ZAMBIA FOOD CONSUMPTION AND MICRONUTRIENT STATUS SURVEY REPORT

TDRC, ZAMBIA

unicef

THE UNIVERSITY OF ARIZONA | MEL AND ENID ZUCKERMAN COLLEGE OF PUBLIC HEALTH

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The Authors

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ACRONYMS AND ABBREVIATIONS

HDDS	Household Dietary Diversity Score
TDRC	Tropical Diseases Research Institute
CRP	C Reactive Protein
AGP	Serum Alpha-1-acid glycoprotein
WRA	Women of Reproductive Age
MACO	Ministry of Agriculture and Cooperatives
NFNC	National Food and Nutrition Commission
UNICEF	United Nations Children's Emergency Fund
MoH	Ministry of Health
ELISA	Enzyme Linked Immunosorbent Assay
HPLC	High Pressure Liquid Chromatography
SEA	Standard Enumeration Area
PPS	Probability proportional to their size
AAS	Atomic Absorption Spectrophotometer
HCl	Hydrochloric acid
TMB	Chromogen Substrate solution
OD	Optical density
SD	Standard deviations
EAR	Estimated Average Requirement
BMP	Beef, other meats and poultry
MFPE	Meat, Fish, Poultry and Eggs

EXECUTIVE SUMMARY

The Zambia Food Consumption Survey was undertaken to provide the critical body of evidence that policy makers and program designers need in order to make informed decisions about effective investments to reduce deficiencies of vitamins and minerals in Zambia. Such decisions will result in substantial contributions to efforts being made to assist Zambians in achieving the Millennium Development Goals.

The survey was carried out in Northern and Luapula Provinces. The two provinces are rural provinces situated in the Northern part of the country. The survey was conducted in 2008 with the purpose of fully characterizing the dietary patterns and health and nutrition outcomes of children 6-59 months of age and women of reproductive age 15-49 years old. Both selected provinces were purposefully selected: within each province, districts and then households were randomly selected in a two-stage process that provided samples representative of that province. Food consumption was measured using the 24-hour recall method with duplicate measurements on a subset of the sample to allow estimation of usual intake. The survey also included an interview to collect background information on dietary habits, socio-demographic status and lifestyle, and the collection of a blood sample to assess hematological and biochemical indices of nutritional status.

The survey reveals that the prevalence of inadequate intake of the various vitamins and minerals vary widely, as do the prevalence among provinces. However, in general, the dietary patterns were found to be highly inadequate for vitamin A, vitamin B-12, folate, iron, zinc, and calcium, based on the dietary profile, which featured low levels of consumption of milk, meat, fish, and dairy products. When compared both provinces, Northern Province showed the highest prevalence of inadequate intake for vitamin B-12 in that region. On the other hand, inadequate intake of the minerals (iron, zinc,) was generally most prevalent in Luapula, while inadequate intake of calcium is higher in Northern. Regardless, the prevalence of inadequate intake of these three minerals is high in both provinces surveyed. The Northern Province also reported a higher prevalence of inadequate intake for vitamin B-1, vitamin B-2, niacin, vitamin B-6, and folate than Luapula. In general, inadequate intake of vitamin B-1 (main sources: meat and poultry, fruits and fruit juice), vitamin B-2 (main sources: meat and poultry, green leafy vegetables), and vitamin B-6 (main sources: other vegetables, grains and nuts) are far less common.

Food group consumption patterns were not different between age groups. Among women the most commonly consumed food groups (consumed by more than 80% of all households) were miscellaneous roots and tubers, beans, nuts, and seeds; followed by vegetables and grains, which were consumed by about 76% of surveyed women. Green leafy vegetables and Fats and oils were consumed by approximately 60% of them, while fruits, sugar and sweets were consumed by 37% and 25%, respectively. In addition, the consumption of animal source foods was not common. Overall, percent nutrient intake by food group for women and children for the first measure versus both measures were high correlated (>0.9992). Paired t tests confirmed that the nutrient means by food group for the one day recall versus the combined two day recall were not different. The diet in the above two regions is predominantly vegetarian; only 4-9% of the energy was supplied by foods of animal origin. Most of the energy in the diet during the period of the study came from roots or tubers (422 to 686 g/day) and grains and grain products (268 to 427 g/day). The combined intake of beans, nuts, and seeds, which are good sources of protein and nutrients of the B complex, including folate, was relatively large (149-264 g/day). Beverages consumption was also large (361-761g/day); median consumption per day varied between 62 and 89g. Consumption of sugar, oil/fat, and vegetables was modest, at approximately 20 to 60 g/day. Fruit intake (100-150 g/day) was also fair. As predicted, and typical for a poor developing country, intake of meat, fish, poultry and eggs was low (25-60 g/day), with this most pronounced in Northern.

In women, those at risk of vitamin A deficiency were 3.2%. The iron profile from this survey showed that only 6.3% of the women surveyed had depleted iron store. About 55% of women were deficient in zinc with no difference observed between the two provinces. Those at risk of vitamin B12 and folate deficiency were 98% and less than 92% respectively. Mean hemoglobin of women was 12.6g/dl, with 30.6% of women (Hb<12g/dl) classified as anemic. Iron deficiency, defined as serum ferritin either, <15µmg/l or ≥19µg/l with CRP>5mg/l and/or AGP >1g/L, was found in 20% of subjects; while 18.6% of the women suffered from iron-deficiency anemia (Hb <12g/dl and iron deficiency).

In children, it was found that 35.3% were vitamin A deficient (VAD), but after correction using Thurnham method it was observed that VAD dropped to 25.8% with no difference between the provinces. The iron profile from this survey showed that only 4% of the children surveyed had depleted iron stores. About 22-34% of them were deficient in zinc depending on the time blood was collected, higher (24% or 38%) in Luapula and lowest (31% or 20%) in Northern. Most of children were deficient in vitamin B12 (97%) and Folate (83.6%). No significant difference was observed between both provinces.

Mean hemoglobin of children was 10.7g/dl, with around 59% of the children classified as anemic (Hb<11mg/dl). Severe anemia (Hb<7mg/dl) was present among 2.7% of children surveyed. Iron deficiency, defined as serum ferritin either, 15µmg/l or ≥15µg/l and CRP>10mg/l and/or AGP >1g/L, was found in 35% of subjects; while 27% suffered from iron-deficiency anemia (iron deficiency and Hb <11mg/dl). No significant difference was observed between the two provinces.

1. INTRODUCTION

1.1 Nutrition Situation in Zambia

Zambia has made great strides in economic development in recent years to the point that the World Bank has reclassified the country as middle-income. However, it is still among the group of countries suffering high levels of macro- and micronutrient deficiencies, particularly among young children and pregnant/lactating women (Harris and Drimie 2012; World Bank 2012).

Undernutrition is endemic in many parts of the country and poses a serious threat to the well-being of many. It is responsible for 52% of all deaths occurring in children below the age of five (UNICEF 2008; DFID 2011). The most recent Zambia Demographic and Health Survey (ZDHS), carried out in 2007, revealed that 45% of children under the age of five were stunted, 5% wasted, 15% underweight, and 8% of children were estimated to be overweight (Central Statistical Office et al 2009). In the case of women, the situation exemplifies the double-burden of malnutrition, with 10% (8% urban and 11% rural) underweight (BMI <18.5 kg/m^2), and 19% (30% urban and 11% rural) overweight or obese (BMI ≥ 25.0 kg/m2) (Central Statistical Office et al 2009).

Another form of undernutiriton is the micronutrient deficiencies which affects both women of child bearing age and children under the age of five in Zambia. The most common of these deficiencies are iron, Vitamin A and Zinc which manifests in Anemia, night blindness and Zinc deficiency. Inadequate intakes of several micronutrients Zambia are widespread because staple diets are predominantly maize-based, and intakes of plant based and animal products are low (Mason and Jayne 2009; Chapoto et al 2010). As a result, the content and bioavailability of micronutrients such as iron, zinc and vitamin A are often low in these diets.

According to the Malaria Indicator survey (2012) anemia affects 55% of children under the age of five and 30% of women in the child bearing age; (MoH, 2012). Although the etiological factors of anemia have not been determined, it is reasonable to assume that in Zambia, as in many African countries, the primary causes are nutritional deficiencies, malaria and intestinal worms (Shaw and Friedman 2011). With regards to Vitamin A deficiency, strategies such as routine Vitamin A supplementation in the primary health care of children and post-partum mothers have been put in place. Despite these efforts, more than half (54%) of children under the age of five and 13% among women of child bearing age are vitamin A deficient (NFNC, 2003). According to an indirect method of estimating rates of zinc deficiency, it is estimated that 38% of the population in Zambia is at risk of low zinc intake (IZiNCG 2004). With the foregoing, it was important to assess the micronutrient status and the dietary intake.

1.2 Rationale for the survey

The poor nutritional situation in Zambia reinforced the urgent need of appropriate and efficient interventions to mitigate malnutrition in the country. However, to effectively formulate and evaluate such nutrition interventions, food consumption data and nutrition status information are required to accelerate the combating this nutritional problem. Unfortunately, there was no updated information on the adequacy of micronutrient intakes in the country. The last National food consumption survey was conducted in 1971 while other micronutrient surveys were limited to few areas. In addition, over the last decade, there have been considerable social, economic and demographic changes in Zambia impacting the food consumption patterns of both rural and urban populations (Mason and Jayne 2009; Chapoto et al 2010). In response, periodic nationally representative food consumption data are critical to the planning and implementation of effective nutrition interventions.

Estimates of iron deficiency are based on hemoglobin measurements and not from specific indicators of iron status while measurement of serum zinc concentration in the Zambian population has never been done. It was therefore pertinent to undertake a holistic survey to generate current data on targeted aspects of nutrition, covering dietary intakes and micronutrient status in Zambia.

This additional information will be useful to all agencies with primary and secondary mandates and foci in nutrition. It will further provide findings designed to assist policy makers and program designers in selecting and tailoring nutritional interventions that best fit the context in which they will be implemented. The critical body of evidence generated from these results will aid informed decision making on effective investments to reduce micronutrient deficiencies in Zambia. Such decisions will result in substantial contributions to efforts being made to assist Zambians in achieving the Millennium Development Goals .

1.3 Objectives

The overall goal of the Food Consumption and Micronutrient Survey (FCMS) was to assess the macro- and micronutrient deficiencies status of the rural populations in Zambia. The main objectives of the assessments were, as follows:

- Establish the consumption of food groups, including fruits, vegetables and animal products and the percentage of children 6-59 months of age and women 15-49 years of age that meet the recommendations of these foods in 2 rural provinces;
- Determine the intake of energy and macronutrients from foods and the percentage of children 6-59 months of age and women 15-49 years of age that meet the recommendations on energy and nutrients in both provinces;
- Assess the vitamin A, Iron, zinc, folic acid and vitamin B12 status of under-5 children and women 15-49 years from food intake and biochemical indices in both provinces;

1.4 Institutional Partnerships

The survey was conducted in partnership between the National Food and Nutrition Commission (NFNC), the Tropical Diseases Research Centre (TDRC), Ministry of Agriculture and Livestock (MAL), Ministry of Health (MoH) and United Nations Children's Fund (UNICEF). UNICEF was responsible for the technical oversight of the assessment and management of the funds. Based on their respective comparative advantages, NFNC was responsible for the food consumption component while TDRC was in charge of the micronutrient component. NFNC received a comprehensive training on the multiple-pass 24-hour recall method in November 2010 and an international consultant was hired to provide further support to NFNC on food consumption assessment, data management and the utilization of the dietary software. TDRC conducted the biological sample collection and analysis. The Ministry of Agriculture and Livestock (MAL) and the Ministry of Health (MoH) were also actively involved in the assessment at decentralized level during data collection. The University of Arizona was responsible for statistical analysis for both food consumption and biochemical data.

2. METHODS

2.1 Study population and recruitment

Study Design

The Zambia Food Consumption and Micronutrient Survey was a cross-sectional study which collected both qualitative and quantitative data. .

2.1.1 Study area

Zambia is a landlocked country in southern Africa with a population of about 13 million. Approximately 75% of the populations are women and children with 61% residing and securing their livelihoods in the rural areas (Central Statistical Office 2011). Administratively, the country is divided into ten provinces and 104 districts which fall under three ecological zones The survey focused on one ecological zone covering 3 provinces namely Muchinga, Northern and Luapula which are predominantly rural with a prevalence of stunting at 48%.. The provinces were selected purposively A total of 19 districts from the 3 provinces were sampled. These included Chilubi, Kaputa Kasama, Luwingu Mporokoso, Mpulugu, Mungwi, Mbala in Northern Province; Chinsali, Isoka, Mpika, and Nakonde in Muchinga Province; and Chiengi, Kawambwa, Mansa, Milenge, Mwense, Nchelenge Samfya in Luapula Province. Within the districts, the administrative units were constituencies which are made up of Wards.

In all the provinces, the districts were selected randomly from a roster of all constituent districts:

2.1.2 Study sample

Sample Size

Based on an expected prevalence of 40-50% for the main biological variables under study, a desired precision of 5% and an expected design effect of 2, the required sample size per survey was calculated to be about 600 children under five (20 children per cluster) and 600 women of child bearing age (20 women per cluster). Thus a total of 220 and 380 households were required in Luapula and in Northern/Muchinga, respectively. The number of children 6-59 months included in the survey in each province ranged from 213 in Luapula to 367 in Northern while the number of women 15-49 years included in the survey ranged from 222 in Luapula to 378 in Northern/Muchinga.

Table 2.1 Sample size of the Zambia Food Consumption and Nutrition Survey by target group and province

Province	**Luapula**		**Northern**		**Total**	
Category	Planned	Surveyed	Planned	Surveyed	Planned	Surveyed
Cluster	11	11	19	19	30	30
Household	220	224	380	386	600	610
Children 6-59 months	220	213	380	367	600	580
Women 15-49 years	220	222	380	378	600	600

Sampling Procedure

The primary sampling unit for the survey was a Standard Enumeration Area (SEA), or cluster, as demarcated by the Zambia Population and Housing Census of 2010 (Census 2010). Clusters refer to the smallest discrete geographical divisions for which the population size is known.

A two-stage procedure was used to select the sample. In the first stage, the SEAs for each sub-county (CSA) were selected with a probability proportional to their size (PPS). In the second stage, households with the eligible pair of individuals (mother/child) were selected on-spot with random selection of a direction from the center of the cluster, random selection of the first household in the selected direction and selection of subsequent households by proximity. Households were eligible for inclusion in the study when at least one woman of child bearing age (15-49 years old) and a child under the age of five (6-59 months old) resided in them. In each household, only one woman aged 15-49 years and one child from 6-59 months were selected. In households where more than one woman and/or child in each age group lived, one woman and one child in each age group were selected randomly.

2.1.3 Ethical Review

The survey protocol mandated procedures to ensure informed consent and maximize confidentiality. Participation in the survey and each interview were completely voluntary and based on written informed consent. Codes were used to label blood samples and questionnaires thereby keeping the subject identity confidential. The protocol was approved by the Ethics Committee of the TDRC while informed consent was obtained from caregivers/mothers of children. Approval for exportation of biological samples was sought from the Directorate of Public Health and Research of the Ministry of Health.

2.2 Data collection and data handling

Data was collected by trained enumerators who were carefully selected based on their performance during the training. Different training materials were developed and used during this process.

The main data collection instrument (questionnaire) had several sections: questionnaire identification, household/demographic information, socioeconomic characteristics of households, food security , 24-hour dietary recall and health. Biological samples were also collected from all the study participants.

2.2.1 General and health questionnaires

Each study participant was interviewed using a standardized and pre-tested questionnaire which included socioeconomic and demographic characteristics (age, sex, education, primary occupation of household heads, cooking fuel, housing and dwelling characteristics, and estimated annual household income, family size, number of rooms and running water in the house) and health related factors (any illnesses recent febrile and non-febrile illnesses, recent intake of dietary supplements, etc.).

2.2.2 Dietary intake assessment

Questionnaires were based on the methods described by Gibson and Ferguson (2008). The multi-pass 24-hour recall method was used to estimate the intake of several nutrients. This method is considered valid and is the currently recommended ‘state-of-the-science’ for carrying out population-based food consumption surveys in developing countries.

A 24-hour recall questionnaire was developed specifically for the survey and was administered by trained fieldworkers. Training materials and a food intake booklet were developed and employed, as appropriate, for the administration of the questionnaire. The multiple pass 24-hour recall interviews are structured into four steps (passes) to maximize respondent recall of foods eaten. The first step involved respondents supplying a broad description of all food and beverage items, including snacks, consumed in the previous day, commencing with the food or drink taken immediately after they or the reference child woke up and ending with the last food or drink taken before going to sleep at night . In the second step, a detailed description of each food or beverage item on the quick list was ascertained through a series of questions and prompts (generated by interviewers) which were specific to each item. Respondents were asked to give information on the ingredients and preparation methods of mixed dishes. The third step was to estimate the amount of each food and beverage and their ingredients consumed. The final step was to review and check the recall responses in conjunction with food picture charts to clarify and confirm responses given about the previous day’s intake.

All days of the week (including the weekend) were proportionately represented in interviews across the sampling units to negate any day-of-the week effects on dietary intakes. Repeat dietary recalls were conducted on 10% of the sampled households in each province on a non-consecutive day, to allow for an estimation of the distribution of usual nutrient intakes by the population, thereby reducing variation due to day-to-day (intra-individual) differences in intakes.

2.2.3 Hematological and biochemical measurements

Blood samples were collected from the antecubital vein of the eligible selected individuals to determine serum ferritin, zinc, folate, vitamin B12, retinol, C-reactive Protein (CRP) and Alpha-1-acid Glycoprotein (AGP). Samples were collected and processed using zinc-free needles, syringes, centrifuge tubes, storage vials and transfer pipettes to avoid any contamination from exogenous sources of zinc. Serum was separated from clotted blood within 20-30 minutes using portable centrifuges and frozen on the spot in liquid nitrogen tanks awaiting transportation to the TDRC labs for storage at -80ºC.

Hemoglobin was measured in the field during blood draw whereas Serum retinol, ferritin, Zinc, Folate, vitamin B12, CRP and AGP were determined at the TDRC laboratory. Malaria slides were prepared at the point of blood draw and were also transported to the TDRC labs for determining positivity and for counting the parasites. Further a sub-sample of serums was also analyzed in Germany at the Vitamin Lab for serum retinol, ferritin and acute-phase protein to validate results from TDRC. The following procedures were used for sample analysis:

Hemoglobin: At the time of the blood draw, hemoglobin concentration of whole blood was determined using a portable hemoglobin-meter (HemoCue AB, Sweden); a single drop of whole blood was transferred from the syringe or needle immediately after collection directly to the microcuvette and results were recorded to the nearest 1 g/L. A commercial standard supplied by the manufacturer was read at the beginning of each day of collection for quality control purposes.

Serum Retinol: Serum retinol was determined by High Pressure Liquid Chromatography (HPLC) (Thurnham et al., 1988). A 100µl of serum sample/control was mixed with an equal volume of an ethanolic retinyl acetate mixture in a clean capped glass tube to release the retinol from its complex. The retinyl acetate acts as the internal standard. After vortex mixing for about 30 seconds, the released retinol was then recovered from the ethanol solution by two extractions with 500 µl of n-hexane mixed into a separate capped tube. The combined hexane extracts were evaporated to dryness under a gentle stream of nitrogen gas. The resulting residue was then dissolved in 100 µl of a mixture of Dichloromethane: Propanol (1:4). Twenty (20) µl of this residue solution was applied on the reverse phase HPLC column (5-µm C18, 25-cm) and eluted at 2 ml/min, using a 98:2, methanol: water solvent, with detection at 325nm.

Serum Zinc: Zinc analysis was conducted using the Atomic Absorption Spectrophotometer (AAS) Perkin Elmer AAnalyst 400. The acetylene gas was used as fuel and compressed air as oxidant, and the instrument used the AAWinlab software. The zinc lamp and background correction provided the desired wavelength.

Prior to application on the machine, standards, controls and samples were prepared in different diluents taking into consideration that serum had a higher viscosity than the standards. The sample/ control diluent was composed of 15 mL of Butanol, 1.23 mL of concentrated Hydrochloric acid (HCl) and made up in 250mL with MilliQ deionised water. In addition to the above reagents, the standard diluent had 12.5 mL of Glycerol in order to make the viscosities comparable.

A standard curve was prepared from 1000ppm zinc (lot # 12 – 31 Zn), atomic spectroscopy standard manufactured by Perkin Elmer. Serially diluted concentrations of 0.5, 0.25, 0.125 and 0.0625 ppm Zinc standards were plotted against their absorbances. Blanking was done with standard diluent. The ensuing straight line with intercept through zero and correlation value of over 0.99 was accepted and used.

Each sample or control (250 µL) was diluted with 1000µL of Sample Diluent in 5mL Sarstedt sterile tubes. The total volume of 1250 µL was vortexed before it was applied on the AAS. A blank of sample diluent was run after every 15 samples. The controls, Humatrol N (lot # N/021) and Humatrol P (lot # P/018A) manufactured by Human diagnostics worldwide were utilized.

For each sample, control or standard, results were produced in replicates of three and the mean value recorded as the result.

Malaria parasites: During blood draw, a drop of blood from the syringe was placed on a glass slide and spread out according to the Standard Operating Procedure (SOP) for malaria slide preparation. The slides were air-dried and stored in a slide box pending shipment to the central laboratory (TDRC).

At the central laboratory, the slides were stained in 3% Giemsa stain for 45 minutes. The slides were then dried and examined under the microscope using oil immersion by a Laboratory Technologist. A number amounting to 10% of all the slides were examined by a second Laboratory Technologist. Where the results of the two readings matched then the first result was considered correct but where the two readings differed, a third Laboratory Technologist was given to examine the slides and whose results were taken as a tie-breaker.

