TANZANIA

National Fortification Assessment Coverage Tool (FACT)

Survey in Tanzania, 2015

Maize Flour

Wheat Flour

Oil

Salt

June 2016

Report

Fortification Assessment Coverage Tool (FACT) Survey in Tanzania

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Contents

1. SUMMARY

In Tanzania, national fortification of salt with iodine began in the 1990's, and fortification of wheat and maize flour with multiple micronutrients and oil with vitamin A has been mandated by law since 2011. Currently, there is a lack of information available on how well these programs are performing, household coverage and intake of fortified foods, and if vulnerable populations are being reached. The Fortification Assessment Coverage Tool (FACT) is a survey instrument developed by the Global Alliance for Improved Nutrition (GAIN) for carrying out coverage assessments of large-scale food fortification programs. In 2015 GAIN, the United States Centers for Disease Control and Prevention (CDC), the Africa Academy of Public Health (AAPH), Ifakara Health Institute and the National Bureau of Statistics (NBS), conducted a cross-sectional, two-stage, cluster household FACT survey in Tanzania from September to October. The purpose of the survey was to assess the coverage and potential contribution of fortified foods to the micronutrient intake of the population.

The survey was designed to be nationally representative and also representative by rural and urban areas of the country. The study population consisted of households and women of reproductive age (15-49 years). Based on sample size calculations and anticipated non-response, 1,050 households were invited to participate nationally (609 in rural areas and 432 in urban areas). The survey instrument collected data on household and individual level factors, including: household demographics and socioeconomic status; education levels within the household; housing conditions; recent infant and child mortality; water, sanitation, and hygiene (WASH) practices; food security; women's dietary diversity; and coverage and consumption of fortified oil, wheat flour, maize flour, and salt. Food samples of oil, wheat flour, maize flour, and salt were collected from participating households and analyzed quantitatively to determine fortification levels of select nutrients.

Three measures of coverage were assessed and are expressed as the proportion of sampled households covered. The measures are: **consumption of a food** (i.e. households report preparing the food at home); **consumption of a fortifiable food** (i.e. consumption of a food vehicle that was not made at home and is assumed to be industrially processed); and **consumption of a fortified food** (i.e. consumption of a food vehicle that is confirmed to be fortified). Three indicators of risk were used to assess the relationship between coverage and risk, which included: poverty (defined by the multi-dimensional poverty index (MPI)), rural residence, and low women's dietary diversity (defined as less than the population median in each stratum (i.e. rural and urban) based on a score out of 10 food groups). Two methods were used to estimate the amount of fortifiable foods consumed daily. For wheat flour only, an individual assessment of all women of reproductive age was conducted, which asked about frequency of consumption and portion size of wheat flour containing foods over the past seven days. For all vehicles, a household assessment method was used, which asked household respondents about the last time they purchased the food vehicle, how much they purchased, and the length of time that amount typically lasts in the household. Adult Male Equivalent (AME) method was used to apportion what amount women (among households that reported to consume the vehicle) apparently consumed of fortifiable foods. For both methods, the corresponding daily nutrient intake was determined by multiplying the amount of food consumed per day by a fortification level based on the quantitative food sample analyses. The daily nutrient intake was then translated into a percentage of the daily recommended nutrient intake (RNI) for the women based on World Health Organization (WHO) guidelines.

The survey response rates were 99.1% nationally, 99.0% in rural areas and 99.3% in urban areas. Nationally and in rural and urban areas, household consumption of oil, salt, and maize flour was high (over 85%, 95% and 75%, respectively) while household consumption of wheat flour was lower (51.5% nationally). The pattern of consumption of fortifiable oil, salt and wheat flour was very similar while consumption of fortifiable maize flour was significantly lower (36.6% nationally) due to the fact that much of the maize flour consumed is not

industrially produced. The proportion of households consuming a fortified product was lower still. Nationally, the proportion of households consuming a fortified food was 53.6% for oil, 33.1% for wheat flour, 2.5% for maize flour, and 69.6% for salt. In rural and urban areas the patterns were similar.

Using the individual assessment method, added iron from wheat flour was estimated to contribute to 10.2% of the iron RNI among women of reproductive age nationally. The added iron in wheat flour was estimated to contribute to 6.0% of the iron RNI in rural areas and 23.2% in urban areas. When households were separated by risk factors nationally and in rural and urban areas, women's iron RNI from wheat flour was lower among those from households at risk of poverty compared to non-poor households, and among those with lower dietary diversity compared to those with higher dietary diversity. Using the AME assessment method, among women from households that reported consuming the vehicles nationally, oil contributed to 20.8% of the vitamin A RNI, wheat flour and maize meal contributed 16.1% and 0%, respectively, to the iron RNI, and salt contributed to 122.5% to the iodine RNI. In rural areas, oil contributed to 17.2% of the vitamin A RNI, wheat flour and maize meal contributed 18.5% and 0%, respectively, to the iron RNI, and salt contributed to 105.9% to the iodine RNI. In urban areas, oil contributed to 28.0% of the vitamin A RNI, wheat flour and maize meal contributed 13.2% and 0%, respectively, to the iron RNI; salt contributed to 148.9% to the iodine RNI. Overall, women's nutrient RNI from all four foods was not different across the strata based on poverty status or dietary diversity.

The fortification quality compared to Tanzania national standards varied greatly by food vehicle. Among oil samples, 16.3% nationally, 18.0% in rural areas and 15.7% in urban areas were adequately fortified. Among wheat flour samples, 18.9% nationally, 20.0% in rural areas and 17.0% in urban areas were adequately fortified. Among maize flour samples, 3.3% nationally, 4.8% in rural areas and 1.6% in urban areas were adequately fortified. Among salt samples, 62.7% nationally, 52.8% in rural areas and 79.6% in urban areas were adequately fortified. Classification of salt samples using the WHO international standard for household samples found that 43% nationally, 34% in rural areas and 58% in urban areas were adequately fortified. Moreover, 15% of salt samples were over fortified according to the WHO standard while less than 1% of salt samples were over fortified according to the national standard.

In conclusion, the potential for fortified foods to contribute significantly to nutrient intakes is high for those foods where a large proportion of the population consumes a fortifiable food. In Tanzania, there is high coverage of fortifiable oil and salt in all areas indicating high potential for impact from fortified foods. Coverage of fortifiable wheat and maize flour is lower than other food vehicles, but there is high potential for impact among urban populations. Fortification adequacy remains a concern for all food vehicles; further efforts are needed to improve quality and enforcement to better address under and over fortification to maximize impact.

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3. ABBREVIATIONS

AAPH	Africa Academy of Public Health
CAPI	Computer-assisted personal interview
CDC	US Centers for Disease Control and Prevention
EA	Enumeration area
FACT	Fortification Assessment Coverage Tool
FMOH	Federal Ministry of Health
GAIN	Global Alliance for Improved Nutrition
IHI	Ifakara Health Institute
LGA	Local Government Area
NAFDAC	National Agency for Food and Drug Administration and Control
NBS	National Bureau of Statistics
OGCS	Office of Government Chief Statisticians Zanzibar
PPS	Probability proportional to size
PSU	Primary sampling unit
RNI	Recommended nutrient intake
WRA	Women of reproductive age

4. BACKGROUND

A. INTRODUCTION

Hunger and malnutrition among Tanzanians continue to impair health, quality of life, and survival (Demographic Health Survey 2010). Nutritional deficiencies have long-term implications for health and wellbeing (Bhutta 2008 and Ezzati 2002). In women of childbearing age specifically, the functional consequences of micronutrient malnutrition do not only affect their own mortality, morbidity and productivity, but also that of their offspring.

Food fortification is an intermediate solution to improving inadequate dietary intake in a population. Fortification of widely distributed and consumed foods with micronutrients has the potential to improve the nutritional status of a large proportion of the population (WHO/FAO 2006) and neither requires changes in dietary patterns nor individual decision for compliance (WHO 2009).

In 2011, Tanzania established mandatory fortification of wheat flour, maize flour and vegetable oil with key micronutrients such as iron and vitamin A. Mandatory iodization of salt has been in effect since 1995. Fortification is not mandatory in Zanzibar, a semi-autonomous part of Tanzania. Without routine monitoring, it is unclear how well the fortification programs are functioning and there is a dearth of data available on the implementation and coverage of the program to date. Wheat flour is produced by only a few large companies that are participating in the fortification program but the degree of compliance is unknown (Institute of Development Studies 2014). Conversely, maize flour is produced by thousands of small-scale millers who have less access to resources or regulatory incentives to fortify their products. Vegetable oil is largely produced by two large companies in the formal sector, but coverage among at-risk populations may be limited as poor households typically purchase from the informal sector, which is not likely to fortify.

Currently in Tanzania wheat flour is fortified with iron, zinc, folic acid, B12, niacin, thiamin, riboflavin and vitamin A. Maize flour is fortified with iron, folic acid and B 12. Oil is fortified with vitamin A, and salt with iodine.

B. THE PROJECT

In 2015, the Global Alliance for Improved Nutrition (GAIN), the United States Centers for Disease Control and Prevention (CDC), the African Academy of Public Health (AAPH), Ifakara Health Institute (IHI) and the National Bureau of Statistics (NBS), conducted a nationally representative fortification assessment survey in Tanzania. The survey focused on assessing program coverage of fortified staple foods, as well as the contributions of fortified foods toward daily recommended nutrient intakes (RNI).

The survey used the Fortification Assessment Coverage Tool (FACT) survey instrument that was developed by GAIN for carrying out coverage assessments of both population-based (large-scale food fortification) and targeted (e.g. point-of-use fortificants or supplements) programs (Aaron 2014). The tool was developed to help stakeholders achieve greater program impact by assessing coverage.

C. RATIONALE

There is limited information on the coverage and consumption of fortified staple foods such as wheat flour, maize flour, salt and vegetable oil at a population level in Tanzania since food fortification began in 2011. The survey is representative nationally and also at the rural and urban level. The rationale for conducting the survey in urban and rural areas in Tanzania is that these areas are likely to be quite different from one other. It is predicted that rural parts of the country will have less access to commercially manufactured foods and that the subsequent health gains in rural areas, as a result of more limited access to fortified staple foods will be lower. It is unknown how large scale fortification programs are performing, who benefits from fortification programs, and whether the most vulnerable populations are reached. The survey will provide important feedback to program stakeholders about barriers and enhancers that could be applied to improve the fortification program in Tanzania.

The findings of this survey provide nationally representative data on program coverage and performance in rural and urban areas of the country. The data from Zanzibar, while not representative, also provide some insight into the coverage of fortified foods. It is hoped that results from this survey will further guide programming efforts and nutrition policy recommendations in Tanzania.

5. OBJECTIVES

A. GENERAL OBJECTIVE

The general objective of this cross-sectional survey was to determine the household coverage and potential contribution of fortified foods to the micronutrient intake among urban and rural households in Tanzania and women of reproductive age (15 to 49 years).

B. SPECIFIC OBJECTIVES

The specific objectives of the project were:

a) To assess the coverage of fortified salt, wheat flour, maize flour, and vegetable oil among households;
b) To measure levels of select nutrients in samples of salt (iodine), wheat flour (iron), maize flour (iron), and vegetable oil (vitamin A) gathered at the household;
c) To estimate the consumption of salt, wheat flour, maize flour and vegetable oil among households and women of reproductive age (15 to 49 years);
d) To assess the contribution of fortified salt, wheat flour, maize flour, and vegetable oil to the intake of select nutrients in the diet of women of reproductive age (15 to 49 years);
e) To evaluate indicators for other health and nutrition conditions to determine their association with the consumption of fortified foods. Such indicators include:
    - Multi-dimensional poverty index
    - Women's dietary diversity.

6. METHODOLOGY

A. STUDY POPULATION

The target survey populations include households and women of reproductive age (15 to 49 years). A person ≥15 years of age familiar with foods purchased for and prepared in the household was asked to complete the household questionnaire. All women of reproductive age (WRA) 15-49 years living in a selected household (including pregnant or lactating women) were asked to complete the female questionnaire. If no eligible women were living in a selected household, only the household questionnaires were completed.

B. SAMPLING

A cross-sectional, two-stage, cluster household survey in Tanzania was conducted. The survey was stratified by urban and rural areas. The entire country (including Zanzibar) was included in the sampling frame.

The sampling frame for the survey was based on data and cartography from the 2012 Tanzania Population and Housing Census. The primary sampling units (PSUs) selected at the first stage were the enumeration areas (EAs), which were small operational areas defined on maps for the 2012 Census enumeration. The EAs had an average of 86 households each (87 for rural EAs and 86 for urban EAs). In Tanzania there are a total of 106,642 EAs in the 2012 Tanzania Census frame. A total of 70 EAs were selected, 29 from urban areas and 41 from rural areas using PPS sampling. On the mainland alone 35 of the selected clusters were rural and 24 were urban. Eleven of the total clusters were from Zanzibar 6 of these EA's were rural and 5 were urban. Although the data from Zanzibar is not statistically representative, due to its political importance, data is also presented separately in the results section for Zanzibar. The total sample size for the survey was 1,050 households. The total number of households to be visited in each EA was 15. For the second stage of sampling, on arrival in each EA the survey team did a complete listing of all the households. From the complete list of households, 15 households were randomly selected by calculating a sampling interval (total number of households in the EA divided by 15, total number of households to be selected). A number between 1 and 15 was randomly selected using a random number table and this was the first house. After that the interval was used to select the 14 remaining households. Post stratification weighting was conducted and appropriate inverse probability statistical weights were calculated to adjust for unequal probability of selecting households within an EA.

C. DATA COLLECTION SUMMARY

After the household listing and household selection was completed the main survey data collection began. Data collection involved the collection of administered questionnaires for the household. The person (at least 15 years of age) most familiar with food purchasing and preparation was selected to complete the household questionnaire. All WRA residing in the household were asked to complete an individual women's questionnaire. Finally household food samples of salt, oil, wheat flour and maize flour were collected if available. A sample was not collected if 1) no sample was available, 2) the respondent reported that the food was produced at home or, 3) the oil was red palm oil because red palm oil is not fortified.

D. QUESTIONNAIRES AND SUPPORTING TOOLS

Questionnaires

GAIN and CDC initially revised questionnaires developed from previous GAIN FACT surveys for this survey, and then AAPH further revised and adapted them to the Tanzanian context. Modifications were reviewed by GAIN and CDC prior to survey implementation. The final English copies of these questionnaires [Household listing; Household questionnaire 1 (HH1); Household questionnaire 2 (HH2); and Women of reproductive age questionnaire (WRA)] are provided in Annex A.

Data collection for the FACT survey was conducted using tablet computers. Interviewers could collect the information either in English or Swahili and the interview took place in the respondents' own homes, in either of the programmed languages. Translation was done in two stages. Initially, translation was carried out by identified professionals with a background education in nutrition and health sciences who were also well grounded in Swahili and English. Further translation and translation revisions were carried out during the training of field teams after understanding the proper context of each question.

Coding and testing of the computer assisted personal interview (CAPI) data-entry program

Before testing the CAPI data-entry program in the field, IHI conducted desk testing. Any feedback was incorporated into the questionnaire and data-entry program design. The CAPI version of the questionnaire was also pre-tested during the pilot survey. This pilot-test helped ensure that the data-entry program for administering the questionnaire was working smoothly, including the necessary logic flow and skips required.

Questionnaire supporting tools

Women's questionnaire: 7 day food frequency questionnaire for wheat flour foods photo grid

Wheat flour is a staple food vehicle that is often purchased by households from markets in the form of already prepared products (e.g. bread is purchased from bakeries). In order to assess consumption of wheat flour, the FACT survey instrument includes an individual assessment of consumption of wheat flour containing foods over a seven day recall period among WRA. A comprehensive list of all food items made with wheat flour and their recipes was developed. Based on a protocol developed by GAIN, portion size photo grids were developed for foods made with wheat flour that are consumed in Tanzania. Two local nutritionists were contracted to assist in the development of the food grids and measurement guides through individual interviews and focus group discussions. They were also asked to come up with a standard recipe for each of the foods included in the food picture grid. Portions of the foods made with wheat flour were re-created from the largest portion (e.g. one large serving of spaghetti or 10 samosas) to the smallest (e.g. a very small serving of spaghetti or half a samosa). Each typical portion was measured and recorded as a proportion of the largest portion (e.g. fourth of a slice of bread). Color photographs of each portion size were used to create one-page grids per food item. In order to facilitate the representation of the actual size, a spoon was used as a reference object and included in each photo (e.g. a spoon next to a slice of bread). Bound booklets of the food grids were color printed for each of the survey enumerators. A standard portion of each food was

weighed and recorded in grams after the photo was taken for each food. Examples of the photo grids are found in Appendix B.

Household questionnaire: Food measurement guide

The food measurement guide was developed to help the respondent to estimate how much oil, wheat flour, maize flour, and salt they last bought for each of these commodities. Some commodities were purchased and the amount is specified on the packet or bottle. Often though the product is in an unmarked container and it is necessary to estimate the amount purchased. For example, looking at the food measurement guide a respondent may say she bought one large cup of flour and point to the container on the guide, which the enumerator knows corresponds to 250 g. Key informant interview and focus groups were also used to develop a set of standard measuring containers that are typically found in Tanzania. An example of the food measurement guide is included in Appendix C.

List of instruments and tools

A series of instruments and supporting tools were developed to facilitate field work and to ensure high quality field work:

a) Household questionnaire 1 (HH1): asked questions on household demographics, asset ownership and housing characteristics;
b) Household questionnaire 2 (HH2): asked questions on the use of fortified foods and vehicles at household level;
c) WRA questionnaire: asked questions on dietary diversity and consumption of fortified foods by WRA;
d) Food lists: a list of commonly consumed foods was created to help WRA assess wheat flour foods consumed in previous 7 days;
e) Photo grid: Pictures of foods in the food lists were used to help WRA estimate consumption of wheat flour foods frequently eaten in previous 7 days;
f) Food measurement guide: A set of photos of commonly used containers to measure food in Tanzania was used to help estimate the amount of wheat flour, maize flour, oil, and salt last purchased, when the volume or weight was not specified on the packaging;
g) Training manual, project introduction and listing guides: provided field staff detailed steps in data collection;
h) Checklists for team leaders and enumerators: provided detailed daily checklists to follow in the field;
i) Field travel and data collection calendar: provided an overview of the travel schedule and work timeline;
j) Cluster control form: listed the households selected for data collection in each EA that was updated by the team leader based on field results from each household;
k) Household control form: provided an inventory and quick check tool for the team leader to ensure all questionnaires and samples were collected and forwarded to the survey coordinator. This form also served as a valuable resource during data cleaning.

E. FIELD STAFF RECRUITMENT, FIELD TEAM STRUCTURE, AND MANAGEMENT

All of the enumerators hired had a college qualification or university degree and most were already staff members of NBS or had been employed by NBS for previous surveys and were experienced in data collection.

The training for the main FACT survey was conducted from 16-18 September 2015 at a hotel conference center in Dar es Salaam. All survey team members, including the enumerators, supervisors and quality control personnel participated in the main survey training. Training was conducted by the core AAPH, IHI and NBS team and CDC. Fieldwork took place from September 23rd until the end of October 22nd 2015. Eight field teams completed the listing and the survey; each team consisted of 3-6 enumerators and one supervisor (total 30 people plus some additional substitutes).

All field staff had checklists to guide daily activities and ensure high quality data collection. Overall supervision was conducted by the members of the FACT survey core research team. A quality control specialist from NBS also worked closely with each of the teams throughout the fieldwork. A field travel calendar was developed to guide the data collection process and team movement. To ensure adequate supervision during the critical first days of data collection, all teams were deployed to the EA's around Dar es Salaam to ensure closer monitoring. It also enabled the team working on the CAPI system to ensure the system was working properly and the data could be uploaded by all teams.

F. TRAINING AND DATA COLLECTION PROCEDURES

Household listing training

The training for the household listing was included as part of the three days of classroom work followed by field pre-testing, pilot-testing and a post-pilot review before survey implementation. During training, the team was taken through the FACT survey background, objectives and the specific purpose of the household listing and sample selection exercise. The core of the training involved explaining the listing tools and the listing guide. Teams were taken through systematic random sampling techniques and introduced to listing and mapping using the actual maps for several pilot EAs obtained from NBS. All teams conducted their pilot in EAs near to Dar es Salaam, which offered a peri-urban setting.

Household listing procedures in each district

A project introduction and field listing guide was given to each team to assist in carrying out their duties. Briefly, each team was tasked to take half a day to a full day to complete the introduction of the survey at district, village and EA levels and to create a list of all households.

On the first day, the quality control officer and the team supervisor explained the survey and secured permissions from the local authorities. Each team then proceeded to the EA to introduce and sensitize these officials using letters endorsed from the district officials. Once the community sensitization was complete the EA listing was started. Initially, the quality control officer and the supervisor held a meeting with the village leader to explain the mapping and listing procedures. Using the EA map, they marked the boundaries of the EA and noted key features to confirm boundaries. The team systematically visited each household and listed it by head of household name and recorded the address/main

landmark for each household. After listing all households in the village, the team randomly selected the required 15 households according to the sampling interval and protocol.

FACT survey training

A training program and schedule for the three days training was developed and a training manual was used to clarify the meaning of questions and field procedures. Training methods included power point presentations, discussions, demonstrations and role playing in English and local languages. After three days of classroom training, the first day of the pilot survey was carried out. After debriefing feedback and additional training, a second day of pilot testing was conducted to give the teams more time to practice survey procedures.

Additional training for supervisors

Prior to the training, supervisors were identified who had previous experience supervising large scale surveys. All of the supervisors selected had demonstrated an understanding of the survey protocols and leadership skills. The supervisor was responsible for overall management of the field worker team and deployment throughout the EA to ensure the survey schedule and protocols were adhered to. The supervisor was also responsible for monitoring interviews, doing back checks and convening daily team meetings.

One additional half day training was added to the general three day training schedule for the supervisors. It focused on sampling, fieldwork plans, advocacy, monitoring tools, communication and logistics in the field, data-transmission protocols and roles and responsibilities in the field.

FACT survey procedures in each district

Supervisors called the local leaders ahead of the field visit to share their field plans and to request their presence and assistance on the appointed days. W possible, local leaders were requested to alert the households in the EA about the arrival of the field teams and their intentions. After the listing was completed, where possible a community leader was asked to help inform selected households when they would be visited. About 2 days were provided for each EA to allow for visiting all 15 households and call back interviews for any households missed on the first day. The main respondent for the survey (HH1 and HH2) had also been identified. Before starting data collection, field teams already had: 1) a list identifying the selected households by household number/landmark, 2) name of the household head and 3) name of the potential respondent that was gathered during the household listing exercise.

The female head of household responsible for food preparation in the household was identified as the respondent for HH1 and HH2. If the female head of the household was not present, another household member most knowledgeable about food preparation in the household was interviewed. The WRA questionnaire was administered to all eligible women between 15-49 years.

After each interview, available samples of the main type of salt, wheat and maize flours most commonly used in the household were collected in small plastic bags. Each specimen was labeled with the designated household food specimen label. In addition, if available in the household, one specimen of the most commonly used oil was collected and stored in a plastic container with a secure lid.

Immediately upon completing data collection in each EA, the data were summarized on a master cluster control form which was used to update the main study coordinators.

G. DATA ENTRY AND MANAGEMENT

Data processing

Data collected were transferred electronically from CAPI by the field supervisors to the data-processing staff at the IHI office on a daily basis. The supervisors retrieved all the tablets and reviewed the data retrieved from each tablet for completeness. After verification, the supervisor uploaded and synchronized the data to a main server. From here, the data manager at IHI downloaded the data, undertook additional consistency checks and saved the data in a central data base at IHI and a back-up stored in the IHI repository.

Data cleaning

The electronic data collection system allowed for a large proportion of the data cleaning to be carried out alongside the data collection thereby increasing efficiency and enabling quick identification of any issues with the data so they could be remedied while the team was in the field.

The data-entry program had in-built checks for unlikely data points and dynamically adjusted drop-down menu options to reduce the scope for errors. The fieldwork supervisors checked for any errors every evening after completion of fieldwork and before uploading the files to the main server. At the IHI office, the data assistant and data manager ran a routine report on a daily basis and did some preliminary analysis of the data to detect any problematic issues, including the following types of checks:

a) Blanks: Cases where a variable should not be blank but is;
b) Skips: Cases where a variable has been filled when it should not have been (i.e. it should have been skipped);
c) Range: Where appropriate non-pre-coded variables (i.e. those that can take on any value) are checked to ensure they fall within a plausible range;
d) Outliers: Non-pre-coded variables were checked against the distribution of each variable across all questionnaires; and
e) Consistency: Variables were cross-checked to ensure that all questionnaire information was internally consistent.

The routine reports were compiled on a weekly basis and shared with the core team members for review. Throughout the period of data collection, interviewers were available for any query on individual questionnaires where necessary. Field teams returned to sampled households if any major data problems were identified by this process.
Additional data cleaning was commenced at the end of the entire data collection exercise. This involved adding final data formats, merging datasets, labeling, and adding necessary data parameters to the dataset. There are three different data sets;

1. Questionnaire 1 dataset (Household questionnaire 1)
2. Questionnaire 2 dataset (Household questionnaire 2)
3. Questionnaire 3 dataset (Women of reproductive age questionnaire)

Data storage

All data collected from the survey were stored on computers at IHI and backed-up on a secure central data base. At the completion of data collection, the data manager produced a dataset, with households and individuals de-identified. Datasets were finalized in Stata

format. The data set had all appropriate labels and descriptions and was accompanied by a codebook.

The entire survey, was supported by the IHI staff, managed by a project manager and supported by a data assistant and data manager. Final datasets were submitted to GAIN and CDC in November 2015.

Storage and shipment of food samples

Food samples were collected from the field in batches and sent to AAPH in Dar es Salaam. This was to ensure that samples did not deteriorate under field conditions or get misplaced. They were transported to the AAPH offices and stored in a cool room until final preparation and shipment to Bio Analyt Lab in Germany. After a courier was solicited and the required certification was obtained, the samples were systematically sorted and packaged according to guidelines provided by GAIN. Salt samples were analyzed for iodine content, oil for vitamin A, and maize and wheat flour for iron. In addition to food samples collected from survey households, samples of unfortified maize and wheat flours from local manufacturers were collected and shipped to enable testing of intrinsic iron content.

H. DATA ANALYSES

Data analyses

Data analyses were completed using SAS version 9.4 (SAS Institute, Cary, NC USA) statistical analysis software and R (R foundation for statistical computing Vienna Austria). Statistical significance was set at $p < 0.05$. Descriptive statistics are presented as mean (95% Confidence Interval (CI)), median (25th percentile, 75th percentile) or percentage (95% CI). Results are presented for the entire country (including Zanzibar), by urban and rural strata and by Zanzibar alone. Differences between categorical and fortification coverage of variables were assessed using Rao-Scott chi-square; adjusted student's t-test for continuous variables, and Wilcoxon rank sum test was used to compare median differences. All analyses were population weighted, where appropriate, using Taylor linear series variance estimation, PSUs were nested within strata to account for clustering independent of sampling weights.

Survey design effects and weighting

A stratified multi-stage sampling approach was used. The primary sampling units (PSUs) were selected as enumeration areas (EAs). At the first stage probability proportional to size (PPS) sampling was used to select 70 EAs total, 41 from the rural strata and 29 from the urban strata, which also included 11 EAs Zanzibar. At the second stage, an inverse probability weighting was used to calculate sample weight or expansion factor for selecting each household within each stratum. This approach also incorporated stratum size and summarized by the notation:

$$Sampling\ Weight = \frac{M_h \times M_{hi}}{N_{FACT} \times M_h \times m_{hi}}$$

where NFACT =number of sample EAs selected in stratum h for the 2015 FACT; Mh =total number of households in the 2012 Census frame of EAs for stratum h; Mhi = total number of households in the frame for the i-th sample EA in stratum h and mhi =number of sample households selected in the i-th sample EA in stratum h (that is, 15). If mhi is constant for each stratum (15, for example), the sample will be approximately self-weighting within each stratum. EAs from Zanzibar were further weighted to generate Zanzibar adjusted final weights.

