	77.3	68.7	1.2	6
A + B + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
A + B + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
A + C + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
A + C + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	47.3	46.1	48.1	1	6
A + C + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4
A + C + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
A + C + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	45.6	77.3	68.7	1.2	6
A + C + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5
A + C + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
A + D + E + F + G	23.2	154.4	66.6	44.3	65.9	137.1	39.5	116.3	93.4	58.6	73.8	0.9	5
A + D + E + F + H	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	47.3	65.8	78.5	0.9	7
A + D + E + G + H	24.5	184.3	40.4	59.4	61.8	79.6	53	115.7	124.3	27.7	45.6	0.8	4
A + D + F + G + H	26.4	183.8	76	67.6	48.3	126.8	60	7.5	122.9	64.1	75.6	0.7	5
A + E + F + G + H	11.3	30.6	68.2	55.5	57.7	113.6	37.2	115	122.6	59	65.8	0.9	3
B + C + D + E + F	39	186	100.3	80.1	99.6	190.7	40.2	132.7	3.3	79	81.5	1.1	8
B + C + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
B + C + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	34.2	46.1	48.1	1	6
B + C + D + F + G	37.8	185.4	96.5	75.8	75.7	170.8	38.8	23.5	92.1	77.4	78.6	0.9	8
B + C + D + F + H	42.2	215.4	109.7	103.4	82	180.4	60.6	23.9	32.8	84.5	83.3	0.9	7
B + C + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4
B + C + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
B + C + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	32.5	77.3	68.7	1.1	6
B + C + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0
Worst-case scenario for, 5 FBR combined - *continued*													
B + C + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
B + D + E + F + H	43.4	216	113.4	107.8	106	200.3	61.9	133.1	34.2	86.2	86.2	1.2	8
B + D + E + G + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
B + D + F + G + H	42.4	215.4	109.7	103.8	82	180.4	60.9	23.9	123.1	84.5	83.3	1	8
B + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7
C + D + E + F + G	43.4	216	113.4	107.8	106	200.3	61.9	133.1	34.2	86.2	86.2	1.2	8
C + D + E + F + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7
C + D + F + G + H	42.4	215.4	109.7	103.8	82	180.4	60.9	23.9	123.1	84.5	83.3	1	8
C + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7
D + E + F + G + H	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	124.3	65.8	78.5	0.9	8
Worst-case scenario for, 6 FBR combined													
A + B + C + D + E + G	35.6	185.9	59.5	66.5	86.2	121.4	31.5	131.7	93.5	39.3	44.3	1	5
A + B + C + D + E + H	39.9	215.9	72.3	93.9	92	130.6	53	132	47.3	46.1	48.1	1	6
A + B + C + D + G + H	38.8	215.4	69.3	90.1	69.6	111.5	52.2	22.9	123	45.2	46.7	0.8	4
A + B + C + E + F + G	22.5	32.3	87.3	62.7	82	155.2	15.7	131	91.7	70.5	64.9	1.1	6
A + B + C + E + F + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	45.6	77.3	68.7	1.2	6
A + B + C + E + G + H	24.7	62.2	65.4	80.9	85.7	109	34.1	130.7	122.6	44	48.1	1	5
A + B + C + F + G + H	25.6	61.7	97.1	86.2	65.5	145.6	36.4	22.2	121.2	76.5	67.2	0.9	5
A + B + D + E + G + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7
A + B + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7
A + C + D + E + G + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7
A + C + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7
A + D + E + F + G + H	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	124.3	65.8	78.5	0.9	8
B + C + D + E + F + H	43.4	216	113.4	107.8	106	200.3	61.9	133.1	34.2	86.2	86.2	1.2	8
B + C + D + E + G + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7
B + C + D + F + G + H	42.4	215.4	109.7	103.8	82	180.4	60.9	23.9	123.1	84.5	83.3	1	8
B + C + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7

Food-Based Recommendation (FBR)	Percentage RNI											GH¢/day[1]	≠ Nutrients ⩾70 % RNI[2]
	Ca	Vit. C	Thiamin	Riboflavin	Niacin	Vit. B_6	Folate	Vit. B_{12}	Vit. A (RAE)	Fe	Zn		
Worst-case scenario without FBR[4]	4.9	0.1	19.8	16.8	28	36.3	12	4.9	0.1	18.7	40.5	0.5	0

Worst-case scenario for, 7 FBR combined													
A + B + C + D + E + G + H	39.9	215.9	72.3	93.9	92	130.6	53	132	124.3	46.1	48.1	1	7
A + B + C + E + F + G + H	26.7	62.2	100.1	90.1	87.7	164.3	37.2	131.3	122.6	77.3	68.7	1.2	7
Best and worst-case scenario, selected FBR													
Best-case scenario, A + D + E + F + G + H	31.3	210.9	84.2	77.2	80	154.2	66.9	195.6	128.5	68.4	85.7	NA[5]	8
Worst-case scenario, A + D + E + F + G + H	27.6	184.4	79.8	71.9	72.3	146.7	61.3	116.6	124.3	65.8	78.5	0.9	8
Best and worst-case scenario, selected and aligned FBR													
Best-case scenario, D + E + F + G + H + I	32.8	212.2	88.4	79.6	86.9	158.2	73	209.9	128.6	73.1	98.4	1.1	10
Worst-case scenario, D + E + F + G + H + I	28.5	184.4	82.6	73.3	74.7	149	64.9	116.7	124.3	68.8	87	1	8

A=14 serves/week of fats, B=7 serves/week of fortified chocolate beverage, C=7 serves/week of bakery cereals, D=14 serves/week of vitamin C rich starchy plants, E=21 serves/week of fish without bones, F=13 serves/week of whole grains, G=7 serves/week of red palm oil, H=7 serves/week of dark green leafy vegetables and I=7 serves/week of legumes, [1]GH¢/day=Daily diet cost in Ghana Cedi's, [2]#Nutrients ≥70% RNI=the number of nutrients that are ≥70% of their RNIs in the worst-case scenario for all CFBRs tested; contrary it maximized level for best-case scenario, [3]Modelled diet for best possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [4]Modelled diet for worst possible individual nutrient intake (11 different diets are modelled, 1 for each nutrient), [5]NA=not available.