Results were recorded as positive if the parasites were found to be present or negative if the parasites were absent. The Negative slides were recorded as 0 parasites per 200 white blood cells (WBCs) and the positive slides were counted against the white blood cells (WBCs) and recorded as parasites per 200 WBCs.

Alpha-1-acid glycoprotein: Serum AGP concentrations were measured by an Enzyme Linked Immunosorbent Assay (ELISA) using commercial kits (ICL Inc, USA) according to manufacturer's instructions. The 96 ELISA micro titer plate with wells coated with affinity purified anti-Human AGP were removed from the pouch and beginning with micro well 1 and 2, 100µl of 7 serially diluted standards (0.0ng/ml to 320ng/ml) were added in duplicate.100µl of pre diluted samples was added in the remaining pre designated wells. The plate was then covered and incubated at room temperature for 45 minutes. After incubation, each micro well was then washed 4 times with an appropriately diluted wash solution, draining the wells after the final wash. 100µl of Enzyme-Antibody Conjugate was added to each well, covered and incubated in the dark for 10 minutes. The plates were then washed 4 times as before after which 100µl of a Chromogen Substrate solution known as Tetramethyl benzidine (TMB) was added, covered and incubated at room temperature for 10 minutes in the dark. The final color was developed by adding 100µl stop solution (0.3 M sulfuric acid). The absorbance of all standards and samples were determined at 450 nm wavelength on an Elisa reader. The calibration graphs were plotted and concentrations of unknown samples read off the graphs.

C - reactive protein: Serum CRP concentrations were measured by an ELISA using commercial kits (ICL Inc, USA) according to manufacturer's instructions. The 96 ELISA micro titer plate with anti-CRP antibodies adsorbed to the surface were removed from the pouch and beginning with micro well 1 and 2, 100µl of 7 serially diluted standards (0.0ng/ml to 100ng/ml) were added in duplicate.100µl of pre diluted samples was added into the remaining pre designated wells. The plate was then covered and incubated at room temperature for 15 minutes. After incubation, each micro well was then washed 4 times with an appropriately diluted wash solution, draining the wells after the final wash. 100µl of Enzyme-Antibody Conjugate was added to each well, covered and incubated in the dark for 15 minutes. The plates were then washed 4 times as before after which 100µl of a Chromogen Substrate solution (TMB) was added, covered and incubated at room temperature for 10 minutes in the dark. The final color was developed by adding a stop solution (0.3 M sulfuric acid). The absorbance of all standards and samples were determined at 450 nm wavelength on an Elisa reader. The calibration graphs were plotted and concentrations of unknown samples read off the graphs.

Serum Ferritin: Serum ferritin concentration was measured by an ELISA using commercial kits (RAMCO Inc., USA) and following manufacturer's instructions. The micro well from the solid phase antihuman Ferritin bottle was placed in the well holder before being shaken to dry. Beginning with micro well C1, 10 µl of pre-diluted ferritin calibrator solution and samples were placed in duplicate into separate wells leaving A1 and B1 for only the conjugate Antihuman ferritin. 200 µl of the conjugate antihuman ferritin was added to each micro well and the plate incubated at room temperature on the shaker at 190 rpm for 2 hours. Each micro well was then washed 3 times with deionized water, draining the wells after the final wash. 200µl of substrate solution was added to each micro well, incubated at room temperature for 30 minutes and the color was developed by adding 100 µl of 0.24% potassium ferricyanide and mixing thoroughly. The absorbance of all samples was read at 510 and 630 nm wavelengths on an Elisa reader. Calibration graphs were plotted and concentrations of unknown samples read off the graphs.

Vitamin B12: All reagents were brought to room temperature and mixed thoroughly by gently swirling before pipetting and avoiding foam formation. The 30ml stock wash buffer was diluted with distilled water 750ml working solution. The standard in lyophilized form was reconstituted with 1.0ml of sample diluents to produce a stock solution of 1000pmol/L. After allowing the solution to stand for 15 minutes with intermittent agitation, the stock solution was diluted serially into the following concentrations: 500ul, 250ul, 125, 62.5ul, 31.2ul, 15.6ul and sample diluents which served as 0ul.

To each appropriate well were added 50ul of standard, Blank or sample before addition of 50ul of Detection A working solution, covering with a plate sealer and tapped to ensure thorough mixing. The plate was then incubated for 1 hour at 37ºC. This was followed by a 3 time aspiration and washing of plate with 400ul of wash buffer after which 100ul of detection reagent B working solution was added to each well and plate covered with new plate sealer and incubated for 45 minutes at 37ºC. This was followed by five times of aspiration/wash process. To each well was added 90ul of substrate solution, covered with new plate sealer and incubated for 25 minutes at 37ºC in the dark. Immediately after incubation, 50ul of stop solution was then added and the optical density of each well determined at once using a microplate reader set at 450nm.

For each plate, a standard curve of the mean Optical Density and concentration was made using the curve expert version 1.3 and the resulting equation, together with the obtained ODs for the unknown samples were used to determine the concentrations of the known samples.

Folate receptor: Prior to starting the analysis all kit components and samples were brought to room temperature. The standard in lyophilized form was reconstituted with 1.0ml of sample diluents to produce a stock solution of 1000pmol/L. After allowing the solution to stand for 15 minutes with intermittent agitation, the stock solution was diluted serially into the following concentrations: 500ul, 250ul, 125, 62.5ul, 31.2ul, 15.6ul and sample diluents which served as 0ul. Six milliliters (6ml) of assay diluent A and 6ml of assay diluent B were each diluted with 6ml of distilled water to make a working solution. The stock detection reagent A and detection reagent B were briefly centrifuged and diluted to a working concentration of 1:100 with assay diluents A or B respectively. The 30X concentrated wash solution was diluted to 1X working solution by adding 580ml distilled water to the stock solution.

In the appropriate wells were added 100ul each of standard, blank and samples. The plate was then covered with a plate sealer and incubated at 37ºC for 2 hours. After the incubation, the liquid was removed from each well and detection reagent A working solution added, sealed with plate sealer and incubated for 1 hour at 37ºC. The solution was aspirated and washed with 350ul of 1X wash solution for 3 times, after which 100ul of detection reagent B working solution was added to each well, covered with plate seal and incubated for 30 minutes at 37ºC. This was followed by 5 times of aspiration/wash process. To each well was added 90ul of substrate solution and incubated for 20minutes at 37ºC in the dark. The addition of 50ul of stop solution changed the color to yellow. The plate was then read immediately at 450nm.

For each plate, a standard curve of the mean Optical Density and concentration was made using the curve expert version 1.3. The resulting equation was used to calculate the concentration of unknown samples using the ODs.

2.2.4 Quality assurance

For the purpose of quality assurance of the interviewers, regular updates of information and different controls were executed. In addition, various quality checks were carried out on the data entered. Firstly, notes made by the interviewers during the recall were checked and handled. For example, if a new food was not available in EPIC-Soft, a note was written, and based on additional information this new food was added to the EPIC-Soft databases. Secondly, several standardized quality checks were performed, such as checks on processing variables, missing quantities and correct use of the household measures (for example, not a heaped spoon for fluid foods). Furthermore, extreme consumption data per food group and extremes in the energy and nutrient intake were checked. This check on extreme values was done using statistical methods in Stata, descriptive statistics and graphic techniques.

As for the quality control of laboratory results, the TDRC has an established Quality Assurance system in which it is affiliated to external organizations that send samples for analysis and results are compared among the participating laboratories in different regions of the world. This is done for the analyzes such as malaria parasites examination, CRP, AGP, Vitamin A, hematological indices including Hb, Ferritin, folate and Vitamin B12. As for Zinc, we have collaboration with Dunedin University in New Zealand. For all the analyses, controls with known values are included in each run and the results of patient samples are accepted based on the results of the controls.

2.3 Data analyses and evaluation

The data were analyzed using Stata version 12. In the results section, the variables or indicators of interest are presented as percentages or means and standard deviations (SDs) as appropriate. In all results tables, the variables and indicators are presented by province. For child nutritional status the results are also presented by sex and age category and only by age category for women. The final sample size for each variable and indicator is reported in the results tables. The comparability of both provinces on relevant variables is presented. To determine if the provinces were comparable, we used the Student's t-test and the Pearson chi-squared statistic for continuous and dichotomous variables, respectively. Results were considered significantly different between the strata if $p < 0.05$. Variables that have significant differences between the study provinces are marked with an asterisk (*) in tables.

The survey included data on 47 asset indicators that can be grouped into three types: household ownership of consumer durables (clock/watch, bicycle, radio, television, bicycle, sewing machine, refrigerator, car); characteristics of the household's dwelling (rooms in the dwelling, building materials used, and the main source of cooking); and household ownership of livestock. Households were sorted by an asset index and established cutoff values for percentiles were used to group households. In 2006, the Zambian poverty headcount ratio at the rural poverty line (% of rural population) was 76.8% while the poverty headcount ratio at the national poverty line (% of population) was 59.3%. Considering these prevalence rates, we referred to the bottom 60% as "poor," the next 20% as "middle," and the top 20% as "rich" at the national level, and 76%, 12% and 12% at the rural level, respectively. We then assigned households to a group on the basis of their value on the index. **Table 2.3** reports the scoring factors from the Principal Components Analysis of the 47 variables. Because most of asset variables took only the values of 0 or 1, a household that owned a radio had an asset index greater by 0.34 compared with the one that does not, owning a refrigerator raised a household's asset index by 2.07 units; using wood as the main cooking fuel lowered the asset index by 0.34.

Table 2.3 Scoring factors and summary statistics for variables entering the computation of the first principal component: results from principal components analysis

Indicators*	Scoring factors, pca	Mean	SD	Asset Index (f/sd)
Roof materials				
Cement/concrete	0.006	0.007	0.081	0.08
Asbestos	0.095	0.008	0.090	1.05
Galvanized iron sheets, new or in good	0.307	0.098	0.298	1.03
repair	-0.308	0.867	0.340	-0.91
Grass/bamboo or other plant materials	0.060	0.005	0.070	0.85
Scrap iron	0.007	0.011	0.107	0.06
Wood planks	-0.015	0.003	0.057	-0.27
Mud				
Wall materials				
Concrete/cement blocks	0.176	0.010	0.010	17.62
Burnt clay bricks with cement	0.153	0.300	0.459	0.33
Unburnt bricks with cement plaster	0.043	0.010	0.099	0.43
Unburnt bricks with mud plaster	-0.153	0.610	0.488	-0.31
Mud and wattle	-0.063	0.066	0.248	-0.25
Grass/bamboo/other plant materials	-0.022	0.005	0.070	-0.31
Floor materials				
Cement/concrete	0.345	0.115	0.319	1.08
Bare earth/mud/sand	-0.341	0.882	0.323	-1.06

Cooking fuel				
Electricity	0.079	0.002	0.040	1.98
Gas	0.124	0.003	0.057	2.18
Kerosene/paraffin	0.014	0.008	0.090	0.16
Charcoal	0.114	0.198	0.399	0.28
Wood	-0.140	0.788	0.409	**-0.34**
Home appliances and tools				
Pressing iron	0.152	0.272	0.445	0.34
Radio	0.167	0.423	0.494	**0.34**
Television	0.293	0.118	0.323	0.91
Refrigerator/Freezer	0.145	0.004	0.070	**2.07**
Landline telephone	-0.018	0.002	0.405	-0.04
Cellular phone	0.227	0.380	0.486	0.47
Power generator	0.092	0.011	0.107	0.86
Solar panels	0.243	0.164	0.370	0.66
Automobile and transportation				
equipment	0.157	0.585	0.493	0.32
Bicycle	0.106	0.005	0.070	1.52
Motorcycle/scooter	0.126	0.008	0.090	1.40
Car/Lorry/other vehicle	-0.019	0.002	0.040	-0.47
Motorized boat	-0.017	0.128	0.334	-0.05
Canoe				
Farming equipment and tools				
Wheelbarrow	0.121	0.028	0.165	0.73
Ox-plough	0.048	0.013	0.114	0.42
Maize sheller/Cassava grater/other	0.014	0.003	0.057	0.24
processor	-0.045	0.213	0.410	-0.11
Fishing net				
Livestock				
Oxen	0.099	0.013	0.114	0.87
Number of Cattle, indigenous breeds	0.038	0.002	0.040	0.96
Cattle, improved/crossbreds	0.049	0.046	0.245	0.20
Number of Goats/sheep	0.106	0.197	0.441	0.24
Number of Pigs	0.026	0.108	0.326	0.08
Number of Chicken, indigenous/free	0.068	0.762	0.579	0.12
range	0.098	0.020	0.180	0.55
Number of Chicken/improved	0.102	0.075	0.299	0.34
Number of Other Poultry/fowls	0.019	0.018	0.156	0.12
Number of Rabbits				
Number of rooms	0.157	0.303	0.460	0.34

Each variable beside number of livestocks (Cattle/ indigenous breeds, Goats/sheep, Pigs, Chicken, indigenous/free range, Chicken/improved, Rabbits and rooms) takes the value 1 if true, otherwise. Scoring factor is the "weight" assigned to each variable (normalized by its mean and standard deviation) in the linear combination of the variables that constitute the first principal component. The percentage of the covariance explained by the first principal component is 21%. The first eigenvalue is 5.32; the second eigenvalue is 2.29.

Portion sizes and recipe amounts in different measurement units were converted into grams by application of gram-weight conversion factors. We also used a food composition database to calculate nutrient intakes. This composition table was constructed based on nutrient values from the Food and Agriculture Organization of the United Nations Nutrient Database for Standard Reference, and was augmented with values from other food composition tables. New foods and new preparations that were documented in this study were added to the food composition table. Participants (women and mother of young child) in each household were asked if the quantity of consumed food from 14 pre-defined food groups in the past 24 hours, providing a simple score out of 14 (Beans, nuts, and seeds; Beef, other meats and poultry (BMP); Beverages; Milk and Dairies; Eggs, Fats and oils; Fish and fish products; Fruits and fruit juices; Grains and grain products; Green leafy vegetables; Miscellaneous; Other vegetables; Roots and tubers; and Sugars and sweets).

From the quantities of foods measured with the 24-hour recall instruments, we calculated intake of nutrients including energy, protein, fat, fiber, thiamin (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), folate (B9), cyanocobalamin (B12), vitamin C (ascorbic acid), iron, zinc, and calcium. Vitamin A, from animal and plant sources, was expressed as retinol (retinol equivalents, based on the Food and Agriculture Organization (FAO) conversion factors (FAO/WHO, 2002). In order to gain insight into the main sources of nutrients, the contribution of each food group to the total energy and nutrient intake on the recall days was calculated for each participant. Subsequently, the mean of all these individual contributions was calculated. A subset of participants completed a second 24-hour recall. Correlations for percent nutrient intake by food group were explored between the one-day 24-hour dietary recall and the combined two days as a sensitivity analysis. Correlation between the one 24-hour dietary recall and the subset duplicate measurements was assessed for usual intakes by food group. Paired t test were also performed to confirm correlations.

To evaluate the diet, habitual intake distributions of nutrients were compared with dietary reference intakes. An individual's intake of a nutrient was classified as inadequate using the WHO EAR cut-point method as described by Allen et al. (2006), that is, when the estimated usual intake of the individual was less than the corresponding EAR value for the age and sex of the individual. When an estimated average requirement (EAR) of a nutrient was available, the habitual intake was compared using the EAR cut point approach. The proportion of subjects adhering to the dietary recommendations was estimated.

3. RESULTS

3.1 Household Demographics

3.1.1 Household Demography and Housing

Overall, mean household size was 6.3 members, with an average of 38% adults and 62% of minors (<18 years of age). More than 89% of the household heads were male; they were on average 38.3 (SD: 10.40) years of age: 87% (n=193) in Luapula and 90% (n=344) in Northern were male-headed. The vast majority of these household heads had low levels of education: completion rates for primary-level education (lower primary school 12%; upper primary school 44%) were two to three times higher than for junior secondary school (25%), and only 10% attended high secondary school. Farming was the primary occupation of the household heads, followed by unemployment and informal trading. However, the difference in unemployment rates between both provinces is significant: 21% in Luapula and 8% in Northern.

Table 3.1a1 Social and economic characteristics of households

	Luapula n=224	**Northern n=386**	**Total N=610**
	n (%)	**n (%)**	**n (%)**
Household	**n=1422**	**n=2378**	**N=3800**
Household size, mean(SD)	6.39(2.22)	6.25(1.96)	**6.30(2.06)**
Number of minors (<18 years old)	898(63.15)	1463(61.52)	**23.61(62.13)**
Number of adults (≥18 years old)	524(36.85)	915(38.48)	**1439(37.87)**
Number of children (0-59 months old)	383(26.93)	587(24.68)	970(25.53)
Head of household			
Age of head of household (mean(SD); years)	38.32(10.32)	38.23(10.46)	**38.26(10.40)**
n=586	**193(86.55)**	**344(90.05)**	**537(88.76)**
Sex of head of household (% male) n=605			
Education of head of household (n=595)			
No formal education	14(6.36)	19(5.07)	33(5.55)
Lower primary school (Grade 1-4)	23(10.45)	46(12.27)	**69(11.60)**
Upper Primary (Grade 5-7)	97(44.09)	166(44.27)	**263(44.20)**
Post-primary vocational certificate	0	3(0.80)	3(0.50)
Junior secondary education (Grade 8-9)	59(26.82)	90(24.00)	**149(25.04)**
High secondary school (Grade 10-12)	21(9.55)	40(10.67)	**61(10.25)**
Post-secondary vocational certificate	1(0.45)	4(1.07)	5(0.84)
College Diploma	2(0.91)	4(1.07)	6(1.01)
University Degree/Diploma	0	1(0.27)	1(0.17)
Other	3(1.36)	0	3(0.50)
Don't know	0	2(0.53)	2(0.34)

Main occupation of head of household (n=605)			
Crop farmer	131(58.74)	282(73.82)	**413(68.26)**
Livestock farmer (include fish farming)	2(0.90)	4(1.05)	6(0.99)
Crop & Livestock farmer	5(2.24)	9(2.36)	14(2.31)
Salaried workers (teacher, nurse, clerk, etc.)	6(2.69)	11(2.88)	17(2.81)
Formal (Licensed) trader	4(1.79)	3(0.79)	7(1.16)
Informal (Unlicensed) trader	25(11.21)	27(7.07)	**52(8.60)**
Casual laborer	3(1.35)	15(3.93)	18(2.98)
Student	0	1(0.26)	1(0.17)
Unemployed*	**47(21.08)**	**30(7.86)**	**77(12.73)**

* Study province difference, p-value < 0.05.

The housing situation was poor in both provinces. Almost all dwellings had bare earth/mud/sand floors (88%) and a roof made out of grass/bamboo or other plant materials (87%); more than half of the households lived in houses with walls made of unburnt bricks with mud plaster (61%) while burnt clay bricks with cement walls were used in 30% of households. Almost all households used firewood for cooking (79%).

Table 3.1a2 Housing characteristics of households

PROVINCE	**Luapula n=224**	**Northern n=386**	**Total N=610**
	n (%)	**n (%)**	**n (%)**
Roof materials			
Cement/concrete	0	4(1.04)	4(0.66)
Asbestos	2(0.89)	3(0.78)	5(0.82)
Galvanized iron sheets, new or in good repair	14(6.25)	46(11.92)	60(9.84)
Grass/bamboo or other plant materials	207(92.41)	322(83.42)	**529(86.72)**
Scrap iron	1(0.45)	2(0.52)	3(0.49)
Wood planks	0	7(1.81)	7(1.15)
Mud	0	2(0.52)	2(0.33)
Wall materials			
Concrete/cement blocks	1(0.45)	5(1.30)	6(0.98)
Burnt clay bricks with cement	89(39.73)	94(24.35)	**183(30.00)**
Unburnt bricks with cement plaster	1(0.45)	5(1.30)	6(0.98)
Unburnt bricks with mud plaster	123(54.91)	249(64.51)	**372(60.98)**
Mud and wattle	9(4.02)	31(8.03)	40(6.56)
Grass/bamboo/other plant materials	1(0.45)	2(0.52)	3(0.49)
Floor materials			
Cement/concrete	20(8.93)	50(12.95)	70(11.48)
Bare earth/mud/sand	203(90.63)	335(86.79)	**538(88.20)**
Other, specify	1(0.45)	1(0.26)	2(0.33)

Cooking fuel			
Electricity	0	1(0.26)	1(0.16)
Gas	0	2(0.52)	2(0.33)
Kerosene/paraffin	2(0.89)	3(0.78)	5(0.82)
Charcoal	86(38.39)	35(9.07)	121(19.84)
Wood	136(60.71)	345(89.38)	**481(78.85)**

3.1.2 Household Assets and Capital

Chicken, indigenous/free range (68%) was the most commonly owned asset, followed by bicycle (58%), radio (42%) and cellular phone (38%). Interestingly, 16% of all households owned solar panels.