Definition of key variables (**Annex G**)

Key outcome variables were fortification coverage followed by nutrient intakes from fortified food. Nutrient intakes were estimated for women of reproductive age (WRA) using two different methods: 1) an individual assessment using a photo grid method for wheat flour-containing foods consumed over the past seven days, and 2) a household assessment using the adult male equivalent method (AME) for all food vehicles based on reported amounts purchased and duration they lasted in the household. Additionally, two stratifying variables were constructed: poverty risk and women's dietary diversity score.

Fortification coverage

Three variables were crafted to assess fortification coverage. They were as follows:

a) **Consumes food**: Households report preparing the food at home, regardless of whether or not it is fortified.
b) **Consumes fortifiable food:** consumption of a food vehicle that was not made at home and is assumed to be industrially processed
c) **Consumes fortified food:** consumption of a food vehicle that is known to be fortified and is confirmed by quantitative analyses of the household sample or if no sample was available, analyses of sample from the reported brand. Refers to analyzed foods confirmed to contain nutrients above the fortification threshold (i.e. at the level of under fortified or higher) as follows:
    - In households where a food sample was taken and laboratory-analyzed, if the sample was above the intrinsic level for iron (i.e. wheat flour > 29.8 mg/kg iron and maize flour >19.6 mg/kg) the household was classified as "yes" for consumes fortified foods. If the sample did not meet the criteria, then the household was classified as "not fortified" for consumes fortified food for each of the food types assessed.
    - In households where a food sample was not taken and the brand name was available, the median nutrient value in the branded samples analyzed from other households in the same stratum was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If it did not meet the criteria, then the household was classified as "not fortified" for consumes fortified food.
    - In households where a food sample was not taken and the brand name was not available, the household was classified as "don't know" for consumes fortified food.

Daily wheat flour consumption (Photo-Grid Method) and micronutrient contribution to RNI

The individual assessment (using the photo-grid method) was used to determine the RNI contribution from wheat flour only. This method targeted only women who completed the WRA questionnaire and included wheat flour foods that could be consumed at home and also outside of the house. Women were asked to report whether they consumed any of the 12 wheat flour containing foods on the list in the last seven days (see female questionnaire in Annex A). For foods they consumed, the frequency (number of times) was asked and the portion size was estimated using photo grids for each food (see photo grid example in Annex B). The grams of flour in each portion size were multiplied by the frequency consumed to estimate the flour consumed by women per week, and then divided by seven to calculate intake/day. A cumulative total of wheat flour consumed in grams per day was obtained by summing all food items containing flour for women per day. For any of the 12 foods a woman

did not consume or for missing (i.e. frequency or portion size), the grams consumed for that food item were assigned a 0.

The next step was to estimate the nutrients contributed by the fortified wheat flour consumed by WRA. With regard to wheat flour, the calculations were performed as follows: The grand median of the added iron content of all wheat flour samples per stratum was multiplied with the amount of flour each woman consumed daily to estimate the daily amount of iron consumed.

The % RNI met was then calculated as follows: amount of nutrient consumed from each food/RNI x 100%. For iron, the RNI for women assumed a 12% bioavailability and was based on World Health Organization (WHO) and FAO thresholds as follows): 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women), (WHO/FAO 2004).

Daily apparent food consumption (using the AME method) and micronutrient contribution to Recommended Nutrient Intake (RNI)

The daily apparent food consumption (using the AME approach) was used to calculate the RNI from fortified foods among women in the household that consumed any of the four food vehicles (oil, salt, wheat and maize flour) at home. The reported amount of food purchased and the duration it lasted for each household were used to calculate daily apparent consumption of each food per household. Local measurements for each food were converted into metric units and duration into days as needed, to derive the apparent daily consumption (i.e. grams/day). The AME food amount apparently consumed/day for WRA was estimated as the product of the amount of household food apparently consumed/day and the household AME fraction for WRA (i.e. household consumption g/day x WRA individual AME).

The WRA individual AME fraction was estimated as the woman's AME divided by the sum of AME values of all household members. Each member on the household roster was assigned a different AME fraction based on their age and sex, with males 18-30 years assigned a value of 1.0. **Box 3** lists the AME fraction for all age and sex groups. The individual AME fraction for each WRA in the household was multiplied with the daily amount of the food apparently consumed by the household to estimate apparent food consumed for each WRA. For example, in a family composed of one male 25 years of age, one woman 20 years of age, and one baby less than 1 year, their AME values are 1.0, 0.786885246, and 0.216721311, respectively. When summed up, this results in a household AME of 2.003606557. The WRA AME fraction in this household is 0.392734413 (i.e. 0.786885246/2.003606557). If the reported household wheat flour consumption was 100 grams/day, the apparent WRA flour consumed is 39.27 grams/day (i.e. 100 grams/day flour x 0.392734413).

Box 3. The adult male equivalent (AME) fractions assigned to household members based on their sex and age (Sununtnasuk 2013).

ADULT MALE EQUIVALENT		
MALE	AGE (y)	FEMALE
0.216721311	0-1	0.216721311
0.311475410	1-2	0.278688525
0.368852459	2-3	0.344262295
0.409836066	3-4	0.377049180
0.442622951	4-5	0.409836066
0.483606557	5-6	0.434426230
0.516393443	6-7	0.467213115
0.557377049	7-8	0.508196721
0.598360656	8-9	0.557377049
0.647540984	9-10	0.606557377
0.704918033	10-11	0.655737705
0.770491803	11-12	0.704918033
0.836065574	12-13	0.745901639
0.909836066	13-14	0.778688525
0.983606557	14-15	0.803278689
1.040983607	15-16	0.819672131
1.090163934	16-17	0.819672131
1.114754098	17-18	0.819672131
1	18-30	0.786885246
0.967213115	30-60	0.770491803
0.803278689	60-150	0.688524590

The next step was to estimate the nutrients contributed by the fortified food apparently consumed by WRA. The nutrients assigned to each household's food were as follows:

a) If a food sample was taken from the home and analyzed, the nutrient value measured in the food sample was assigned to the household (e.g. 25 mg/kg iron in wheat flour).
b) In households where a food sample was not taken and the brand name was available, the median nutrient value out of all the samples analyzed from that brand that were collected from other households was used in that strata.
c) In households where a food sample was not taken and the brand name was not available (fortification unknown), the median nutrient value in the unbranded samples analyzed from other households in that strata was used.

The nutrients consumed from these foods were then expressed as a percentage of the nutrient RNI as noted by WHO/FAO (2004). The iron RNI for women, assuming 12% bioavailability, was as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The vitamin A RNI for women is as follows: 600 micrograms retinol equivalents (mcg RE)/day (15-18 years), 500 mcg RE/day (19-50 years), 800 mcg RE/day (pregnant women), and 850 mcg RE/day (lactating women). The iodine RNI for women was as follows: 150 µg/day (15-18 years), 150 µg/day (19-50 years), 200 µg/day (pregnant women), and 200 µg/day (lactating women). For women who were both pregnant and lactating, the pregnancy RNI was used for all nutrients. The percent of RNI met was calculated as follows: amount of nutrient consumed from food / nutrient RNI

x 100%. The pregnancy and lactation status of all women in the household was not known, as not all women in the household were necessarily available to participate in the survey. This information was only known for the subset of women who answered WRA questionnaire. Thus, all non-surveyed women (who were listed on the household roster) were assumed to be non-pregnant and non-lactating.

Multidimensional Poverty Index (MPI)

The MPI is adapted from Alkire and Santos (2013) and is derived from three domains: living standards (mpiS), household education (mpiED), and health and nutrition (mpiHN). The household living standard score was based on six variables: no electricity, inadequate flooring, inadequate cooking fuel, < 2 key assets owned, unsafe drinking water, and inadequate toilet sanitation). If affirmative, each living standard variable got a score of 1/18. The household education dimension was based on two variables: household head had less than five years of education and any school age child was not attending school. If affirmative, each education variable was scored 1/6. For households without a school age child the household was assigned a non-affirmative score 0/6. For health and nutrition, the domain was based on three variables: hunger (calculated using the household hunger index), recently born child died, and poor access to preventative services. All affirmative responses were given a score of 1/9. Next the scores from each domain were summed (i.e. mpiLS + mpiED + mpiHN) to obtain a maximum score of 1. Households with an MPI score greater than or equal to 0.33 were defined as at "at-risk of acute poverty" (poor) while households with an MPI less than 0.33 were classified as "non-poor".

The household hunger index instruments and scoring were adapted from Deitchler et al. (2010), Ballard et al. (2011) and Deitchler et al. (2011). The hunger score was calculated as a household cumulative sum of responses to 3 questions on "lack of food", "insufficient food over the past month", and "insufficient food (day and night)".

Women's dietary diversity score

The dietary diversity instrument and scoring were based on the 10 point score (FAO and FHI 360, 2016). Women were asked about their consumption of 18 food groups over the previous 24 hours. These responses were distilled into a 10 point scoring system based on the following 10 food groups: 1. All starchy staple foods, 2. Beans and peas, 3. Nuts and seeds, 4. dairy, 5. Flesh foods, 6. Eggs, 7. Vitamin A rich dark green leafy vegetables, 8. Other vitamin a-rich fruits and vegetables, 9. Other vegetables, and 10. Other fruits. If a woman consumed a food from a food group, she received a score of 1 for the food group and a maximum of 10 if she consumed foods from all of the food groups. This summary score (0-10) was the woman's dietary diversity score. A woman's score less than the population median in each stratum (i.e. rural or urban residence) was classified as "lower dietary diversity (below the median)", otherwise it was termed "higher dietary diversity (at or above the median)".

To obtain the proportion of women that consumed plant sources of vitamin A, a woman had to have consumed in the last 24 hours a food from either food groups 7,or 8; for animal sources of vitamin A groups 4, 5 or 6; for iron rich foods and for zinc rich foods groups 4 or 5.

I. ETHICAL CONSIDERATIONS

Ethical approval for the FACT survey was granted by the National Institute of Medical Research (NIMR) (**Annex E**). Data collection began only after ethical approval was obtained. At each selected household, the advantages and risks for participating household members were described by data collection teams. Written informed consent was obtained from the participants. The consent form was written in Swahili in a format that could be easily understood by study participants with little or no education. The consent form was read out

loud to the participant if he/she was unable to read Swahili. If necessary, a survey team member or other community member was enlisted to translate the consent form to the potential participant's native language. At the time of analyzing information and publishing the results of the study, identifying information was not used.

J. LIMITATIONS

There were several limitations of the project that are outlined below:

a) The fortification program in Tanzania includes fortificants other than iron in wheat and maize flour (e.g. maize is also fortified with folic acid and vitamin B12), but in this survey only iron was assessed in wheat and maize flour and served as a “marker” to reflect likely fortification of other micronutrients including vitamin A and folate. Laboratory testing was conducted on all food samples collected in the households, but the small number of samples collected for many brands limits the reliability of brand specific information.

b) The two methods used to assess dietary intake of iron-fortified foods use self-report and have limitations that could affect the estimated contribution of fortified foods to nutrient intakes. Self-reporting can introduce recall bias, as people were asked to recall the amount of foods they purchased and consumed. The use of the adult male equivalent (AME) methodology to estimate apparent consumption of foods and nutrients has recognized limitations, due to the extrapolations of household purchases to consumption, and of assuming that intra-household food distribution is the same in all households based on the person’s age, sex and physiological status (Imhoff-Kunsch 2012). The photo grid methodology uses a short food frequency questionnaire and is subject to the limitations of that method (Thompson 2015). It should be noted that the FACT survey tool has not been compared with other methods of dietary intake. The photo grids and recipes used to estimate the intake of wheat flour-based foods were not validated. When more than one woman of reproductive age answered the dietary diversity information per household, the dietary diversity score of one woman was randomly selected and applied to the household. The method did not take into account intra–household clustering of dietary habits of women within the same household. One woman’s dietary diversity may not reflect the pattern of multiple family members.

c) Using the grand median added iron levels from household wheat flour samples when calculating the RNI contribution in the individual assessment is a limitation as household samples do not necessarily capture the variety of wheat flour types used in wheat flour products purchased and consumed away from the home. Moreover, due to the small number of wheat samples collected and analyzed (i.e. 191) for many brands, the reliability of brand specific information per household was limited. As a result, the grand median level was used for all women as an estimate of what consumers on average are likely to consume. Analysis of wheat flour samples collected at market level may have been more representative of fortification levels in wheat flour however that was beyond the scope of this survey.

d) The definition of ‘fortified’ food for a household was based on the median nutrient of the brand the household reported to consume when food samples were not collected.

This is subject to recall bias as more popular brands are more likely dominate responses.

e) The term 'fortified' for wheat and maize flour was based on the nutrient content above the 'intrinsic value' for both these foods. Unfortunately only a small number of known unfortified samples were used to determine this intrinsic value, one sample for wheat flour and eight samples for maize. This intrinsic amount was then subtracted from each analyzed specimen to obtain the added nutrient content, apparently due to fortification. The main limitation is that very few samples were used to determine this intrinsic value. Additionally, in Tanzania the fortification standard is based on added iron versus total iron content. As a result, many Tanzanian samples of maize flour are classified as unfortified, even though in other countries the amount of total iron present may have been high enough to classify them as fortified.

f) Labelling of the collected food samples followed a systematic process but unfortunately several of the food samples were unlabeled (39 oil, 17 wheat, 58 maize and 39 salt), so it was not possible to link the food sample to the household or determine if the food sample came from the urban or rural strata. The results from the unlabeled food specimens contributed only to the national fortification standards estimates.

g) The data from Zanzibar was included in the results section of the report due to the semi-autonomous governance of this part of Tanzania and the request from the government to also provide information that is Zanzibar specific. A limitation of the sampling and analysis is that the data from Zanzibar is not representative, unlike the data from the national, urban and rural strata, which also includes the data from Zanzibar.

7. RESULTS

The response rate for household questionnaire 1 was 99.1% nationally, 99.3% for urban, 99.0% in for rural and 96.4% for Zanzibar (**Table 1**). In total, 1,050 households were invited to participate in the survey, 9 households refused and a total of 1041 households were interviewed (609 rural and 432 urban (which included mainland and Zanzibar) and 159 for Zanzibar alone). Response information for household questionnaire 2 and the female survey was not available.

Table 1. Response rate for different components of the survey.

			Household questionnaire1[2]
Sample	National*	Planned[1]	1050
		Interviewed	1041
		Response rate (%)	99.1
	Rural	Planned[1]	615
		Interviewed	609
		Response rate (%)	99.0
	Urban	Planned[1]	453
		Interviewed	432
		Response rate (%)	99.3
	Zanzibar	Planned[1]	165
		Interviewed	159
		Response rate (%)	96.4

[1] These are the number that were planned to be visited, based on sample size calculations.

[2] Household questionnaire 1 asked about the household roster; birth history of women in household; household characteristics; water, sanitation and hygiene; and health services access.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, urban estimates include all EAs classified as urban including those urban EAs in Zanzibar, and Zanzibar includes only EAs in Zanzibar.*

The median household size was 4.4 nationally, 4.6 for rural, 4.1 for urban and 4.3 for Zanzibar (**Table 2**).The household dependency rate was 0.9 nationally, 0.9 rural, 0.6 urban and 0.7 for Zanzibar, indicating fewer dependents (those below 15 years and above 64 years) per independents (those between 15 and 64 years of age) in the households. Female-headed households were 25.6% nationally, 23.4% in the rural and 30.2% in the urban areas and 32.6% in Zanzibar. Overall, the mean age of the household head was 43.7 years.

Table 2. Summary of household characteristics.[1]

Characteristic	National* N=1041	Rural N=609	Urban N=432	Zanzibar N=159	P-value[†]
	Median (25%, 75%), % (95% CI) or mean (95% CI)	Median (25%, 75%), % (95% CI) or mean (95% CI)	Median (25%, 75%), % (95% CI) or mean (95% CI)	Median (25%, 75%), % (95% CI) or mean (95% CI)	
Household size[2]	4.4 (2.8-6.2)	4.6 (2.9-6.5)	4.1 (2.6-5.7)	4.3 (2.6-5.9)	0.0036
Household dependency ratio[2,3]	0.9 (0.4-1.4)	0.9 (0.5-1.5)	0.6 (0.3-1)	0.7 (0.2-1.2)	0.0001
Female-headed household[4]	25.6 (22.5-28.8)	23.4 (19.2-27.5)	30.2 (25.8-34.6)	32.6 (21.0-44.2)	0.0164
Age of head of household[2]	43.7 (42.6-44.9)	43.7 (42.3-45.2)	43.7 (41.6-45.8)	45.1 (41.3-48.8)	0.8509

Abbreviation: CI= confidence interval

[1] All values are median, mean or percent as indicated, adjusted for probability of selection by PPS and are weighted to correct for unequal probability of selection.

[2] Median (25%, 75%).

[3] Household dependency ratio = Number of household members below 15 years of age and above 64 years of age / Number of household members between 15 and 64 years of age.

[4] Percent (95% CI)

[†] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

Women who participated in the female questionnaire were on average 28.7 years, 28.7 in the rural and 28.6 in the urban areas and 28.4 in Zanzibar (**Table 3**). Overall, 5.6% were pregnant, 6.3% in rural areas, 6.3% in urban areas and 5.6 % in Zanzibar. The proportion of women breastfeeding was 27.7% overall, 30.2% in rural, 23% in urban and 22.1% in Zanzibar.

Table 3. Summary characteristics of women of reproductive age who participated in the female questionnaire.[1]

Characteristic	National* N=1236	Rural N=706	Urban N=530	Zanzibar N=182	P-Value[†]
	Mean (95% CI), % (95% CI)	Mean (95% CI), % (95% CI)	Mean (95% CI), % (95% CI)	Mean (95% CI), % (95% CI)	
Age in years[2]	28.7 (28.2-29.1)	28.7 (28.1-29.3)	28.6 (27.9-29.3)	28.4 (26.8-30)	0.7889
Pregnant[3]	5.6 (4.1-7.1)	6.3 (4.3-8.3)	4.2 (2.1-6.3)	5.6 (1.2-9.9)	0.1505
Breast feeding[3]	27.7 (24.6-30.9)	30.2 (25.9-34.5)	23.0 (19.1-26.8)	22.1 (13.6-30.7)	0.0077

Abbreviation: CI= confidence interval

[1] All values are mean or percent as indicated, and are weighted to correct for unequal probability of selection.

[2] Mean (95% CI).

[3] Percent (95% CI).

[†] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

An estimated 45% households overall were classified as at risk of acute poverty based on the MPI; 59.4% in rural areas, 16.0% in urban areas and 28.9% in Zanzibar (see **Table 4).** MPI is constructed from three domains: living standards, household education, and health and nutrition. One of the variables that composes living standards which has the most marked difference between rural and urban areas is lack of electricity; 70.5% overall, 87.3% rural, 36.6% urban and 50.3% in Zanzibar lacked electricity. Any household member 5-14 years not currently attending school is a component of the education domain: 15% overall, 17.8% of rural, 9.3 of urban and 15.7 of Zanzibari households had at least one household member of school-attending age who was not in school. The health and nutrition domain has a component related to whether a child less than five years of age died in the past five years; Overall 1.2% of households had a child that died in the past five years; 1% for rural, 1.8 for urban and 3.1% in Zanzibar.

Table 4. Multidimensional Poverty Index (MPI) and the variables that compose it.[1]

MPI and components	National* N=1041	Rural N=609	Urban N=432	Zanzibar N=159	P-Value†
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	
At risk of acute poverty (MPI ≥0.33)[2]	45.0 (37-53.1)	59.4 (50.2-68.6)	16.0 (10.6-21.4)	28.9 (11-46.9)	<.0001
Living standards component					
No electricity	70.5 (62.7-78.3)	87.3 (81.5-93.1)	36.6 (25.5-47.7)	50.3 (27.2-73.4)	<.0001
Inadequate cooking fuel sources[3]	96 (93.9-98.1)	99.0 (98.1-100)	89.9 (84.5-95.2)	95.6 (88.6-100)	<.0001
Inadequate flooring[4]	52.5 (43.7-61.3)	72.5 (65-79.9)	12.1 (5.5-18.8)	22.6 (5.6-39.7)	<.0001
Unimproved drinking water source[5]	45 (35-55)	54.7 (41.6-67.8)	25.3 (13.3-37.2)	17.6 (3.9-31.4)	0.0008
Inadequate toilet sanitation[6]	75.4 (70.2-80.6)	77.7 (71.8-83.7)	70.6 (60.3-80.9)	83.0 (70.1-95.9)	0.1989
< 2 household assets[7]	4.3 (1.9-6.7)	6.3 (2.8-9.8)	0.3 (0-0.8)	3.8 (0-8.6)	<.0001
Education component					
Head of household with less than five years of education, % (95% CI)	22.5 (18.1-26.9)	26.3 (20.3-32.2)	14.8 (9.8-19.8)	30.2 (15-45.4)	0.0017
Any household member 5-14 years NOT currently attending school	15.0 (12.3-17.7)	17.8 (14.4-21.2)	9.3 (5.7-12.9)	15.7 (6.4-25.1)	0.0005
Health and nutrition component					
Moderate to severe household hunger	17.3 (12.8-21.8)	19.8 (13.3-26.3)	12.3 (8.1-16.3)	15.7 (2.7-28.8)	0.0303
Child 0-59 months who died in past 5 years (%, 95%CI)	1.2 (0.5-2.0)	1.0 (0.2-1.8)	1.8 (0-3.6)	3.1 (0.8-5.5)	0.3634
Poor access to health services	43.6 (33.7-53.6)	55.8(43-68.6)	19.0 (9.2-28.7)	22.6 (0.3-45)	<.0001

Abbreviations: CI, confidence interval; MPI, multidimensional poverty index

[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection.

[2] MPI greater than or equal to 0.33 is a proxy for poverty risk.

[3] Inadequate cooking fuel sources include any sources not from electricity or liquefied petroleum gas

[4] Flooring made of earth, dung or sand
[5] Any water source that is not piped water into yard/plot, public tap, neighbors tap
[6]Toilet sanitation is considered inadequate if the household does not use a flush toilet piped into a sewer system or to a septic tank
[7] From an asset list with 15 items (Television, mobile phone, fixed phone, refrigerator, table, chair, sofa set, bed, cupboard, clock, watch, bicycle, motorcycle/scooter, animal drawn cart, car or truck, boat with motor, boat without motor).
[†] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects
**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

Median dietary diversity scores for women of reproductive age were 4.7 overall, 4.2 in rural areas, 5.4 in urban and 4.7 in Zanzibar (**Table 5**). Correspondingly, 73.2% of women in Tanzania overall were classified as having a higher dietary diversity score, 71.5% in Rural areas, 76.4% in urban areas and 80.4% in Zanzibar. More than 90% of women in all areas consumed vitamin-A rich sources of animal origin. Nationally 69.3% of women consumed iron rich foods and it was as low as 62.8% in rural areas. However in urban areas and in Zanzibar it was 81.9% and 88.6% respectively.

Table 5. Dietary diversity score and its components for women of reproductive age.[1]

Dietary diversity score and components	**National* N=1236**	**Rural N=706**	**Urban N=530**	**Zanzibar N=182**	**P - Value[†]**
	Median (25%, 75%), % (95% CI)	Median (25%, 75%), % (95% CI)	Median (25%, 75%), % (95% CI)	Median (25%, 75%), % (95% CI)	
Dietary diversity score[2]	4.7 (3.1-6.3)	4.2 (2.8-5.9)	5.4 (4-7.2)	4.7 (3.4-6.3)	0.2120
Higher dietary diversity score (at or above the median)[3,4, ¥]	73.2 (69.1-77.3)	71.5 (66.1-77))	76.4 (70.5-82.3)	80.4 (72.8-88.1)	0.0331
Consumed plant sources of vitamin A[3,5]	84.6 (81.6-87.6)	82.6 (78.5-86.7)	88.6 (84.5-92.7)	80.6 (71.4-89.9)	0.0051
Consumed animal sources of vitamin A[3,5]	97.3 (96-98.7)	96.5 (94.5-98.5)	98.9 (98-99.8)	100 (--)	<.0001
Consumed iron-rich foods[3,5]	69.3 (64-74.6)	62.8 (55.4-70.2)	81.9 (76.3-87.5)	88.6 (81.4-95.7)	<.0001
Consumed zinc-rich foods[3,5]	69.1 (63.8-74.5)	62.6 (55.2 -70.1)	81.9 (76.3-87.5)	88.6 (81.4-95.7)	0.2120

Abbreviation: CI, confidence interval
[1] All values are median or percent as indicated, adjusted for probability of selection by PPS and are weighted to correct for unequal probability of selection.
[2] Median (25%, 75%).
[3] Percent (95% CI).
[4] Dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence).

[5] Women consumed at least one food item from the relevant food groups. Plant sources of vitamin A consumed in the last 24 hours a food from either food groups 7 or 8; for animal sources of vitamin A groups 4, 5 or 6; for iron rich foods and for zinc rich foods groups 4 or 5.

[¶] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

[¥] Categorization of lower and higher dietary diversity was based on an integer median score of 4 and 5 respectively for rural and urban strata. Additionally, as the strata median came from a non-symmetric distribution, the estimated proportions accounted for complex survey design effects and may not evenly divide the population along median quantile for the overall dietary diversity and related component variables.

When stratified by household poverty risk (from the Multidimensional Poverty Index), the proportion of women with a higher dietary diversity score was statistically significantly different between poor (63.8%) and non-poor (80.1%) households nationally (**Table 6**). In rural areas the proportion of women with a higher dietary diversity score was lower for poor (64.5%) than the non-poor (81.3%), in urban areas there was also a statistically significant difference between poor (58.1%) and non-poor (79.1%). In Zanzibar there was no statistically significant difference between poor (76.1%) and non-poor (81.9%) women. In Zanzibar there was no statistical difference between poor and non-poor women for any of the indicators. Nationally, in rural areas and urban areas there were similar patterns where women in poor households were less likely to have consumed iron and zinc rich foods than women in non-poor households. The pattern was different in Zanzibar, where there was no statistical difference between poor and non-poor women consuming iron and zinc rich foods.