Table 3.1b1 Asset ownership among households

PROVINCE	Luapula n=224	Northern n=386	Total N=610
	n (%)	**n (%)**	**n (%)**
Home appliances and tools			
Pressing iron	46(20.54)	120(31.09)	166(27.21)
Radio	99(44.20)	159(41.19)	**258(42.30)**
Television	20(8.93)	52(13.47)	72(11.80)
Refrigerator/Freezer	1(0.45)	2(0.52)	3(0.49)
Landline telephone	1(0.45)	0	1(0.16)
Cellular phone	85(37.95)	147(38.08)	**232(38.03)**
Power generator	4(1.79)	3(0.78)	7(1.15)
Solar panels	29(12.95)	71(18.39)	**100(16.39)**
Automobile and transportation equipment			
Bicycle	131(58.48)	226(58.55)	**357(58.52)**
Motorcycle/scooter	1(0.45)	2(0.52)	3(0.49)
Car/Lorry/other vehicle	1(0.45)	4(1.04)	5(0.82)
Motorized boat	0	1(0.26)	1(0.16)
Canoe	51(22.77)	27(6.99)	78(12.79)
Farming equipment and tools			
Wheelbarrow	4(1.79)	13(3.37)	17(2.79)
Ox-plough	0	8(2.07)	8(1.31)
Maize sheller/Cassava grater/other processor	1(0.45)	1(0.26)	2(0.33)
Fishing net	66(29.46)	64(16.58)	130(21.31)
Livestock			
Oxen	0	8(2.07)	8(1.31)
Cattle, indigenous breeds	1(0.45)	22(5.70)	23(3.77)
Cattle, improved/crossbreds	0	1(0.26)	1(0.16)

Goats/sheep	28(12.50)	81(20.98)	109(17.87)
Pigs	14(6.25)	49(12.69)	63(10.33)
Chicken, indigenous/free range	149(66.52)	269(69.69)	**418(68.52)**
Chicken/improved	0	8(2.07)	8(1.31)
Other Poultry/fowls	20(8.93)	20(5.18)	40(6.56)
Rabbits	1(0.45)	8(2.07)	9(1.48)
Other	1(0.45)	0	1(0.16)

When asked about their different sources and amount of income received by different members of the household, most of households (65%) responded that they raised cash through sale of crops followed by informal trading (19%), although there is a significant difference between both provinces. In Northern, most of surveyed households relied on sale of crops (70%). However, in Luapula, 28% of surveyed households raised cash through informal trading, in addition to sale of crops (50.6%). Yearly income ranged from $103.25-$753.87, while 89% having the average income less than $1.5 USD per day.

Table 3.1b2: Source and amount of income by different members of households

PROVINCE	**Luapula n=344**	**Northern n=956**	**Total N=1300**
	n (%)	**n (%)**	**n (%)**
Income source			
Salaried employment (regular job, regular salary)	13(3.78)	33(3.45)	46(3.54)
Farming (sale of crops)***	**174(50.58)**	**668(69.87)**	**842(64.77)**
Farming (sale of livestock)	6(1.74)	11(1.15)	17(1.31)
Farming (sale of milk and other dairy products)	0	1(0.10)	1(0.08)
Fishing farming (exclude fish vending)***	23(6.69)	11(1.15)	34(2.62)
Formal business (registered/licensed)	4(1.16)	3(0.31)	7(0.54)
Informal trading (unlicensed, occasional, not farming or fishing)***	**98(28.49)**	**156(16.32)**	**254(19.54)**
Casual employment (wages paid, not sale of	25(7.27)	68(7.11)	93(7.15)
products)	1(0.29)	3(0.31)	4(0.31)
Remittances/Donations from relatives, faith organizations, other	0	2(0.21)	2(0.15)
Self-employed, transportation			
Amount per year	n=342	n=958	N=1300
Mean(SD), US Dollar	440.25 (298.36)	472.72 (211.74)	**428.56 (325.31)**
n(%) less than $1.5 USD	299(87.43)	853(89.04)	**1152(88.62)**

*** Study province difference, p-value < 0.001.

3.1.3 Household Socio-economic Status Indices

The difference in the average index between the poorest and the middle group is 2.84 units at the national level (2.19 at rural level). One example of a combination of assets that would produce this difference is owning a bicycle (0.32), owning an ox-plough (0.42), having a wall made of unburnt bricks with cement plaster (0.43), having a cell phone (0.47), and not having firewood as cooking fuel (0.34). The average asset index is 4.28 units at the national level (5.15 at rural level) higher for the richest than for the middle group. This difference is equivalent to owning an asbestos roof (1.05), owning a power generator (0.86), having cement/concrete walls (1.08), and using gas as the main cooking fuel (2.18).

Table 3.1c1 Mean socio-economic score by tertile among households

	Poorest	Middle	Richest
At National level	-1.89	-0.54	3.74
At rural level	-1.63	0.56	5.71

Overall, at the national level, 60% of households are poor (Luapula 59%; Northern 60%) and 20% are rich (Luapula 17%; Northern 21%). However, at the rural level, 76% of households are poor (Luapula 78%; Northern 75%) while 12% are rich (Luapula 8%; Northern 14%).

Table 3.1c2 Proportion of households in low, medium and high socio-economic groups

PROVINCE	Luapula n=224	Northern n=385	Total N=609
	n (%)	n (%)	n (%)
At the national level			
Poorest 60%	**133(59.38)**	**231(60.00)**	**364(59.7)**
Middle 20%	52(23.21)	72(18.70)	124(20.36)
Richest 20%	**39(17.41)**	**82(21.30)**	**121(19.87)**
At the rural level			
Poorest 76%	**174(77.68)**	**290(75.32)**	464(76.19)
Middle 12%	31(13.84)	42(10.91)	73(11.99)
Richest 12%	**19(8.48)**	**53(13.77)**	**72(11.82)**

3.1.4 Household food security

On average, 16% of childbearing age women missed a meal the day before being interviewed and 12% of them ate less than usual. Both prevalences were greater in Northern (33%) than in Luapula (20%). Average dietary diversity was similar in both provinces. On average, 1% of women reported consuming fewer than 4 food groups out of 14 during the previous day.

Table 3.1 d1 Household hunger and dietary diversity among childbearing age women

	Luapula n=222	Northern n=378	Total N=600
Household hunger			
n(%) women that missed meals day before interview (n=600)	28(12.61)	70(18.52)	98(16.33)
n(%) women that ate less than usual before interview* (n=571)	15(7.08)	51(14.21)	66(11.56)
n(%) women that missed meals and ate less than usual* (n=88)	5(20.0)	31(49.21)	36(40.91)
Household dietary diversity			
HDDS, mean(SD)	8.0(1.74)	8.18(1.62)	8.11(1.67)
n(%) women with HDDS ≤ 4	4(1.80)	3(0.79)	7(1.17)

**Not because they were sick*

A similar proportion of children 6–59 months of age (17%) missed a meal the day before the interviews and less than 16% ate less than usual. The proportion of children with a minimum dietary diversity was very low (around 4%) in both provinces.

Table 3.1 d2 Household hunger and dietary diversity among children 6-59 months

	Luapula n=185	Northern n=323	Total N=508
Household hunger			
n(%) children that missed meals day before interview (n=580)	97(16.72)	35(16.43)	62(16.89)
n(%) children that ate less than usual before interview* (n=508)	32(17.30)	47(14.55)	79(15.55)
n(%) children that missed meals and ate less than usual* (n=72)	11(40.74)	20(44.44)	31(43.06)
Household dietary diversity			
HDDS mean(SD)	2.9(1.3)	3.6(0.5)	3.28(1.0)
n(%) children with HDDS ≤ 4	12(5.6)	13(3.4)	25(4.2)

**Not because they were sick*

The food group consumption patterns were not different between age groups. In childbearing age women, the most commonly consumed food groups (consumed by more than 80% of all households) were miscellaneous, roots and tubers, beans, nuts, and seeds; followed by vegetables and grains, which were consumed by about 76% of surveyed women. Green leafy vegetables and Fats and oils were consumed by approximately 60% of them, while fruits, sugar and sweets were consumed by 37% and 25%, respectively. The consumption of animal source foods was not common: Around 64% reported having consumed fish and seafood in the past 24 hours, and a lower proportion of women consumed meat and poultry (12%) or milk and dairy products or eggs or beverages (11%) or insects (2%). Similar food group patterns were observed among children. Among 24–59 months of age children: miscellaneous, roots and tubers (>80%); beans, nuts, and seeds, vegetables and grains (70%); vegetables and grains (60%); fruits (44%), sugar and sweets (27%); fish and seafood (60%); meat and poultry (8.6%); milk and dairy products or eggs or beverages (9-11%) or insects (0%). As for 6-23 months of age: miscellaneous, roots and tubers (>80%); grains (70%); beans, nuts, and seeds, vegetables (60%); fruits (44%), sugar and sweets (29%); fish and seafood (60%); meat and poultry (8.1%); milk and dairy products or eggs or beverages (9-11%). Surprisingly, children 6-23 months of age consumed 8% of insects.

Figure 3.1a Consumption of food groups during the past 24 hours by childbearing age women

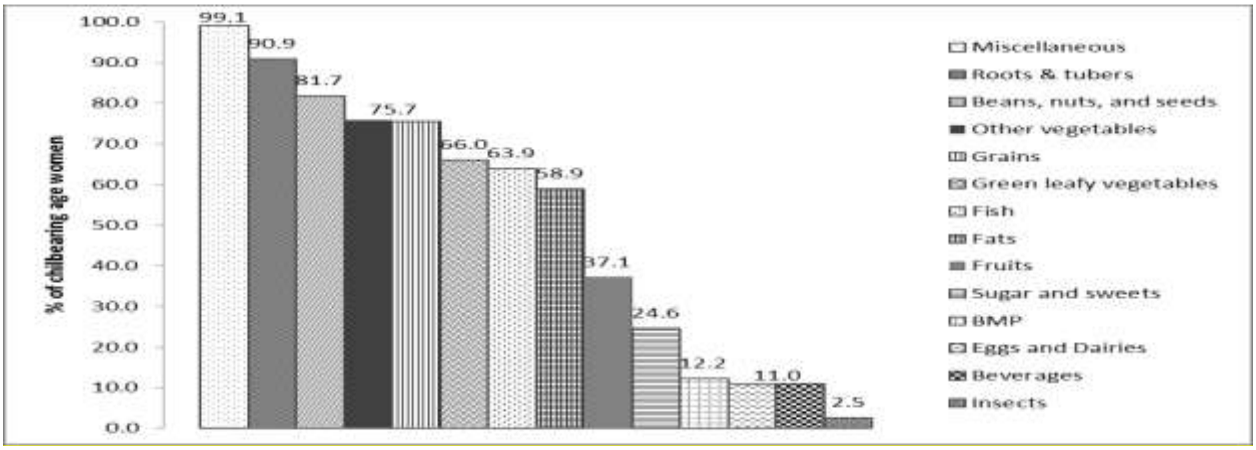


Figure 3.1b Consumption of food groups during the past 24 hours by children 6–23 months of age

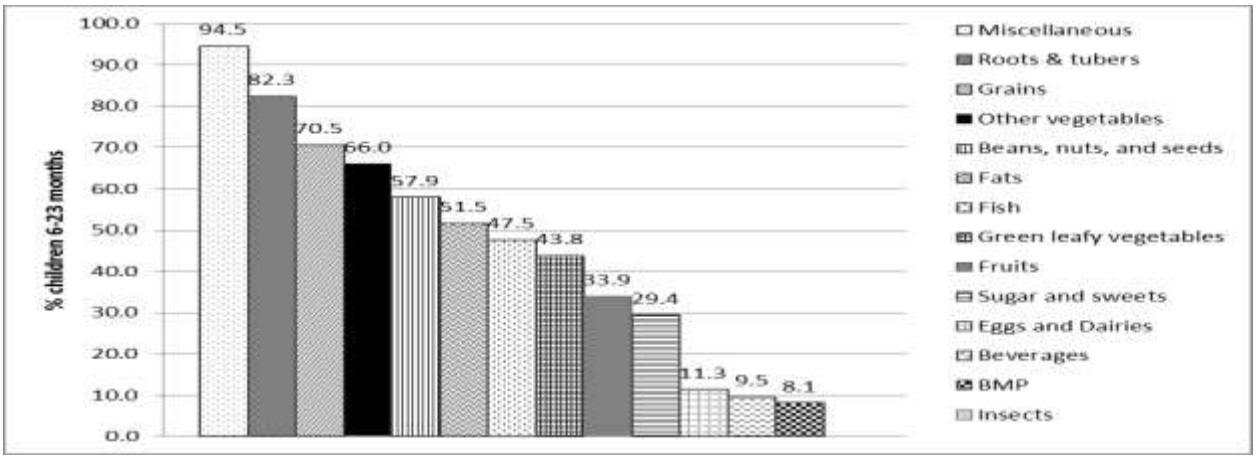
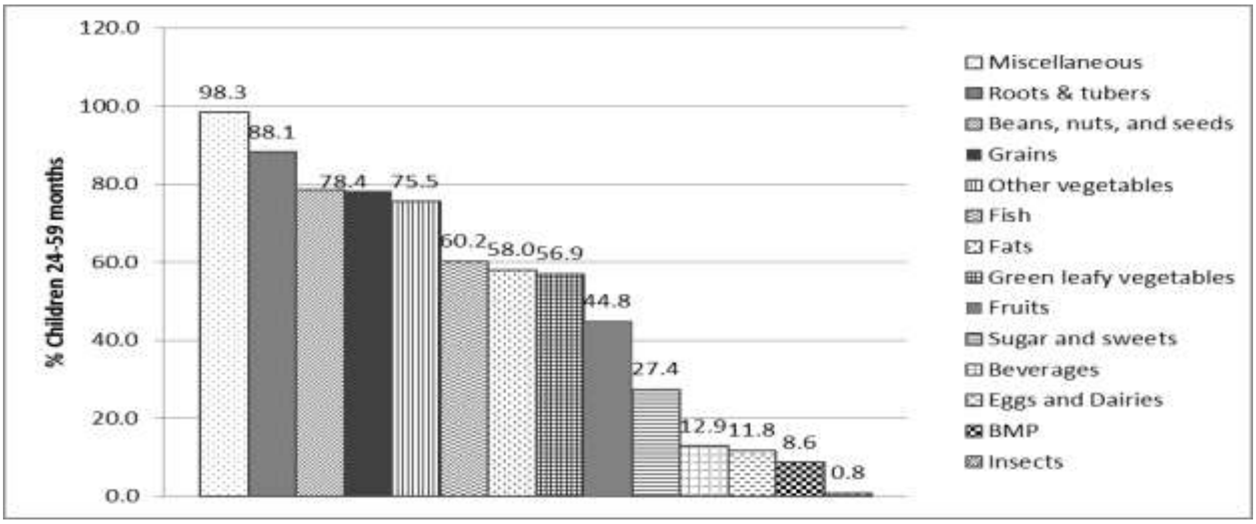


Figure 3.1c Consumption of food groups during the past 24 hours by children 24–59 months of age



3.2 Women Nutrition and Health

The following section details the characteristics and activities of childbearing age women, and their nutrition and health status within the household.

3.2.1 Women Characteristics and Status

The sample of childbearing age women was mostly comprised of lactating women (54%) while 36% and 9% of them were non-pregnant & non-lactating, and pregnant, respectively. Northern had more pregnant and lactating women than Luapula while more women were non-pregnant & non-lactating, and both pregnant and lactating in Luapula than Northern. Most women in both provinces ranged in age from 23 to 39 years, and their level of education was low: completion rates for post-primary vocational certificate were high (37%) across both provinces. However, completion rates for upper primary-level education were far higher in Northern than Luapula ($P<0.001$). Women in Luapula were more likely to have completed high secondary school than those in Northern, but they were equally likely to complete junior secondary education, college and university at very low rate (<1%).

Consistent with the heads of household, almost all women reported occupational activities in the agricultural sector (81%). However, more women in Northern were involved in household chores and lifting of loads than those in Luapula (95 vs. 56%; 39 vs. 0% respectively). Correspondingly, the mothers' contribution to household expenses was greater in Northern than Luapula (62% vs. 50%; $P<0.001$).

Table 3.2a Women characteristics and activities in households

	Luapula n=222	Northern n=378	Total N=600
	n (%)	n (%)	n (%)
Physiological status			
Non-pregnant & non-lactating	**84(37.84)**	130(34.39)	**214(35.67)**
Pregnant	18(8.11)	**37(9.79)**	**55(9.17)**
Lactating	114(51.35)	**210(55.56)**	**324(54.00)**
Pregnant & Lactating	**4(1.80)**	0	4(0.67)
Age(years)	31.19(7.58)	30.74(8.00)	**30.91(7.84)**
Non-pregnant & non-lactating	34.12(7.79)	34.64(8.22)	34.42(8.02)
Pregnant	28.06(5.18)	29.93(5.73)	29.28(5.56)
Lactating	29.46(6.85)	28.87(7.1)	29.10(6.99)
Pregnant & Lactating	31.25(6.55)	0	31.25(6.55)
Education n=(599)			
No formal education	16(7.21)	39(10.32)	55(9.17)
Lower primary school (Grade 1-4)	0	0	0
Upper Primary (Grade 5-7)***	**40(18.02)**	**125(33.07)**	165(27.5)
Post-primary vocational certificate	67(30.18)	158(41.80)	**225(37.5)**
Junior secondary education (Grade 8-9)	0	1(0.26)	**1(0.17)**
High secondary school (Grade 10-12)***	**48(21.62)**	**44(11.64)**	**92(15.33)**
Post-secondary vocational certificate***	17(7.66)	8(2.12)	25(4.17)
College Diploma	1(0.45)	0	**1(0.17)**
University Degree/Diploma	1(0.45)	1(0.26)	**2(0.33)**
Other	0	1(0.26)	1(0.17)
Don’t know	32(14.41)	1(0.26)	33(5.5)
Main activities			
Farming	**185(83.33)**	**303(80.16)**	**488(81.33)**
Household chores***	**125(56.31)**	**361(95.50)**	**486(81.00)**
Office work, most seated	1(0.45)	0	1(0.17)
Office work, mostly moving up and down	0	5(1.32)	5(0.83)
Work involving lifting of loads e.g. fetching	0	**149(39.42)**	**149(24.83)**
water***	0	2(0.53)	2(0.33)
Machine operation including vehicle operation	1(0.45)	4(1.06)	5(0.83)
School teacher/health nurse	4(1.80)	8(2.12)	12(2.00)
Shop keeper/Market stall attendant	1(0.45)	7(1.85)	8(1.33)
Unemployed, mostly passive stay at home	30(13.51)	31(8.20)	61(10.17)
Other			
Women’s contribution to household income* **	112(50.45)	**235(62.17)**	347(57.83)

*** Study province difference, p-value < 0.001.

3.2.2 Food group intakes

Information on main food groups consumed is presented (Figure 3.2a and Tables 3.2b1 to 3.2b2) Median intakes, as well as the percentiles (from 5th to 95th) of intake are presented. The Zambian diet is predominantly vegetarian; only 4-9% of the energy is supplied by foods of animal origin. Most of the energy in the diet during the period of the study came from roots or tubers (422 to 686 g/day) and grains and grain products (268 to 427 g/day). The combined intake of beans, nuts, and seeds, which are good sources of protein and nutrients of the B complex, including folate, was relatively large (149-264 g/day). Beverages consumption was also large (361-761g/day); median consumption per day varied between 62 and 89g.

Consumption of sugar, oil/fat, and vegetables was approximately 20 to 60 g/day, fruit intake100-150 g/day, and meat, fish, poultry and eggs (MFPE) intake25-60 g/day..

The mean daily intake of milk in both provinces was 245g. However, in order to meet daily requirements for calcium delivered only from milk, a person should consume between 3 and 4 cups of milk per day depending on the age.

Figure 3.2a: Mean intake (in grams) by food group for all women of reproductive age

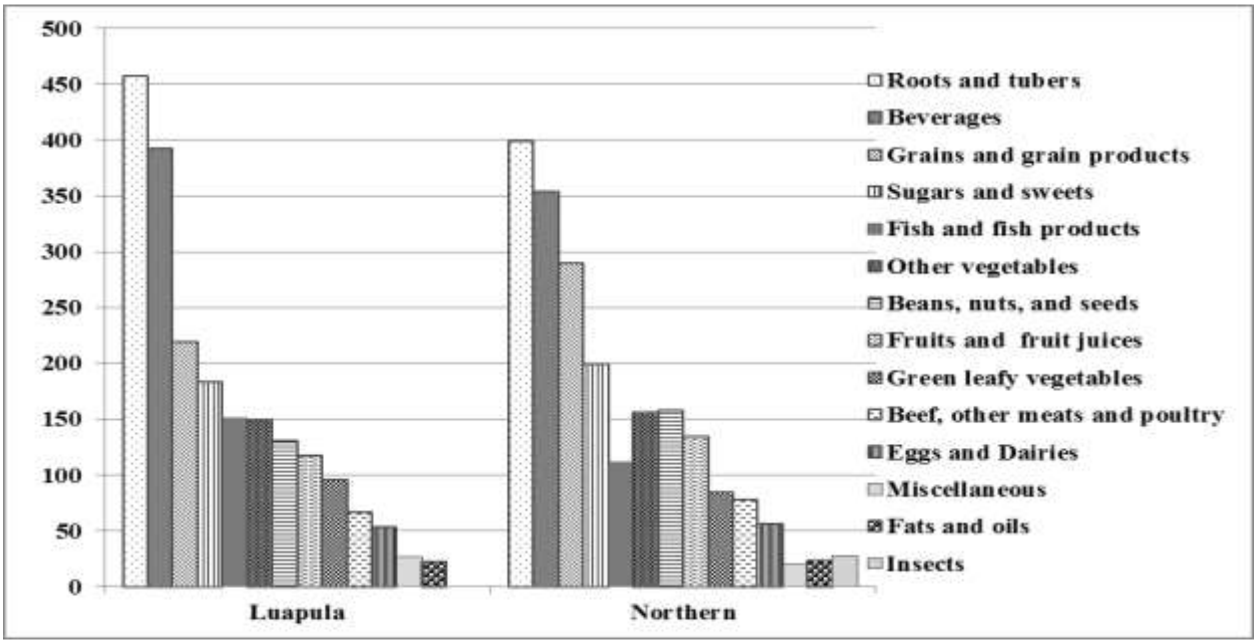


Table 3.2b1 Average consumption of food group (means/SD) among women of reproductive age

Physiological status	Non Pregnant & non lactating		Pregnant		Lactating	
	n=214		n=55		n=324	
Food groups/Province	**Luapula**	**Northern**	**Luapula**	**Northern**	**Luapula**	**Northern**
Beans, nuts, and seeds (g/day)	127.86	161.83	121.92	116.41	136.09	163.13
	93.26	120.57	87.46	86.05	101.44	129.59
Beef, other meats and poultry (g/day)	59.00	58.23	129.00	59.17	73.80	93.17
	32.54	29.20	.	32.07	58.30	53.62
Beverages (g/day)	624.17	435.24	.	477.33	141.33	382.44
	889.64	378.35	.	35.02	100.08	310.78
Milk and Dairies (g/day)	84.29	56.50	44.50	55.33	33.14	56.65
	90.70	33.82	27.58	38.68	29.68	34.91
Eggs (g/day)	21.13	22.13	20.33	24.94	24.11	25.28
	17.00	15.05	10.02	20.93	19.16	19.17
Fats and oils (g/day)	132.66	114.44	119.38	95.09	166.17	114.03
	200.52	134.33	83.93	77.75	204.75	140.76
Fish and fish products (g/day)	110.19	91.40	198.00	127.86	115.44	165.58
	109.70	77.05	138.86	125.82	104.23	188.13
Fruits and fruit juices (g/day)	210.59	253.47	191.89	292.31	230.46	312.51
	109.60	144.35	126.55	153.09	132.94	179.64
Grains and grain products (g/day)	103.30	90.74	100.30	82.48	91.32	81.02
	57.69	68.94	66.91	43.07	78.03	50.48
Green leafy vegetables (g/day)	.	25.00		126.00		17.50
	.	23.68		.		12.94
Miscellaneous (g/day)	26.86	19.02	9.06	22.86	29.08	20.58
	30.64	26.21	9.81	21.54	35.62	29.59
Other vegetables (g/day)	165.03	163.10	129.42	164.15	149.64	150.92
	196.95	173.74	125.28	217.34	172.04	193.33
Roots and tubers (g/day)	406.83	375.72	450.33	442.13	498.26	407.45
	254.45	244.96	250.78	251.81	305.50	250.66
Sugars and sweets (g/day)	123.65	229.25	357.50	169.67	221.20	183.74
	147.14	425.10	45.96	255.67	228.05	149.21
Insects (g/day)	127.86	161.83	121.92	116.41	136.09	163.13
	93.26	120.57	87.46	86.05	101.44	129.59

Table 3.2b2 Food group intake distributions for non-pregnant and non-lactating women

Food groups	Province	P5	P10	P25	P50	P75	P90	P95
Beans, nuts, and seeds (g/day)	Luapula	23	26	62	96	155	224	343
	Northern	22	46	78	140	209	309	369
Beef, other meats and poultry (g/day)	Luapula	129	129	129	129	129	129	129
	Northern	37	53	53	73.5	119	166	195
Beverages (g/day)	Luapula	.	.	.	.	.	.	.
	Northern	82	107	194	294	388	873	961

Eggs, Milk and Dairies (g/day)	Luapula	25	25	25	44.5	64	64	64
	Northern	10	12	29	53	76.5	107	117
Fats and oils (g/day)	Luapula	7	7	16	18	23	43	43
	Northern	4	7	12	21	33	50	65
Fish and fish products (g/day)	Luapula	11	49	56	95	127	250	268
	Northern	14	20	35	69	126	241	415
Fruits and fruit juices (g/day)	Luapula	26	26	26	249	282	356	356
	Northern	13	26	37	92	199	465	525
Grains and grain products (g/day)	Luapula	65	65	105	156	235	476	476
	Northern	59	112	183	300	402	561	639
Green leafy vegetables (g/day)	Luapula	48	52	60	80	110	204	275
	Northern	16	22	45.5	67	109.5	165	172
Insects (g/day)	Luapula							
	Northern	7	7	9	13	21.5	46	46
Miscellaneous (g/day)	Luapula	2	3	4	5	9	31	37
	Northern	2	2	4	6	24.5	63	88
Other vegetables (g/day)	Luapula	10	37	44	76	210	293	395
	Northern	13	19	43	86	165	360.5	491
Roots and tubers (g/day)	Luapula	128	128	241	402.5	612	852	957
	Northern	81.5	103.5	231	368.5	533.5	760	898
Sugars and sweets (g/day)	Luapula	325	325	325	357.5	390	390	390
	Northern	20	25	72	144	292	408	504

Table 3.2b3 Food group intake distributions for pregnant women

Food groups	Province	P5	P10	P25	P50	P75	P90	P95
Beans, nuts, and seeds (g/day)	Luapula	5	10	25	50	75	90	95
	Northern	14	29	61	93	172	198	325
Beef, other meats and poultry (g/day)	Luapula	23	26	62	96	155	224	343
	Northern	26	26	49	53	53	121	121
Beverages (g/day)	Luapula	129	129	129	129	129	129	129
	Northern	437	437	437	495	500	500	500
Eggs, Milk and Dairies (g/day)	Luapula	.	.	.	.	.	.	.
	Northern	33	33	33	33	100	100	100
Fats and oils (g/day)	Luapula	25	25	25	44.5	64	64	64
	Northern	1	3	11	15	44	58	67
Fish and fish products (g/day)	Luapula	7	7	16	18	23	43	43
	Northern	34	35	38	70	129	184	190
Fruits and fruit juices (g/day)	Luapula	11	49	56	95	127	250	268
	Northern	13	18	26	62	250	319	329
Grains and grain products (g/day)	Luapula	26	26	26	249	282	356	356
	Northern	103	107	144	284.5	428	531	533
Green leafy vegetables (g/day)	Luapula	65	65	105	156	235	476	476
	Northern	35	36	47	76	106	128	186
Insects (g/day)	Luapula	48	52	60	80	110	204	275
	Northern	126	126	126	126	126	126	126
Miscellaneous (g/day)	Luapula	2	3	4	5	9	31	37

	Northern	2	3	5	14	34	54	69
Other vegetables (g/day)	Luapula	10	37	44	76	210	293	395
	Northern	12	14	36	86	155	502	684
Roots and tubers (g/day)	Luapula	128	128	241	402.5	612	852	957
	Northern	103	184	275.5	356.5	638.5	713	823
Sugars and sweets (g/day)	Luapula	325	325	325	357.5	390	390	390
	Northern	9	9	29	72	144	813	813

Table 3.2b4 Food group intake distributions for lactating women

Food groups	Province	P5	P10	P25	P50	P75	P90	P95
Beans, nuts, and seeds (g/day)	Luapula	5	10	25	50	75	90	95
	Northern	22	46	78	140	209	309	369
Beef, other meats and poultry (g/day)	Luapula	15	28	46	121.5	199	257	334
	Northern	37	53	53	73.5	119	166	195
Beverages (g/day)	Luapula	9	10	15	55	117	175	196
	Northern	82	107	194	294	388	873	961
Milk and Dairies (g/day)	Luapula	29	29	29	174	221	221	221
	Northern	10	12	29	53	76.5	107	117
Eggs (g/day)	Luapula	5	11	17	25.5	34	66	122
	Northern	4	7	12	21	33	50	65
Fats and oils (g/day)	Luapula	2	4	9	18	34	54	59
	Northern	14	20	35	69	126	241	415
Fish and fish products (g/day)	Luapula	18	25	47	88	199	414	544
	Northern	13	26	37	92	199	465	525
Fruits and fruit juices (g/day)	Luapula	13	21	37	82.5	153	300	361
	Northern	59	112	183	300	402	561	639
Grains and grain products (g/day)	Luapula	63	116	160	203	265	362	425
	Northern	16	22	45.5	67	109.5	165	172
Green leafy vegetables (g/day)	Luapula	19	28	42	69	118	189	210
	Northern	7	7	9	13	21.5	46	46
Miscellaneous (g/day)	Luapula	2	3	6	11	45	72	114
	Northern	2	2	4	6	24.5	63	88
Other vegetables (g/day)	Luapula	6	18	49	91.5	220	322	413
	Northern	13	19	43	86	165	360.5	491
Roots and tubers (g/day)	Luapula	95	135	285	446	658	906	996
	Northern	81.5	103.5	231	368.5	533.5	760	898
Sugars and sweets (g/day)	Luapula	23.5	27.5	36.5	169.5	292	599	766.5
	Northern	20	25	72	144	292	599	504
Insects (g/day)	Luapula	5	10	25	50	75	90	95
	Northern	22	46	78	140	209	309	369

The consumption of cereals was between 90-200 g/day except for wheat flour equivalent consumption. Cereals included wheat flour and wheat products (bread, biscuits, and others), as well as maize grain, rice, and millet.

Table 3.2b5: Amounts of cereals consumed (g/day) by all women, described by both medians (50th percentiles) and means and standard deviations (SD)

Type of flour and products	Luapula		Northern	
	Median	Mean(SD)	Median	Mean(SD)
Total wheat flour equivalent consumption	27	35.64(28.21)	40	55.38(44.35)
Total maize flour equivalent consumption	122	130.98(68.70)	137	147.93(69.45)
Total rice consumption	66	92.29(90.49)	91	104.48(62.80)
Total maize grain consumption	76	92.32(59.54)	139	151.66(96.31)
Total millet consumption	196.5	196.50(188.80)	170	157.64(114.61)

3.2.3 Frequency of consumption of Food Fortification Vehicles and the Amounts Consumed

3.2cl Estimated percentiles of vegetable oil, sugar, wheat and Maize flour consumption by all women of reproductive age

Provinces	P5	P10	P25	P50	P75	P90	P95
Luapula	1	1	3	7	14	21	26
Northern	1	2	5	8	13	20	25
Sugar							
Luapula	10	12	25	32	43	54	57
Northern	10	18	23	30.5	44.5	60	72
Wheat							
Luapula	5	11	21	25	36	86	105
Northern	17	20	25	46	77	128	129
Maize flour							
Luapula	44	58	87.5	122	158.5	215	246
Northern	51	65	97	137	192	245	271

Table3.2c2: Percentile distribution of usual nutrient intake among women of child bearing age

Non Pregnant and Non Lactating women								
Food groups	**Province**	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**
Energy (kcal)	Luapula	1482	1695	2790	3512.5	4662.5	5800	6517
	Northern	2085	2460	2952	3806	4909	5929.5	6767
Carbohydrate (g)	Luapula	257.8	321	490.65	615.6	780.7	946	1036.9
	Northern	321.8	411.6	519.1	656.95	862.7	1017.65	1098.7
Fat (g)	Luapula	9.3	17.5	38.7	71.15	118.75	189	202.8
	Northern	19.5	27.8	45.7	72.9	109.8	165.2	193.7
Protein (g)	Luapula	30.1	40	58.9	85.4	131	186.9	218.3
	Northern	39.1	57.3	77.4	99.55	130.5	184.55	208
Fiber (g)	Luapula	29	33	40.5	57	74	89	105
	Northern	27	33	51	69	98	125.5	146
Pregnant women								

Energy (kcal)	Luapula	1703	1739	2437	3580.5	4025	4611	6272
	Northern	1856	2156	2762	3719	4569	6294	7181
Carbohydrate (g)	Luapula	231	314.7	392.7	577.65	725.6	997.5	1175
	Northern	335.2	346.7	465.4	690	864.8	1075.8	1390.7
Fat (g)	Luapula	16	20.2	40.6	75.8	88	133.7	156
	Northern	21	28.5	38.6	53.3	77.8	133.8	173.4
Protein (g)	Luapula	38.9	41.5	69.2	94.35	130.4	164	178.4
	Northern	39.8	49.3	72.2	96.4	121.9	163.1	276.2
Fiber (g)	Luapula	17	25	40	51	72	112	123
	Northern	32	36	54	65	86	114	149
Lactating women								
Energy (kcal)	Luapula	2181	2459	3012	3913	4835	5982	6392
	Northern	1717	2101	3065	4164	5096	6279	7427
Carbohydrate (g)	Luapula	378	410.5	542.9	659.35	879.1	1063.7	1229
	Northern	320.2	365.3	523	717.3	934.1	1120	1324.1
Fat (g)	Luapula	11.7	18.7	37.1	75.05	120.4	172.7	201.4
	Northern	11.9	20.35	44.1	75.75	114.1	141.55	193.3
Protein (g)	Luapula	35.8	42.3	68.4	106.6	144.5	193.6	232.8
	Northern	35.9	45.95	78.2	109.9	139.4	192.95	234.9
Fiber (g)	Luapula	30	35	45	57	74	94	112
	Northern	26	35	53	76.5	104	129	151

The distributions (in percentiles) of usual intake of the four food vehicles being fortified or considered for mass fortification in Zambia: oil, sugar, wheat flour, and maize flour are presented (Table 3.2c). Wheat flour and maize flour are the most widely consumed of these vehicles. In Northern, sugar is more commonly consumed than in Luapula while oil is more in Luapula than Northern. The data show that a higher proportion of the population in Northern consumes these four foods, and consumes substantially more of them, than do the populations of Luapula.

Table 3.2c: Table3.2d3: Percentile distribution of usual nutrient intake among women of child bearing age

Provinces	P5	P10	P25	P50	P75	P90	P95
Luapula	1	1	3	7	14	21	26
Northern	1	2	5	8	13	20	25
Sugar							
Luapula	10	12	25	32	43	54	57
Northern	10	18	23	30.5	44.5	60	72
Wheat							
Luapula	5	11	21	25	36	86	105
Northern	17	20	25	46	77	128	129
Maize flour							
Luapula	44	58	87.5	122	158.5	215	246

Northern	51	65	97	137	192	245	271

3.2.4 Energy and macronutrient intakes

The dietary profile for women of child bearing age indicating the energy and protein intakes are presented. The energy intake was above 3500g and protein was above 90g in the provinces for individuals in the 50th percentile. (**Tables 3.2d3**).

Mean intakes of both Energy and Protein was 4029 kcal and 111g respectively. The intakes of carbohydrate, fat and fiber were between 314 and 1225 g/day, 11.7 and 201.4 g/day, and 27 and 147 g/day respectively.

Table 3.2d1 Mean intakes of total energy and macronutrients among child bearing age women

Physiological status	Non Pregnant & non lactating		Pregnant		Lactating	
Food groups/Province	**Luapula**	**Northern**	**Luapula**	**Northern**	**Luapula**	**Northern**
Energy (kcal)	3749.16	4014.80	3377.44	3899.46	4110.55	4192.90
	1549.33	1506.51	1176.73	1532.47	1573.89	1691.11
Carbohydrate (g)	636.59	682.34	593.84	707.06	731.76	740.35
	243.95	253.36	253.08	286.10	315.69	296.82
Fat (g)	84.78	84.95	70.33	69.16	84.63	85.01
	59.59	52.97	40.73	46.92	58.11	61.55
Protein (g)	103.21	108.75	100.19	106.57	113.60	115.41
	66.43	51.49	44.90	59.17	63.17	57.20
Fiber (g)	60.45	75.58	58.67	73.41	63.75	80.67
	25.04	34.81	30.09	34.60	27.82	39.96

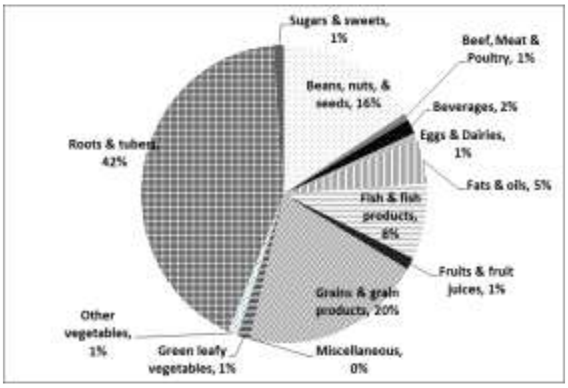
The daily average energy consumption consisted of 70% carbohydrates, 19% fats and 11% proteins. This barely meets the minimum recommended intake by FAO/WHO which is 55-75% carbohydrates, 15-30% fats and 10-15% protein.

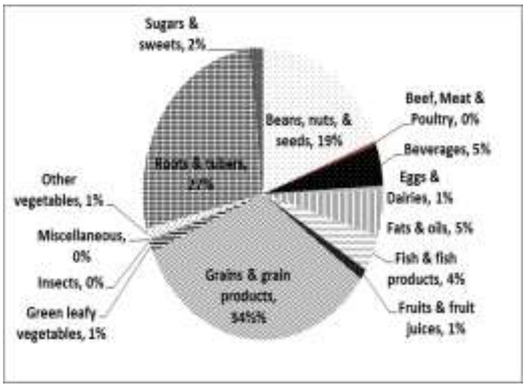
Table 3.2d2 Contributions of macronutrients to energy among child bearing age women

	Luapula	Northern
	Mean%	**Mean%**
% of energy from Carbohydrate	69.81	70.52
% of energy from Fat	19.12	18.45
% of energy from Protein	11.08	11.03

Roots and tubers were the main source of energy in Luapula contributing 42% but was the second largest contributor in Northern (24%). Grain was the main largest contributor to energy intake in Northern providing 34% of intake, but contributed much less in Luapula (20%). Beans, nuts and seeds contributed increasing proportions of energy with provinces, from 16% in Luapula and 19% in Northern (**Figure 3.2b**).

Figure 3.2b Contributions to energy intake by food groups for all women of reproductive age

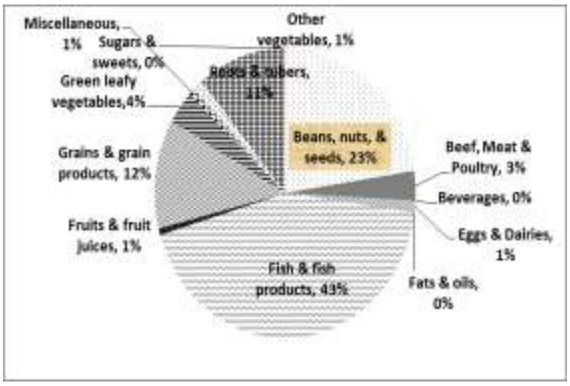


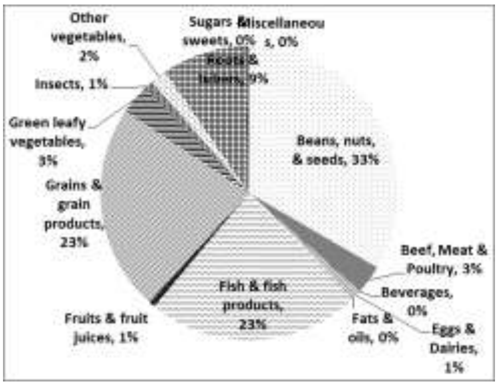


Luapula **Northern**

Protein provided 11% food energy in both provinces. Fish products were the largest contributors to protein intake, followed by beans, nuts and seeds, and grain and grain products in Luapula: 43, 23 and 12%. However, beans, nuts and seeds were the major contributor to protein intake in Northern, followed by Fish products and grain and grain products providing 33, 23 and 23% of intake, respectively.

Figure 3.2c Contributions to protein intake by food groups for all women of reproductive age

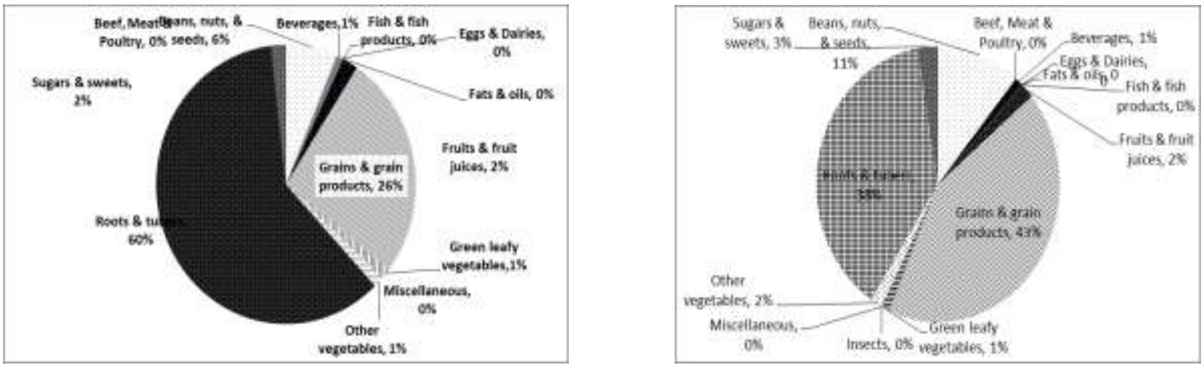




Luapula **Northern**

Total carbohydrate intakes provided 70% food energy in both provinces. The major contributor to carbohydrate intake in Luapula was roots and tubers (60%), followed by grains and grains products (26%). However, in Northern, grains and grains products were the main contributor to carbohydrate intake (43%), followed by roots and tubers (38%) (Fig 3.2d).