Table 6. Dietary diversity score and its components for women of reproductive age by poverty risk.[1]

Dietary diversity score and components	Poor (% (95% CI))[2]	Non-poor (% (95% CI))[2]	p-value[3]
National*	**N=460**	**N=771**	
Higher dietary diversity score, at or above the median[4, ¥]	63.8 (57.3-70.3)	80.1 (75.8-84.5)	<.0001
Consumed plant sources of vitamin A[5]	78.9 (73.1-84.6)	89.0 (85.9-92.0)	0.0006
Consumed animal sources of vitamin A[5]	94.9 (92.1-97.6)	99.1 (98.2-100)	0.0001
Consumed iron-rich foods[5]	53.6 (46.6-60.5)	80.9 (76.4-85.5)	<.0001
Consumed zinc-rich foods[5]	53.6 (46.6-60.5)	80.8 (76.1-85.4)	<.0001
Rural	**N=393**	**N=310**	
Higher dietary diversity score, at or above the median[4]	64.5 (57.3-71.6)	81.3 (74.6-88)	0.0003
Consumed plant sources of vitamin A[5]	78.9 (72.7-85.1)	87.7 (83-92.5)	0.0253
Consumed animal sources of vitamin A[5]	94.4(91.2-97.5)	99.2 (97.6-100)	0.0207
Consumed iron-rich foods[5]	52.8 (45.2-60.5)	76 (67.8-84.1)	<.0001

Dietary diversity score and components	Poor (% (95% CI))[2]	Non-poor (% (95% CI))[2]	p-value[3]
National*	**N=460**	**N=771**	
Consumed zinc-rich foods[5]	58.1(42.5-73.6)	79.1 (73.2-84.9)	<.0001
Urban	**N=67**	**N=461**	
Higher dietary diversity score, at or above the median[4]	58.1 (42.5-73.6)	79.1 (73.2-84.9)	0.0013
Consumed plant sources of vitamin A[5]	78.2 (62.8-93.6)	90.1 (86.1-94.1)	0.0463
Consumed animal sources of vitamin A[5]	98.3 (95.2-100)	99.0 (98-99.9)	0.6271
Consumed iron-rich foods[5]	59.8 (44.1-75.6)	85.6 (81.2-90.1)	<.0001
Consumed zinc-rich foods[5]	59.8 (44.1-75.6)	85.6 (81.2-90.1)	<.0001
Zanzibar	**N=45**	**N=137**	
Higher dietary diversity score, at or above the median[4]	76.1 (38.8-89.8)	81.9 (73.1-90.7)	0.5061
Consumed plant sources of vitamin A[5]	68.6 (47.1-90)	84.8 (74.4-95.2)	0.1089
Consumed animal sources of vitamin A[5]	100 (--)∞	100 (--)∞	ǂ
Consumed iron-rich foods[5]	85.4 (70.5-100)	89.7 (82.4-97)	0.4959
Consumed zinc-rich foods[5]	85.4 (70.5-100)	89.7 (82.4-97)	0.4959

Analytic sample size is based on all women interviewed. There were 1236 women interviewed, of these 5 of the women did not have household poverty data, which resulted in an effective sample size n of 1231(460 poor and 771 non-poor).

Abbreviation: CI, confidence interval

[1] All values are percent as indicated, adjusted for probability of selection by PPS and are weighted to correct for unequal probability of selection.

[2] Multidimensional Poverty Index (MPI) greater than or equal to 0.33 is "poor" and MPI less than 0.33 is "non-poor".

[3] Comparing poor versus non-poor. Complex survey chi-square test was used to compare percentages.

[4] Dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence). The population median is 4 in rural areas and 5 in urban areas.

[5] Women consumed at least one food item from this food group.

∞ The 95% CI was not estimable as the standard error around the proportion was 0.

ǂ Chi-square test P values not estimable because at least one table cell has 0 frequency.

¥ Categorization of lower and higher dietary diversity was based on an integer median score of 4 and 5 respectively for rural and urban strata. Additionally, as the strata median came from a non-symmetric distribution, the estimated proportions accounted for complex survey design effects and may not evenly divide the population along median quantile for the overall dietary diversity and related component variables.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The household food samples laboratory analyzed is summarized in **Table 7**. Nationally 725 oil samples were analyzed and 856 salt samples. There were far fewer wheat and maize flour samples available for analysis, 191 wheat and 333 maize flour. Results from the food sample analysis can be found in **Figure 4**, **Annex I**.

Table 7. Summary of food samples analyzed

Food samples	National[1]	Rural	Urban	Zanzibar
Oil	725	400	286	47
Wheat flour	191	80	94	30
Maize flour	333	75	177	23
Salt	856	483	334	86

[1] A number of samples (i.e. 39 oil, 17 wheat flour, 58 maize flour, and 39 salt samples) could not be utilized in rural urban stratified analyses due to missing specimen identifier information, labelling issues, and or could not be linked to the household database. As a result, the sum of rural and urban will not equal total the national samples shown.

The household coverage of foods is noted in **Figure 1** and **Annex I**. For oil, 96.2% of households nationally reported consuming oil (**Figure 1A**) and 92.6% of households consumed fortifiable oil (i.e.: oil that was not made at home and is assumed to be industrially processed). An estimated 53.6% of households nationally, 51.4% in rural areas, 58% in urban areas and only 8.9% in Zanzibar consumed fortified oil.

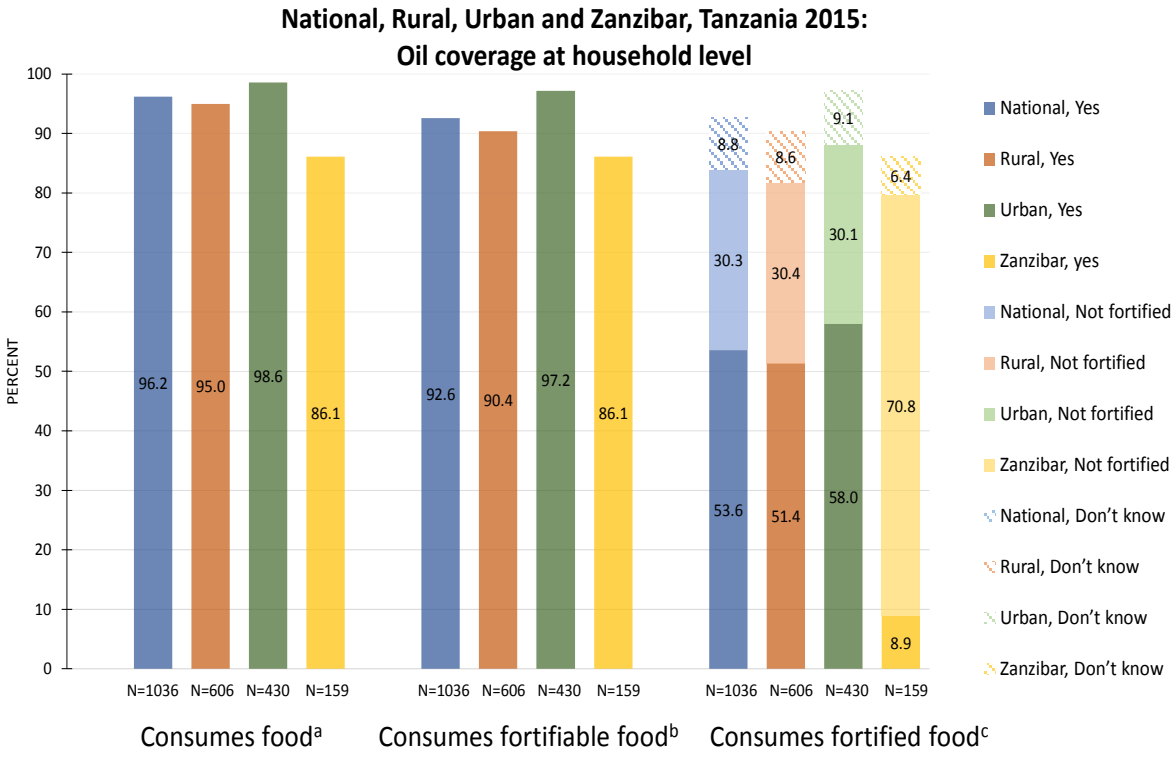
For wheat flour, just over half of the households nationally consumed wheat flour and fortifiable wheat flour, while 33.1% consumed fortified wheat flour (**Figure 1B**).The proportion of households consuming wheat flour was far higher in urban areas of Tanzania and Zanzibar. Only 25.2% of rural households consumed fortified wheat flour compared to 49% of urban household and 71.3% of households in Zanzibar.

Nationally 93.0% of all households reported consuming maize flour, 36.6% consumed fortifiable flour, and 2.5% consumed fortified maize flour (**Figure 1C**). For rural areas, 91.9%, 20.8% and 1.5% of households consumed maize flour, fortifiable maize flour, and fortified maize flour, respectively. For urban areas, 95.4%, 68.4 and 4.6% of households consumed maize flour, fortifiable maize flour, and fortified maize flour, respectively. In Zanzibar the proportion of households that consumed maize flour, fortifiable maize flour was high (over 76%) but none of the maize flour was fortified.

Among all foods, the highest coverage was observed for fortified salt (**Figure 1D**). Nearly 100% of all households reported consuming salt and fortifiable salt nationally; however, only 69.6% nationally, 61.6% in rural areas, 79.5% in urban areas and 55.8% in Zanzibar consumed fortified salt.

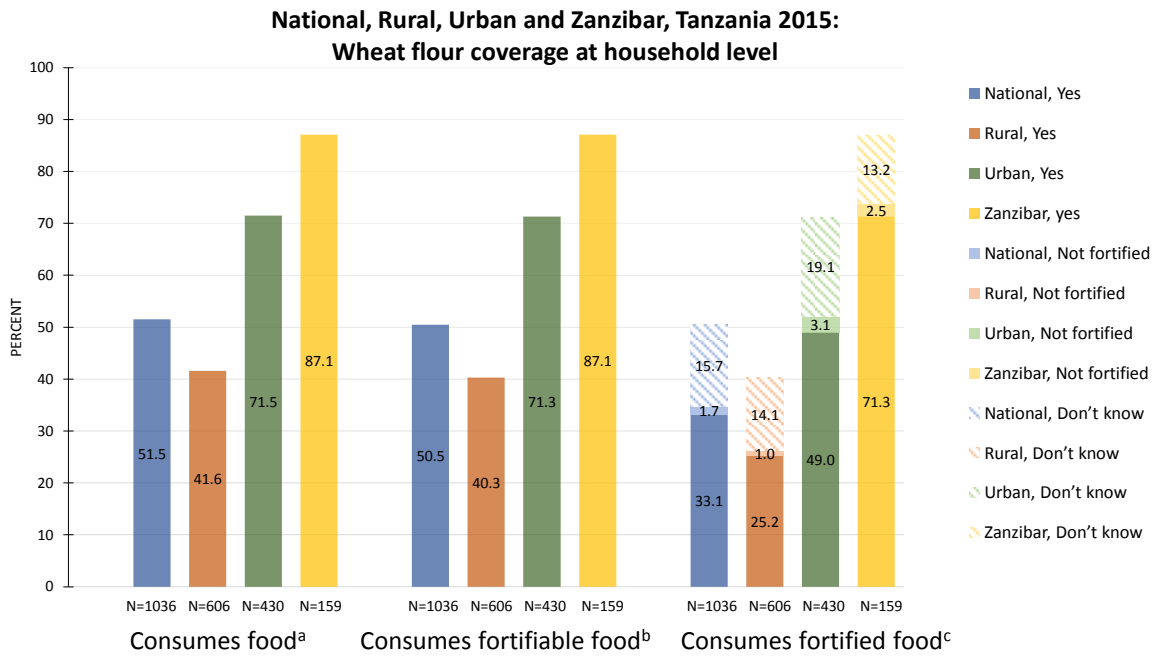
Figure 1. Household coverage of foods.[1,2]

A



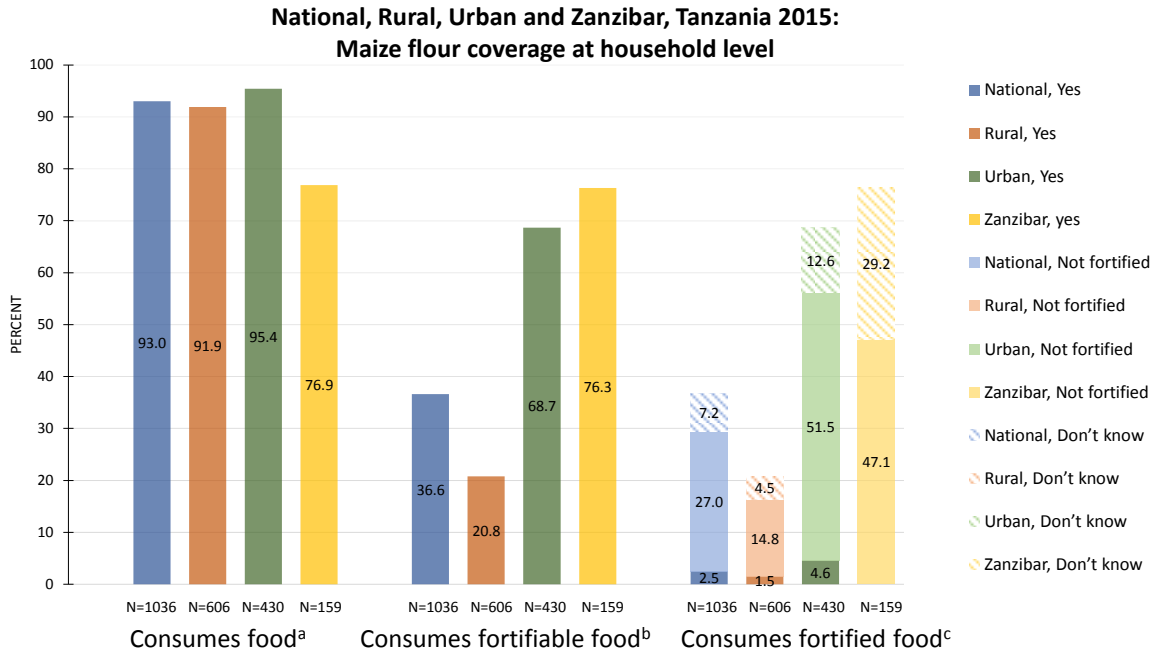
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

B.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

C.



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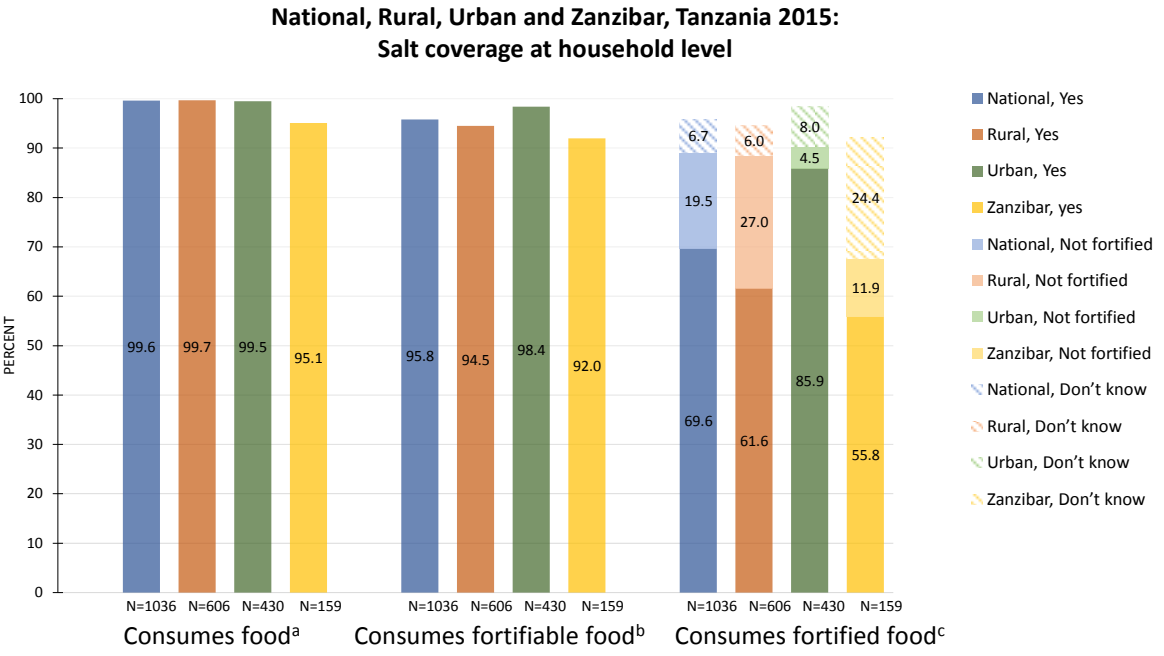
D.



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[1] *"Consumes food" refers to households that report preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed. "Consumes fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine). "Consumes fortified food" was determined as follows:*
(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food are not shown.

Household coverage of foods was stratified by poverty risk for households nationally, in rural and urban areas and in Zanzibar (**Figure 2** and **Annex I**). Nationally, oil was consumed in 98.6% of non-poor households compared to 93.3% of poor households ($p<0.05$) (**Figure 2A**). However nationally there was no difference between poor (55.0%) and non-poor households (52.5%) consuming fortified oil. There were no statistically significant differences between poor and non-poor households in rural and urban areas and in Zanzibar regarding the consumption of fortified oil.

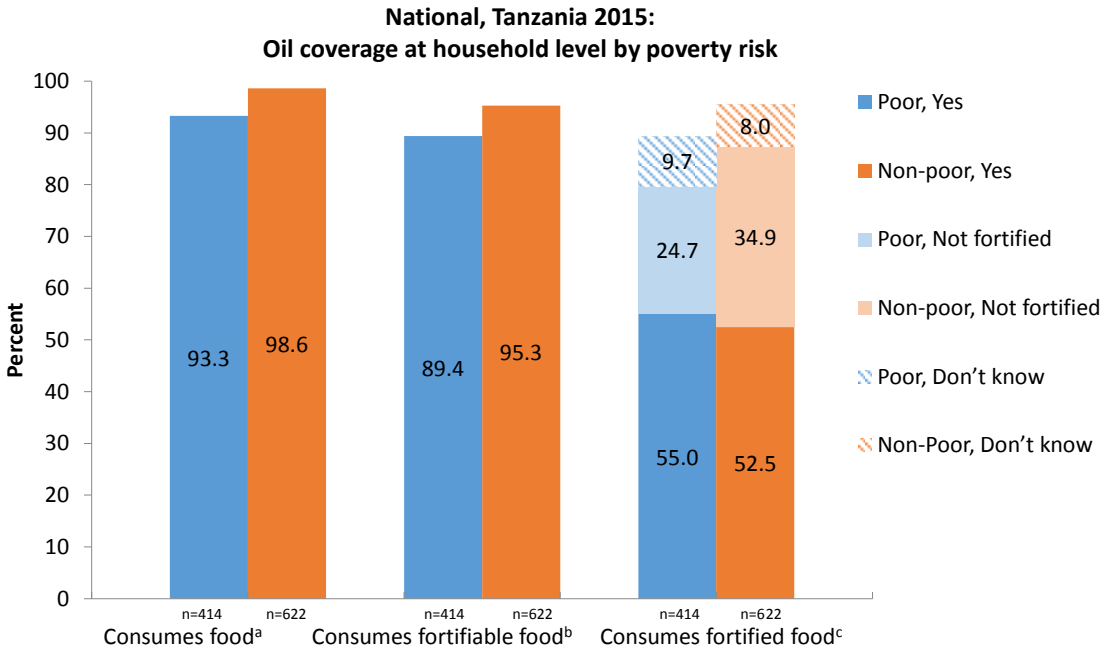
A significantly greater proportion of non-poor households nationally and in rural and urban areas consumed wheat flour, fortifiable wheat flour, and fortified wheat flour compared with non-poor households (**Figure 2B**). In Zanzibar however, there was no statistical difference between poor and non-poor households.

Nationally a significantly greater proportion of non-poor households consumed maize flour and consumed fortifiable maize flour than in poor households but only 2.8% of poor households and 2.3% of non-poor households consumed fortified maize flour at all. A similar trend was also seen in rural and urban areas and in Zanzibar. The main significant difference was that in poor households in urban areas 11.9% of households consumed fortified maize flour compared to only 3.2% of non-poor households (**Figure 2K**).

For salt, most households consumed salt and consumed fortifiable salt at high levels nationally and in rural, urban areas and in Zanzibar. The proportion of households consuming fortified salt tended to be lower in poor households compared to non-poor, but there was only a significant difference nationally and in rural areas where only 51.6% of poor household's consumed fortified salt compared to 76.2% of non-poor households (**Figure 2H**).

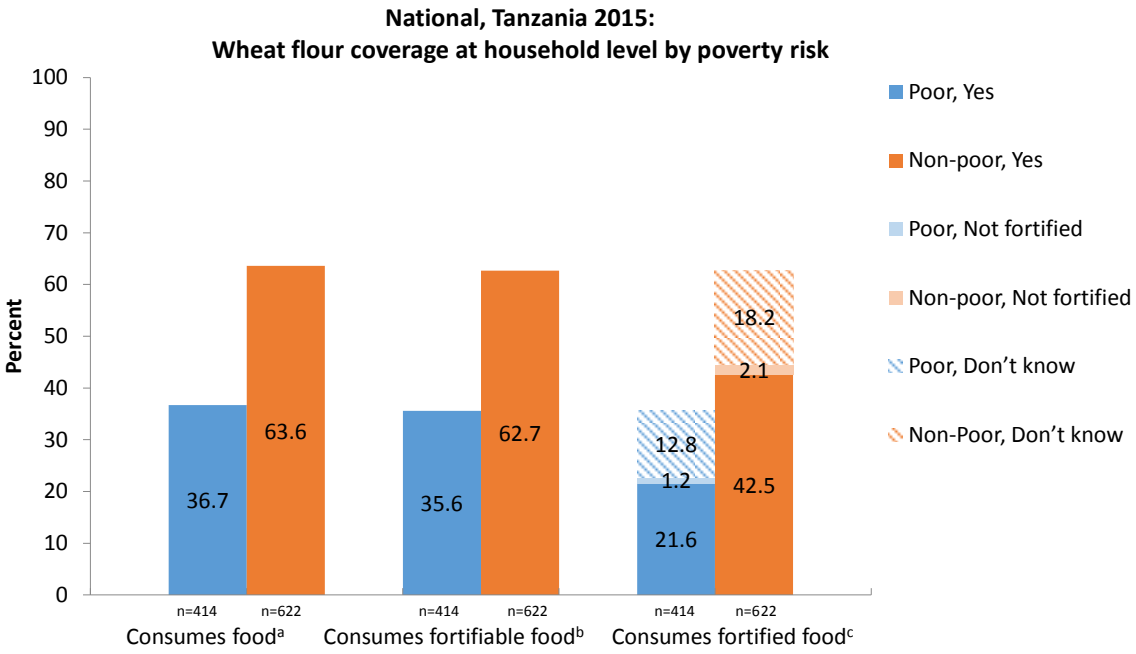
Figure 2. Household coverage of foods by poverty risk.[1,2]

A.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

B.



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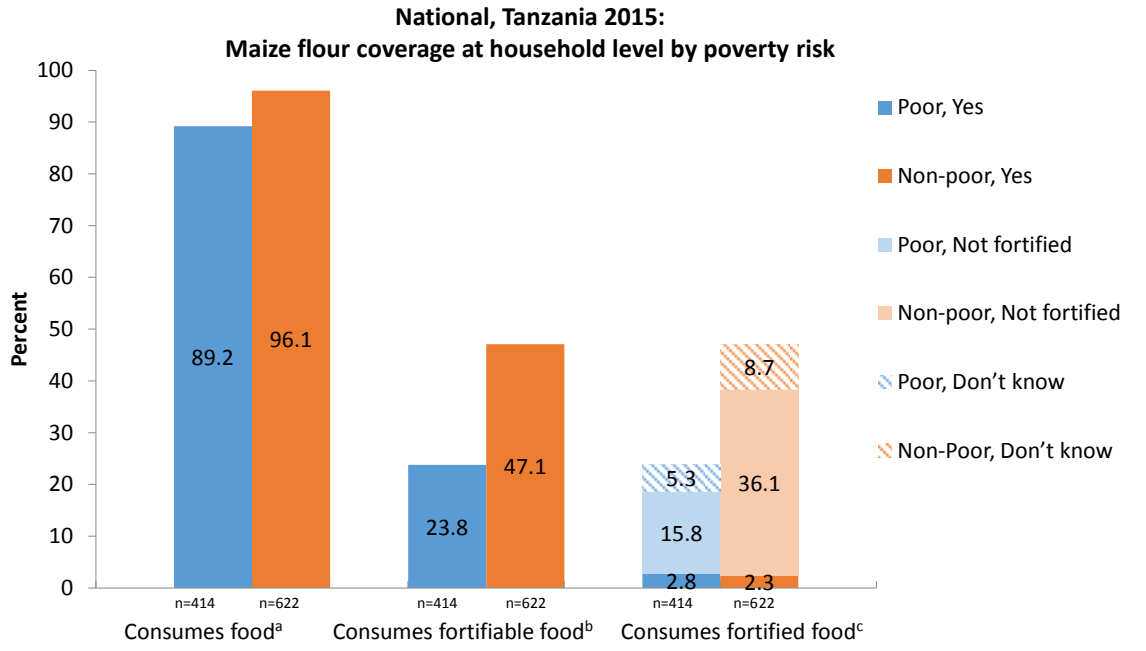
C.



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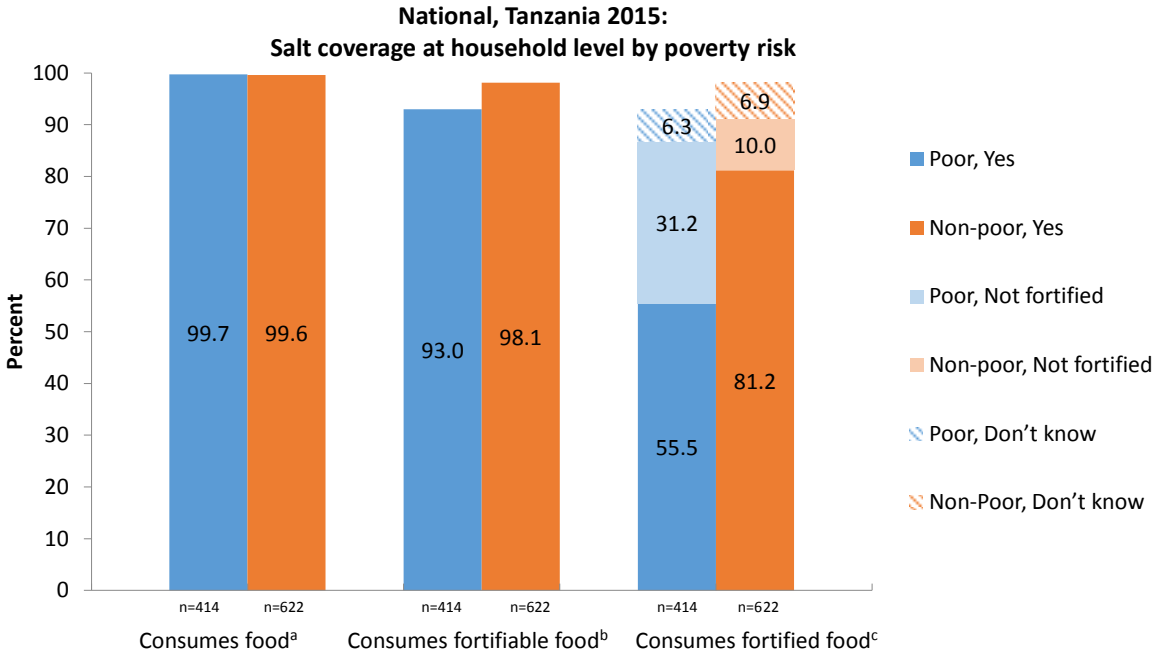
D.



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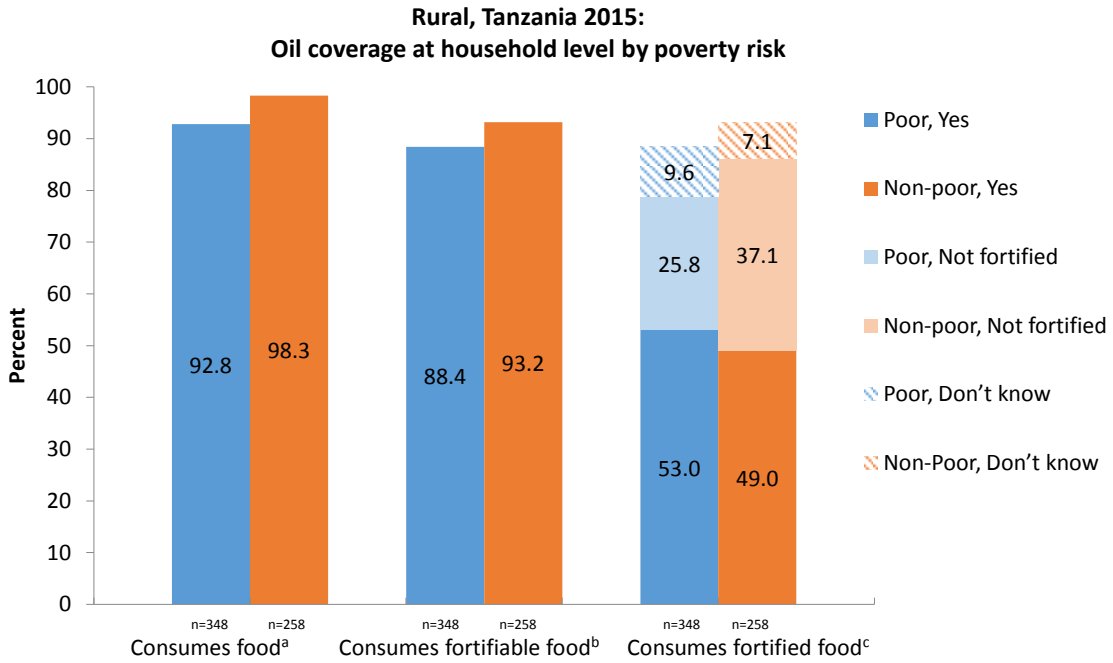
E.



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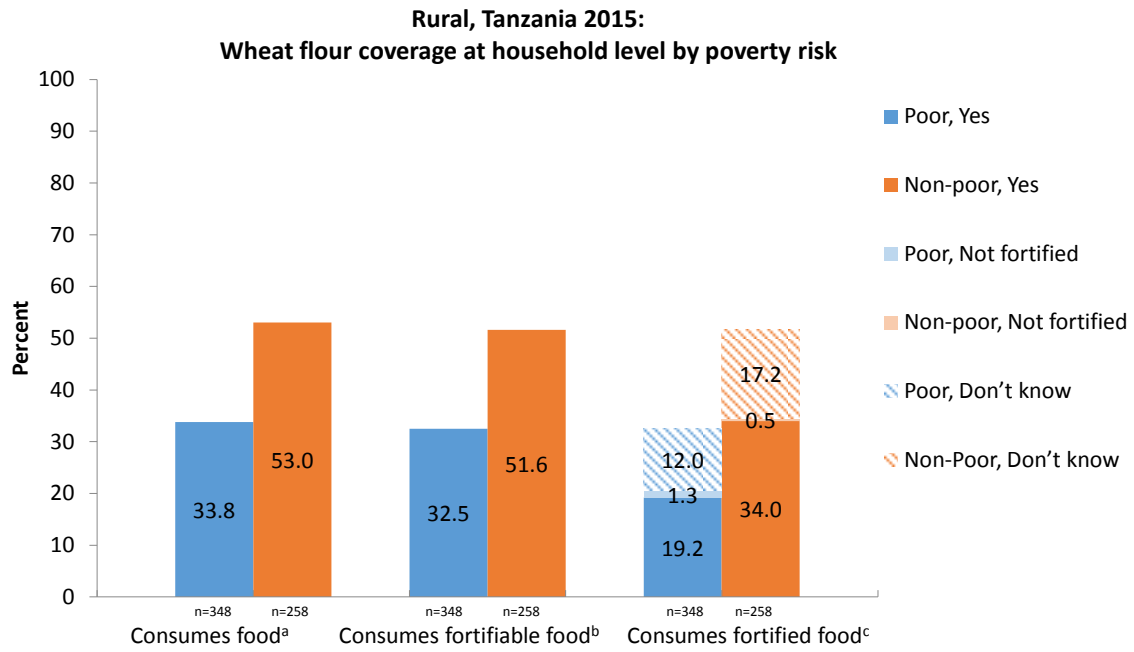
F.



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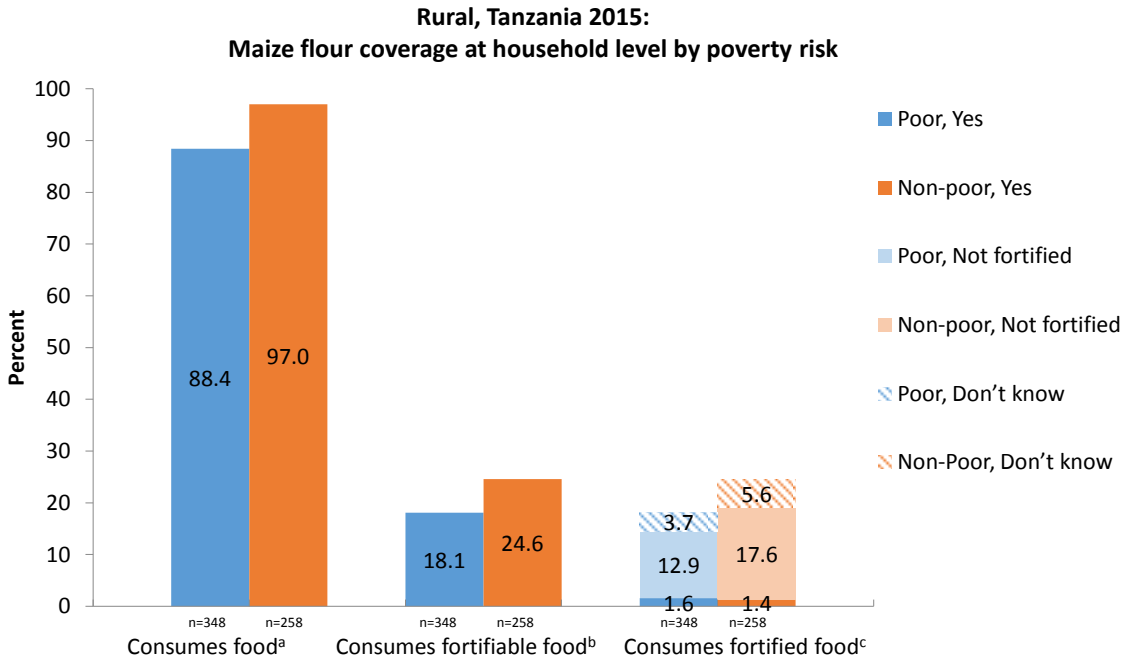
G.



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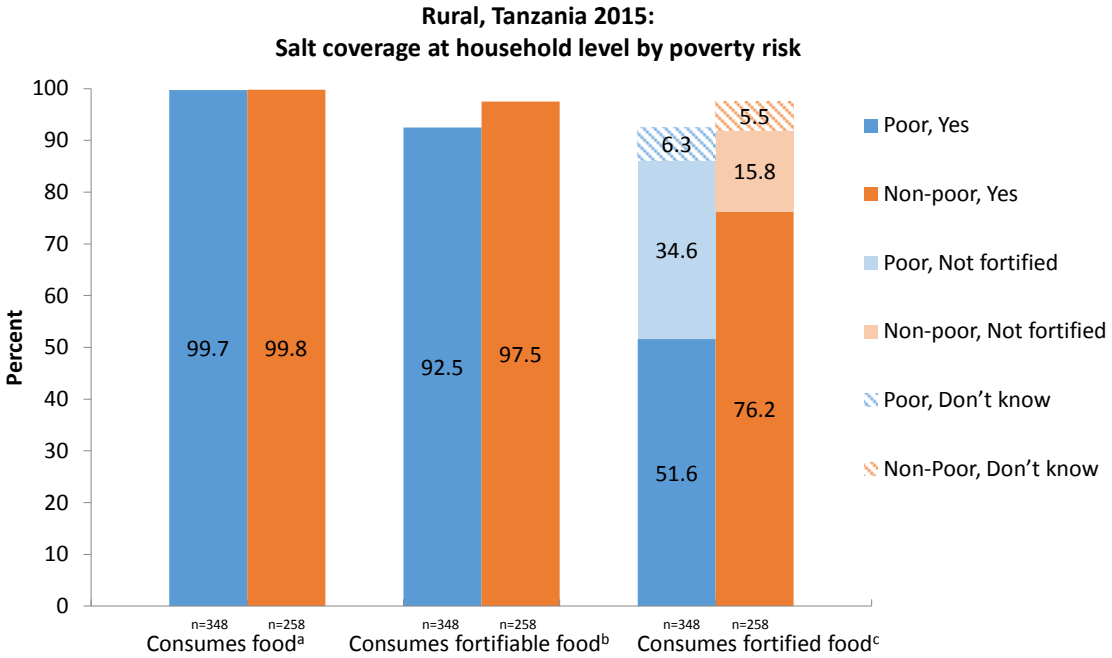
H.



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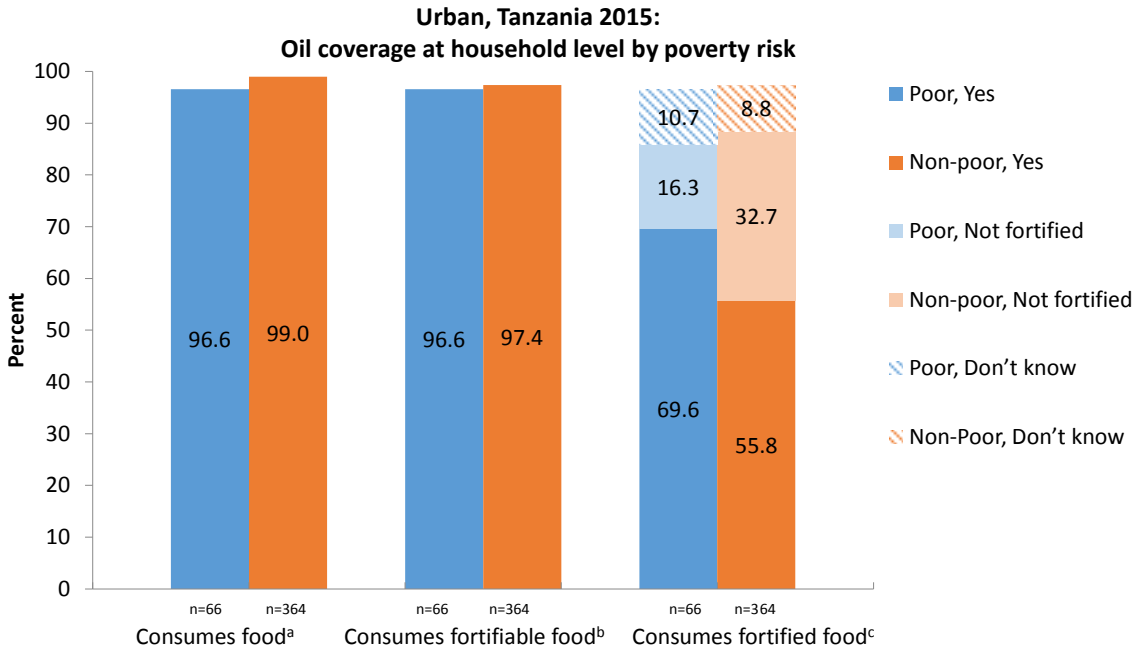
I.



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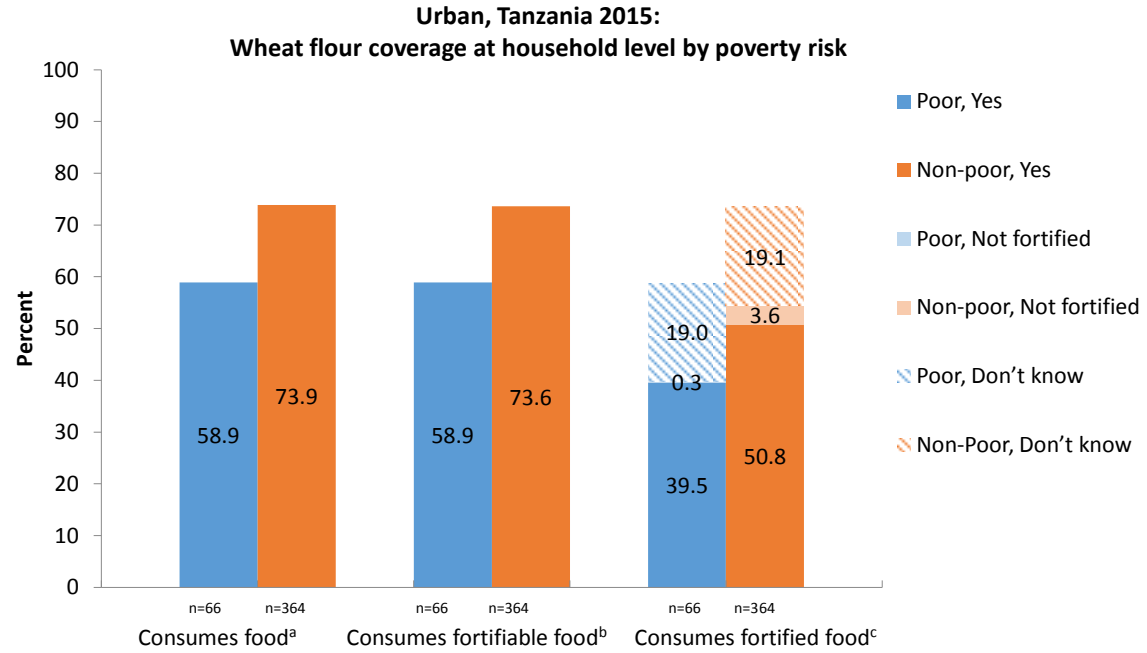
J.



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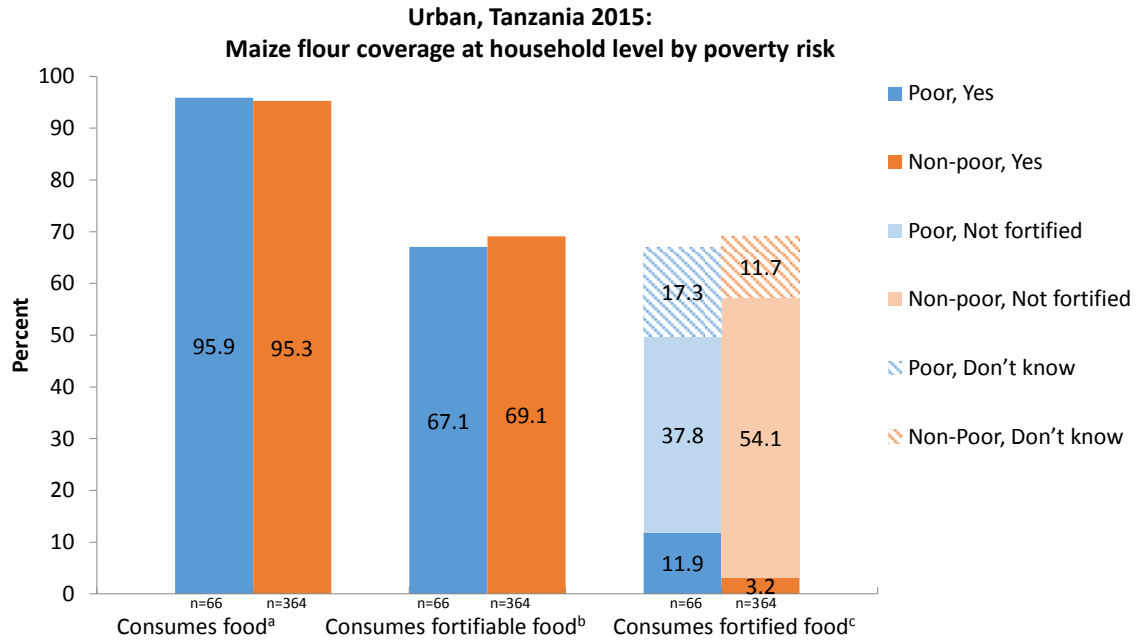
K.



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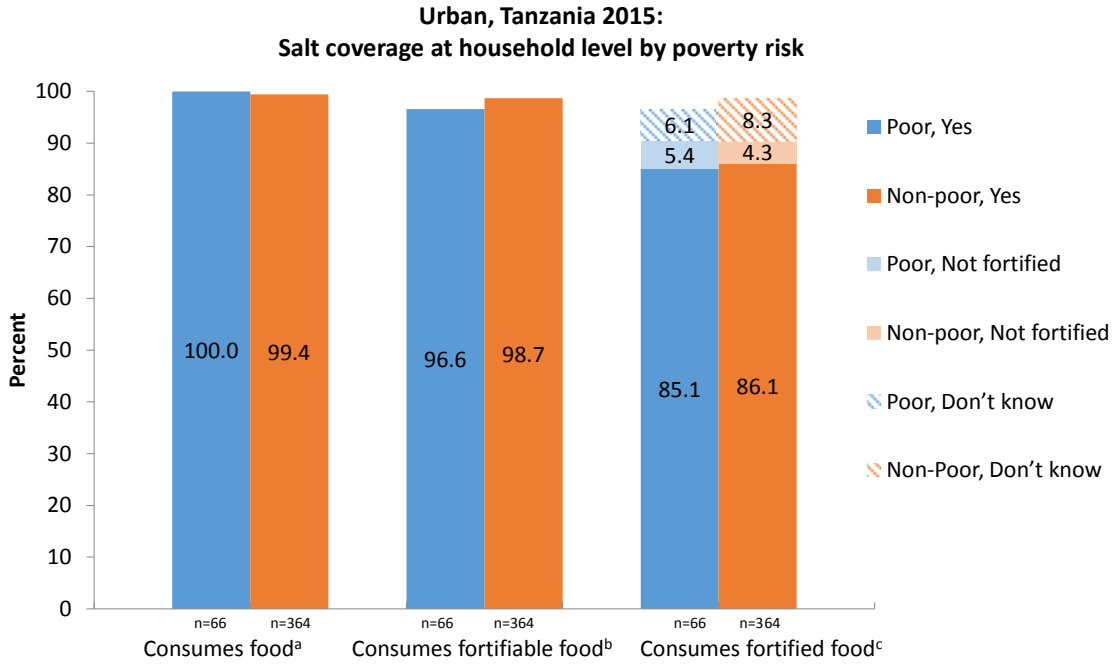
L.



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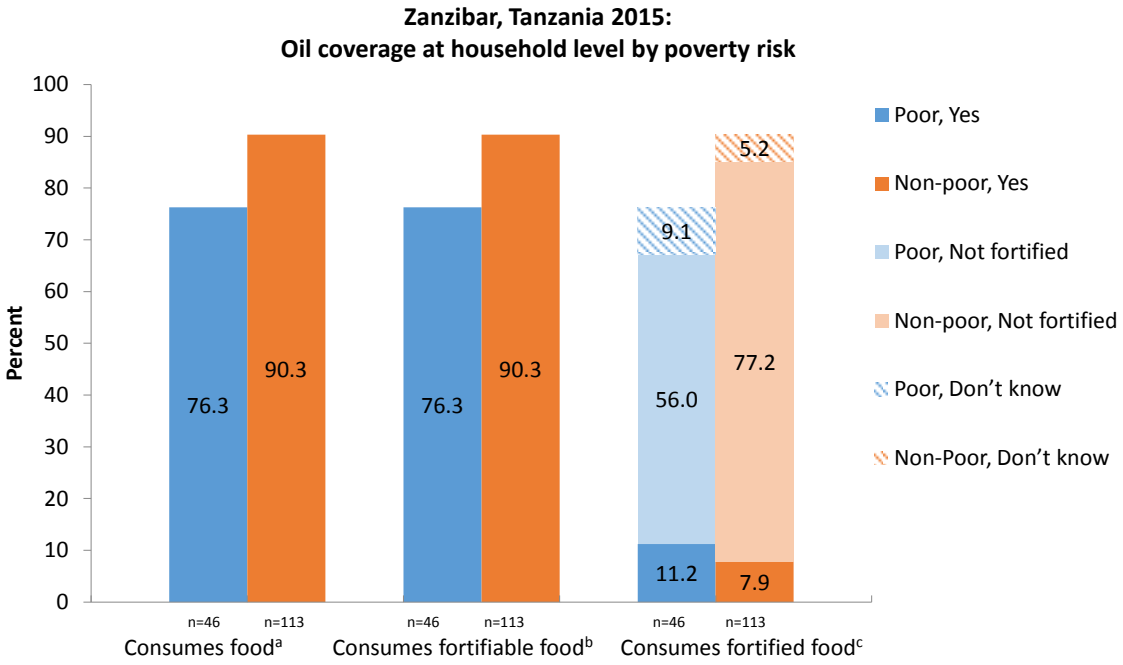
M.



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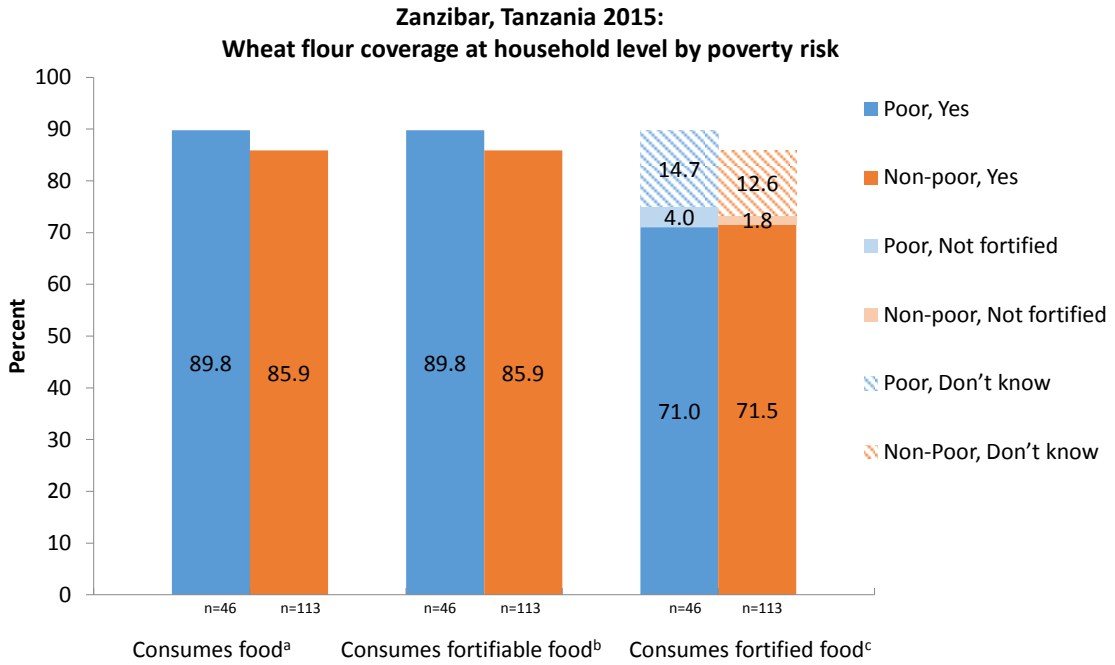
N.



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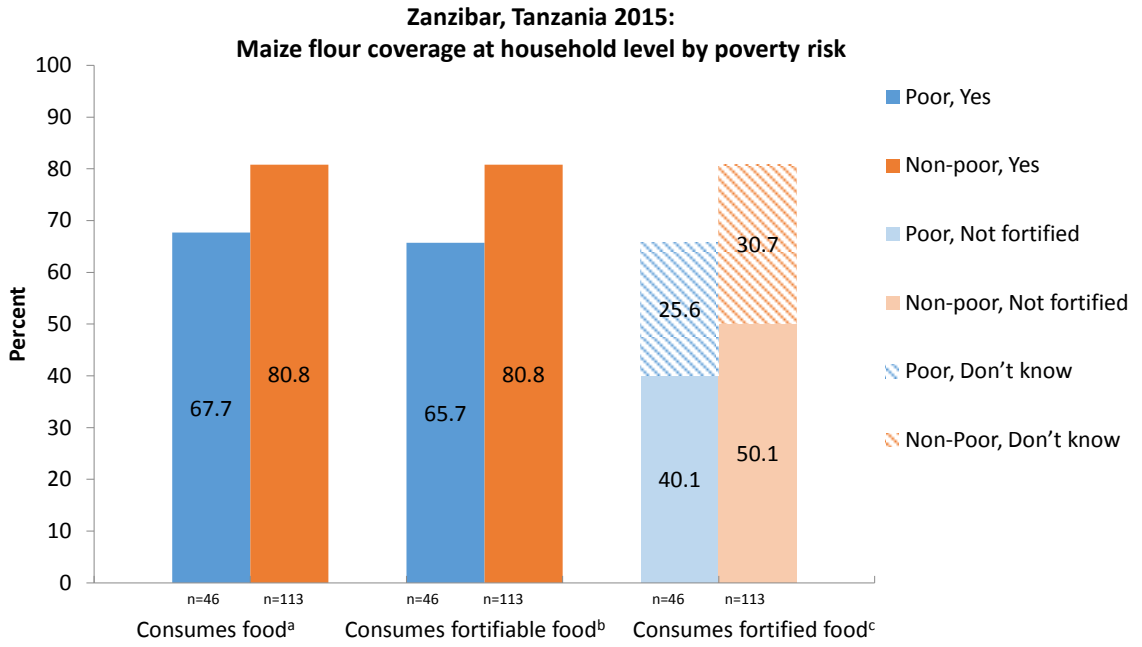
O.