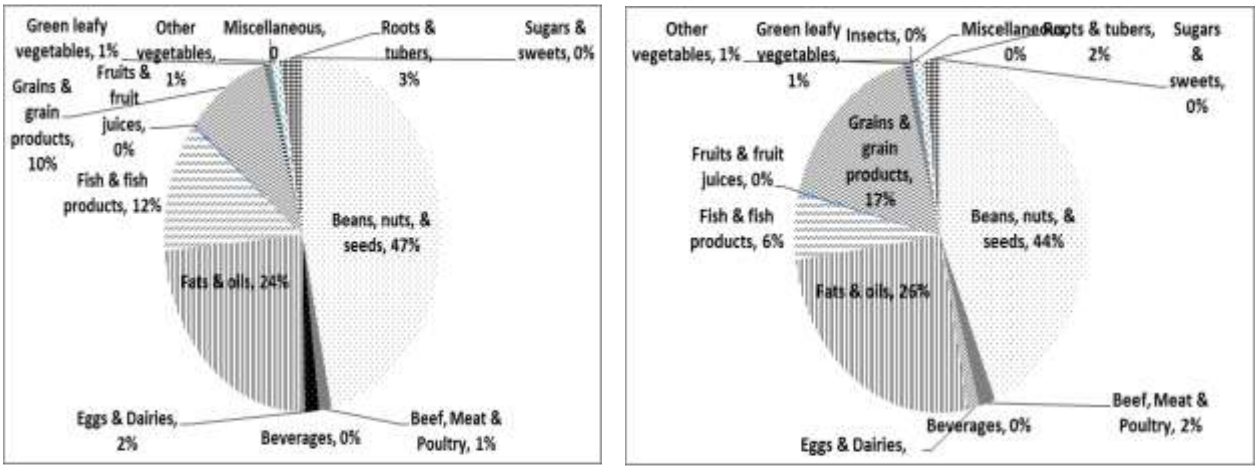
Figure 3.2d Contributions to carbohydrate intake by food groups for all women of reproductive age



Luapula **Northern**

Total fat provided 19% of food energy across all age groups. The major contributor to fat intake was beans, nuts, and seeds with the contribution ranging from 47% in Luapula, and 44% in Northern. Fat and oils groups were the second largest contributor to fat intake, providing 24-26% of intake (Fig 3.2e).

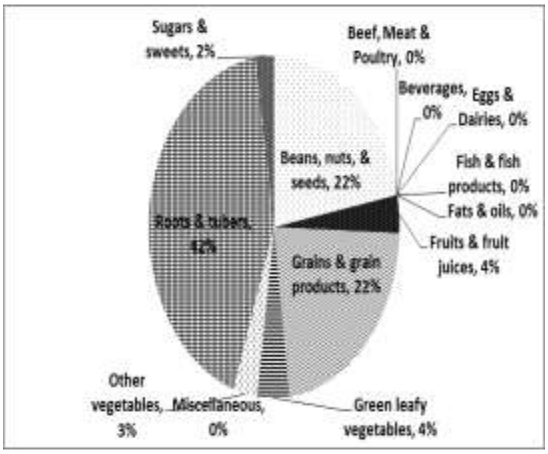
Figure 3.2e Contributions to fat intake by food groups for all women of reproductive age



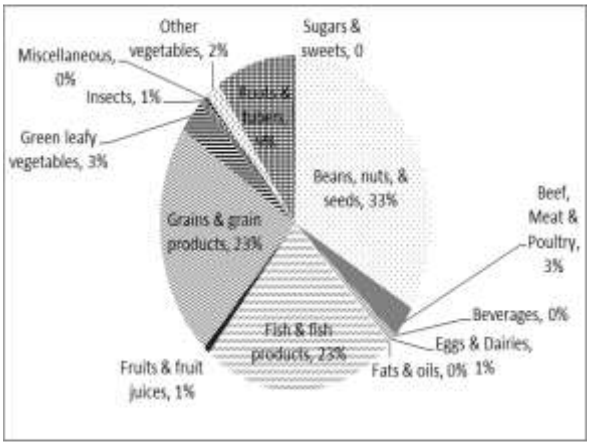
Luapula **Northern/Muchinga**

Roots and tubers were the largest contributors to fiber intake, followed by beans, nuts and seeds, and fruits in Luapula: 42, 22 and 22% respectively. Grains and grain products were the major contributor to fiber intake in Northern/Muchinga, followed by grain and grain products and vegetables providing 31, 29 and 27% of intake, respectively (fig 3.2f).

Figure 3.2f Contributions to fiber intake by food groups for women of reproductive age



Luapula



Northern/Muchinga

3.2.5 Micronutrient intakes

The percentage of women of child bearing age with inadequate intake of micronutrients is presented (Table 3.2e1).More than 99% of the women had inadequate Vitamin A in all provinces. In Luapula province 54.9% of women had inadequate iron intake.

Table 3.2e1: Percentages of women of child bearing age with inadequate usual intake of micronutrients

Food groups	Luapula	Northern
	%	%
Vitamins		
Vitamin A (µg RE)	**99.10**	**99.74**
Vitamin B1-Thiamin (mg)	3.15	4.50
Vitamin B2-Riboflavin (mg)	6.76	10.32
Vitamin B6 (mg)	0	0.79
Folate (µg DFE)	**19.82**	**17.72**
Vitamin B12 (µg)	**32.43**	**60.05**
Vitamin C (mg)	10.36	18.25
Vitamin B3 Niacin (mg NE)	4.50	8.47
Minerals		
Calcium (mg)	**39.19**	**52.91**
Iron (mg)	**54.95**	**35.19**
Zinc (mg)	**16.67**	**10.58**

The percentages of women of child bearing age with inadequate intake of micronutrients are presented. All non pregnant and non lactating women in Northern/Muchinga province and more than 98% in Luapula had inadequate Vitamin A intake. In Luapula province 67.8 % of women had inadequate iron intake (Table 3.2e2). All pregnant women in Luapula and Northern/Muchinga Provinces had inadequate Vitamin A intake while more than 86% had inadequate iron intake (Table 3.2e3).

All lactating women in Luapula Province and almost all (99.5%) in Northern/Muchinga Provinces had inadequate Vitamin A intake while more than 50% in Luapula had inadequate iron intake (Table 3.2e4).

Table 3.2e2: Percentages of non-pregnant and non-lactating women with inadequate intake of micronutrients

Food groups	EAR	Luapula		Northern	
		Mean(sd)	%	Mean(sd)	%
Vitamins					
Vitamin A (µg RE)	357	1142.67	**98.81**	1154.99	**100**
		1112.32		1222.14	
Vitamin B1-Thiamin (mg)	0.9	4.92	5.95	4.67	3.85
		4.35		3.89	
Vitamin B2-Riboflavin (mg)	0.9	1.79	**14.29**	1.71	**10.0**
		0.89		0.96	
Vitamin B6 (mg)	1.1	33.34	**0**	34.49	**0.77**
		20.43		22.51	
Folate (µg DFE)	320	541.48	21.43	721.98	14.62
		321.73		453.15	
Vitamin B12 (µg)	2.0	11.21	**38.10**	5.92	**59.23**
		18.22		12.28	
Vitamin C (mg)	37	182.46	11.90	171.45	16.15
		266.97		188.77	
Vitamin B3 Niacin (mg NE)	11	26.27	8.33	23.76	6.92
		14.37		11.39	
Minerals					
Calcium (mg)	833	1078.63	**42.86**	977.28	**50**
		755.21		579.18	
Iron (mg)	26.5	23.56	**67.86**	29.31	**49.23**
		10.82		13.93	
Zinc (mg)	8.2	14.50	**20.24**	16.56	**10.77**
		6.58		7.11	

Table 3.2e3: Percentages of pregnant women with inadequate usual intake of micronutrients

Food groups	EAR	Luapula		Northern	
		Mean(sd)	%	Mean(sd)	%
Vitamins					
Vitamin A (µg RE)	571	1075.50	**100**	1102.62	**100**
		1230.26		735.02	
Vitamin B1-Thiamin (mg)	1.2	6.13	11.11	4.73	13.51
		8.70		5.00	
Vitamin B2-Riboflavin (mg)	1.2	1.52	**27.78**	1.75	**13.51**
		0.46		0.60	
Vitamin B6 (mg)	1.6	16.24	**5.56**	32.29	**0**
		17.85		22.03	
Folate (µg DFE)	480	548.28	55.56	649.08	45.95
		326.96		432.83	

Vitamin B12 (µg)	2.2	14.77	33.33	6.30	67.57
		16.96		12.21	
Vitamin C (mg)	46	179.57	16.67	185.07	13.51
		190.44		158.57	
Vitamin B3 Niacin (mg NE)	14	24.28	11.11	21.62	8.11
		8.51		6.97	
Minerals					
Calcium (mg)	833	1011.50	**44.44**	1064.81	**43.24**
		435.94		671.32	
Iron (mg)	40	22.92	**88.89**	34.45	**86.49**
		14.22		32.62	
Zinc (mg)	11.7	12.61	**55.56**	16.16	**27.03**
		6.83		7.88	

Table 3.2e4: Percentages of lactating women with inadequate usual intake of micronutrients

Food groups	EAR	Luapula		Northern	
		Mean(sd)	%	Mean(sd)	%
Vitamins					
Vitamin A (µg RE)	607	1068.90	**100**	958.60	**99.52**
		1142.72		1004.29	
Vitamin B1-Thiamin (mg)	1.3	5.55	9.65	4.64	10.48
		4.79		4.55	
Vitamin B2-Riboflavin (mg)	1.3	1.88	**21.93**	1.73	**32.86**
		0.73		0.83	
Vitamin B6 (mg)	1.7	32.36	**0**	30.62	**1.43**
		19.76		20.79	
Folate (µg DFE)	400	558.81	36.84	714.07	29.52
		283.23		483.63	
Vitamin B12 (µg)	2.3	14.05	28.95	7.01	61.43
		20.41		15.91	
Vitamin C (mg)	58	155.97	27.19	159.47	39.05
		163.44		339.94	
Vitamin B3 Niacin (mg NE)	13	29.46	4.39	25.21	15.71
		14.39		13.23	
Minerals					
Calcium (mg)	833	1170.07	**36.84**	989.35	**56.19**
		620.76		816.48	
Iron (mg)	23.4	25.34	**50.88**	30.50	**32.38**
		11.72		14.82	
Zinc (mg)	15.8	14.82	**64.04**	17.96	**44.76**
		6.51		8.65	

The distribution of the usual micronutrient intake among women of child bearing age are presented (Table 3.2e5- 3.2e7)

Table 3.2e5: Percentiles of the usual nutrient intake distributions for non-pregnant and non-lactating women

Food groups	EAR	Province	P5	P10	P25	P50	P75	P90	P95
Vitamins									
Vitamin A (µg RE)	357	Luapula	33.00	92.00	343.50	770.00	1495.00	2763.00	3397.00
		Northern	40.00	90.50	298.00	828.00	1532.00	2601.50	3198.00
Vitamin B1-Thiamin (mg)	0.9	Luapula	0.85	1.21	1.99	3.95	6.11	9.14	13.00
		Northern	0.91	1.30	1.72	3.36	6.20	9.98	12.39
Vitamin B2-Riboflavin (mg)	0.9	Luapula	0.64	0.81	1.21	1.63	2.18	3.16	3.59
		Northern	0.78	0.89	1.15	1.50	1.99	2.71	3.19
Vitamin B6 (mg)	1.1	Luapula	3.91	7.80	20.94	29.42	43.98	62.49	67.39
		Northern	3.49	9.10	17.87	30.21	48.50	65.78	76.30
Folate (µg DFE)	320	Luapula	163.00	220.00	336.50	458.50	658.50	919.00	1132.00
		Northern	194.00	291.00	376.00	603.50	897.00	1489.00	1651.00
Vitamin B12 (µg)	2.0	Luapula	0.00	0.00	0.18	3.10	14.38	39.98	50.84
		Northern	0.00	0.00	0.00	1.30	3.91	19.51	34.84
Vitamin C (mg)	37	Luapula	21.20	31.20	66.65	101.25	218.90	364.10	497.80
		Northern	13.60	28.40	54.00	115.20	210.80	417.30	477.20
Vitamin B3 Niacin (mg NE)	11	Luapula	9.67	11.19	15.13	22.84	37.67	45.11	50.92
		Northern	8.52	11.54	15.69	21.46	29.29	39.64	46.35
Minerals									
Calcium (mg)	833	Luapula	213	316	581.5	994.5	1348.5	2099	2454
		Northern	325	405.5	596	840.5	1195	1725	2245
Iron (mg)	26.5	Luapula	10.3	12.3	16.05	20.8	30.15	37.4	39.4
		Northern	11.7	12.95	19.2	26.5	37.3	47.75	59
Zinc (mg)	8.2	Luapula	6	7.4	9	14.15	18.5	24.4	26.3
		Northern	6.6	8.1	11	15.7	20.6	27.35	30.3

Table 3.2e6: Percentiles of the usual nutrient intake distributions for pregnant women

Food groups	EAR	Province	P5	P10	P25	P50	P75	P90	P95
Vitamins									
Vitamin A (µg RE)	571	Luapula	6.00	67.00	138.00	833.00	1660.00	2523.00	5009.00
		Northern	51.00	149.00	623.00	911.00	1577.00	2012.00	2769.00
Vitamin B1-Thiamin (mg)	1.2	Luapula	0.98	0.98	1.46	2.54	5.83	20.81	31.98
		Northern	0.93	1.10	1.74	3.57	5.70	9.96	15.51
Vitamin B2-Riboflavin (mg)	1.2	Luapula	0.69	0.97	1.11	1.52	1.93	2.00	2.23
		Northern	1.00	1.19	1.34	1.62	2.12	2.84	3.04
Vitamin B6 (mg)	1.6	Luapula	1.15	3.17	3.63	9.64	20.52	49.80	67.89
		Northern	2.96	8.51	15.60	30.34	41.57	58.52	84.33
Folate (µg DFE)	480	Luapula	226.00	306.00	361.00	451.50	562.00	1326.00	1414.00
		Northern	218.00	230.00	356.00	528.00	836.00	1204.00	1671.00
Vitamin B12 (µg)	2.2	Luapula	0.00	0.00	0.35	6.96	27.98	48.01	49.69
		Northern	0.00	0.00	0.12	1.07	3.01	25.45	42.97
Vitamin C (mg)	46	Luapula	25.70	26.50	59.40	86.65	214.60	535.30	641.30
		Northern	32.80	44.80	69.20	185.60	253.20	319.40	365.60

Vitamin B3 Niacin (mg NE)	14	Luapula	12.81	13.96	16.95	23.13	33.39	35.51	38.35
		Northern	11.78	14.52	17.44	20.67	24.95	28.87	40.24
Minerals									
Calcium (mg)	833	Luapula	346	478	648	889	1466	1606	1659
		Northern	294	414	626	969	1333	1790	2567
Iron (mg)	40.0	Luapula	6.8	10.4	13.5	19	26.4	49.4	63.4
		Northern	11.7	14.7	20.1	26.7	34.6	68.6	97.1
Zinc (mg)	11.7	Luapula	5.3	6.4	8.1	10.05	14.1	27.6	30.5
		Northern	7.4	7.5	11.6	13.8	19.2	26.1	33.7

Table 3.2e7: Percentiles of the usual nutrient intake distributions for lactating women

Food groups	EAR	Province	P5	P10	P25	P50	P75	P90	P95
Vitamins									
Vitamin A (µg RE)	607	Luapula	22.00	82.00	285.00	739.00	1436.00	2398.00	2931.00
		Northern	21.00	51.50	177.00	720.00	1253.00	2335.00	2751.00
Vitamin B1-Thiamin (mg)	1.3	Luapula	1.14	1.31	1.91	4.01	7.72	12.61	16.45
		Northern	0.88	1.26	1.92	2.99	6.07	9.13	13.61
Vitamin B2-Riboflavin (mg)	1.3	Luapula	0.98	1.04	1.38	1.79	2.25	2.71	3.14
		Northern	0.75	0.85	1.18	1.55	2.07	2.97	3.48
Vitamin B6 (mg)	1.7	Luapula	3.90	7.79	17.54	30.12	43.98	61.69	67.48
		Northern	3.35	7.79	13.97	27.07	42.21	61.97	65.78
Folate (µg DFE)	400	Luapula	216.00	277.00	349.00	489.00	691.00	967.00	1084.00
		Northern	184.00	233.50	365.00	581.00	930.00	1305.00	1526.00
Vitamin B12 (µg)	2.3	Luapula	0.00	0.00	1.86	4.60	17.01	40.25	67.98
		Northern	0.00	0.00	0.00	1.27	5.90	19.71	41.12
Vitamin C (mg)	58	Luapula	27.40	41.50	57.60	97.35	223.00	390.10	422.50
		Northern	17.40	25.65	41.30	79.95	186.70	293.70	363.60
Vitamin B3 Niacin (mg NE)	13	Luapula	13.45	15.84	18.87	25.21	36.35	49.51	62.70
		Northern	8.85	10.86	15.86	22.77	30.53	43.64	53.70
Minerals									
Calcium (mg)	833	Luapula	380	476	683	1070.5	1573	2113	2294
		Northern	282	348	527	772	1238	1836.5	2199
Iron (mg)	23.4	Luapula	11.9	14.7	17.4	23.3	28.7	42.7	46.7
		Northern	10.6	14.35	20.1	28.3	38.8	48.05	62.7
Zinc (mg)	15.8	Luapula	6.4	7.8	10	13.75	17.8	22.3	27.8
		Northern	5.8	8.2	12.2	17.45	22.1	28.2	38.5

The contribution of food groups to the intake of Vitamins among women of child bearing age are presented (Table 3.2e8- 3.2e10).

Table 3.2e8: Contribution of food groups to the intake of vitamins for all women of childbearing age. (%)

Food groups	Vitamin A		Thiamin		Riboflavin		Vitamin B6	
	L	N	L	N	L	N	L	N
Beans, nuts, and seeds	0.13	0.05	8.25	11.84	8.36	12.65	10.94	14.98
Beef, other meats and poultry	0.17	0.22	7.40	3.78	2.50	1.88	0.83	0.66
Beverages	0.00	0.00	0.00	2.11	0.00	2.32	0.00	0.21
Eggs and Dairies	1.50	1.43	4.38	7.26	3.72	2.62	1.42	1.35
Fats and oils	10.16	0.74	0.00	0.00	0.00	0.00	0.00	0.00
Fish and fish products	2.11	1.04	2.67	1.70	16.17	8.56	10.62	5.98
Fruits and fresh/pure fruit juices	1.85	0.71	44.66	37.18	2.03	2.10	5.43	3.90
Grains and grain products	0.04	0.05	4.78	10.22	10.26	20.51	6.53	8.00
Green leafy vegetables	28.77	31.93	2.46	2.68	16.48	14.43	11.71	11.92
Insects		0.00		0.05		0.26		0.63
Miscellaneous	0.05	0.03	17.03	14.22	1.51	1.11	6.01	4.92
Other vegetables	21.70	21.88	0.97	1.65	5.74	6.77	21.70	33.51
Roots and tubers	30.16	36.60	7.21	7.01	32.90	26.25	24.81	13.93
Sugars and sweets	3.37	5.32	0.18	0.29	0.32	0.55	0.00	0.00

Table 3.2e9: Contribution of food groups to the intake of vitamins for all women of childbearing age (%)

Food groups	Folic Acid		Vitamin B12		Vitamin C		Niacin	
	L	N	L	N	L	N	L	N
Beans, nuts, and seeds	36.99	54.95	0.10	0.12	0.20	0.93	32.81	35.43
Beef, other meats and poultry	0.14	0.11	2.13	2.49	0.00	0.00	2.25	2.17
Beverages	0.00	0.06	0.00	0.02	11.89	20.83	0.00	0.16
Eggs and Dairies	0.63	0.51	1.33	1.70	0.15	0.05	0.08	0.05
Fats and oils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fish and fish products	7.15	3.26	94.89	93.32	0.40	0.18	26.50	16.63
Fruits and fresh/pure fruit juices	4.77	2.71	0.00	0.00	30.52	20.45	1.33	1.44
Grains and grain products	6.38	9.84	0.04	0.20	0.00	0.00	8.57	18.47
Green leafy vegetables	8.73	6.01	0.00	0.00	31.13	33.50	4.04	3.53
Insects		0.01		0.41		0.00		0.01
Miscellaneous	0.13	0.09	1.51	1.73	0.01	0.01	1.27	1.06
Other vegetables	5.39	6.00	0.00	0.00	8.76	11.28	2.99	4.16
Roots and tubers	29.68	16.46	0.00	0.00	16.14	11.40	20.01	16.62
Sugars and sweets	0.00	0.00	0.00	0.00	0.80	1.37	0.16	0.29

Table 3.2e10: Contribution of food groups to the intake of minerals for all women of childbearing age (%)

Food groups	Calcium		Iron		Zinc	
	L	N	L	N	L	N
Beans, nuts, and seeds	10.23	19.91	19.77	31.29	26.26	31.95
Beef, other meats and poultry	0.19	0.19	1.89	1.14	3.51	2.81
Beverages	3.88	7.43	0.05	0.06	0.04	0.04
Eggs and Dairies	3.12	1.31	0.42	0.41	1.18	0.65
Fats and oils	0.01	0.00	0.05	0.00	0.00	0.00
Fish and fish products	7.60	3.69	8.63	3.52	11.02	4.55
Fruits and fresh/pure fruit juices	1.84	1.21	0.61	0.56	0.75	0.65
Grains and grain products	1.61	3.26	20.58	28.77	24.43	36.27
Green leafy vegetables	10.50	15.54	8.28	5.60	3.63	3.38
Insects		0.05		1.71		0.06
Miscellaneous	0.24	0.19	0.06	0.06	0.17	0.11
Other vegetables	3.86	5.03	3.90	3.59	2.93	3.02
Roots and tubers	56.55	41.51	32.82	19.30	26.03	16.52
Sugars and sweets	0.37	0.69	2.94	3.99	0.04	0.00

3.2.6 Nutritional composition of composite dishes

Among the 7 composite dishes (Table 3.2f1), Nshima contributed the most to; energy (70-76%), carbohydrates (82%), fiber (60-75%), calcium (46-68%), iron (50-62%) and zinc (50-66%). Relish contributed to the highest amounts of; fat (62-70%), vitamin A (95-98%), folic acid (51-72%), vitamin B12 (97%), and vitamin C (85-92%). Both Nshima and relish contained protein, riboflavin, folic acid, p vitamin B6, niacin, calcium, iron and zinc but their contribution to these nutrients was low.