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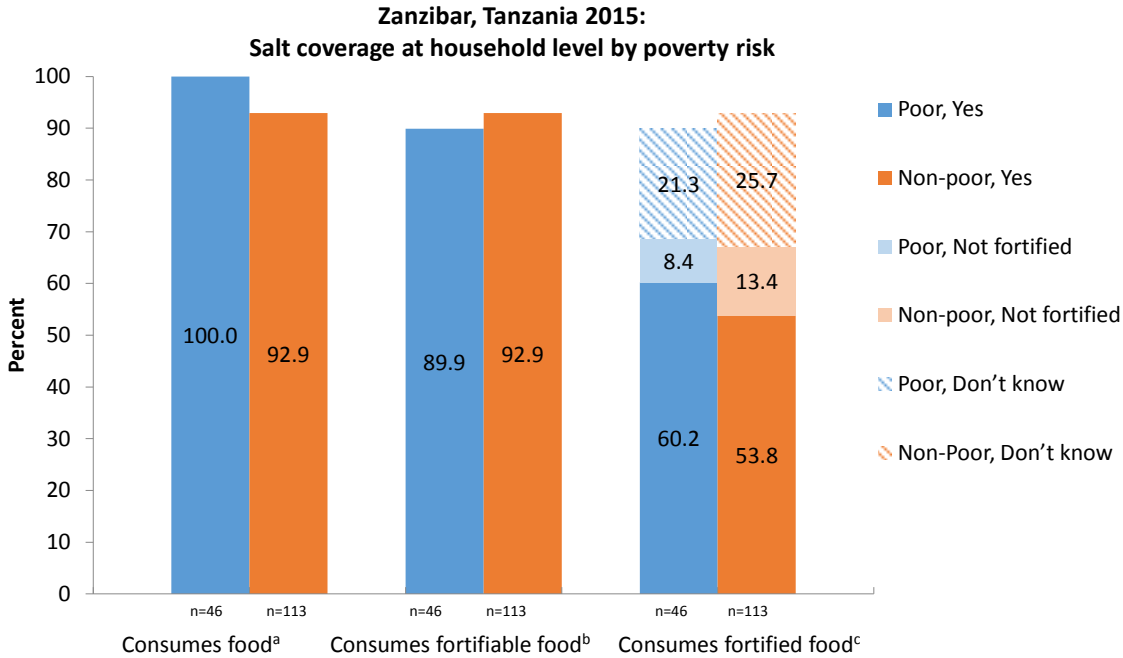

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[1] "Consumes food" refers to households that report preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed. "Consumes fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine.) "Consumes fortified food" was determined as follows:

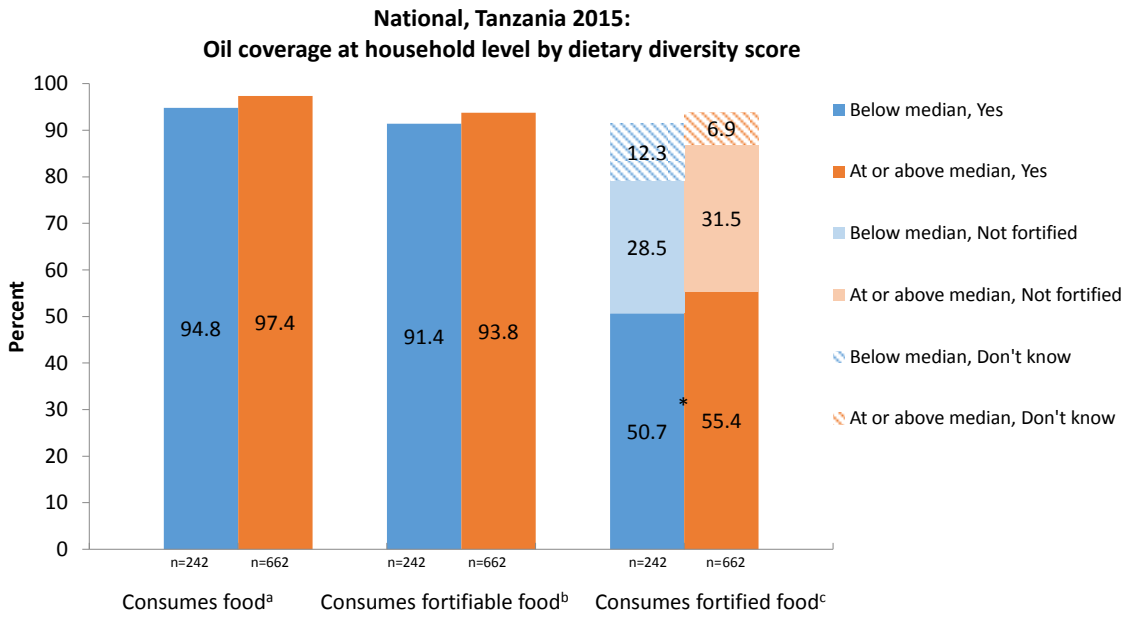
(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food are not shown.

[2]Multidimensional Poverty Index (MPI) greater than or equal to 0.33 is "poor" and MPI less than 0.33 is "non-poor".

The next series of figures show household coverage of foods stratified by women's dietary diversity score: lower dietary diversity (below the median) or higher dietary diversity (at or above the median) (**Figure 3** and **Annex I**). For households nationally, in rural and urban areas, and in Zanzibar, the trend tended to be the same for oil, maize flour and salt: the proportion of households consuming the food, fortifiable food and fortified food was generally higher in households where women had higher dietary diversity than in households where women had lower dietary diversity. The difference between women with lower dietary diversity and higher dietary diversity tended to be the most pronounced in rural areas. There was a significant difference between women with lower and higher dietary diversity and the consumption of wheat flour, fortifiable wheat flour and fortified wheat flour.

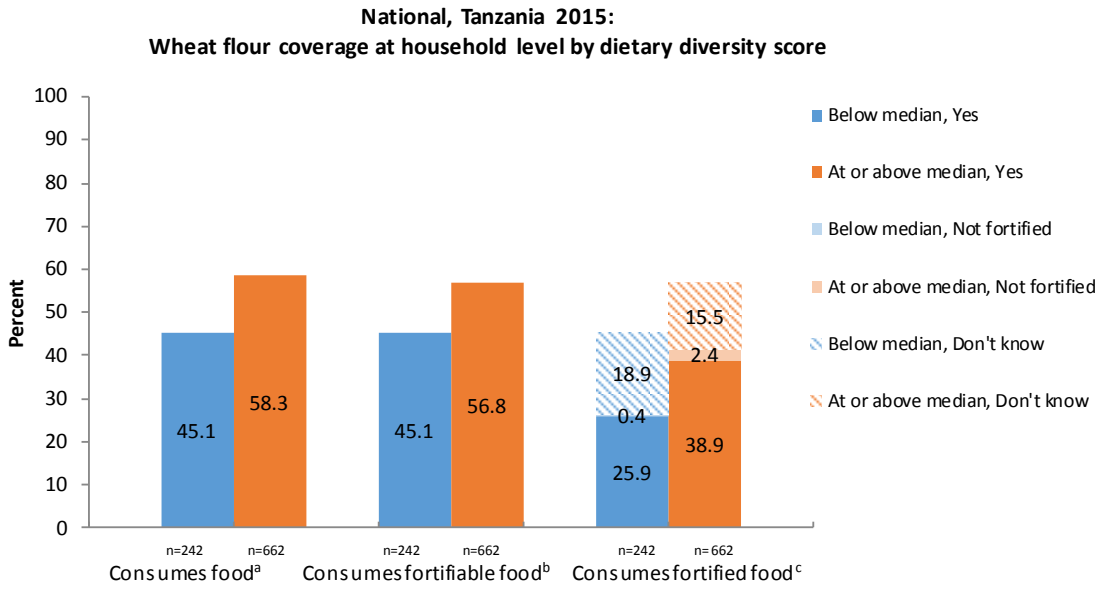
Figure 3. Household coverage of foods by women's dietary diversity score.[1,2]

A.



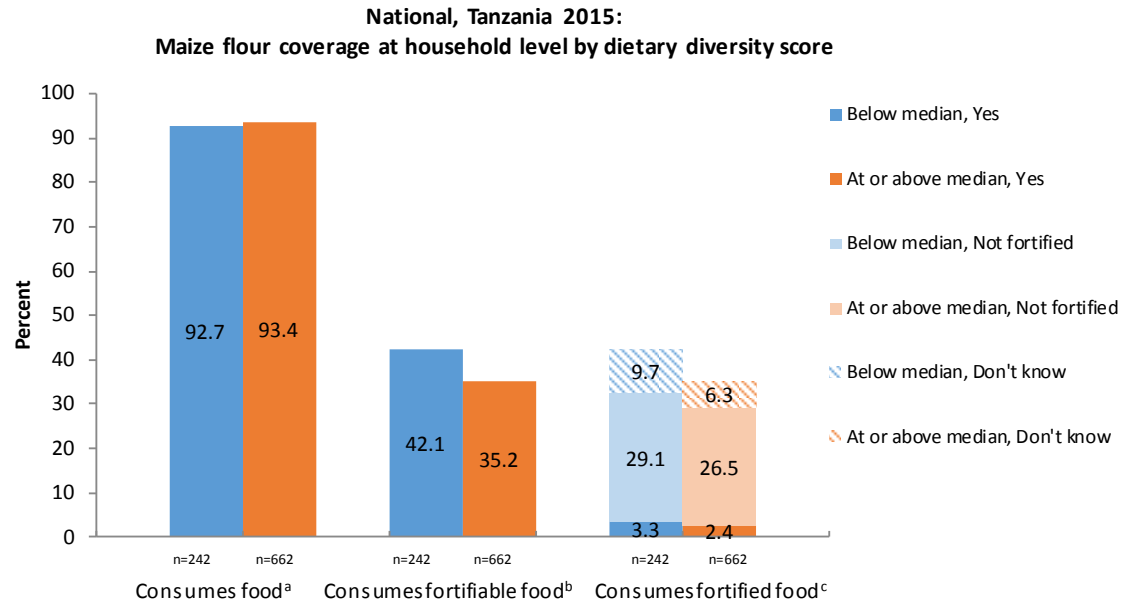
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

B.



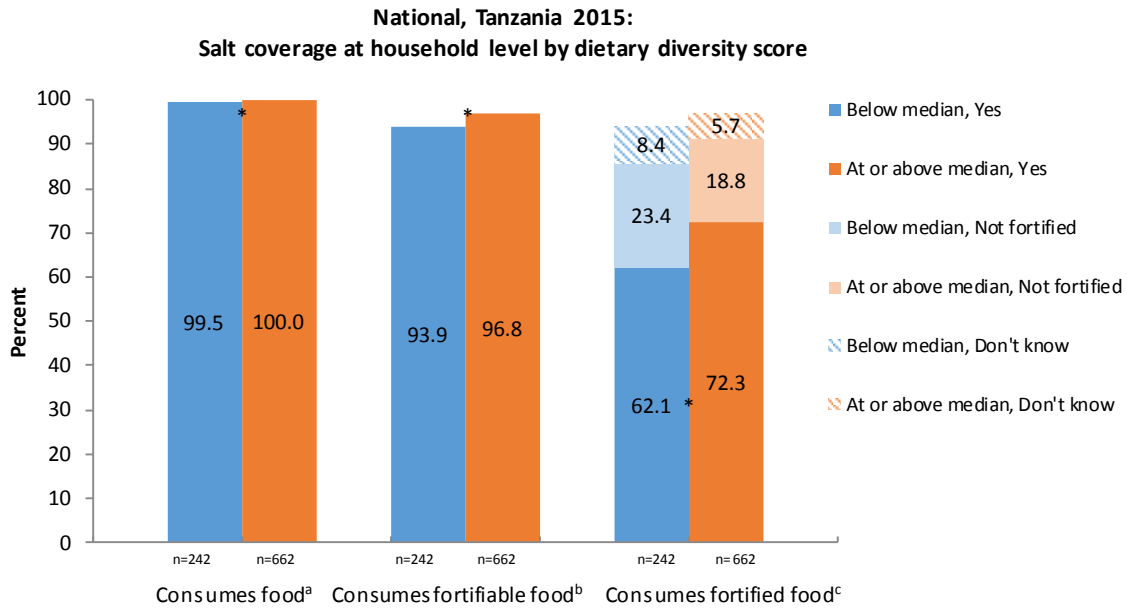
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

C.



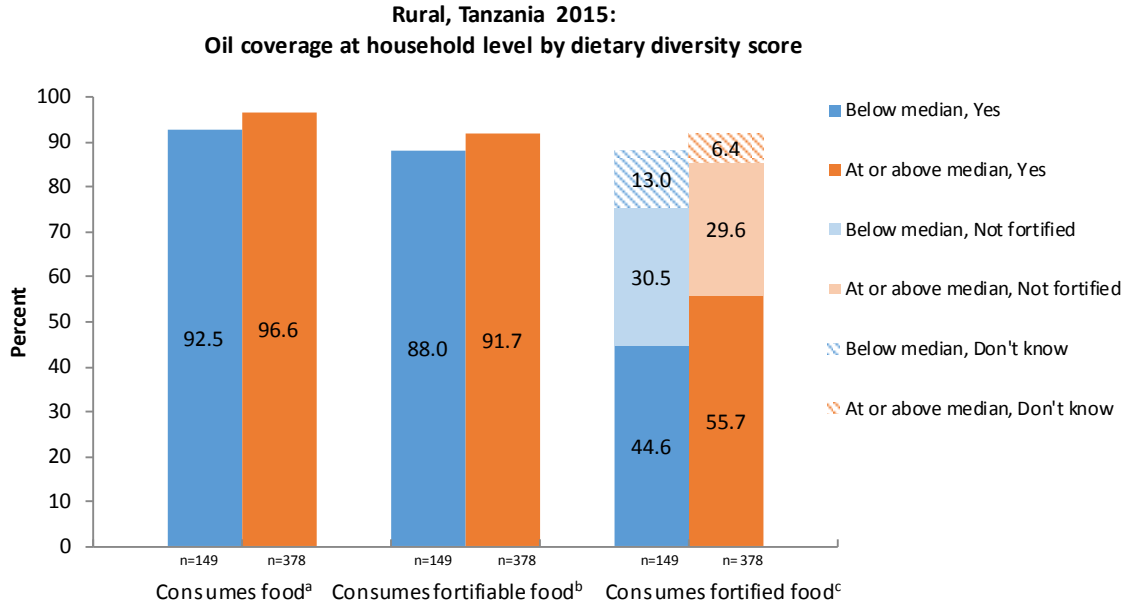
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

D.



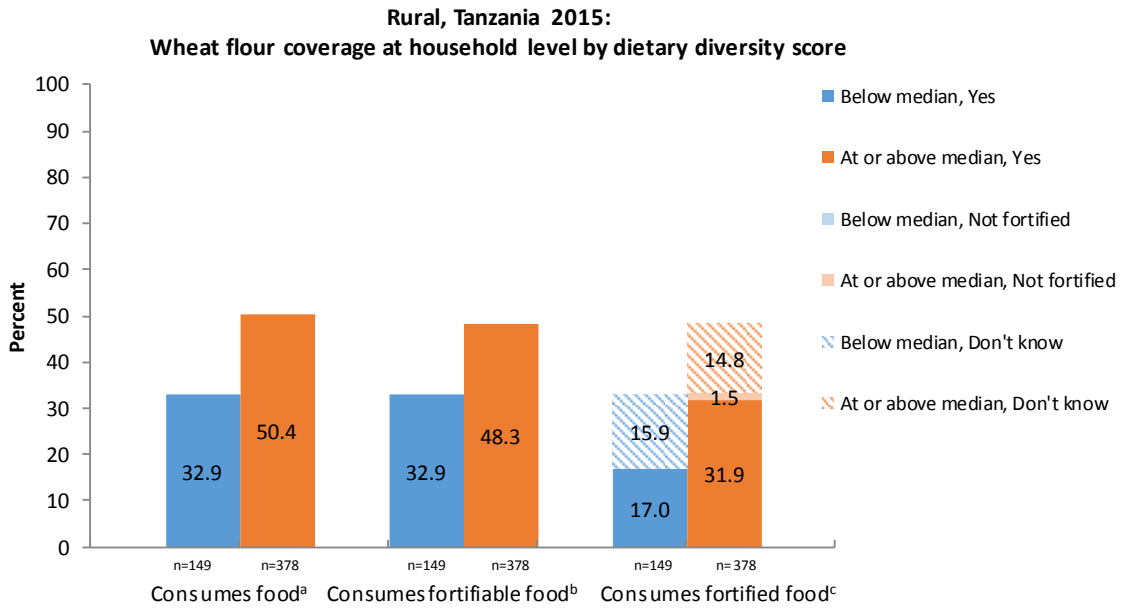
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

E.



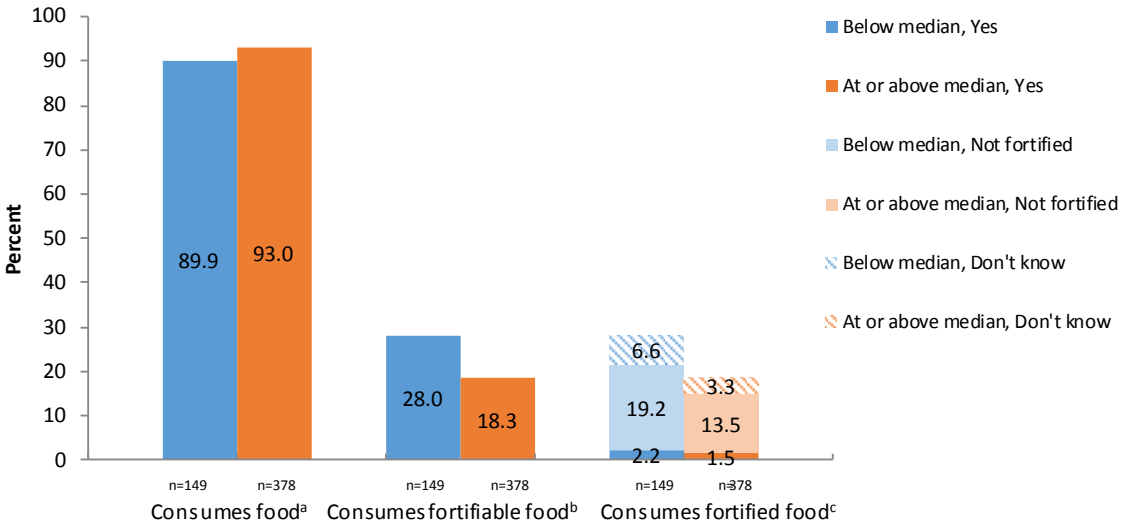
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

F.



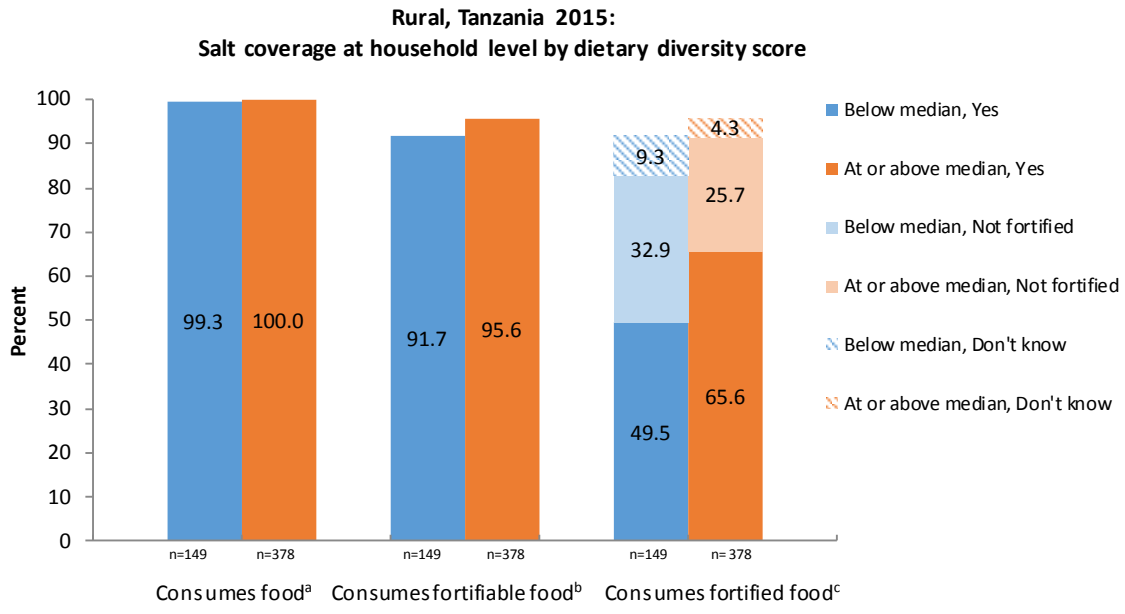
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

G.



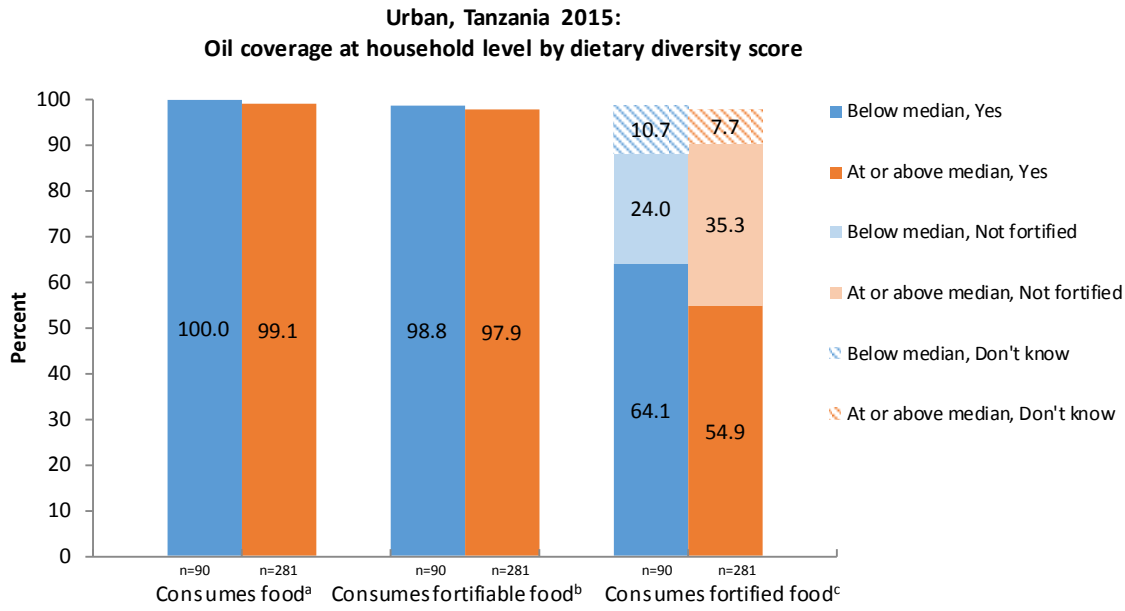
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

H.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

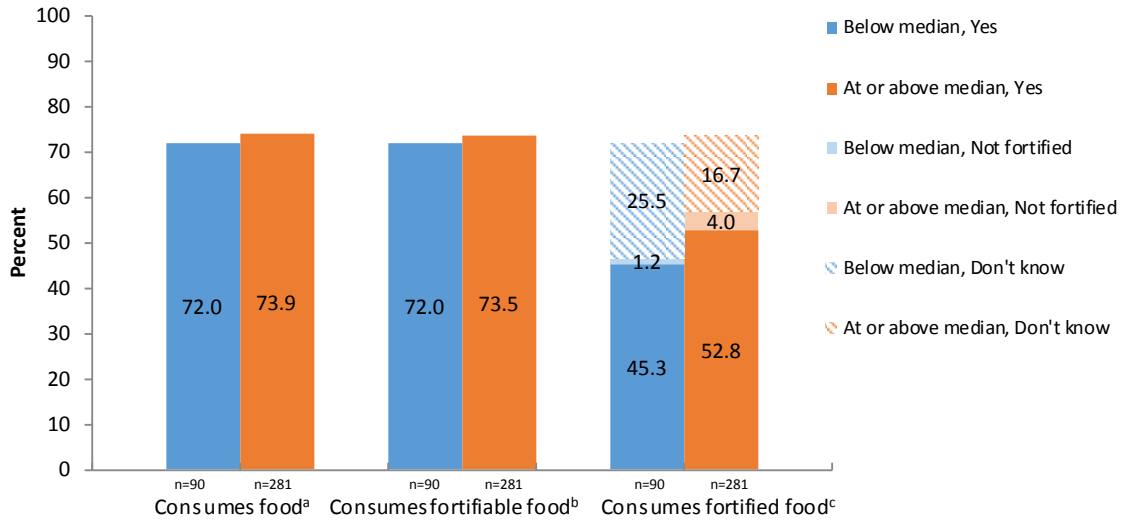
I.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

J.

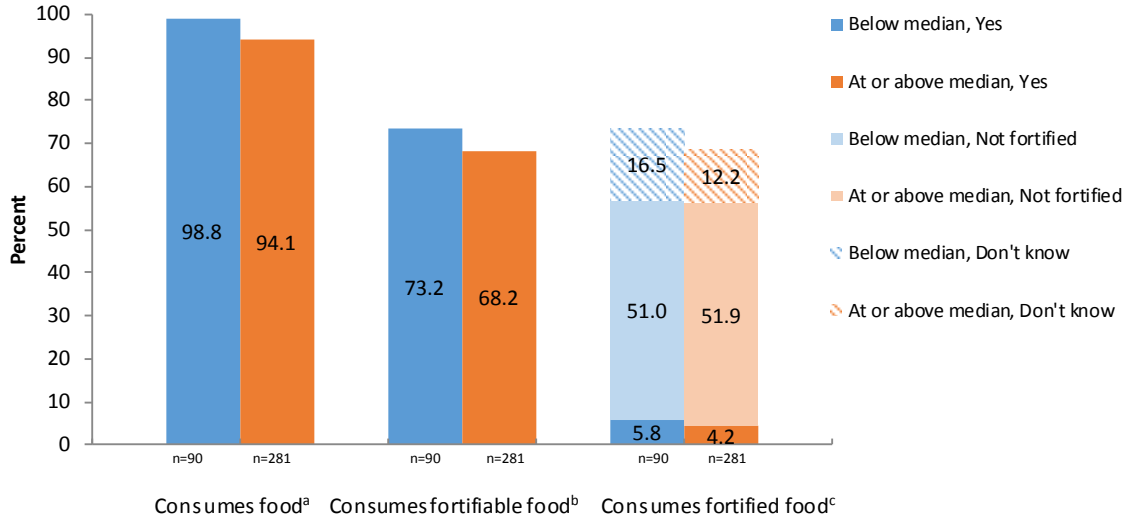
Urban, Tanzania 2015:
Wheat flour coverage at household level by dietary diversity score



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

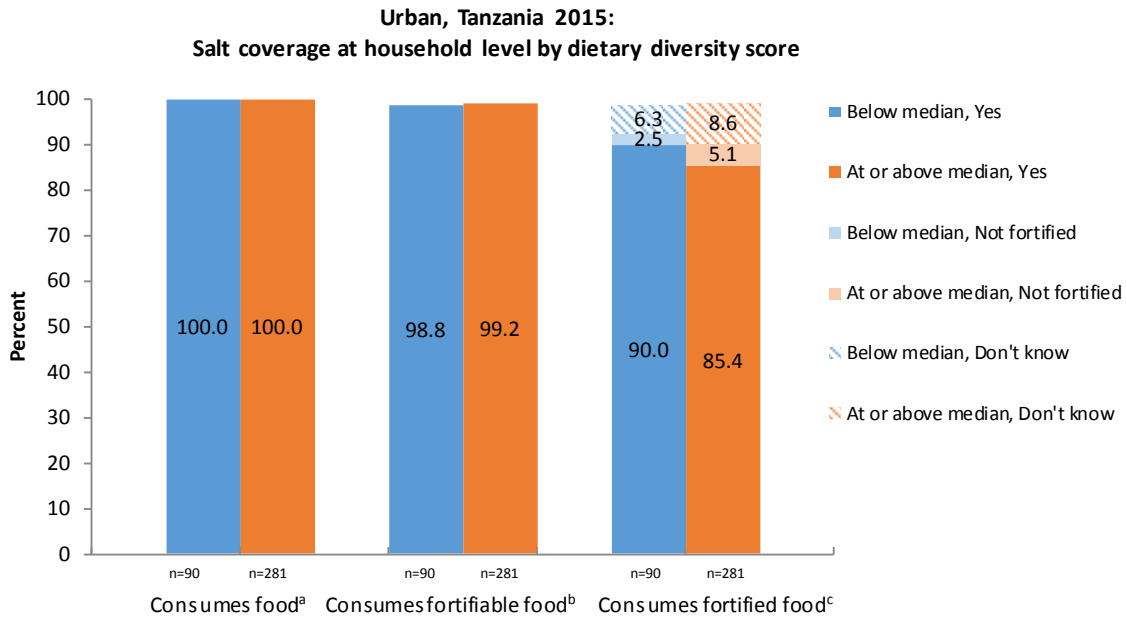
K.

Urban, Tanzania 2015:
Maize flour coverage at household level by dietary diversity score



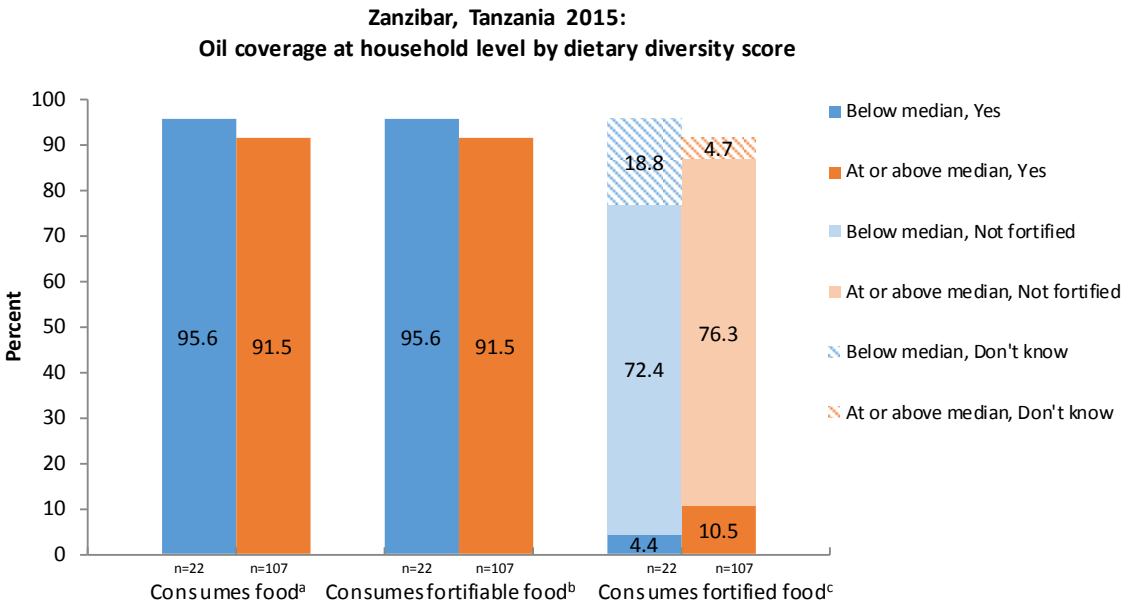
[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

L.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

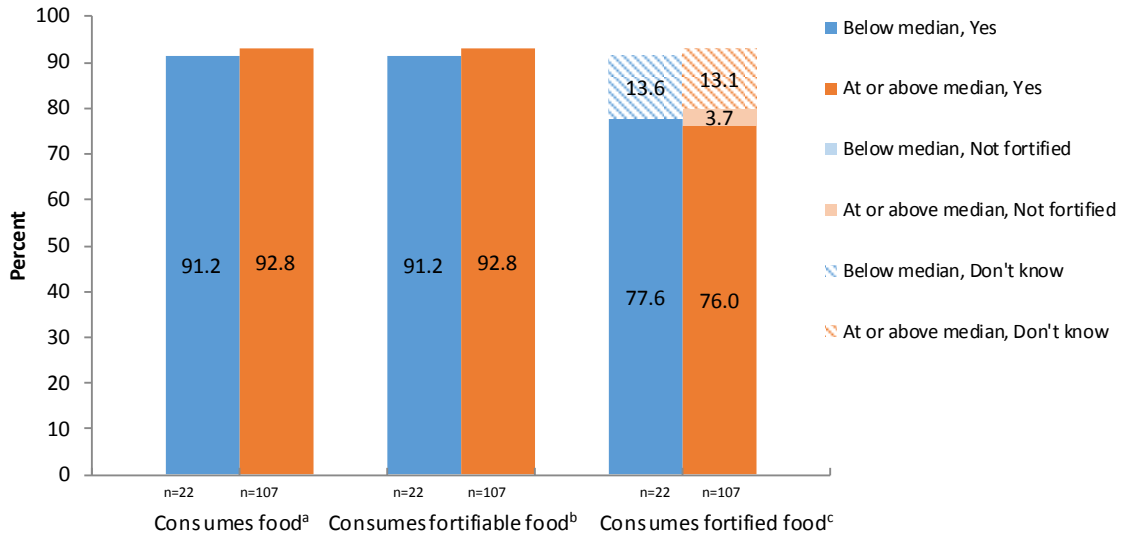
M.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

N.

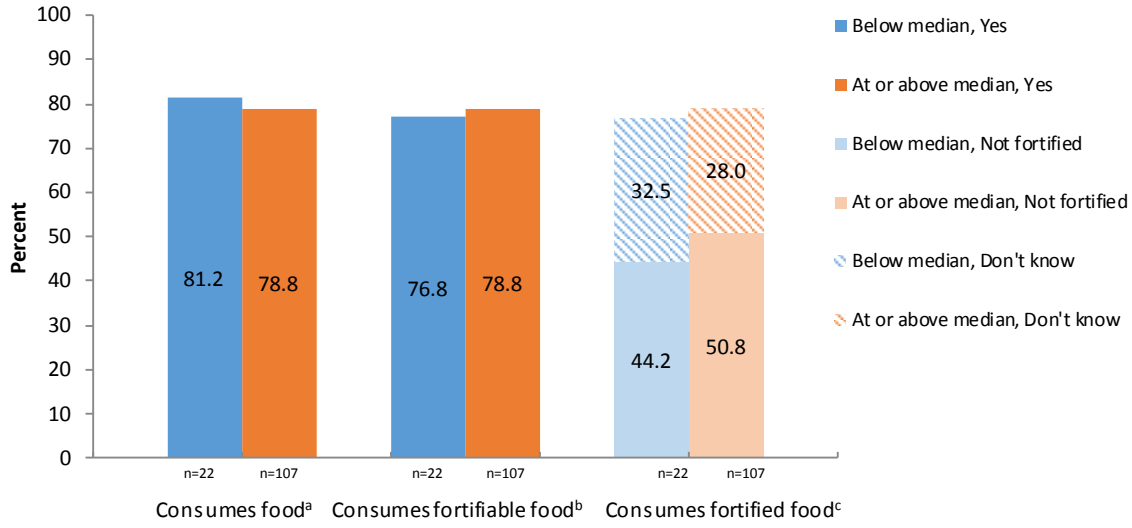
Zanzibar, Tanzania 2015:
Wheat flour coverage at household level by dietary diversity score



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

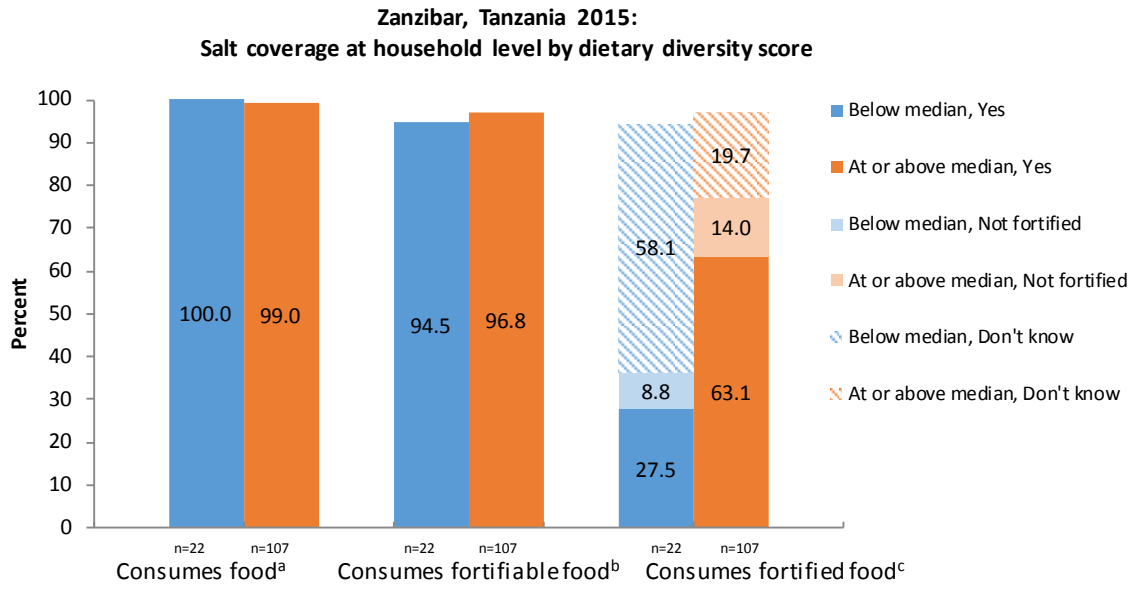
O.

Zanzibar, Tanzania 2015:
Maize flour coverage at household level by dietary diversity score



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

P.



[a]Reported; [b]Fortifiable refers to a food that was not made at home and is assumed to be industrially processed; [c]Households were classified as fortified if they provided a sample or reported consuming a brand that was confirmed to be fortified by quantitative analyses; Don't know refers to a household that could not be classified because no food sample was available and no brand was reported.

[1] *"Consumes food" refers to households that report preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed. "Consumes fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine.). "Consumes fortified food" was determined as follows:*

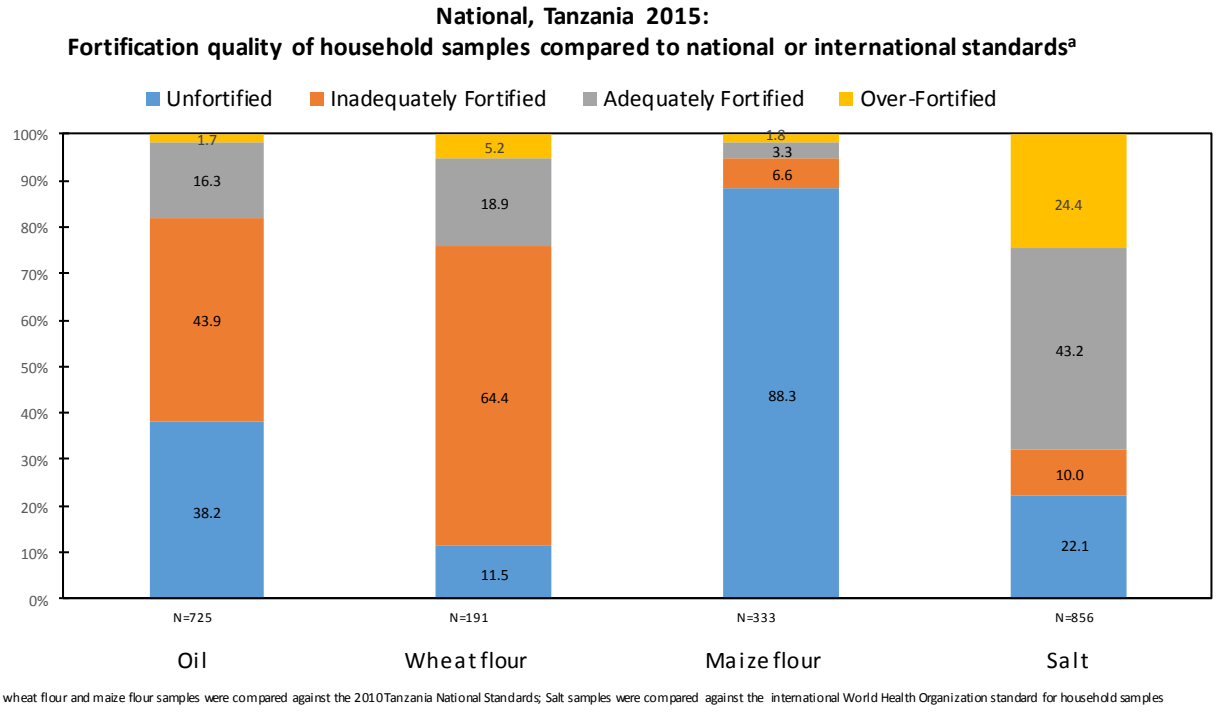
(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food are not shown.

[2]*Below median refers to a dietary diversity score lower than the population median in each stratum (i.e. rural or urban residence). At or above median refers to a dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence). The population median is 4 in rural areas and 5 in urban areas. When more than one woman of reproductive age completed a WRA in a household and provided the dietary diversity information per household, the dietary diversity score of one woman was randomly selected and applied to the household.*

The fortification quality compared to national standards varied greatly depending on the food (**Figure 4** and **Annex I**). Nationally 38.2% of oil samples, 11.5% of wheat flour samples, 88.3% of maize flour samples and 22.1% of salt samples that were analyzed were deemed unfortified. (**Figure 4A**). There were some differences between strata but in general the percentage of adequately fortified foods was low. For oil, the proportion of adequately fortified samples was overall 16.3%, in rural areas 18%, urban areas 15.7% and in Zanzibar 2.1%. For wheat flour, the proportion of adequately fortified samples was overall 18.9%, rural area 20.0%, urban areas 17.0% and Zanzibar 16.7%. For maize flour, the proportion of adequately fortified samples was overall 3.3%, rural area 4.8%, urban areas 1.6%, and 0% in Zanzibar. Finally for salt, the proportion of adequately iodized samples was 43.2% according to the WHO cutoff and 62.7% according to country standard cut offs. In rural areas it was 34.1% according to the WHO cutoff and 52.8% country cut offs, urban areas, 58.1% WHO cut off and 79.6% country cut off, and in Zanzibar 36.1% WHO cutoff and 39.5% country cut off.

Figure 4. Fortification quality of household food samples compared to Tanzania national standards for oil, wheat and maize flour and international standards for salt.[1,2,3,4,5]

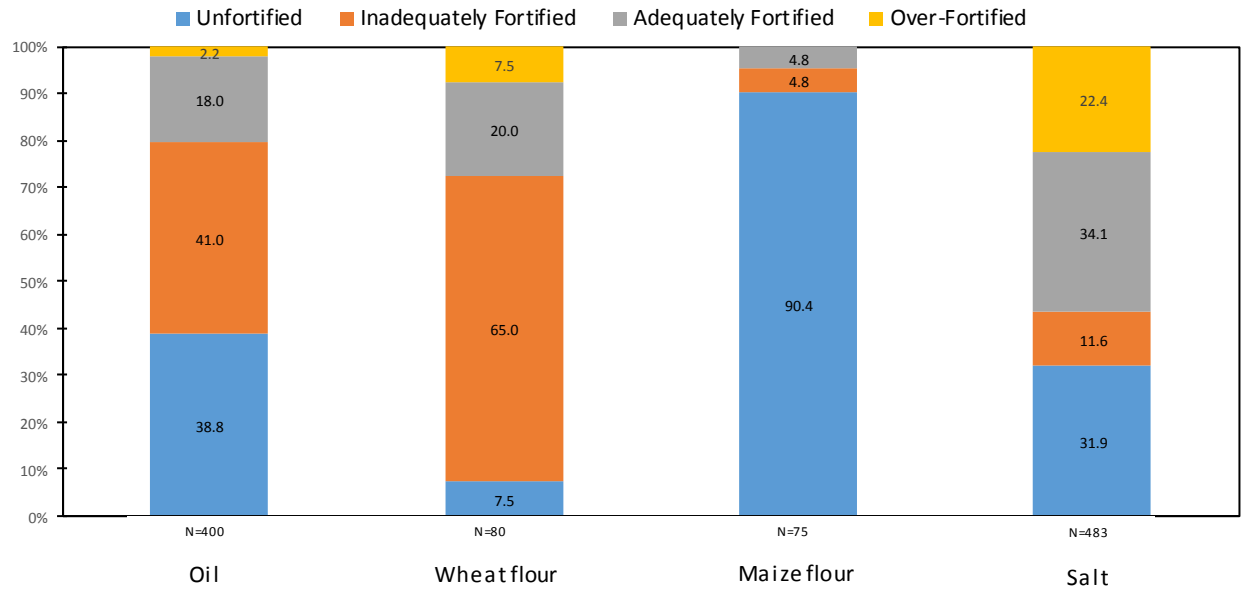
A.



[a]Oil, wheat flour and maize flour samples were compared against the 2010 Tanzania National Standards; Salt samples were compared against the international World Health Organization standard for household samples

B.

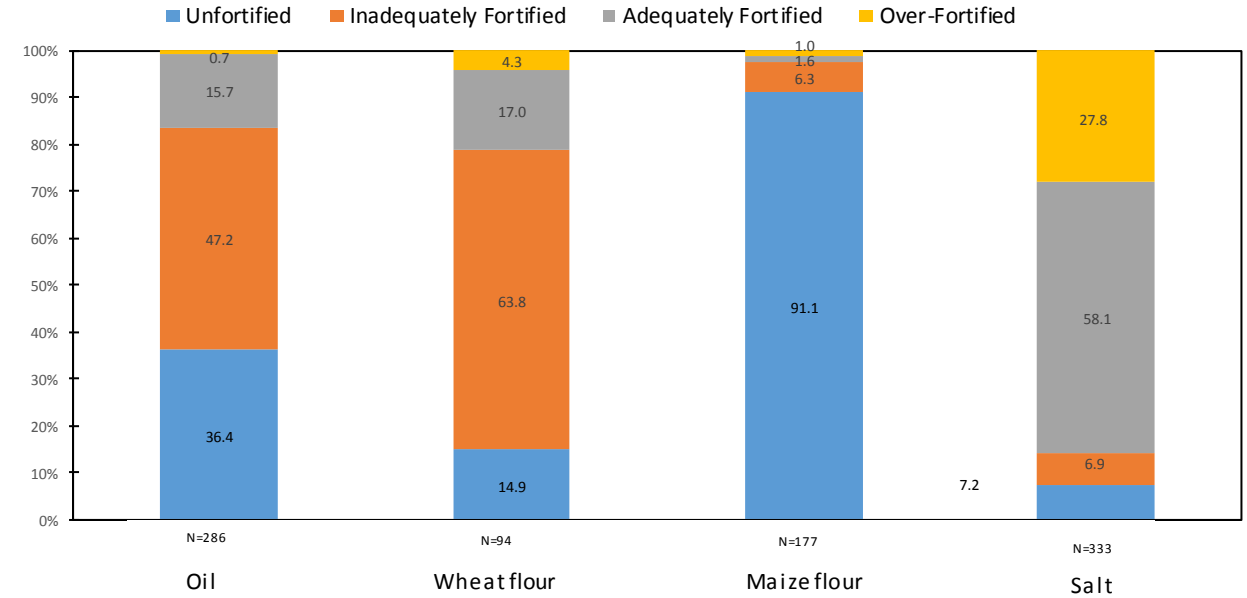
Rural, Tanzania 2015:
Fortification quality of household samples compared to national or international standards[a]



[a]Oil, wheat flour and maize flour samples were compared against the 2010 Tanzania National Standards; Salt samples were compared against the international World Health Organization standard for household samples

C.

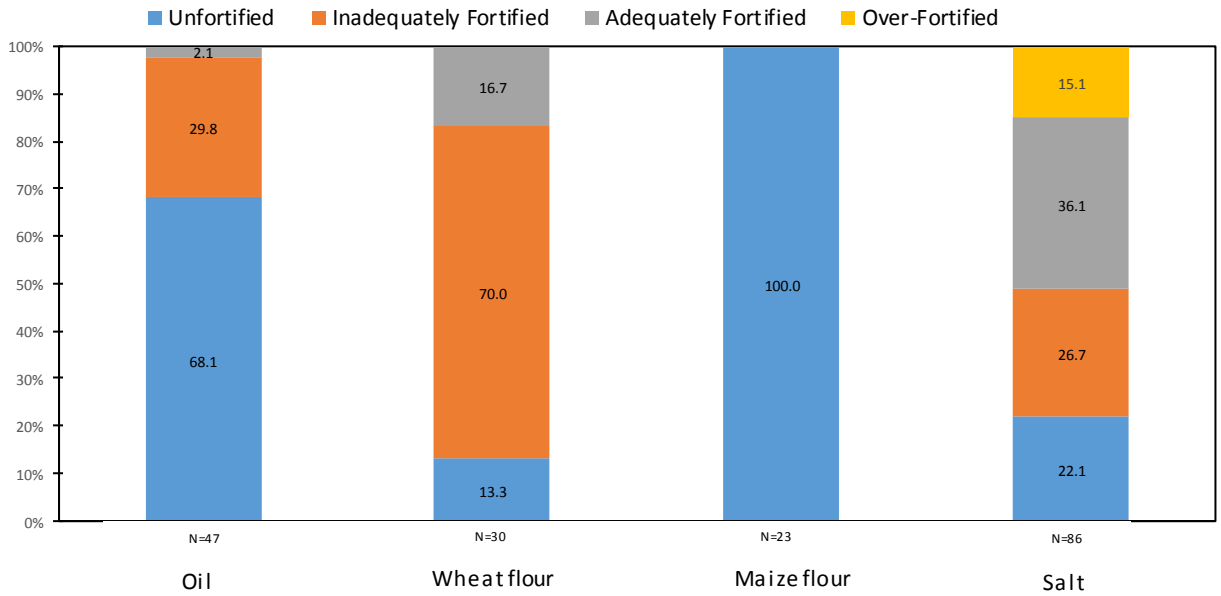
Urban, Tanzania 2015:
Fortification quality of household samples compared to national or international standards[a]



[a]Oil, wheat flour and maize flour samples were compared against the 2010 Tanzania National Standards; Salt samples were compared against the international World Health Organization standard for household samples

D.

Zanzibar, Tanzania 2015:
Fortification quality of household samples compared to national or international standards[a]



[a]Oil, wheat flour and maize flour samples were compared against the 2010 Tanzania National Standards; Salt samples were compared against the international World Health Organization standard for household samples

[1] The "n" below each bar refers to the total number of samples analyzed and proportions are based on the unweighted number of food specimens collected from the households.

[2] Fortification quality for oil was determined by analyzing the vitamin A levels in samples taken from households and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" <3 mg/kg vitamin A, "inadequately fortified" 3-<16 mg/kg vitamin A, "adequately fortified" ≥16- 28 mg/kg vitamin A, and "over fortified" >28 mg/kg of vitamin A.

[3] Fortification quality for wheat flour was determined by analyzing the total iron levels in samples taken from households, subtracting an estimate of the level of intrinsic iron naturally occuring in wheat flour. (in this study the instrinsic level of iron in the wheat flour was determined to be 29.8 mg/kg based on analyses of unfortified wheat flour samples from Tanzania), and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" 0 mg/kg added iron, "inadequately fortified" hd >0-<30 mg/kg added iron, "adequately fortified" ≥30- 50 mg/kg added iron, and "over fortified" >50 mg/kg added iron.

[4] Fortification quality for maize flour was determined by analyzing the iron level levels in samples taken from households, subtracting an estimate of the level of intrinsic iron naturally occuring in maize flour. (in this study the instrinsic level of iron in the maize flour was determined to be 19.6 mg/kg based on analyses of unfortified maize flour samples from Tanzania), and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" 0 mg/kg added iron, "inadequately fortified" >0-<5 mg/kg added iron, "adequately fortified" ≥5- 25 mg/kg added iron, and "over fortified" >25 mg/kg added iron.

[5] Fortification quality for salt was determined by analyzing the iodine levels in samples taken from households and comparing the result to the World Health Organization international standard for household samples as follows: "Unfortified" <7.6 ppm iodine (difficult to detect iodine below 7.6 ppm), "inadequately fortified" 7.6-<15 ppm iodine, "adequately fortified" 15-<40 ppm iodine, and "over fortified" ≥40 ppm of iodine.

For Tanzania's fortification logo, 13.3% of respondents nationally reported ever seeing the logo (**Table 8**). In urban areas this was as high as 20%. Only 4.7% of respondents nationally reported positive attributes to this logo and only 5.8% said it would influence their decision to buy a product with the logo on it.

Table 8. Fortification logo and knowledge results.[1]

Characteristic	National* N=1041	Rural N=609	Urban N=432	Zanzibar N=159	P-Value[†]
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	
Reported ever seeing fortification logo	13.3 (11.2-15.4)	8.6 (6.3-10.8)	20.0 (16.2-23.8)	5.7 (2-9.3)	<.0001
Reported positive attributes[2] to logo	4.7 (3.4-6)	1.8 (0.7-2.9)	8.8 (6.1-11.5)	0.6 (0-1.9)	<.0001
Reported that logo influences decision to buy	5.8 (4.4-7.2)	2.8 (1.5-4.1)	10.0 (7.2-12.8)	0.6 (0.0-1.9)	<.0001

Abbreviation: CI, confidence interval
[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection.
[2] Reported that the logo means "fortified / enriched / added micronutrients", "good for health" or "better quality".
[†] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects
**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

Based on the individual dietary assessment it was estimated that women in Tanzania consume 106.8 g per day of wheat flour which contributes to 10.2% of their daily iron requirements (RNI) (Table 9). This estimate is as high as 23.0% RNI in urban areas and as low as 6.0% RNI in rural areas.

Table 9. Daily food consumption and micronutrient contribution (% RNI) for all surveyed women of reproductive age based on individual assessment of women.[1]

Food	National* N=1231	Rural N=702	Urban N=529	Zanzibar N=182	P-Value[†]
	Median (25%, 75%)	**Median (25%, 75%)**	**Median (25%, 75%)**	**Median (25%, 75%)**	
Wheat flour consumed[2] (grams/day)	106.8 (21.9-239.9)	57.1 (0-167.6)	205.3 (108.4-329)	182.0 (69-370.9)	<.0001
Added iron from wheat flour (% RNI[3])	10.2 (2.1-26.5)	6.0 (0-15.7)	23.2 (11.9-39.2)	16.5 (5.9-29.3)	<.0001

Abbreviation: RNI, recommended nutrient intakes
[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.
[2] Women were asked to report the frequency in the past 7 days with which they consumed foods containing wheat flour. They were asked to approximate the portion size they ate at each sitting, using picture cards of different portion sizes. The flour in the portion sizes was estimated from recipes

and used in conjunction with the frequency and number of portion sizes to estimate the daily flour consumed by women. The grand median nutrient value for all wheat flour samples analyzed in each strata was multiplied with women's daily flour consumed, to estimate daily nutrient consumed.

[3] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women).

[†] P-values based on national in rural vs. urban differences with adjustment for complex survey design effects.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The contribution of wheat flour to women's nutrient RNIs was stratified by households' poverty risk (**Table 10**). Nationally and also in rural areas and in urban areas there was a statistically significant difference in the contribution of fortifiable wheat flour to iron RNIs, respectively, based on households' poverty status. However, a higher iron intake (% RNI) was observed from wheat flour for poor women in Zanzibar compared to non-poor women, 24.2% versus 12.5%.

Table 10. Daily food consumption and micronutrient contribution (% RNI) for all surveyed women of reproductive age based on individual assessment of women by poverty risk.[1]

Food	Poor (Median (25%, 75%)[2]	Non-poor (Median (25%, 75%)[2]	p-value[3]
National*	**N=460**	**N=771**	
Wheat flour consumed[4] (grams/day)	38.9 (0-119.2)	168.9 (68.6-295.4)	<.0001
Added iron from Wheat flour (% RNI[5])	4.4 (0-11.6)	17.1 (6.8-32.5)	<.0001
Rural	**N=391**	**N=311**	
Wheat flour consumed[4] (grams/day)	27.4 (0-103.3)	112 (25.2-239.5)	<.0001
Added iron from Wheat flour (% RNI[5])	3.1 (0-9.2)	9.8 (2.6-23.1)	<.0001
Urban	**N=69**	**N=460**	
Wheat flour consumed[4] (grams/day)	164 (39.8-263.3)	213.8 (114.1-340.9)	0.0333
Added iron from Wheat flour (% RNI[5])	17.1 (6.2-33.1)	23.9 (13-40)	0.0776
Zanzibar	**N=45**	**N=137**	
Wheat flour consumed[4] (grams/day)	257.4 (126-394.8)	142.8 (67.3-338.8)	0.0386
Added iron from Wheat flour (% RNI[5])	24.2 (9.3-32.8)	12.5 (5.5-28.6)	0.1174

Analytic sample size is based on all women interviewed. They were 1236, 5 of the women did not have household poverty data. This resulted in an effective sample size n of 1231 (460 poor and 771 non-poor).
Abbreviation: RNI, recommended nutrient intakes
[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.
[2] Multidimensional Poverty Index (MPI) greater than or equal to 0.33 is "poor" and MPI less than 0.33 is "non-poor".
[3] Comparing poor versus non-poor. Wilcoxon rank sum test was used to compare median values. P-values as derived from Wilcoxon nonparametric medians tests. The daily food consumption is shown as median with population distribution spread presented as 25th and 75th percentiles and not 95% CI. Thus overlapping 25th and 75th percentiles does not indicate non-significance as the test is based on the median point estimate between poor and non-poor households.
[4] Women were asked to report the frequency in the past 7 days with which they consumed foods containing wheat flour. They were asked to approximate the portion size they ate at each sitting, using picture cards of different portion sizes. The flour in the portion sizes was estimated from recipes and used in conjunction with the frequency and number of portion sizes to estimate the daily flour consumed by women. The grand median nutrient value for all wheat flour samples analyzed in a stratum was multiplied by the women's daily amount of flour consumed to estimate the daily amount of nutrient consumed The amount of nutrient consumed daily was then translated into a percentage of the daily reference nutrient intake (RNI) for the women based on World Health Organization guidelines
[5] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women).
**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The contribution of wheat flour to women's nutrient RNIs was stratified by individual women's dietary diversity scores (**Table 11**). In all areas there was a greater contribution of iron (%RNI) coming from consumption of wheat flour among women with higher dietary diversity (at or above the median) than women with lower dietary diversity (below the median). In rural areas, women with lower dietary diversity received 0% of their RNI for iron from wheat flour.