Table 3.2f1: Contribution of food groups to the intake of energy and macronutrients for all childbearing age women (%)

Food groups	Energy		Fat		Protein		Carbohydrates		Fiber	
	L	N	L	N	L	N	L	N	L	N
Nshima	**75.8**	**69.8**	20.1	28.3	**40.0**	**42.2**	**90.9**	**81.7**	**75.0**	**61.4**
Omelette	0.3	0.2	1.5	1.4	0.3	0.3	0.0	0.0	0.0	0.0
Porridge/Grits	1.2	1.6	1.0	1.3	1.1	1.4	1.3	1.7	1.4	1.5
Potato Dish	0.8	0.9	2.0	2.5	1.3	1.2	0.5	0.6	1.3	1.2
Relish	19.7	24.1	**70.7**	**61.7**	**54.3**	**52.1**	5.7	13.1	22.2	35.9
Rice Dish	1.5	2.9	1.7	3.4	1.1	2.0	1.5	2.9	0.0	0.0
Soup	0.7	0.4	3.0	1.5	1.9	0.9	0.1	0.1	0.1	0.0

Table 3.2f2: Contribution of food groups to the intake of vitamins for all childbearing age women (%)

Food groups	VitA		Thiamin		Riboflavin		Vit B6	
	L	N	L	N	L	N	L	N
Nshima	0.04	0.0	23.40	29.6	**46.09**	**46.3**	18.2	13.6
Omelette	0.4	0.4	0.0	0.0	0.5	0.5	1.2	0.7
Porridge/Grits	0.7	1.7	0.7	1.0	0.7	1.1	3.0	1.8
Potato Dish	0.0	2.1	0.8	1.1	0.8	1.0	0.2	0.3
Relish	**97.8**	**95.4**	18.4	25.0	**48.9**	**48.2**	**55.4**	**67.1**
Rice Dish	0.7	0.1	0.4	0.6	0.3	0.8	2.6	3.8
Soup	0.4	0.3	**56.4**	**42.7**	2.7	2.0	19.3	12.8

Table 3.2f3: Contribution of food groups to the intake of vitamins for all childbearing age women (%)

Food groups	Folic Acid		Vitamin B12		Vitamin C		Niacin	
	L	N	L	N	L	N	L	N
Nshima	**46.2**	25.9	0.0	0.0	13.7	7.4	**47.7**	**52.9**
Omelette	0.2	0.1	0.1	0.3	0.1	0.0	0.0	0.0
Porridge/Grits	0.6	0.6	0.0	0.0	0.1	0.0	1.1	1.9
Potato Dish	1.5	1.2	0.0	0.0	0.2	0.3	2.1	2.8
Relish	**50.7**	**71.7**	**97.5**	**96.9**	**85.3**	**91.7**	**44.4**	**37.1**
Rice Dish	0.2	0.3	0.0	0.0	0.2	0.2	1.0	2.5
Soup	0.6	0.2	2.3	2.8	0.5	0.3	3.6	2.8

Table 3.2f4: Contribution of food groups to the intake of minerals for all childbearing age women (%)

Food groups	Calcium		Iron		Zinc	
	L	N	L	N	L	N
Nshima	**67.8**	**46.3**	**62.0**	**49.9**	**65.6**	**49.9**
Omelette	0.1	0.1	0.2	0.1	0.2	0.1
Porridge/Grits	0.4	0.2	1.1	1.2	1.5	1.2
Potato Dish	0.7	1.0	0.9	0.9	1.0	0.9
Relish	**30.7**	**51.9**	**35.1**	**47.0**	**30.0**	**47.0**
Rice Dish	0.1	0.3	0.4	0.8	1.2	0.8
Soup	0.3	0.2	0.2	0.1	0.5	0.1

3.2.7 Dietary pattern

Foods and drinks were consumed more at home than in other places. When asked about alcoholic beverage consumption, a higher proportion of women (11%) in Northern consumed alcohol than those in Luapula (<1%).

Table 3.2g1: Food consumption practices for all childbearing age women

	Luapula	Northern	Total
	n=222	n=378	N=600
Average contribution of places of consumption to total food group consumption			
Meals at home	163(73.4)	309(81.8)	472(78.7)
Meals outside home	59(26.6)	69(18.2)	128(21.3)
% women that drank alcohol day before interview		41(10.85)	43(7.17)
Non pregnant & non lactating (n=214)	2(0.90)	17(13.08)	19(8.88)
Pregnant (n=55)	2(2.38)	2(5.41)	2(3.64)
Lactating (n=324)	0	22(10.48)	22(6.79)
Non pregnant & non lactating (n=4)	0	0	0

Foods and drinks were consumed over the whole day. Most of the basic foods were consumed during the main meals. Time of consumption has been categorized into morning, afternoon, evening and night meals. Lunch (afternoon meal) was the most important food consumption occasion for ‘Grains and grain products’, ‘Vegetables’, ‘Meat and meat products’, ‘Fish and fish products’, ‘ ‘Fat’, ‘Miscellaneous’ and ‘Insects’ (Table 4.6b. Breakfast provided most ‘Sugars’ (60%), ‘Fruits and fruit juices’ (54%), “Roots and Tubers”(48%), ‘Beverages’ and ‘Beans, nuts, and seeds’. Consumption of ‘Dairy products’ was equally distributed over the various food consumption occasions.

Table 3.2g2: Contribution of food consumption occasions to food group consumption of childbearing age women

	Morning	Afternoon	Evening	Night
	Mean%	Mean%	Mean%	Mean%
Beans, nuts, and seeds	**41.3**	36.0	13.7	9.0
Beef, other meats and poultry	3.8	**41.3**	**36.2**	18.8
Beverages	**41.9**	**37.2**	18.9	2.0
Eggs and Dairies	**29.3**	21.8	**35.9**	13.0
Fats and oils	10.3	**49.1**	**22.9**	17.8
Fish and fish products	8.8	**49.2**	**23.8**	18.2
Fruits and fresh/pure fruit juices	**53.9**	**37.8**	4.3	4.0

Grains and grain products	18.2	**46.7**	**20.9**	14.2
Green leafy vegetables	7.1	**52.5**	**22.5**	17.9
Insects	1.7	**37.7**	**26.0**	**34.6**
Miscellaneous	6.5	**51.5**	**26.2**	15.9
Other vegetables	**27.1**	**48.4**	14.4	10.1
Roots and tubers	**47.8**	**29.8**	13.8	8.5
Sugars and sweets	**59.9**	**27.9**	5.5	6.6

While 24% of pregnant women had taken Iron/Folic acid during the 24-hour recording period, only 9% of participating pregnant women had consumed supplements of vitamin A.

Table 3.2g3: Percentage of women of childbearing age consuming dietary supplements

Food groups	LUAPULA n=222	NORTHERN n=378	TOTAL N=600
Iron/Folic acid			
Non pregnant & non	3(3.57)	3(2.31)	6(2.80)
lactating(n=214)	4(22.22)	9(24.32)	**13(23.64)**
Pregnant (n=55)	4(3.51)	11(5.24)	15(4.63)
Lactating (n=324)	4(100)	0	4(100)
Pregnant & lactating (n=4)			
Vitamin A			
Non pregnant & non	7(8.33)	2(1.54)	9(4.21)
lactating(n=214)	1(5.56)	4(10.81)	**5(9.09)**
Pregnant (n=55)	12(10.53)	17(8.10)	29(8.95)
Lactating (n=324)	4(100)	0	0
Pregnant & lactating (n=4) (n=4)			

3.2.8 Women nutritional status

In women, those at risk of vitamin A deficiency were 3.2%. The iron profile from this survey showed that only 6.3% of the women surveyed had depleted iron store. About 55% of women were deficient in zinc with no difference observed between the two provinces. Those at risk of vitamin B12 and folate deficiency were 98% and less than 92% respectively.

Table 3.2h1: Micronutrients status of women of childbearing age15 to 49 years by province

Status	LUAPULA	NORTHERN	TOTAL
Vitamin A status (corrected for infection)			
Mean (sd)	n=188 **43.43(24.02)**	n=286 **42.67(14.67)**	n=474 **42.98(18.95)**

n(%) women with serum retinol <20µg/dl	7 (3.7)	8 (2.8)	15 (3.2)
Iron status (based on serum ferritin corrected for infection)			
Mean (sd) N (%) with serum ferritin <15µg/l	n=192 71.5(53.4) 8(4.2)	n=283 71.2(67.3) 22(7.8)	n=475 71.3(62.0) **30(6.3)**
Zinc status			
Mean (sd)	n=166 11.27(4.06)	n=286 10.27(3.41)	n=452 10.64(3.70)
n(%)women with serum zinc <10.7 µmol/l	92(55.4)	156(54.6)	**248(54.9)**
Vitamin B12 status			
Mean (sd) n(%) with serum B12 <150pmol/l	n=221 22.43(50.17) 220(99.55)	n=360 36.53(108.17) 351(95.50)	n=581 31.17(90.80) **571(98.28)**
Folate/Folic Acid status			
Mean (sd) n(%) with serum folate <4ng/ml	n=193 2.2(3.3) 180 (93.3)	n=278 2.1(3.3) 255 (91.7)	n=4712.2(3.3) **435 (92.4)**

Mean hemoglobin of women was 12.6g/dl, with 30.6% of women (Hb<12g/dl) classified as anemic. Iron deficiency, defined as serum ferritin either, <15µmg/l or ≥19µg/l with CRP>5mg/l and/or AGP >1g/L, was found in 20% of subjects; while 18.6% of the women suffered from iron-deficiency anemia (Hb <12g/dl and iron deficiency).

Table 3.2h2: Prevalence of anemia, iron deficiency and iron deficiency anemia among women of childbearing age 15 to 49 years by province

	Luapula	Northern	Total
Anemia			
Hb, mean(sd)	**n=205** 12.43 (1.67)	**n=311** 12.75(1.61)	n=516 **12.62(1.64)**
n(%)women Hb<12g/dl	76(37.1)	82(26.4)	**158(30.6)**
Iron deficiency			
Serum ferritin <15µg/l	n=219 7(3.20)	n=346 21(6.07)	n=490 28(4.96)
Serum ferritin ≥19µg/l and	n=219 19(8.68)	n=327 34(10.40)	n=546 53(9.71)

CRP>5mg/l			
Serum ferritin ≥19µg/l and AGP >1g/L	n=219 20(9.13)	n=339 11(3.24)	n=558 31(5.56)
n (%) with iron deficiency	n=219 44(20.09)	n=326 63(19.33)	n=545 **107(19.63)**
Iron deficiency anemia			
n(%)women Hb <12g/dl and iron deficiency	n=149 33(22.2)	n=248 41(16.5)	n=397 **74(18.6)**

3.2.9 Women Health

Around 15% of selected women had at least one infection in weeks preceding the survey: 10% and 5% of them were found suffering acute disease and chronic infections in weeks preceding the survey, respectively. However, only 3% of women had malaria. Using inflammatory/infection markers, AGP and CRP, it was found that about 27% of the women were in some stage of infection (Table 3.2i1) with no difference observed between the two provinces.

Table 3.2i1: Prevalence of morbidity among women of childbearing age 15 to 49 years by province

Status	LUAPULA	NORTHERN	Total
Infections mean(SD)			
	n=201	n=298	n=499
Healthy: AGP<1g/l and CRP<5mg/l	145 (72.1)	220 (73.8)	365 (73.2)
Incubation: AGP<1g/l and CRP>=5mg/l	39 (19.4)	66 (22.2)	105 (21.0)
Early Convalescence: AGP>=1g/l and CRP>=5mg/l	5 (2.5)	4 (1.3)	9 (1.8)
Late Convalescence: AGP>=1g/l and CRP<5mg/l	12 (6.0)	8 (2.7)	20 (4.0)
Malaria			
n(%) women with malaria(n=598)	n=231 9(3.90)	n=367 11(3.00)	n=598 **20(3.34)**

* Study province difference, p-value < 0.05.

3.3 Child Nutrition and Health

3.3.1 Infant and young child feeding practices

A total of 595 children were surveyed and a total population of 63% was between 24 and 59 months old. Children between 6 and 11 months old account for 10%, 8% in Luapula and 11% in Northern. In terms of sex, the male to female ratio seems to be balanced: male 51% and female 49%.

Table 3.3a1: Numbers and percentages of children surveyed, by gender and age group

Province	Luapula n=217	Northern n=378	Total N=595
Sex (n=594)			
Male	108(49.77)	184(48.81)	292(49.16)
Female	109(50.23)	193(51.9)	302(50.84)
Age (months)			
6-11	21(9.68)	40(10.58)	61(10.25)
12-23	60(27.65)	100(26.46)	160(28.89)
24-59	136(62.67)	238(62.96)	374(62.86)

Breastfeeding practices among this population were optimal in many aspects. Of children aged 6–11 months, 92% were still breastfeeding: 97% in Northern and 81% in Luapula. Similar results were observed among children between 12 and 23 months old: 71% and 65% respectively. However, breastfeeding practices were very low among children between 24 and 59 months old in both provinces (<2%). As for dietary supplements consumption, only 3% of children surveyed reported consumed iron/Folic acid while 16% consumed vitamin A supplements.

Table 3.3a2: Infant and young child feeding practices

Province	Luapula n=217	Northern n=378	Total N=595
%Children that still breastfed			
6-11 months (n=61)	17(80.95)	39(97.50)	56(91.80)
12-23 months (n=160)	39(65.00)	71(71.00)	110(68.75)
24-59 months (n=374)	0	5(2.10)	5(1.34)
%children consuming Iron/Folic acid			
6-11 months (n=61)	3(14.29)	0	3(4.92)
12-23 months (n=160)	4(6.67)	4(4.00)	8(5.00)
24-59 months (n=374)	2(1.47)	4(1.68)	6(1.60)
%children consuming Vitamin A			
6-11 months (n=61)	4(19.05)	8(20.00)	12(19.67)
12-23 months (n=160)	13(21.07)	19(19.00)	32(20.00)
24-59 months (n=374)	16(11.76)	36(15.13)	52(13.90)

3.3.2 Food group intakes

Consumption patterns of children are similar to those of the women. Their diet is predominantly vegetarian; only 6-8% of the energy is supplied by foods of animal origin. Most of the energy came from roots or tubers (158 to 290 g/day) and grains and grain products (87 155 g/day). The combined intake of beans, nuts, and seeds, was relatively large (68-125 g/day). Beverages consumption was also large (138-254g/day). Consumption of sugar, oil/fat, and vegetables was modest, at approximately 10 to 70 g/day. Fruit intake (70-150 g/day) was also fair. Intake of meat, fish, poultry and eggs (MFPE) was low (30-80 g/day), with this most pronounced in Northern. The mean daily intake of milk in both provinces was less than a cup.

Figure 3.3a: Mean intake (in grams) by food group for children

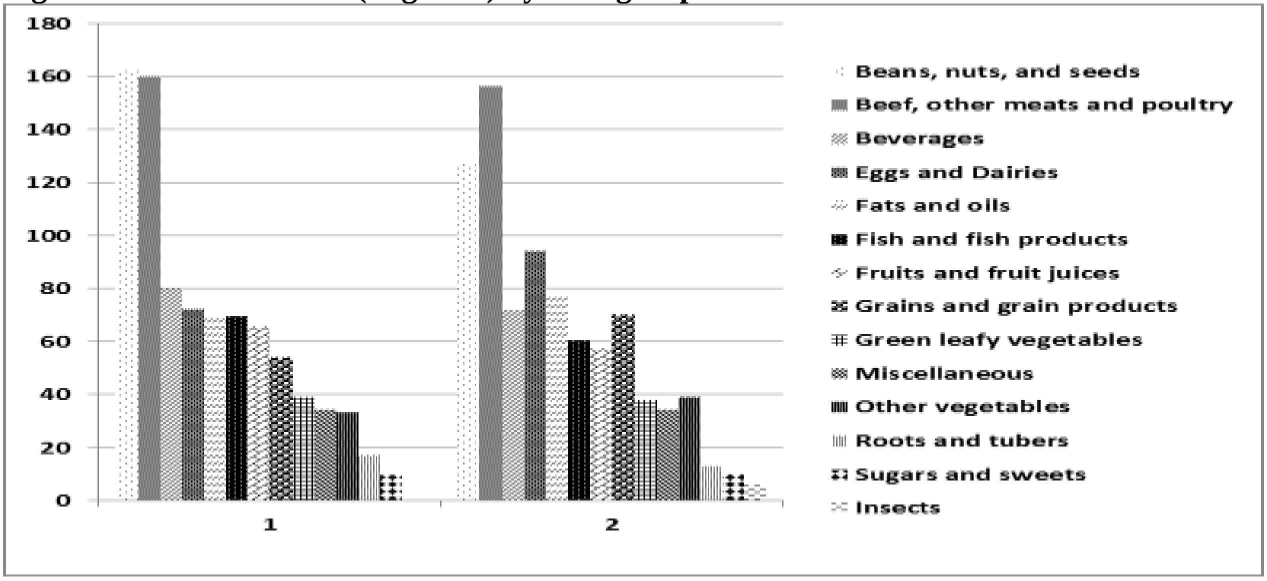


Table 3.3b: Food group intake distributions for children

Food groups	Province	5th	10th	25th	50th	75th	90th	95th
Beans, nuts, and seeds (g/day)	Luapula	6	10	19	45	71	122	157
	Northern	6	12	23	53	94	151	179
Beef, other meats and poultry (g/day)	Luapula	3	4	9	32	50	66	71
	Northern	7	9	19	29	48	68	83
Beverages (g/day)	Luapula	20	58	108	147	206	262	343
	Northern	9	14	35	87	158	315	500
Eggs and Dairies (g/day)	Luapula	4.5	9	14	17	50.5	75.5	106.5
	Northern	8	14	24	33	50	66	86
Fats and oils (g/day)	Luapula	1	1	4	7	14	23	31
	Northern	1	2	4	8	14	21	27
Fish and fish products (g/day)	Luapula	4	6	18	41	79	171	233
	Northern	5	7	15	30.5	60	156	259
Fruits and fresh/pure fruit juices (g/day)	Luapula	6	9	20	44	94	171	210
	Northern	9	13	23	37	132	184	217

Grains and grain products (g/day)	Luapula	11	16	35	59	105	139	176
	Northern	18	22.5	41	79	127	187.5	237
Green leafy vegetables (g/day)	Luapula	4	8	16	29	53	79	91
	Northern	6	9	17	32	52.5	72	102
Miscellaneous (g/day)	Luapula	0	1	2	6	23	43	57
	Northern	0	0	1	3	17	40	56
Other vegetables (g/day)	Luapula	2	6	17.5	40	87.5	142	256
	Northern	4	6	15	33	68	144	200
Roots and tubers (g/day)	Luapula	16	28	59	127.5	226	319	388
	Northern	11	22	61	125.5	222.5	328	404
Sugars and sweets (g/day)	Luapula	2	3	14	58	72	144	216
	Northern	5	6	13.5	32	86.5	204	288
Insects (g/day)	Luapula	0	0	0	0	0	0	0
	Northern	3	3	3	6	9	9	9

3.3.3 Energy and macronutrient intakes

Nutrient requirements vary considerably by age in younger children. The FAO/WHO/UNU (1985) estimated daily energy requirements, averaged for gender, for ages 24-36, 36-47, 48-59 months, are1360, 1500, and 1650 kcal/day, respectively. The mean of these requirements, assuming equal distribution across age groups, is 1492 kcal/day. Given that data presented in Table 5.3a are not weighted for age, and that the sample has greater numbers of older children than younger children, the estimates of 1247 and 1380 kcal/day in Luapula and Northern seem low. Protein intake seems appropriate in both provinces. The daily average energy consumption consists of 70% carbohydrates, 22% fats and 7% proteins. It is important to notice that the average energy consumption of protein is only 1%.