Table 11. Daily food consumption and micronutrient contribution (% RNI) for all surveyed women of reproductive age based on individual assessment of women by women's dietary diversity score.[1]

Food	Lower dietary diversity[2,3] (25%, 75%)	Higher dietary diversity[2,3] (25%, 75%)	p-value[3]
National*	**N=317**	**N=919**	
Wheat flour consumed[4] (grams/day)	38.9 (0-141.5)	127.6 946-279.7)	<.0001
Added iron from Wheat flour (% RNI[5])	4.3 (0-13.4)	13.5 (4.5-29.9)	<.0001
Rural	**N=199**	**N=507**	
Wheat flour consumed[4] (grams/day)	0 (0-68.1)	81.6 (9.4-208.1)	<.0001
Added iron from Wheat flour (% RNI[5])	0 (0-6.6)	7.9 (1.2-19.5)	<.0001
Urban	**N=118**	**N=412**	
Wheat flour consumed[4] (grams/day)	142.7 (56.6-233.8)	223.6 (130.1-354.3)	0.0013
Added iron from Wheat flour (% RNI[5])	17.2 (5.8-28.9)	26.3 (14.8-43.40	0.0003
Zanzibar	**N=37**	**N=146**	
Wheat flour consumed[4] (grams/day)	120.2 (68.5-339.3)	205.1 (68.9-375.5)	0.2002
Added iron from Wheat flour (% RNI[5])	9.0 (5.5-26.1)	18 (6-29.5)	0.1283

Abbreviation: RNI, recommended nutrient intakes

[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.

[2] Lower dietary diversity refers to a dietary diversity score lower than the population median in each stratum (i.e. rural or urban residence). Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence). The population median is 4 in rural areas and 5 in urban areas.

[3] Comparing lower dietary diversity versus higher dietary diversity. Wilcoxon rank sum test was used to compare median values. P-values as derived from Wilcoxon nonparametric medians tests. The daily food consumption is shown as median with population distribution spread presented as 25th and 75th percentiles and not 95% CI. Thus overlapping 25th and 75th percentiles does not indicate non-significance as the test is based on the median point estimates between higher and lower dietary diversity.

[4] Women were asked to report the frequency in the past 7 days with which they consumed foods containing wheat flour. They were asked to approximate the portion size they ate at each sitting, using picture cards of different portion sizes. The flour in the portion sizes was estimated from recipes and used in conjunction with the frequency and number of portion sizes to estimate the daily flour consumed by women. The grand median nutrient value for all wheat flour samples analyzed in a strata or nationally was multiplied with women's daily flour consumed, to estimate daily nutrient consumed. The amount of nutrient consumed daily was then translated into a percentage of the daily reference nutrient intake (RNI) for the women based on World Health Organization guidelines.

[5] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The percent of RNI met was calculated as follows: amount of nutrient consumed from flour / nutrient RNI x 100%.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The amount of foods apparently consumed and the corresponding contribution to RNI of select micronutrients among women of reproductive age from households that reported consuming the food was estimated using the household assessment method and fortification quality results for the food samples analyzed (**Table 12**). Nationally, women of reproductive age apparently consumed 22.2 milliliters of fortifiable oil per day which contributed 20.8% of their vitamin A RNI. They apparently consumed 162.0 grams of fortifiable wheat flour daily which contributed 16.1% of women's iron RNI. While women apparently consumed 161.3 grams daily of fortifiable maize flour, this did not contribute at all to women's iron RNI due to low levels of added iron in the maize flour. Finally, women apparently consumed 8 grams daily of fortifiable salt, contributing over 100% of their iodine RNI. There were some differences between national, rural and urban areas and Zanzibar, but the general trends were similar. Fortifiable maize flour did not contribute to women's iron RNI.

Table 12. Daily apparent food consumption and micronutrient contribution (% RNI) for women of reproductive age among households that reported consuming the food based on household assessment and adult male equivalent methodology.[1]

Food	National*	Rural	Urban	Zanzibar	P-Value†
	Median (25%, 75%)	Median (25%, 75%)	Median (25%, 75%)	Median (25%, 75%)	
	N=833	**N=472**	**N=361**	**N=117**	
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	22.2 (11.9-40.6)	18.8 (11.0-33.1)	31.1 (17.7-58.8)	35.4 (18.0 - 68.3)	<.0001
Vitamin A from fortifiable[2] oil (% RNI[4])	20.8 (9.1-48.8)	17.2 (7.3-42)	28.0 (14-67.3)	15.3 (8.2-34.1)	<.0001
	N=530	**N=253**	**N=277**	**N=116**	
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	162.0 (106.4-225.3)	162.7 (110.5-220.6)	161.0 (99.4-229.9)	185.6 (105.2-261.6)	0.4580
Added iron from fortifiable[2] wheat flour (% RNI[4])	16.1 (8.6-27.3)	18.5 (10.5-30.9)	13.2 (6.8-22.8)	14.7 (7.8-25.9)	<.0001
	N=402	**N=140**	**N=262**	**N=99**	
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	161.3 (111.4-224)	176.2 (140.1-246)	147.7 (94.5-209.2)	191 (118.3-250.4)	0.3612
Added iron from fortifiable[2] maize flour (% RNI[4])	0.0 (--)	0 .0(--)	0.0 (--)	0.0 (--)	<.0001
	N=857	**N=493**	**N=364**	**N=122**	
Fortifiable[2] salt apparently consumed[3] (grams/day)	8.0 (4.9-12.2)	8.2 (5.3-12.7)	7.5 (4.4-11.1)	7 (3.7-11.4)	0.0006
Iodine from fortifiable[2] salt (% RNI[4])	122.5 (64.1-222.6)	105.9 (51.6-192.5)	148.9 (86.4-257.8)	81.1 (38.6-154.9)	<.0001

Abbreviation: RNI, recommended nutrient intakes

[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.

[2] Fortifiable refers to any food that was not made at home and is assumed to be industrially processed.

[3] Households were asked to report the amount of food purchased and the period the food lasted. With this information, the daily amount of food available for consumption in the home was estimated. The nutrient level assigned to each food in a household was done as follows: (A) If a food sample was taken from the home and analyzed, the nutrient value measured in the food sample was assigned to the household. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value in the branded samples analyzed from other households was used. (C) In households where a food sample was not taken and the brand name was not available, the median nutrient value in the unbranded samples analyzed from other households within each stratum was used. The total number of persons (and their age and sex) usually living in the household was collected. This information was used to determine the "apparent food consumption" by women of reproductive age using the adult male equivalent methodology.

[4] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The vitamin A RNI for women, per the World Health Organization, is as follows: 600 micrograms retinol equivalents (mcg RE)/day (15-18 years), 500 mcg RE/day (19-50 years), 800 mcg RE/day (pregnant women), and 850 mcg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is as follows: 150 mcg/day (15-18 years), 150 mcg/day (19-50 years), 200 mcg/day (pregnant women), and 200 mcg/day (lactating women). For women who were both pregnant and lactating, the pregnancy RNI was used for all nutrients. The percent of RNI met was calculated as follows: amount of nutrient consumed from food / nutrient RNI x 100%. The pregnancy and lactation status of all women in the household was not known. This information was known for the subset of women who answered the women's survey. All non-surveyed women were assumed to be non-pregnant and non-lactating.

[†] P-values based on national in rural vs. urban differences. Wilcoxon rank sum test was used to compare median food consumption and %RNI values. Estimates are shown as median with population distribution spread presented as 25th and 75th percentiles and not 95% CI. Thus overlapping 25th and 75th percentiles does not indicate non-significance as the test is based on the median point estimate between urban and rural strata.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The apparent food consumption and nutrient contributions for women of reproductive age from households that reported consuming the food was stratified by households' poverty risk (**Table 13**). Nationally, women from poor households typically consumed less fortifiable oil and salt compared to women from non-poor households. Poor women consumed more fortifiable wheat and maize flour, which resulted in poor women nationally meeting a higher proportion of their iron RNI from wheat flour (19.9% poor women and 14.0 % non-poor). As maize flour was not fortified there was no impact on the iron RNI from maize flour.

In rural areas the pattern was similar and more poor women consumed more wheat flour and met a greater portion of their iron RNI from wheat flour. In urban areas and in Zanzibar apparent consumption did not differ by poverty status, nor did the nutrient contribution of these foods.

Table 13. Daily apparent food consumption and micronutrient contribution (% RNI) for women of reproductive age among households that reported consuming the food based on household assessment and adult male equivalent methodology by poverty risk.[1]

Food	Poor	Non-Poor	p-value[3]
	Median (25%, 75%)[2]	Median (25%, 75%)[2]	
National*			
	N=525	**N=308**	
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	17.0 (9.5-32.2)	26.4 (15.1-49.2)	<.0001
Vitamin A from fortifiable[2] oil (% RNI[4])	17.2 (8-40.8)	22.3 (10.6-53.6)	0.0007
	N=381	**N=149**	
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	169.2 (97.5-241.6)	158.6 (109.6-221.6)	0.2468
Added iron from fortifiable[2] wheat flour (% RNI[4])	19.9 (10.5-34.8)	14.0 (8.1-24.1)	0.0008
	N=303	**N=99**	
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	172.2 (134.4-250.7)	153.6 (101.3-220.2)	0.0094
Added iron from fortifiable[2] maize flour (% RNI[4])	0.0 (--)	0.0 (--)	0.2084

Food	Poor	Non-Poor	p-value[3]
	Median (25%, 75%)[2]	Median (25%, 75%)[2]	
	N=538	**N=319**	
Fortifiable[2] salt apparently consumed[3] (grams/day)	8.6 (5.6-13.5)	7.7 (4.8-11.4)	0.0042
Iodine from fortifiable[2] salt (% RNI[4])	98.6 (44.7-191.7)	138 (80.5-235.8)	0.0015
Rural			
	N=215	**N=257**	
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	16.3 (9.4-31.2)	20.6 (11.9-36.5)	0.0004
Vitamin A from fortifiable[2] oil (% RNI[4])	16.8 (6.9-38.3)	17.7 (7.4-46.1)	0.3299
	N=137	**N=116**	
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	170.8 (107.6-259.8)	153.7 (110.9-205.8)	0.0324
Added iron from fortifiable[2] wheat flour (% RNI[4])	21.9 (10.7-36.7)	16.9 (10.3-24.6)	0.0404
	N=76	**N=64**	
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	174.7 (141.7-252.9)	176.4 (134.9-223.7)	0.3434
Added iron from fortifiable[2] maize flour (% RNI[4])	0.0 (--)	0.0 (--)	0.6589
	N=225	**N=268**	
Fortifiable[2] salt apparently consumed[3] (grams/day)	8.7 (5.6-13.7)	7.9 (5.1-11.6)	0.0480
Iodine from fortifiable[2] salt (% RNI[4])	90.4 (41.4-177.9)	131.2 (70.5-198.8)	0.0402
Urban			
	N=310	**N=51**	
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	24.4 (13-38.6)	32.8 (18.9-60.6)	0.0248
Vitamin A from fortifiable[2] oil (% RNI[4])	18.7 (11.1-58.7)	28.7 (14.5-68.1)	0.3330
	N=244	**N=33**	
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	141 (83.8-194.7)	161.4 (104.3-232.5)	0.1502
Added iron from fortifiable[2] wheat flour (% RNI[4])	16.4 (9.4-23.1)	12.5 (6.4-21.9)	0.5334
	N=227	**N=35**	
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	155.8 (114.9-199.1)	143.1 (93.2-209.2)	0.3354
Added iron from fortifiable[2] maize flour (% RNI[4])	0.0 (--)	0.0 (--)	0.0439
	N=313	**N=51**	
Fortifiable[2] salt apparently consumed[3] (grams/day)	7.2 (4.4-10.2)	7.5 (4.4-11.2)	0.9314
Iodine from fortifiable[2] salt (% RNI[4])	148.1 (82.4-267.3)	149 (86.4-257.2)	0.8961

Food	Poor	Non-Poor	p-value[3]
	Median (25%, 75%)[2]	Median (25%, 75%)[2]	
Zanzibar			
	N=88	**N=29**	
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	27.2 (11.8-57.1)	37.3 (19.1-69.4)	0.3263
Vitamin A from fortifiable[2] oil (% RNI[4])	11.6 (4.9-33.6)	16.7 (8.4-32.4)	0.4855
	N=84	**N=32**	
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	191.1 (124.5-265.8)	173.9 (103.4-258.3)	0.5677
Added iron from fortifiable[2] wheat flour (% RNI[4])	14.6 (7.3-24.5)	14.8 (7.8-25.8)	0.9951
	N=77	**N=22**	
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	224.6 (151.9-248.1)	184.1 (110.4-250.6)	0.4023
Added iron from fortifiable[2] maize flour (% RNI[4])	0.0 (--)	0.0 (--)	0.6808
	N=90	**N=32**	
Fortifiable[2] salt apparently consumed[3] (grams/day)	7.2 (4.3-11.7)	6.9 (3.6-11)	0.2362
Iodine from fortifiable[2] salt (% RNI[4])	96.2 (69-174)	63.1 (31.6-141.4)	0.0169

Abbreviation: RNI, recommended nutrient intakes

[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.

[2] Multidimensional Poverty Index (MPI) greater than or equal to 0.33 is "poor" and MPI less than 0.33 is "non-poor".

[3] Comparing poor versus non-poor. Wilcoxon rank sum test was used to compare median values. P-values as derived from Wilcoxon nonparametric medians tests. The daily food consumption is shown as median with population distribution spread presented as 25th and 75th percentiles and not 95% CI. Thus overlapping 25th and 75th percentiles does not indicate non-significance as the test is based on the median point estimates differences between poor and non-poor.

[4] Fortifiable refers to any food that was not made at home and is assumed to be industrially processed.

[5] Households were asked to report the amount of food purchased and the period the food lasted. With this information, the daily amount of food available for consumption in the home was estimated. The nutrient levels assigned to each food in a household was done as follows: (A) If a food sample was taken from the home and analyzed, the nutrient value measured in the food sample was assigned to the (B) In households where a food sample was not taken and the brand name was available, the median nutrient value in the branded samples analyzed from other households was used. (C) In households where a food sample was not taken and the brand name was not available, the median nutrient value in the unbranded samples analyzed from other households within each stratum was used. The total number of persons (and their age and sex) usually living in the household was noted. This information was used to determine the "apparent food consumption" by women of reproductive age using the adult male equivalent methodology.

[6] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The vitamin A RNI for women, per the World

Health Organization, is as follows: 600 micrograms retinol equivalents (mcg RE)/day (15-18 years), 500 mcg RE/day (19-50 years), 800 mcg RE/day (pregnant women), and 850 mcg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is as follows: 150 mcg/day (15-18 years), 150 mcg/day (19-50 years), 200 mcg/day (pregnant women), and 200 mcg/day (lactating women). For women who were both pregnant and lactating, the pregnancy RNI was used for all nutrients. The percent of RNI met was calculated as follows: amount of nutrient consumed from food / nutrient RNI x 100%. The pregnancy and lactation status of all women in the household was not known. This information was known for the subset of women who answered the women's survey. All non-surveyed women were assumed to be non-pregnant and non-lactating.

[7]It is not possible to calculate a p-value when comparing two zero values.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

The information presented in Table 14 was stratified by women's dietary diversity score (**Table 14**). In Tanzania, among households that reported consuming the fortifiable food, women's apparent consumption of fortifiable food and the contribution of this food to women's nutrient intakes did not differ by women's dietary diversity score. The trend was generally the same for women in rural and urban areas and in Zanzibar. There was one main exception, nationally, in rural areas, urban areas and Zanzibar, women with lower dietary diversity tended to consume more fortifiable maize flour than women with higher dietary diversity. Despite this difference the contribution of maize flour to iron intake was nothing due to very little of the maize being fortified.

Table 14. Daily apparent food consumption and micronutrient contribution (% RNI) for women of reproductive age among households that reported consuming the food based on household assessment and adult male equivalent methodology by women's dietary diversity score.[1]

Food	Lower dietary diversity[2,3]	Higher dietary diversity[2,3]	p-value
	Median (25%, 75%)[1]	Median (25%, 75%)[1]	
National*			
	N=223	**N=610**	
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	19.2 (11-35.2)	23.4 (12.4-41.8)	0.0260
Vitamin A from fortifiable[4] oil (% RNI[6])	20.9 (9.2-43.6)	20.8 (8.8-51.8)	0.7910
	N=123	**N=407**	
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	179.8 (122.4-230.9)	159.2 (101.7-221.2)	0.0970
Added iron from fortifiable[4] wheat flour (% RNI[6])	16.8 (10-30.2)	15.5 (8.4-26.1)	0.1898
	N=115	**N=287**	
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	176.2 (127.2-232)	156.4 (106.8-221.3)	0.0240
Added iron from fortifiable maize flour (% RNI[6])	0.0 (--)	0.0 (--)	0.6156
	N=228	**N=629**	
Fortifiable[4] salt apparently consumed[5] (grams/day)	7.8 (4.5-12.9)	8.0 (5.1-12)	0.5339
Iodine from fortifiable salt (% RNI[6])	110.5 (54.1-191.9)	125.6 (64.8-227.7)	0.7785
Rural			
	N=133	**N=339**	
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	16.1 (10-29.4)	19.4 (11.3-35.5)	0.0341
Vitamin A from fortifiable[4] oil (% RNI[6])	16.5 (7.9-32.8)	18.1 (7-45.5)	0.2968

Food	Lower dietary diversity[2,3]	Higher dietary diversity[2,3]	p-value
	Median (25%, 75%)[1]	Median (25%, 75%)[1]	
	N=57	N=196	
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	184.5 (127.6-248.5)	159.0 (106.1-215.1)	0.0830
Added iron from fortifiable[4] wheat flour (% RNI[6])	22.2 (11.7-35)	17.8 (9.7-29.7)	0.1215
	N=47	N=93	
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	190.3 (149.9-263.6)	171.4 (134.1-232.3)	0.2876
Added iron from fortifiable maize flour (% RNI[6])	0.0 (--)	0.0 (--)	0.4856
	N=138	N=355	
Fortifiable[4] salt apparently consumed[5] (grams/day)	8.1 (4.8-14)	8.2 (5.4-12.3)	0.4975
Iodine from fortifiable salt (% RNI[6])	103.8 (39.8-174.9)	112.0 (54.6-197.7)	0.4548
Urban			
	N=90	N=271	
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	29.6 (16-60.7)	32.5 (19.7-57)	0.7013
Vitamin A from fortifiable[4] oil (% RNI[6])	28.9 (15.2-71.9)	27.1 (13.4-65)	0.2307
	N=66	N=211	
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	172.2 (121.2-219.5)	159.3 (91-232.5)	0.5024
Added iron from fortifiable[4] wheat flour (% RNI[6])	14.6 (7.4-21.8)	12.7 (6.4-23.2)	0.5331
	N=68	N=194	
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	156.8 (96.8-209.6)	142.7 (93-209.1)	0.1207
Added iron from fortifiable maize flour (% RNI[6])	0.0 (--)	0.0 (--)	0.8738
	N=90	N=274	
Fortifiable[4] salt apparently consumed[5] (grams/day)	7.4 (4.1-10.3)	7.5 (4.5-11.4)	0.9714
Iodine from fortifiable salt (% RNI[6])	147.7 (91.6-245.3)	150.2 (86.0-258.3)	0.5877
Zanzibar			
	N=24	N=93	
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	24.5 (11.5-47.2)	38.1 (21.1-69.4)	0.2205
Vitamin A from fortifiable[4] oil (% RNI[6])	11.6 (5.6-24.2)	16.7 (8.7-35.1)	0.2582
	N=23	N=93	
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	189.3 (115.5-299.5)	182.3 (102.2-257.4)	0.4360
Added iron from fortifiable[4] wheat flour (% RNI[6])	15.3 (8.9-28.8)	14.6 (7.5-24)	0.3625
	N=20	N=79	
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	227.6 (160.1-267.1)	183.1 (107.8-246.4)	0.0338
Added iron from fortifiable maize flour (% RNI[6])	0.0 (--)	0.0 (--)	0.9710
	N=24	N=98	
Fortifiable[4] salt apparently consumed[5] (grams/day)	11.7 (7.2-16.6)	6.3 (3.6-9.5)	0.0005
Iodine from fortifiable salt (% RNI[6])	98.8 (68-192.6)	65.3 (34.8-140.2)	0.0442

Abbreviation: RNI, recommended nutrient intakes

[1] All values are median as indicated, and are weighted to correct for unequal probability of selection.

[2] Lower dietary diversity refers to a dietary diversity score lower than the population median in each stratum (i.e. rural or urban residence). Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence). The population median is 4 in rural areas and 5 in urban areas. When more than one woman of reproductive age answered the dietary diversity information per household, the dietary diversity score of one woman was randomly selected and applied to the household.

[3] Comparing lower dietary diversity versus higher dietary diversity. Wilcoxon rank sum test was used to compare median values. The daily food consumption is shown as median with population distribution spread presented as 25th and 75th percentiles and not 95% CI. Thus overlapping 25th and 75th percentiles does not indicate non-significance as the test is based on the median point estimate between higher and lower dietary diversity.

[4] Fortifiable refers to any food that was not made at home and could be processed and is assumed to be industrially processed.

[5] Households were asked to report the amount of food purchased and the period the food lasted. With this information, the daily amount of food available for consumption in the home was estimated. The nutrient levels assigned to each food in a household was done as follows: (A) If a food sample was taken from the home and analyzed, the nutrient value measured in the food sample was assigned to the (B) In households where a food sample was not taken and the brand name was available, the median nutrient value in the branded samples analyzed from other households was used. (C) In households where a food sample was not taken and the brand name was not available, the median nutrient value in the unbranded samples analyzed from other households within each stratum was used. The total number of persons (and their age and sex) usually living in the household was noted. This information was used to determine the "apparent food consumption" by women of reproductive age using the adult male equivalent methodology.

[6] The iron RNI for women, assuming 12% bioavailability, was drawn from the World Health Organization and is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The vitamin A RNI for women, per the World Health Organization, is as follows: 600 micrograms retinol equivalents (mcg RE)/day (15-18 years), 500 mcg RE/day (19-50 years), 800 mcg RE/day (pregnant women), and 850 mcg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is as follows: 150 mcg/day (15-18 years), 150 mcg/day (19-50 years), 200 mcg/day (pregnant women), and 200 mcg/day (lactating women). For women who were both pregnant and lactating, the pregnancy RNI was used for all nutrients. The percent of RNI met was calculated as follows: amount of nutrient consumed from food / nutrient RNI x 100%. The pregnancy and lactation status of all women in the household was not known. This information was known for the subset of women who answered the women's survey. All non-surveyed women were assumed to be non-pregnant and non-lactating.

**National estimates include all 70 enumeration areas (EAs). Rural estimates include all EAs classified as rural including those rural EAs in Zanzibar, Urban estimates include all EAs classified as urban including those urban EAs in Zanzibar and Zanzibar includes only EAs in Zanzibar.*

8. ANNEXES

Annex A : Household questionnaire 1 and 2, and WRA questionnaire

TANZANIA FACT COVERAGE SURVEY 2015
HOUSEHOLD QUESTIONNAIRE 1

dateint	*Date of interview*	DD / MM / YY ☐☐/☐☐/☐☐			
teamid	*Team identifier*	☐☐	intid	Interviewer identifier	☐☐
psu	*Cluster identifier*	☐☐			
psuname	*Cluster name (quarter/block)*	_____			
hh	*Household identifier*	☐☐			
resid	*Residence*	01. Urban 02. Rural			☐☐
regid	*Region*	01. 02. 03. 04. 05.		06. 07. 08. 09. 10.	☐☐
disid	*District*	11. 12. 13. 14. 15.		16. 17. 18. 19. 20.	☐☐

Hello, my name is _____. I'm from African Academy of Public Health (AAPH). We are conducting a study on food fortification in Tanzania. This catchment area has been selected to participate in this study and your household has been selected by chance to participate. We are interested in learning about your family and food in your house and we would like to speak to the person in your household who is most knowledgeable about purchasing and preparing most of the food for your family. We would also like permission to speak to all the women residing in the house 15-49 years of age, We want to talk to them about the kind of foods they eat and the amount of wheat based products they consume.

Who is the person in the household most knowledgeable about purchasing and preparing food in the household? PIEAse may we speak to this person?

If this person is available:

- *Ask him/her to complete household questionnaires 1 and 2;*
- *Ask all eligible women in the household to complete the WRA questionnaire.*

If this person is not available:

- *Ask another household member to complete household questionnaire 1;*
- *Ask all eligible women in the household to complete the WRA questionnaire;*
- *Schedule a second visit to return to complete the household questionnaire 2 when the person knowledgeable about food in the household is available.*

On the second visit:

- *If the person knowledgeable about food is available, ask him/her to complete household questionnaire 2.*
- *If the person knowledgeable about food is not available, ask the next most knowledgeable person to complete household questionnaire 2. If no one is available, end.*

We would like to ask you some questions about questions about the gender and size of the household, some general characteristics about your household and more generally about diets and eating practices. We would also like to collect a few small samples of foods like oil, maize meal, wheat flour and salt. Your participation in this survey is completely voluntary and you can decide whether or not to participate. Even if you agree, you can still stop the interview any time you chose. The information you provide is confidential and will not be shared with anyone. Do you agree to participate?

(Do not interview a household member <15 years of age.)

cons	*Consent obtained*	Yes……1 No……2	If **yes**, begin If **no**, end
visitno	*Number of attempts to visit household (up to one return visit)* *(Record at the time of completing the interview or after second household visit*)		☐
outhh	Outcome of HH questionnaire 1	Completed.....1 Refused.....2 No household member at home or no adult respondent at home at time of	If 3 or 4, return later for a second visit.

	Fill in only after questionnaire has been completed for this household.	visit(s).....3 Household member incapacitated or intoxicated……..4 Dwelling vacant for extended period of time.....5 Household has permanently moved or address is not a dwelling.....6 Dwelling destroyed.....7 Other: _____.....99	If 2, 5, 6 or 7,go on to next selected household.