Table 3.3c1: Mean intakes of total energy and macronutrients among children 6-59 months

	Luapula	Northern	Total
	Mean(sd)	**Mean(sd)**	**Mean(sd)**
Energy (kcal)	1247.24(734.77)	1379.78(867.75)	1331.28(823.46)
Carbohydrate (g)	205.05(123.05)	236.33(150.56)	224.89(141.81)
Fat (g)	31.30(30.68)	32.27(28.34)	31.91(29..20)
Protein (g)	40.01(30.62)	41.99(32.61)	41.26(31.88)
Fiber (g)	19.89(13.64)	26.85(19.58)	24.29(17.95)

Table 3.3c2: Contributions of macronutrients to energy among child bearing age women

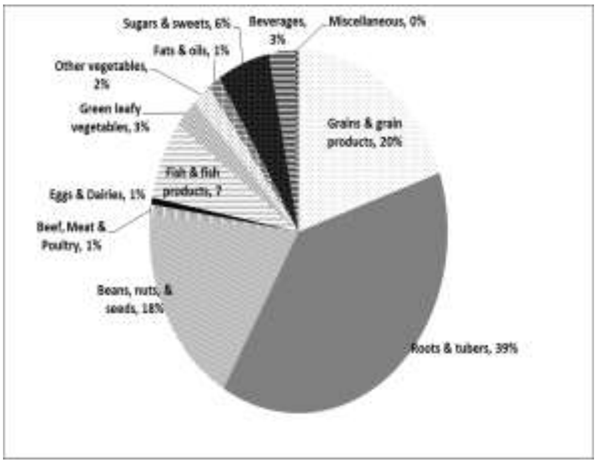
	Luapula	Northern
	Mean%	**Mean%**
% of energy from Carbohydrate	65	76
% of energy from Fat	22	23
% of energy from Protein	13	1

Table 3.3c3: Percentiles of the usual nutrient intake distributions for children 6-59 months

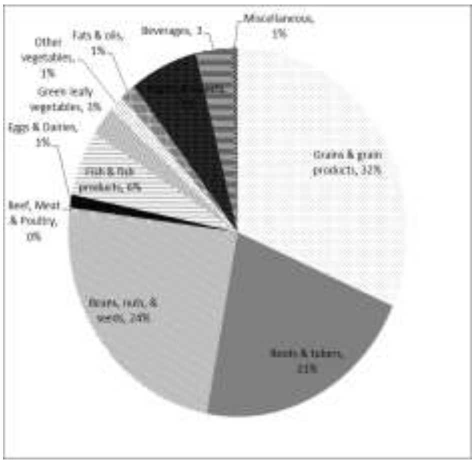
Food groups	Province	5th	10th	25th	50th	75th	90th	95th
Energy (kcal)	Luapula	205	321	663	1208	1669	2210	2607
	Northern	248	366	685.5	1229	1932.5	2508	2892
Carbohydrate (g)	Luapula	39.4	53.2	106.2	188.8	267.2	398	469.7
	Northern	44.2	65.2	119.6	216.9	316.8	467.9	524.3
Fat (g)	Luapula	0.7	2.4	8.4	23.3	45.6	67.3	101.1
	Northern	1.4	3.7	10..35	26.6	46.85	68.0	80.7
Protein (g)	Luapula	0.5	1.3	4.6	7.1	10.2	11.4	11.9
	Northern	1.3	2.5	5	7.05	10.7	11.9	12.7
Fiber (g)	Luapula	2	5	9	18	27	34	47
	Northern	2	5	12	23	38	52	65

Roots and tubers (39%) were the main source of energy in Luapula, followed by Grains and grain products (20%) and beans (18%). Grains and grain products were the first largest contributor to energy intake in Northern providing 32% of intake, followed by beans, nuts and seeds (24% and roots and tubers (21%) (**Figure 4.3a**).

Figure 3.3b Contributions to energy intake by food groups for children 6-59 months



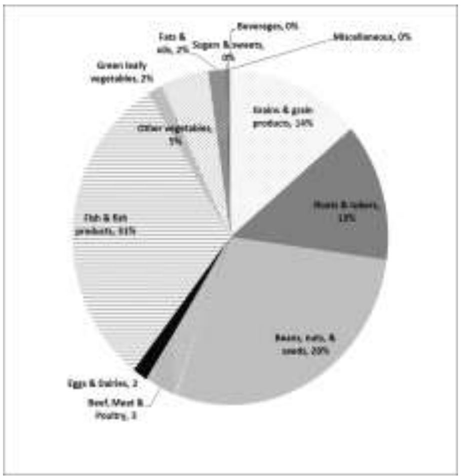
Luapula

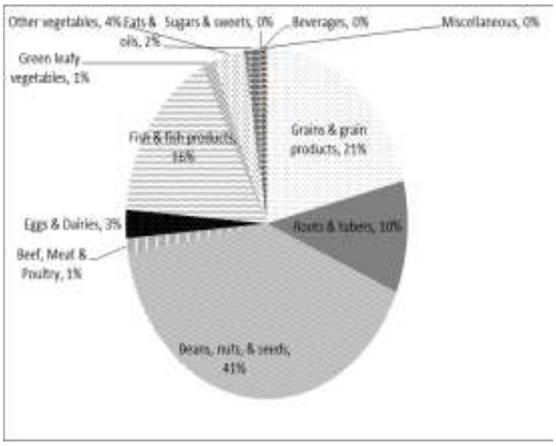


Northern

Protein provided 13% food energy in Luapula and 1% food energy in Northern. Fish products were the largest contributors to protein intake, followed by beans, nuts and seeds in Luapula: 31and 28%. However, Beans, nuts and seeds were the major contributor to protein intake in Northern, followed by grain products and fish providing 41, 21and 16% of intake, respectively.

Figure 3.3c Contributions to protein intake by food groups for children 6-59 months

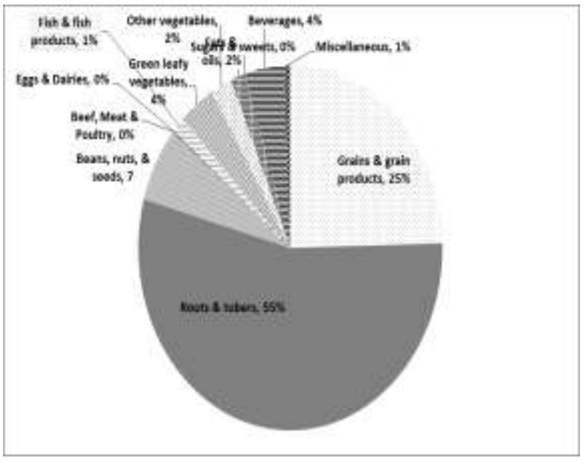


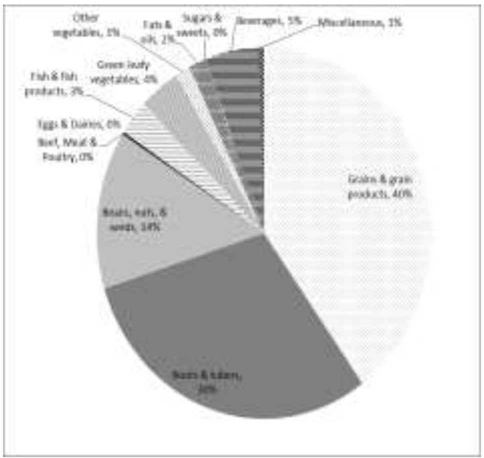


Luapula **Northern**

Total carbohydrate intakes provided 65% food energy in Luapula and 76% in Northern. The major contributor to carbohydrate intake was roots and tubers, in Luapula, followed by grains products (55%, 25%; respectively).. However, the grains group was the first largest contributor to carbohydrate intake followed by roots and beans, nuts and seeds in Northern, 40, 30, 14% respectively.

Figure 3.3d Contributions to carbohydrate intake by food groups for children 6-59 months

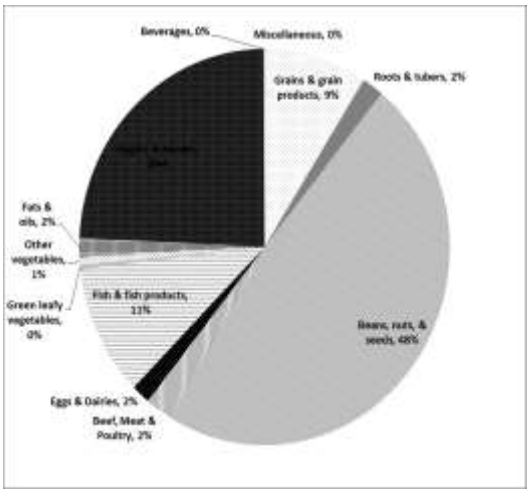


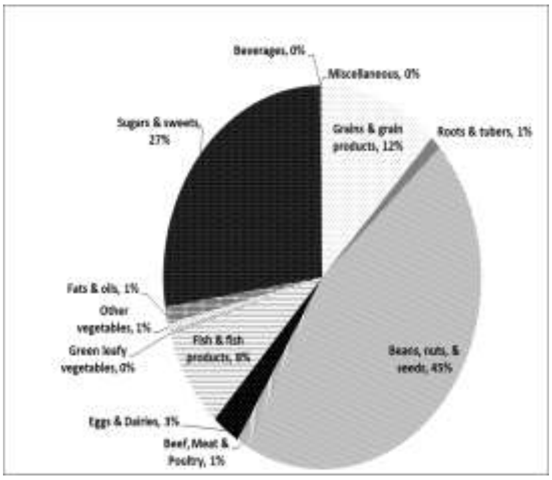


Luapula **Northern**

Total fat provided 22-23% of food energy across all age groups. The major contributor to fat intake was beans, nuts and seeds, with the contribution ranging from 48% in Luapula, and 45% in Northern. Surprisingly, sugars and sweets were the second largest contributor to carbohydrate intake, providing 24-27% of intake.

Figure 3.3e Contributions to fat intake by food groups for children 6-59 months

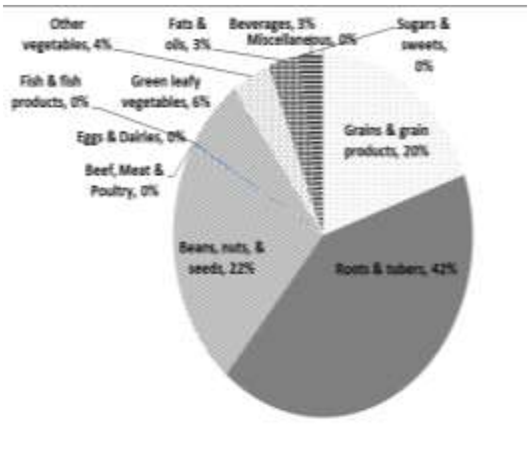


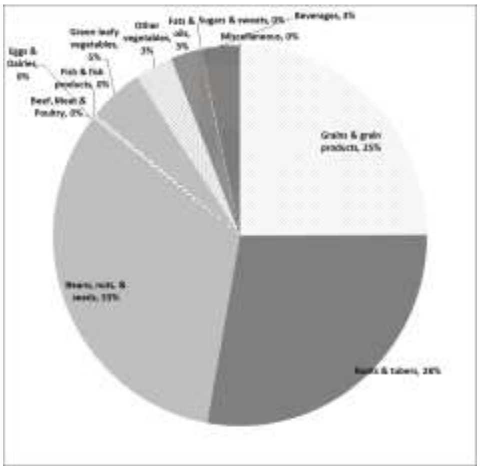


Luapula **Northern**

Roots and tubers were the largest contributors to fiber intake, followed by Beans, nuts and seeds, and grain products in Luapula: 42, 22 and 20%. However, Nuts products were the major contributor to fiber intake in Northern, followed by roots and tubers and grains providing 33, 28 and 25% of intake, respectively.

Figure 3.3f Contributions to fibre intake by food groups for children 6-59 months





Luapula **Northern**

3.3.4 Micronutrient intakes

The prevalence of inadequate intake of the various vitamins and minerals also vary widely among children. In children 6-23 months, the dietary patterns were found to be highly inadequate for vitamin A, vitamin B2, folate, vitamin B12, vitamin C, niacin, folate, iron, zinc, and calcium. When compared both provinces, Northern showed the highest prevalence of inadequate intake for vitamin B-12. On the other hand, inadequate intake of the minerals (iron, zinc,) was generally most prevalent in Luapula, while inadequate intake of calcium is higher in Northern. Regardless, the prevalence of inadequate intake of these three minerals is high in both provinces surveyed. Northern reported a higher prevalence of inadequate intake for vitamin A, vitamin B-2, vitamin C and niacin than Luapula. In general, inadequate intake of vitamin B-6 (main sources: beans, nuts, and seeds, meats products and miscellaneous) are far less common.

Table 3.3d1: Percentages of children 6-23 months with inadequate usual intake of micronutrients

Food groups	EAR	Luapula		Northern		Total	
		Mean(sd)	%	Mean(sd)	%	Mean(sd)	%
Vitamins							
Vitamin A (g)	286	332.25(460.45)	**61.73**	263.45(317.63)	**65.71**	288.66(376.75)	**64.25**
Vitamin B1-Thiamin (g)	0.3	2.40(3.66)	25.93	1.76(2.05)	21.43	1.99(2.76)	23.08
Vitamin B2-Riboflavin (g)	0.4	0.44(0.37)	**58.02**	0.38(0.29)	**62.14**	0.41(0.32)	**60.63**
Vitamin B6	0.4	37.64(21.20)	3.70	38.06(19.76)	0.71	37.91(20.26)	1.08
Folate/ Folic Acid	92	117.07(113.45)	**49.38**	176.95(209.83)	**45.71**	155.00(182.58)	**47.06**
Vitamin B12	0.7	3.63(9.73)	**53.09**	1.29(3.01)	**72.86**	2.15(6.43)	**65.61**
Vitamin C	25	45.11(92.23)	**51.85**	50.58(163.79)	**62.14**	48.58(141.60)	**58.37**
Vitamin B3 Niacin	3.8	5.90(5.38)	**46.91**	4.87(5.63)	**52.86**	5.24(5.55)	**50.68**
Minerals							
Calcium (g/day)	375	231.74(233.26)	**82.72**	22.08(349.56)	**85.0**	225.35(311.48)	**84.16**
Iron (g/day)	6.4	5.04(4.52)	**72.84**	6.28(5.46)	**66.43**	5.83(5.16)	**68.78**
Zinc (g/day)	7.0	2.93(2.60)	**90.12**	3.47(2.83)	**87.86**	3.27(2.76)	**88.69**

Table 3.3d2: Percentages of children 24-59 months with inadequate usual intake of micronutrients

Food groups	EAR	Luapula		Northern		Total	
		Mean(sd)	%	Mean(sd)	%	Mean(sd)	%
Vitamins							
Vitamin A (g)	304	529.63(544.91)	**44.85**	542.54(575.21)	37.29	537.82(563.62)	**40.05**
Vitamin B1-Thiamin (g)	0.5	3.08(3.25)	3.68	2.95(2.81)	2.97	3.00(2.97)	3.23
Vitamin B2-Riboflavin (g)	0.5	0.81(0.45)	9.56	0.82(0.57)	14.41	0.81(0.53)	12.63
Vitamin B6	0.5	44.89(20.30)	0.73	45.34(22.99)	0.42	45.18(22.02)	0.54
Folate/ Folic Acid	167	236.66(144.33)	7.35	333.13(238.70)	9.75	297.86(214.09)	8.87
Vitamin B12	0.8	6.67(10.72)	**27.21**	2.89(5.74)	**50**	4.27(8.13)	**41.67**
Vitamin C	25	76.9(106.73)	23.53	77.19(124.06)	31.78	77.09(117.87)	28.76
Vitamin B3 Niacin	5.4	12.77(7.36)	6.62	11.69(7.11)	6.78	12.09(7.21)	6.72
Minerals							
Calcium (g/day)	45	412.04(241)	**52.94**	445.94(402.8	**55.51**	433.55(352.4	**54.5**

	9			6)		3	**7**
Iron (g/day)	5.1	9.58(4.80)	24.26	13.13(7.67)	15.25	11.83(6.97)	18.55
Zinc (g/day)	7.5	5.77(2.92)	**70.59**	7.49(4.01)	**49.58**	6.86(3.74)	**57.26**

Table 3.3d3: Percentiles of the usual nutrient intake distributions for children 6-23 months

Food groups	Province	5th	10th	25th	50th	75th	90th	95th
Vitamins								
Vitamin A	Luapula	2	6	66	177	414	800	1041
	Northern	0	3.5	38.5	166	375.5	624	885
Vitamin B1-Thiamin (g)	Luapula	0.07	0.14	0.29	1.49	2.93	5.27	6.95
	Northern	0.11	0.19	0.33	0.96	2.55	4.01	5.88
Vitamin B2-Riboflavin (g)	Luapula	0.06	0.1	0.18	0.35	0.59	0.89	1.05
	Northern	0.07	0.1	0.16	0.32	0.54	0.76	0.94
Vitamin B6	Luapula	4.40	10.71	26.48	35.80	48.96	70.56	76.00
	Northern	9.39	12.89	25.34	35.47	49.70	66.65	76.74
Folate/ Folic Acid	Luapula	14	26	47	92	138	208	305
	Northern	12.5	25.5	47	103	206	429	628
Vitamin B12	Luapula	0	0	0.01	0.66	2.61	6.97	16.31
	Northern	0	0	0	0.17	0.89	3.73	6.74
Vitamin C	Luapula	0.4	2.1	7.9	21.7	44.2	91.8	112.2
	Northern	1.05	1.6	4.5	14	43.95	102.65	141.4
Vitamin B3 Niacin	Luapula	0.56	0.93	2.34	4.18	7.46	14.23	15.17
	Northern	0.64	1.15	2.01	3.67	6.08	10.05	12.06
Minerals								
Calcium	Luapula	24	45	89	152	300	489	755
	Northern	11	28.5	67	142	263.5	441	675
Iron	Luapula	0.6	1	2.1	3.9	6.4	10.8	12.1
	Northern	0.8	1.3	2.4	4.4	8	13.7	18.6
Zinc	Luapula	0.3	0.4	1	2.1	4.1	6.8	8.9
	Northern	0.5	0.6	1.35	2.55	4.65	7.45	8.55

Table 3.3d4: Percentiles of the usual nutrient intake distributions for children 24-59 months

Food groups	Province	5th	10th	25th	50th	75th	90th	95th
Vitamins								
Vitamin A	Luapula	10	36	154	347.5	736.5	1308	1678
	Northern	8	29	135	398	758.5	1135	1573
Vitamin B1-Thiamin (g)	Luapula	0.33	0.56	0.94	2.13	4.07	6.28	9.17
	Northern	0.37	0.50	0.89	1.95	4.04	6.57	8.99
Vitamin B2-Riboflavin (g)	Luapula	0.26	0.4	0.51	0.69	0.98	1.33	1.63
	Northern	0.24	0.33	0.50	0.68	0.99	1.35	1.75
Vitamin B6	Luapula	12.40	20.62	30.93	43.21	58.98	73.23	82.29
	Northern	10.07	17.97	28.11	41.90	59.70	77.63	86.30

Folate/ Folic Acid	Luapula	77	101	139	203.5	289.5	387	510
	Northern	68	97	161.5	266	444.5	671	871
Vitamin B12	Luapula	0	0	0.64	1.97	7.83	25.14	30.84
	Northern	0	0	0	0.7	2.75	8.23	15.42
Vitamin C	Luapula	8.80	13.8	25.3	44.3	90.6	165.8	221.7
	Northern	6.1	10.3	19.6	38.85	99.9	182.4	229.3
Vitamin B3 Niacin	Luapula	3.05	5.14	7.12	11.78	16.33	22.23	27.31
	Northern	2.98	4.32	6.78	10.17	14.72	21.03	25.28
Minerals								
Calcium	Luapula	119	169	237	364.5	526.5	768	825
	Northern	91	134	221	342.5	539.5	823	10.68
Iron	Luapula	3.2	4.3	6.4	8.8	11.75	15.9	18.7
	Northern	3.8	5.3	7.15	11.7	16.95	24.2	30.9
Zinc	Luapula	1.9	2.7	3.7	5.4	7.25	9.90	11.6
	Northern	2.1	3	4.4	7	10.3	12.6	14.6

Table 3.3d5: Contribution of food groups to the intake of vitamins for children (%)

Food groups	Vitamin A		Thiamin		Riboflavin		Vitamin B6	
	L	N	L	N	L	N	L	N
Grains and grain products	3.21	0.03	7.59	10.42	10.14	16.55	16.14	**22.45**
Roots and tubers	**35.98**	**38.19**	4.71	4.88	**30.55**	**24.53**	**25.01**	13.91
Beans, nuts, and seeds	0.23	0.05	5.42	9.42	8.13	13.54	11.96	14.50
Beef, other meats and poultry	2.58	0.86	5.51	3.47	2.90	1.61	2.27	0.74
Insects								
Eggs and Dairies	1.39	2.96	5.92	12.61	3.28	6.10	0.83	1.30
Fish and fish products	1.60	0.78	15.37	12.07	17.85	11.68	11.62	7.43
Fruits and fresh/pure fruit juices								
Green leafy vegetables	2.46	0.82	**45.42**	**42.19**	3.66	3.82	5.66	3.89
Other vegetables	**20.55**	**25.36**	1.60	2.06	16.50	14.63	10.37	9.40
Fats and oils	**18.84**	**17.60**	7.35	1.08	6.41	6.08	15.80	**25.53**
Sugars and sweets	5.58	2.18	0.00	0.00	0.00	0.17	0.00	0.18
Beverages	7.57	11.16	0.61	0.69	0.46	0.66	0.00	0.00
Miscellaneous	0.00	0.00	0.50	1.10	0.11	0.63	0.35	0.66

Table 3.3d6: Contribution of food groups to the intake of vitamins for children (%)

Food groups	Folic Acid		Vitamin B12		Vitamin C		Niacin	
	L	N	L	N	L	N	L	N
Grains and grain products	6.12	7.52	1.08	9.58	0.00	0.00	10.17	16.04
Roots and tubers	**25.11**	13.98	0.00	0.00	11.90	8.74	**20.08**	15.57
Beans, nuts, and seeds	**39.30**	**58.12**	0.04	2.06	0.22	0.90	**38.59**	**37.98**
Beef, other meats and poultry	1.13	0.30	2.70	1.33	1.64	0.57	2.21	1.08
Insects								
Eggs and Dairies	0.91	1.17	1.23	4.31	0.02	0.09	0.04	0.10
Fish and fish products	3.81	3.31	**94.87**	**72.61**	14.81	**26.52**	17.55	11.11
Fruits and fresh/pure fruit juices								
Green leafy vegetables	8.20	4.32	0.00	0.00	**38.59**	**26.76**	2.53	2.64

Other vegetables	9.25	5.67	0.00	0.00	**24.21**	**26.04**	4.86	3.70
Fats and oils	6.14	5.20	0.00	0.00	7.88	9.20	3.69	3.77
Sugars and sweets	0.00	0.03	0.00	9.73	0.00	0.00	0.00	7.64
Beverages	0.00	0.00	0.00	0.00	0.74	1.19	0.17	0.32
Miscellaneous	0.04	0.37	0.09	0.39	0.00	0.00	0.11	0.06

Table 3.3d7: Contribution of food groups to the intake of minerals for children (%)

Food groups	Calcium		Iron		Zinc	
	L	N	L	N	L	N
Grains and grain products	1.82	2.67	19.24	0.65	23.14	31.33
Roots and tubers	**50.38**	**35.14**	**31.34**	0.51	25.42	16.54
Beans, nuts, and seeds	11.18	**20.96**	**21.02**	**98.32**	**28.94**	**37.16**
Beef, other meats and poultry	1.79	0.63	2.72	0.02	3.05	1.69
Insects		0.01		0.00		0.00
Eggs and Dairies	1.22	3.03	0.78	0.03	1.09	1.67
Fish and fish products	14.42	14.63	6.94	0.09	9.65	3.88
Fruits and fresh/pure fruit juices						
Green leafy vegetables	3.44	1.82	1.10	0.03	1.29	1.22
Other vegetables	10.41	15.54	8.78	0.16	4.16	3.91
Fats and oils	4.72	4.31	4.45	0.08	3.06	2.44
Sugars and sweets	0.00	0.34	0.01	0.00	0.00	0.07
Beverages	0.46	0.69	3.51	0.11	0.00	0.00
Miscellaneous	0.16	0.22	0.13	0.00	0.20	0.11

3.3.5 Nutritional composition of composite dishes

Among the 7 dishes and as among women, Nshima contributed the most to energy, fiber, in addition to fat (72-85%) among children. Relish contributed to the highest amounts of protein (68-76%), carbohydrate (60%), vitamin A (90-96%), Folic acid (54-78%), vitamin B12 (100%), and vitamin C (88-93%). Both dishes also contained thiamin, riboflavin, vitamin B6, folic acid, niacin, calcium, iron, and zinc, but their contribution was lower.

Table 3.3e1: Contribution of food groups to the intake of energy and macronutrients for children (%)

Food groups	Energy		Fat		Protein		Carbohydrates		Fiber	
	L	N	L	N	L	N	L	N	L	N
Nshima	**66.71**	**59.79**	**84.83**	**72.42**	**15.69**	**21.75**	**31.27**	**33.14**	**69.95**	**51.67**
Porridge/Grits	3.17	4.49	3.88	5.12	1.39	3.07	2.16	3.11	3.35	3.62
Potato Dish	1.58	0.75	1.11	0.47	3.44	2.08	2.24	0.65	2.74	0.64
Relish	**24.03**	**29.59**	6.39	**16.97**	**75.62**	**68.01**	**61.54**	**59.68**	**23.96**	**44.07**
Rice Dish	3.21	4.35	3.37	4.57	2.76	3.56	2.24	2.77	0.00	0.00
Soup	1.30	1.04	0.42	0.44	1.10	1.52	0.55	0.65	0.00	0.00

Table 3.3e2: Contribution of food groups to the intake of vitamins for children (%)

Food groups	Vitamin A		Thiamin		Riboflavin		Vitamin B6	
	L	N	L	N	L	N	L	N
Nshima	0.05	0.02	**34.72**	**30.47**	**35.60**	**38.25**	**52.72**	**42.36**
Porridge/Grits	4.00	7.85	1.98	2.66	1.40	2.41	3.50	4.53
Potato Dish	0.00	1.65	2.74	0.84	1.50	0.55	0.08	0.04
Relish	**95.86**	**90.32**	**35.31**	**39.09**	**59.51**	**56.05**	**37.98**	**46.32**
Rice Dish	0.04	0.06	5.66	2.19	0.81	1.11	2.68	4.59
Soup	0.04	0.09	**19.60**	**24.75**	1.18	1.63	3.05	2.16

Table 3.3e3: Contribution of food groups to the intake of vitamins for children (%)

Food groups	Folic Acid		Vitamin B12		Vitamin C		Niacin	
	L	N	L	N	L	N	L	N
Nshima	**39.92**	**19.36**	0.00	0.00	10.86	6.04	**39.19**	**44.48**
Porridge/Grits	1.10	1.34	0.00	0.00	0.07	0.02	1.65	3.94
Potato Dish	2.89	0.58	0.00	0.00	0.45	0.55	3.83	1.80
Relish	**54.48**	**77.56**	**99.99**	**99.97**	**88.47**	**93.11**	**51.97**	**43.88**
Rice Dish	0.34	0.30	0.00	0.00	0.08	0.11	2.10	3.69
Soup	1.27	0.86	0.01	0.03	0.07	0.16	1.26	2.22

Table 3.3e4: Contribution of food groups to the intake of minerals for children (%)

Food groups	Calcium		Iron		Zinc	
	L	N	L	N	L	N
Nshima	62.43	38.71	**56.78**	**41.03**	**58.31**	**49.30**
Porridge/Grits	0.58	0.55	2.68	2.93	3.27	3.94
Potato Dish	1.42	0.49	1.92	0.48	2.13	0.56
Relish	**35.09**	**59.61**	**37.05**	**54.03**	**33.37**	**43.03**
Rice Dish	0.29	0.43	1.09	1.11	2.70	2.95
Soup	0.19	0.22	0.48	0.42	0.22	0.21

3.3.6 Child nutritional status

In children, it was found that 35.3% were vitamin A deficient (VAD), but after correction using Thurnham method it was observed that VAD dropped to 25.8% with no difference between the provinces. The iron profile from this survey showed that only 4% of the children surveyed had depleted iron stores. About 22-34% of them were deficient in zinc depending on the time blood was collected, higher (24% or 38%) in Luapula and lowest (31% or 20%) in Northern. Most of children were deficient in vitamin B12 (97%) and Folate (83.6%). No significant difference was observed between both provinces.

Table 3.3f1: Micronutrients status of children by province

Status	LUAPULA	NORTHERN	TOTAL
Vitamin A status			
Mean (sd) of uncorrected retinol	n=199 23.48(8.66)	n=291 25.30(9.39)	n=490 24.56 (9.14)
n(%) with uncorrected serum retinol <20µg/dl	76(38.19)	97(33.33)	173(35.31)
Mean (sd) of corrected Retinol	n=150 25.5 (8.90)	n=226 26.2 (9.15)	n=376 25.9 (9.05)
n (%) with serum retinol Corrected <20µg/dl using Thurnhan method	38(25.3)	59(26.1)	97(25.8)
Iron status			
Uncorrected Ferritin Mean (sd)	n=176 164.15(246.21)	n=256 109.60(148.93)	n=432 131.83 (197.64)
n(%) children with serum ferritin <12µg/l	**5(2.84)**	**14(5.47)**	**19(4.40)**
Corrected Ferritin Mean (sd)	n=158 137.7 (227.3)	n=211 85.3 (95.8)	n=369 107.8 (167.2)
n(%) children with serum ferritin <12µg/l	5 (3.2)	9 (4.3)	14 (3.8)
Zinc status			
Mean (sd)	n=151 11.61(4.23)	n=251 11.95(4.07)	n=402 11.82(4.13)
n(%) children with serum zinc <9.9µmol/l	**58(38.41)**	**78(31.08)**	136(33.83)
n(%) with serum zinc <8.7 µmol/l	**36(23.84)**	**52(20.72)**	88(21.89)
Vitamin B12 status			
Mean (sd)	n=194 16.49(25.96)	n=304 49.71(185.29)	**n=498** **36.76(146.48)**
n(%) children with serum vitamin B12 <150pmol/l	193(99.48)	292(96.05)	**485(97.39)**
Folate/ Folic Acid status			
Mean (sd)	n=184 2.72(1.26)	n=246 2.97(1.9)	n=430 2.86(1.65)
# children with serum folate <4ng/ml	140(83.8)	181(83.4)	321(83.6)

* Study province difference, p-value < 0.05.

Mean hemoglobin of children was 10.7g/dl, with around 59% of the children classified as anemic (Hb<11mg/dl). Severe anemia (Hb<7mg/dl) was present among 2.7% of children surveyed. Iron deficiency, defined as serum ferritin either, 15µmg/l or ≥15µg/l and CRP>10mg/l and/or AGP >1g/L, was found in 35% of subjects; while 27% suffered from iron-deficiency anemia (iron deficiency and Hb <11mg/dl). No significant difference was observed between the two provinces.

Table 3.3f2: Prevalence of anemia, iron deficiency and iron deficiency anemia among children aged 6 to 59 months by province

	LUAPULA	NORTHERN	Total
Anemia			
Hb, mean(sd)	n=182 10.51(1.81)	n=283 10.78(5.49)	n=465 10.68(4.45)
n(%) children with Hb<11.0g/dl	110(60.4)	164(58.0)	**274(59.06)**
n(%) children with Hb<7.0mg/dl	5(2.45)	9(2.76)	14(2.67)
Iron deficiency			
n (%) children with serum ferritin <15µg/l	n=176 5(2.84)	n=256 14(5.47)	n=432 **19(4.40)**
n (%) children with serum ferritin ≥15µg/l and CRP>5mg/l	n=175 29(16.57)	n=240 64(26.67)	n=415 93(22.41)
n (%) children with serum ferritin ≥15µg/l and AGP >1g/L	n=175 37(21.14)	n=253 28(11.07)	n=428 65(15.19)
n (%) with iron deficiency	n=175 62(35.43)	n=254 88(34.65)	n=429 **150(34.97)**
Iron deficiency anemia			
Hb <11.0g/dl + iron deficiency	n=175 44(25.14)	n=244 70(28.69)	n=419 **114(27.21)**

* Study province difference, p-value < 0.05.

3.3.7 Child Health

During the preceding 2 weeks before the day of data collection, 19 to 43% of children experienced morbidity symptoms such as diarrhea, respiratory infection or fever. The prevalence of these symptoms was higher in Luapula than Northern (25 vs. 15%; 54 vs. 36%; and 47 vs. 27%, respectively). Around 25% of selected children had at least one infection in weeks preceding the survey: 23% and 16% of the children, respectively, were found suffering acute disease and chronic infections in weeks preceding the survey. The prevalence of infections was greater in female 6-23 months old age than 24-59 months while it was higher among 24-59 months male children than 6-23 months old age. Using inflammatory/infection markers, AGP and CRP, it was found that about 45% of the children were in some stage of infection (Table 3.3g2) with no difference observed between the two provinces. About 11% of children had malaria.

Table 3.3g1: Child health and prevalence of morbidity symptoms among children

PROVINCE	LUAPULA n=217	NORTHERN n=378	TOTAL N=595
During the past 2 weeks, % that experienced:			
Diarrhea	54(24.88)	57(15.08)	**111(18.66)**
Respiratory infection (cold, cough)	117(53.92)	140(37.04)	**257(43.19)**
Fever	103(47.47)	102(26.98)	**205(34.45)**

Table 3.3g2: Morbidity among children by province

Status	LUAPULA	NORTHERN	Total
	n=166	n=250	n=416
Healthy: AGP<1g/l and CRP<5mg/l	91 (54.8)	138 (55.2)	229 (55.0)
Incubation: AGP<1g/l and CRP>=5mg/l	43 (25.9)	80 (32)	123 (29.6)
Early Convalescence: AGP>=1g/l and CRP>=5mg/l	16 (9.6)	26 (10.4)	42 (10.1)
Late Convalescence: AGP>=1g/l and CRP<5mg/l	16 (9.6)	6 (2.4)	22 (5.3)
Malaria	n=204	n=335	n=539
n(%) children with malaria	34(16.67)	27(8.06)	**61(11.32)**

* Study province difference, p-value < 0.05.

Table 3.3g3: Morbidity among children by age and gender

	FEMALE			MALE		
	6-59 months	6-23 months	24-59 months	6-59 months	6-23 months	24-59 months
Infections	n=234	n=83	n=151	n=238	n=84	n=154
CRP>10mg/l	57(24.36)	25(30.12)	32(21.19)	52(21.85)	18(21.43)	34(22.08)
	n=242	n=85	n=157	n=244	n=86	n=158
AGP >1g/L	37(15.29)	18(21.18)	19(12.10)	39(15.98)	9(10.47)	30(18.99)
Malaria	n=268	n=98	n=170	n=271	n=94	n=177
n(%) children with malaria	20(7.46)	3(3.06)	17(10.00)	41(15.13)	9(9.57)	32(18.08)

Table 3.3g4. Overview of the evaluation of the micronutrients status and the conclusions

Status	Population groups	% inadequacy	Conclusions
Anemia	Women	30.6	Public health problem
	Children	59.06	Severe public health problem
Vitamin A deficiency	Women	3.2	No public health problem
	Children	25.8	Public health problem
Zinc deficiency	Women	55	Public health problem
	Children	21.89/33.83	Public health problem
Vitamin B12	Women	98	Public health problem
	Children	97.39	Public health problem
Folate/Folic Acid	Women	92.4	Public health problem
	Children	83.6	Public health problem

4. DISCUSSIONS

The 2012 Zambia food consumption survey was undertaken to provide the information needed by the Zambia's policy makers, and program designers and evaluators to make informed decisions about sound investments to reduce inadequate intake of vitamins and minerals in Zambia and so aid in achieving the Millennium Development Goals. Dietary behaviors are known to be complex, and measuring individual nutrient intakes with acceptable validity and reliability is difficult, time-consuming, relatively expensive, and prone to a number of errors. Nevertheless, the authors believe that the findings presented in this report are of high quality and represent an accurate description of dietary patterns in the provinces of Luapula and Northern.

As can be seen prevalence's of inadequate intake of the various vitamins and minerals have varied widely, as are the prevalence among provinces. However, in general, the dietary patterns were found to be highly inadequate for vitamin A, vitamin B-12, folate, iron, zinc, and calcium, based on the dietary profile, which featured low levels of consumption of milk, meat, fish, and dairy products. When the two provinces were compared, Northern Province showed the highest prevalence of inadequate intake for vitamin B-12 in that region. On the other hand, inadequate intake of the minerals (iron, zinc,) was generally most prevalent in Luapula, while inadequate intake of calcium was higher in Northern. Regardless, the prevalence of inadequate intake of these three minerals is high in both provinces surveyed. The Northern Province also reported a higher prevalence of inadequate intake for vitamin B-1, vitamin B-2, niacin, vitamin B-6, and folate than Luapula. In general, inadequate intake of vitamin B-1 (main sources: meat and poultry, fruits and fruit juice), vitamin B-2 (main sources: meat and poultry, green leafy vegetables), and vitamin B-6 (main sources: other vegetables, grains and nuts) are far less common.

Food group consumption patterns were not different between age groups. Among women the most commonly consumed food groups (consumed by more than 80% of all households) were miscellaneous roots and tubers, beans, nuts, and seeds; followed by vegetables and grains, which were consumed by about 76% of surveyed women. Green leafy vegetables and Fats and oils were consumed by approximately 60% of them, while fruits, sugar and sweets were consumed by 37% and 25%, respectively. In addition, the consumption of animal source foods was not common. Overall, percent nutrient intake by food group for women and children for the first measure versus both measures were highly correlated (>0.9992). Paired t tests confirmed that the nutrient means by food group for the one day recall versus the combined two day recall were not different. The diet in the above two regions is predominantly vegetarian; only 4-9% of the energy was supplied by foods of animal origin. Most of the energy in the diet during the period of the study came from roots or tubers (422 to 686 g/day) and grains and grain products (268 to 427 g/day). The combined intake of beans, nuts, and seeds, which are good sources of protein and nutrients of the B complex, including folate, was relatively large (149-264 g/day). Beverages consumption was also large (361-761g/day); median consumption per day varied between 62 and 89g. Consumption of sugar, oil/fat, and vegetables was modest, at approximately 20 to 60 g/day. Fruit intake (100-150 g/day) was also fair. As predicted, intake of meat, fish, poultry and eggs was low (25-60 g/day), with this most pronounced in Northern.

Percent nutrient intake by food group for women and children for the first measure versus both measures were highly correlated (>0.9992). Paired t tests confirmed that the nutrient means by food group for the one day recall versus the combined two days recalls were not different (data not shown). There is no need for a correction to the one day dietary recall as it estimated the usual intakes almost identically to the two day dietary recall usual intakes.

In addition, there was a strong divergence between the mean and the median intake of cereals consumed by surveyed WRA (Table 4.2b1). The mean, in particular, may be a misleading indicator of the consumption of a food in a population because the consumption of cereals is often highly skewed to the right (consumption is very high in a few individuals), while many of the population consume nothing. The median is also a poor indicator of the consumption pattern, because this will be zero when fewer than 50% of the women consumed these foods. To better describe the consumption pattern of a potential vehicle for fortification and the impact it may have on micronutrient intake, the percentile distribution is presented in **Tables 3.2f-3.2j**.

The prevalence of inadequate intake of the various vitamins and minerals vary widely, as do the prevalence among provinces. However, in general, the dietary patterns were found to be highly inadequate for vitamin A, vitamin B-12, folate, iron, zinc, and calcium, based on the dietary profile, which featured low levels of consumption of milk, meat, fish, and dairy products. When compared both provinces, Northern showed the highest prevalence of inadequate intake for vitamin B-12. On the other hand, inadequate intake of the minerals (iron, zinc) was generally most prevalent in Luapula, while inadequate intake of calcium is higher in Northern/Muchinga. Regardless, the prevalence of inadequate intake of these three minerals is high in both provinces surveyed. The Northern/Muchinga reported a higher prevalence of inadequate intake for vitamin B-1, vitamin B-2, niacin, vitamin B-6, and folate than Luapula. In general, inadequate intake of vitamin B-1 (main sources: meat and poultry, fruits and fruit juice), vitamin B-2 (main sources: meat and poultry, green leafy vegetables), and vitamin B-6 (main sources: other vegetables, grains and nuts) are far less common.

In women, those with vitamin A deficiency were 3.2% (3.7% in Luapula and 2.7% in Northern).. About 54% of women were deficient in zinc depending on the time of blood collection. Those at risk of vitamin B12 and folate deficiency were respectively 98% and 92.4%. Mean hemoglobin of the women was 12.6g/dl, with around 30.6% of women (Hb<11g/dl) classified as anemic. Iron deficiency, defined as serum ferritin either, <15µg/l or

≥19µg/l and CRP>5mg/l and/or AGP >1g/L, was found in 19.6% of subjects; while 18.6% of women suffered from iron-deficiency anemia (Hb <12g/dl and iron deficiency).

In children, those with vitamin A deficiency (based on serum retinol adjusted for infection using AGP and CRP) were 25.8% (25.3% in Luapula and 26.1% in Northern). About 22-34% of them were deficient in zinc depending on the time blood was collected, higher (24% or 38%) in Luapula and lowest (31% or 20%) in Northern. Most of children were deficient in vitamin B12 (97%) and in Folic acid (83.6%). No significant difference was observed between both provinces. Mean hemoglobin of children was 10.7g/dl, with around 59% of the children classified as anemic (Hb<11mg/dl). Iron deficiency, defined as serum ferritin either, 15µmg/l or ≥15µg/l and CRP>10mg/l and/or AGP >1g/L, was found in 35% of subjects; while 27% suffered from iron-deficiency anemia (iron deficiency and Hb <11mg/dl). No significant difference was observed between both provinces.

5. CONCLUSION

The information collected provides a strong foundation to guide discussions for further developing of nutrition policies and intervention design. The differences in diets of the two provinces and micronutrient status described in this report highlight the well-known, but too often ignored, requirement to design interventions in ways that fit the specific contexts of targeted populations. This difference in context requires recognition in designing both policy and programs. Another recognition that requires attention is that of concerning the poor consumption of animal source foods.

6. REFERENCES

1. International Zinc Nutrition Consultative Group (IZiNCG). Assessment of the risk of zinc deficiency in populations and options for its control. Hotz C and Brown KH, eds. Food and Nutrition Bulletin 25: S91-S204, 2004.

2. Chapoto, A., Govereh, J., Haggblade, S., & Jayne, T. S. (2010, January). Staple food prices in Zambia. In Prepared for the COMESA policy seminar on “Variation in staple food prices: Causes, consequence, and policy options”, Maputo, Mozambique (pp. 25-26).

3. Mason, N. and T.S. Jayne. 2009. Staple Food Consumption Patterns in Urban Zambia: Results from the 2007/2008 Urban Consumption Survey. Food Security Research Project Working Paper 42. Lusaka: Michigan State University.

4. Harris, J., & Drimie, S. (2012). Toward an Integrated Approach for Addressing Malnutrition in Zambia. IFPRI

5. World Bank, editor. 2012. Country and Lending Groups. Washington, DC.

6. Central Statistical Office. 2010 Census of population and housing preliminary report. Lusaka: Republic of Zambia, Central Statistical Office; 2011.

7. Siwila J, Phiri IG, Enemark HL, Nchito M, Olsen A. Intestinal helminths and protozoa in children in pre-schools in Kafue district, Zambia. Trans R Soc Trop Med Hyg. 2010 Feb;104(2):122-8.

8. DFID (October 2011) Business Case for Tackling Maternal and Child Under-nutrition in Zambia

9. Shaw, J. G., & Friedman, J. F. (2011). Iron deficiency anemia: focus on infectious diseases in lesser developed countries. Anemia, 2011.

10. Central Statistical Office, Ministry of Health, Tropical Diseases Research Centre, University of Zambia, and Macro International Incorporated. 2009. Zambia Demographic and Health Survey 2007. Lusaka, Zambia, and Calverton, MD, USA.

11. WHO-CDC, Assessing the iron status of population, second edition 2007.

12. WHO-FAO: Vitamin and mineral requirements in human nutrition, second edition, 2004

13. Thurnham DI, Smith E, Flora PS. Concurrent liquid chromatographic assay of retinol, tocopherol, beta-carotene, alpha-carotene, lycopene and beta-cryptoxanthin in plasma with tocopherol acetate as an internal standard. Clin Chem 34:377-381; 1988.

14. Thurnham DI, McCabe GP. Influence of infection and inflammation on biomarkers of nutritional status with an emphasis on vitamin A and iron. In: World Health Organization. Report: Priorities in the assessment of vitamin A and iron status in populations, Panama City, Panama, 15–17 September 2010. Geneva, World Health Organization, 2012

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