HOUSEHOLD ROSTER

Please give me the names of the persons who usually live in your household. By 'household', we mean all people who usually sleep in this dwelling and eat from the same pot.
Start by listing the head of the household

LNR (line number for respondent)	A. Name	B. Sex	C. Age *(in years OR months)* *Record in months if <5 years or <60 months*			
			Years	Months	D. Currently attending school or college?	E. 5 or more years of education?
01	Head of Household	M / F	☐☐		Yes.....1 No.....2	Yes.....1 No.....2
02		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
03		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
04		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
05		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
06		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
07		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
08		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
09		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
10		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
12		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2

13		M / F	☐☐	☐☐	Yes……1 No……2	Yes……1 No……2
14		M / F	☐☐	☐☐	Yes……1 No……2	Yes……1 No……2
15		M / F	☐☐	☐☐	Yes……1 No……2	Yes……1 No……2
16		M / F	☐☐	☐☐	Yes……1 No……2	Yes……1 No……2
hh1a	Are there any other persons such as small children or infants that we have not listed?					
hh1b	Are there any other people who may not be members of your family, such as domestic servants, or friends who usually live here and share common cooking or eating arrangements?					
lnr	*Enter the line number of the respondent of the questionnaire from the household roster*				☐☐	

SHORT BIRTH HISTORY

N°	QUESTIONS	ANSWERS	SKIPS
bh1	Altogether, how many live births have there been in your household in the last 5 years? Please include any baby who cried or showed other signs of life. *(IF 'NONE', RECORD 00. IF 'DON'T KNOW', RECORD 88.)*	☐☐	If **00** or **88**, skip to **household characteristics** module.
bh2	Is this child / are these children still alive?	All alive.....1 One or more has died in the Past 5 years.....2 Don't know……88	

HOUSEHOLD CHARACTERISTICS

N°	QUESTIONS	ANSWERS	SKIPS
hc1	Does your household have electricity?	Yes……...1 No……2	
hc2	What fuel does your household mainly use for cooking? *(*	Electricity…….. 1 Bottled gas ……2 Paraffin/kerosene ……3 Charcoal ……4 Firewood ……5 Crop residuals, straw, grass ……6 Animal dung . .. . 7 No food cooked in household…… 8 Other _____ …..99	

hc3	Does your household or anyone in the household own a … ? ***(PROMPT FOR EACH ITEM**; RECORD ALL ITEMS OWNED BY HOUSEHOLD OR A MEMBER...)* *(SELECT ONLY **ONE** ANSWER FOR EACH ITEM.)*	A. Radio Yes……..1 No……..…….2	
		B. CD/Cassette player Yes……..…1 No……..……2	
		C. Television Yes……..…1 No……2	
		D. Mobile telephone Yes……..1 No……2	
		E. Fixed phone Yes……..…1 No……2	
		F. Refrigerator Yes……..1 No……2	
		G. Table Yes……..1 No……..…2	
		H. Chair Yes……..……1 No……2	
		I. Sofa set Yes……..……..1 No……2	
		J. Bed Yes……1 No……2	
		K. Cupboard Yes……..1 No……2	
		L. Clock Yes……1 No……..2	
		N. Watch Yes……..1 No……..…2	
		O. Bicycle Yes……..1 No……..……2	
		P. Motorcycle, motorscooter Yes……..…1 No……..…2	

		H. Animal drawn cart Yes……...1 No……..……2	
		I. Car or truck Yes……..1 No……2	
		P. Boat with motor Yes……...1 No……2	
		Q. Boat without motor Yes……..1 No……2	
hc4	*WHAT IS THE MAIN MATERIAL OF THE FLOOR OF THE DWELLING?* *(OBSERVATION.)* *(*Mark only one).	Earth, sand, dung . .. . . . ……. 1 Wood planks, bamboo, palm . ……..… . 2 Parquet or polished wood . …….. . 3 Vinyl or asphalt strips . . . . . ……..…..4 Ceramic tiles, terrazzo . . . . . …… . 5 Cement . . . . . ……..... 6 Carpet . . . . . ……. .. . . 7 Other _____ ……..99	
hc5	*WHAT IS THE MAIN MATERIAL OF THE ROOF OF THE DWELLING?* *(OBSERVATION.)*	Grass / thatch / mud . . . . . ……... . 1 Iron sheets . . . . . ……. . . . 2 Tiles . . . . . ……... . . . . . 3 Concrete. . . . . ……... . . . . . 4 Asbestos . . . . . ……. . . . 5 Other _____ ……99	
hc6	*WHAT IS THE MAIN MATERIAL OF THE EXTERIOR WALLS OF THE DWELLING?* *(OBSERVATION.)*	Grass . . . .……...1 Poles and mud . . . . . ……2 Sun-dried bricks . . . . . ……... . 3 Baked bricks . . . . . ……. . . 4 Wood, timber . . . . . ……... . . . . 5 Cement blocks . . . . ……. . . . .. 6 Stones . . . . ……... . . . . . 7 Other _____..... 99	

WATER, SANITATION, AND HYGIENE (WASH)			
N°	QUESTIONS	ANSWERS	SKIPS
w1	What is the main source of drinking water for the members of your household?	**Piped water** Piped into dwelling . . . ……..… 1 Piped into yard/plot . . . ……..……...2 Public tap . . . . . ……... 3 Neighbour's tap . . . . . ……... 4 **Water from open well** Open well in dwelling . . ……... . . . .. 5 Open well in yard/plot . . . ……... … 6 Open public well . . . ……. . . .7 Neighbour's open well ……. . . 8 **Water from covered well or Borehole** Protected well in Dwelling……..……9 Protected well in yard/plot……..……..10 Protected public well . …….. 11 Neighbour's borehole . . . ……... . . . . 12 **Surface water** Spring . . . . . ……... . . . . . .13 River/stream . . ……. . . . . .. 14 Pond/lake . . . . . ……... . . . . 15 Dam . . . . . ……. . . . . .. 16 Rainwater . . . . . ……. 17	

		Tanker truck . . . . . 18 Bottled water . . . . . 19 **Other** _____ 99	
w2	Where is that water source located? *ELECT ONLY **ONE** ANSWER.)*	In own dwelling……1 In own yard/plot……2 Elsewhere……3	If **1 or 2**, skip to **w4**
w3	How long does it take to go there, get water and come back? *(IF 'DON'T KNOW', RECORD 888.)*	Minutes…… ☐☐☐	
w4	Do you **usually** do anything to your drinking water to make it safer to drink?	Yes……1 No……2	If **2**, skip to **w6**
w5	What do you **usually** do to the water to make it safer to drink? *(DO **NOT** PROMPT. PROBE "ANYTHING ELSE?")* *(CIRCLE YES FOR EACH ITEM MENTIONED AND NO FOR EACH ITEM NOT MENTIONED.)*	A. Boil Yes……1 No……2	
		B. Add bleach / chlorine Yes……1 No……2	
		C. Strain through a cloth Yes……1 No……2	
		D. Use a water filter (ceramic / sand / composite ...) Yes……1 No……2	
		E. Solar disinfection Yes……1 No……2	
		F. Let it stand and settle Yes……1 No……2	
		G. Add Waterguard Yes……1 No……2	
		H. Don't know Yes……1 No……2	
		A. Other: _____ Yes……1 No……2	
w6	What kind of toilet facility do members of your household usually use?	Flush or pour flush toilet to piped sewer system……1 Flush/ pour flush to piped septic tank . ……2. Flush/ pour flush to pit latrine . ……3 Flush/ pour flush to elsewhere ……4 Ventilated improved pit latrine (vip) 5	

		Pit latrine with slab . ……..6 Pit latrine without slab/open pit . . . . . …. 7 Composting toilet/ecosan..……8 Bucket . . . . 9 No facility/bush/field …….. . 10 Other _____ ..……..99	
w7	Do you usually share this facility with other households?	Yes……..1 No……2	

HEALTH SERVICES ACCESS			
N°	QUESTIONS	ANSWERS	SKIPS
hs1	How long does it take to travel to the nearest hospital or health center facility? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)* *(IF 'DON'T KNOW', RECORD 88.)*	A. Duration ☐☐ B. Minute(s)……..1 Hour(s).....2 Day(s).....3	If **A** is **88**, do not complete B. End here

TANZANIA FACT COVERAGE SURVEY 2015
HOUSEHOLD QUESTIONNAIRE 2

dateint	Date of interview	DD / MM / YY ☐☐/☐☐/☐☐			
teamid	Team identifier	☐☐	intid	Interviewer identifier	☐☐
psu	*Cluster identifier*	☐☐			
psuname	*Cluster name (quarter/block)*	_____			
hh	*Household identifier*	☐☐			
lnr	*Line number of respondent* *(Write in the number from the household roster in household questionnaire 1.)*				☐☐
outhh	Outcome of HH questionnaire 2 *Fill in only after questionnaire has been completed for this household.*	Completed.....1 No household member at home or no adult respondent at home at time of visit(s).....2 Household member incapacitated or intoxicated……..3 Dwelling vacant for extended period of time.....4 Household has permanently moved or address is not a dwelling……..5 Dwelling destroyed.....6 Other: _____.....99			If 2 or 3, return later for a second visit. If 4,5,6,go on to next selected household.

"I would like to ask some questions about the availability of food in your household over the last month."

HOUSEHOLD HUNGER SCALE			
N°	QUESTIONS	ANSWERS	SKIPS
hh1	How many times in the last month did anyone in your house go to sleep at night hungry because there was not enough food? *(IF 'NONE', RECORD 00.)*	Number of times ☐☐	
hh2	How many times in the last month did anyone in your house go for a whole day and night without eating anything at all because there was not enough food? *(IF 'NONE', RECORD 00.)*	Number of times ☐☐	
hh3	How many times in the last month was there ever no food to eat of any kind in your house because of lack of resources to get food? *IF 'NONE', RECORD 00.)*	Number of times ☐☐	

Now I'm going to ask you some questions about food items including cooking oil and fats, maize flour, wheat flour, and salt. If you have any of these food items in your household, please bring them here now before we start."

OIL FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
of1	First I would like to talk with you about cooking oil. Does your household prepare foods using cooking oil? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes, regularly……..1 Yes, sometimes ……2 No, never ……..3	If **3**, skip to **maize flour** module.
of2	What is the **main** type of cooking **oil** that is used in your household for most meals on most days? *(CIRCLE ONLY **ONE** ANSWER.)*	Vegetable oil…….....1 Sunflower oil.....2 Corn oil……...3 Sesame oil…….....4 Red palm oil.....5 Shea nut oil……..…...6 Soybean oil.....7 Groundnut oil.....8 Olive oil.....9 Don't know / Don't remember.....88 Other: _____.....99	
of3	Can you show me this **main** cooking **oil**? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
of4	*(IF MAIN OIL TYPE IS AVAILABLE):* When your household got this [MAIN OIL TYPE], where did you get it from? *(IF MAIN OIL TYPE IS NOT AVAILABLE):* The **last time** your household got [MAIN OIL TYPE], where did you get it from? *(CIRCLE ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from food aid.....3 Don't know / Don't remember…....88 Other: _____...99	If **2,** skip to **maize flour** module.
of5	*(IF MAIN OIL TYPE IS AVAILABLE):* When your household got this [MAIN OIL TYPE], how was it packaged?	Original package…….....1 Re-packaged……...2	

	(IF MAIN OIL TYPE IS NOT AVAILABLE): The **last time** your household got [MAIN OIL TYPE], how was it packaged? *(READ **ALL** RESPONSES)* *(CIRCLE ONLY **ONE** ANSWER.)*	My own container.....3 Don't know/dont remember .....88 Other: _____.....99	
of6	*(IF MAIN OIL TYPE IS AVAILABLE):* When your household got this [MAIN OIL TYPE], how much did you get? *(IF MAIN OIL TYPE IS NOT AVAILABLE):* The **last time** your household got [MAIN OIL TYPE], how much did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Quantity ☐☐☐☐ B. Kg.....1 g.....2 L.....3 mL.....4	
of7	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Month(s).....2	
of8	*(IF MAIN OIL TYPE IS AVAILABLE):* ***OBSERVE BRAND**.* *(IF MAIN OIL TYPE IS NOT AVAILABLE, **ASK THE RESPONDENT**):* What is the brand of this [MAIN OIL TYPE]? *(CIRCLE ONLY **ONE** ANSWER.)*	Korie.....1 Sundrop.....Safi Mo.....3 Kimbo.....4 Singida.....5 Sunola.....6 Maisha.....7 Marina----------8 Don't know/dont remember .....88 Other: _____.....99	
of9	*(IF MAIN OIL TYPE IS AVAILABLE):* ***OBSERVE PRODUCER**.* *(IF MAIN OIL TYPE IS NOT AVAILABLE, **ASK THE RESPONDENT**):* Who is the producer of this [MAIN OIL TYPE]? *(CIRCLE ONLY **ONE** ANSWER.)*	BIDCO .....1 EAst Coast .....2 Murzah Oil Mill.....3 Don't know/don't remember.....88 Other: _____.....99	If **oil is not availabl e,** skip to **maize flour** module.

of10	***LOOK FOR FORTIFICATION LOGO***. *(CIRCLE ONLY **ONE** ANSWER.)*	Logo not observed (labelled)……1 Logo not observed (no label)……2 Logo observed……..……...3	
of11	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK OIL LABEL ON SAMPLE CONTAINER.)*	Sample taken……1 No sample taken……..…2	

MAIZE FLOUR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
mf1	Now, I would like to talk with you about maize flour. Does your household prepare foods using maize flour (e.g., posho, porridge)? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes, regularly……..……...1 Yes, sometimes ……2 No, never ……..3	If **3**, skip to **wheat flour** module.
mf2	Can you show me what **main maize flour** your household uses? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
mf3	*(IF MAIZE FLOUR IS AVAILABLE):* When your household got this maize flour, where did you get it from? *(IF MAIZE FLOUR IS NOT AVAILABLE):* The **last time** your household got maize flour, where did you get it from? *(CIRCLE ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **wheat flour** module.
mf4	*(IF MAIZE FLOUR IS AVAILABLE):* When your household got this maize flour, how was it packaged? *(IF MAIZE FLOUR IS NOT AVAILABLE):* The **last time** your household got maize flour, how was it packaged? *(READ **ALL** RESPONSES)* *(CIRCLE ONLY **ONE** ANSWER.)*	Original package……...1 Re-packaged……..2 My own container.....3 Don't know/dont remember .....88 Other: _____.....99	

mf5	*(IF MAIZE FLOUR IS AVAILABLE):* When your household got this maize flour, how much did you get? *(IF MAIZE FLOUR IS NOT AVAILABLE):* The **<u>last time</u>** your household got maize flour, how much did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Quantity ☐☐☐☐ B. Kg.....1 g.....2	
mf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Month(s).....2	
mf7	*(IF MAIZE FLOUR IS AVAILABLE):* ***<u>OBSERVE BRAND</u>***. *(IF MAIZE FLOUR IS NOT AVAILABLE,* ***<u>ASK THE RESPONDENT</u>****):* What is the brand of this maize flour? *(CIRCLE ONLY **<u>ONE</u>** ANSWER.)*	Azam.....1 Dada Ntilie.....2 Pembe.....3 Soko.....4 Pride.....5 White Star.....6 Azania.....7 Nyati .....88 Other: _____.....99	
mf8	*(IF MAIZE FLOUR IS AVAILABLE):* ***<u>OBSERVE PRODUCER</u>***. *(IF MAIZE FLOUR IS NOT AVAILABLE,* ***<u>ASK THE RESPONDENT</u>****):* Who is the producer of this maize flour? *(CIRCLE ONLY **<u>ONE</u>** ANSWER.)*	MWanji.....1 Zerason mills.....2 Bakheresa Group.....3 Azania.....4 Nyati.....5 Don't know/dont remember.....88 Other: _____.....99	If **maize flour is not availabl e,** skip to **wheat flour** module.
mf9	***<u>LOOK FOR FORTIFICATION LOGO</u>***. *(CIRCLE ONLY **<u>ONE</u>** ANSWER.)*	Logo not observed (labelled)……1 Logo not observed (no label)……2 Logo observed……3	

mf10	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK MAIZE FLOUR LABEL ON SAMPLE CONTAINER.)*	Sample taken……1 No sample taken……2	
WHEAT FLOUR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
wf1	Now, I would like to talk with you about wheat flour. Does your household prepare foods using wheat flour (e.g. bread or other wheat flour products)? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……2 No, never ……..……..3	If **3**, skip to **salt** module.
wf2	Can you show me what **main wheat flour** your household uses? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
wf3	*(IF WHEAT FLOUR IS AVAILABLE):* When your household got this wheat flour, where did you get it from? *(IF WHEAT FLOUR IS NOT AVAILABLE):* The **last time** your household got wheat flour, where did you get it from? *(CIRCLE ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **salt** module.
wf4	*(IF WHEAT FLOUR IS AVAILABLE):* When your household got this wheat flour, how was it packaged? *(IF WHEAT FLOUR IS NOT AVAILABLE):* The **last time** your household got wheat flour, how was it packaged? *(READ **ALL** RESPONSES)* *(CIRCLE ONLY **ONE** ANSWER.)*	Original package……...1 Re-packaged……..2 My own container.....3 Don't know/dont remember.....88 Other: _____.....99	

wf5	*(IF WHEAT FLOUR IS AVAILABLE):* When your household got this wheat flour, how much did you get? *(IF WHEAT FLOUR IS NOT AVAILABLE):* The **last time** your household got wheat flour, how much did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Quantity ☐☐☐☐ B. Kg.....1 g.....2	
wf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Month(s).....2	
wf7	*(IF WHEAT FLOUR IS AVAILABLE):* ***OBSERVE BRAND**.* *(IF WHEAT FLOUR IS NOT AVAILABLE,* ***ASK THE RESPONDENT**):* What is the brand of this wheat flour? *(CIRCLE ONLY **ONE** ANSWER.)*	Azania.....1 Pembe.....2 Maisha.....3 Safi.....4 Poa.....5 Taifa.....6 Azam.....7 Nayti……..……8 Jumbo……..…9 Sunkist……..……10 Don't know .....88 Other: _____.....99	
wf8	*(IF WHEAT FLOUR IS AVAILABLE):* ***OBSERVE PRODUCER**.* *(IF WHEAT FLOUR IS NOT AVAILABLE,* ***ASK THE RESPONDENT**):* Who is the producer of this wheat flour? *(CIRCLE ONLY **ONE** ANSWER.)*	Azania.....1 Pembe.....2 Maisha.....3 Safi.....4 Poa.....5 Taifa.....6 Azam.....7 Nayti……8 Jumbo……..…9 Sunkist……..……10 Don't know .....88 Other: _____.....99	If **wheat flour is not availabl e,** skip to **salt** module.

wf9	***LOOK FOR FORTIFICATION LOGO***. *(CIRCLE ONLY **ONE** ANSWER.)*	Logo not observed (labelled)……1 Logo not observed (no label)……2 Logo observed…….....3	
wf10	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK WHEAT FLOUR LABEL ON SAMPLE CONTAINER.)*	Sample taken……..……1 No sample taken……..……2	

SALT IODIZATION COVERAGE

N°	QUESTIONS	ANSWERS	SKIPS
si1	Now, I would like to talk with you about salt. Does your household use salt? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..…2 No, never ……..……..3	If **3**, skip to **bouillon and sEAsonings** module.
si1a	What is the **main** type of **salt** that is used in your household? *(CIRCLE ONLY **ONE** ANSWER.)*	Refined white salt……1 Rock salt……..……2 Large crystal salt…… 3 Don't know / Don't remember.....88 Other: _____...99	
si2	Can you show me this **main** **salt**? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
si3	*(IF SALT IS AVAILABLE):* When your household got this salt, where did you get it from? *(IF SALT IS NOT AVAILABLE):* The **last time** your household got salt, where did you get it from? *(CIRCLE ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **bouillon and sEAsonings** module.

si4	*(IF SALT IS AVAILABLE):* When your household got this salt, how was it packaged? *(IF SALT IS NOT AVAILABLE):* The **last time** your household got salt, how was it packaged? *(READ **ALL** RESPONSES)* *(CIRCLE ONLY **ONE** ANSWER.)*	Original package……...1 Re-packaged……..2 My own container.....3 Don't know /dont remember.....88 Other: _____.....99	
si5	*(IF SALT IS AVAILABLE):* When your household got this salt, how much did you get? *(IF SALT IS NOT AVAILABLE):* The **last time** your household got salt, how much did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Quantity ☐☐☐☐ B. Kg.....1 g.....2	
si6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Month(s).....2	
si7	*(IF SALT IS AVAILABLE):* ***OBSERVE BRAND**.* *(IF SALT IS NOT AVAILABLE, **ASK THE RESPONDENT**):* What is the brand of this salt? *(CIRCLE ONLY **ONE** ANSWER.)*	Malindi.....1 Kay salt.....2 Ken Salt.....3 Sea Salt.....4 Don't know .....88 Other: _____.....99	
si8	*(IF SALT IS AVAILABLE):* ***OBSERVE PRODUCER**.* *(IF SALT IS NOT AVAILABLE, **ASK THE RESPONDENT**):* Who is the producer of this salt? *(CIRCLE ONLY **ONE** ANSWER.)*	Malindi.....1 Kay salt.....2 Ken Salt.....3 Sea Salt.....4 Don't know .....88 Other: _____.....	If **salt is not availabl e,** skip to **next** module.

si9	***LOOK FOR FORTIFICATION LOGO***. *(CIRCLE ONLY **ONE** ANSWER.)*	Logo not observed (labelled)……1 Logo not observed (no label)……2 Logo observed……..…….....3	
si10	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK SALT LABEL ON SAMPLE CONTAINER.)*	Sample taken……..……1 No sample taken……..……2	

BOUILLON AND SEASONINGS FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
bcf1	What is the **main** brand of **bouillon cube** or **seasoning product** used in most meals on most days in your household? *(CIRCLE ONLY **ONE** ANSWER.)*	Royco.....1 Knorr.....2 Onga.....3 Don't use.....77 Don't know / Don't remember.....88 Other:_____.....99	If **77**, skip to **logo** module.
bcf2	The **last time** your household got this bouillon cube or seasoning product how much did you get? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Quantity ☐☐☐☐ B. Kg.....1 g.....2 Cubes……3	
bcf3	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. CIRCLE THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Month(s).....2	

FORTIFICATION LOGO KNOWLEDGE AND INFLUENCE			
lk1	*(SHOW TANZANIA FORTIFICATION LOGO.)* Have you ever seen this logo? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..……1 No……..2	If 2 end the questionnaire
lk2	What does this logo mean? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(CIRCLE **ALL** RESPONSES THAT APPLY.)*	Fortified / enriched / added micronutrients ……..…..1 Good for health……..……2 Better quality ……..……3 Bad quality……4 More expensive……..……...5 No meaning ……6 Don't know/don't remember……88 Other: _____.....99	
lk3	Does this logo influence your decision to buy? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(CIRCLE ONLY **ONE** ANSWER.)*	No, it does not influence my decision to buy.....1 Yes, it motivates me to buy the product.....2 Yes, it discourages me to buy the product.....3 Don't know/don't remember.....88 Other: _____.....99	

TANZANIA FACT COVERAGE SURVEY 2015

FEMALE RESPONDENT (15 to 49 YEARS) QUESTIONNAIRE

dateint	Date of interview	DD / MM / YY ☐☐/☐☐/☐			
teamid	Team identifier	☐☐	intid	Interviewer identifier	☐☐
disid	District	21. AA 22. BB 23. CC 24. DD 25. EE		26. FF 27. GG 28. HH 29. II 30. JJ	☐☐
subid	Sub-county	31. AA 32. BB 33. CC 34. DD 35. EE		36. FF 37. GG 38. HH 39. II 40. JJ	☐☐
resid	Residence	03. Urban 04. Rural			☐☐
psu	Cluster identifier	☐☐			
psuname	Cluster name (quarter/block)	_____			
hh	Household identifier	☐☐			
lnr	Line number of respondent *Write in the number from the household roster in household questionnaire 1.*				☐☐
cons	Written consent obtained?	Yes……1 No……2			If **yes**, begin If **no**, end
visitno	Number of attempts to visit household (up to one return visit) *Record at the time of completing the interview or after second household visit*				☐
outhh	Outcome of HH questionnaire *Fill in only after questionnaire has been completed for*	Completed.....1 Refused.....2 No household member at home or no adult respondent at home at time of visit(s).....3 Household member incapacitated or intoxicated……..4 Dwelling vacant for extended period of time.....5 Household has permanently moved or address is not a			If 3 or 4, return later for a second visit. If 2, 5, 6 or 7, go on to next selected household.

	this household.	dwelling……6 Dwelling destroyed.....7 Other: _____.....99	
		Supervisor check	Initial for yes _____

HEALTH DATA			
N°	QUESTIONS	ANSWERS	SKIPS
hd1	Are you currently pregnant? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2 Don't know……3	
hd2	Are you currently breastfeeding? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2	

DIETARY DIVERSITY

Since the time you woke up yesterday to when you woke up today, did you have any of the following things to eat or drink?
I am interested in whether you had the item I mention, even if it was combined with other foods. For example, if you ate a millet porridge made with a mixed vegetable sauce, you should reply yes to any food I ask about that was an ingredient in the porridge or sauce. PIEAse do not include any food used in a small amount for sEAsoning or condiments (like chilies, spices, herbs, or fish powder), I will ask you about those foods separately.

*(READ **ALL** QUESTIONS. CIRCLE ONLY **ONE** ANSWER FOR EACH.)*

N°	ITEMS	
dd1	Any [INSERT ANY LOCAL FOODS, E.G. UGALI, NSHIMA], bread, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice, wheat, or [INSERT ANY OTHER LOCALLY AVAILABLE GRAIN]?	Yes…….....1 No……..2
dd2	Any potatoes, yams, manioc, cassava or any other foods made from roots or tubers?	Yes…….....1 No……..2
dd3	Any food made from vegetables or root crops with yellow or orange flesh such as carrots, pumpkin, red sweet potatoes?	Yes…….....1 No……..2
dd4	Any food made from dark green leafy vegetables such as cassava leaves, potato leaves, kale, spinach and other locally available dark green leafy vegetables?	Yes…….....1 No……..2

dd5	Any other vegetables, such as cabbage, egg-plant, tomatoes?	Yes…….....1 No……..2
dd6	Any food made from fruits with yellow or orange flesh such as pawpaw, mango, guava or papaya?	Yes…….....1 No……..2
dd7	Any other fruits, such as pineapple, apple, oranges… ?	Yes…….....1 No……..2
dd8	Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds?	Yes…….....1 No……..2
dd9	Any liver, kidney, heart, or other organ meats?	Yes…….....1 No……..2
dd10	Any eggs?	Yes…….....1 No……..2
dd11	Any fresh or dried fish or shellfish?	Yes…….....1 No……..2
dd12	Any cowpea, groundnut, locust bean, soya bean, or other foods made from beans, peas, lentils, or legumes?	Yes…….....1 No……..2
dd13	Any cashew, walnut, pecan, shea nut, almond or other foods made from nuts?	Yes…….....1 No……..2
dd14	Any cheese, yogurt, milk or other milk products?	Yes…….....1 No……..2
dd15	Any foods made with oil, fat, margarine or butter?	Yes…….....1 No……..2
dd16	Any sugar or honey?	Yes…….....1 No……..2
dd17	Any other foods, such as condiments, coffee, tea?	Yes…….....1 No……..2
dd18	Red palm oil	Yes…….....1 No……..2

INDIVIDUAL WHEAT FLOUR CONSUMPTION

1. **In the last 7 days**, how many times did you eat products made from wheat flour, such as [FOOD ITEM]?

(REPEAT QUESTION FOR EACH FOOD ITEM LISTED BELOW)

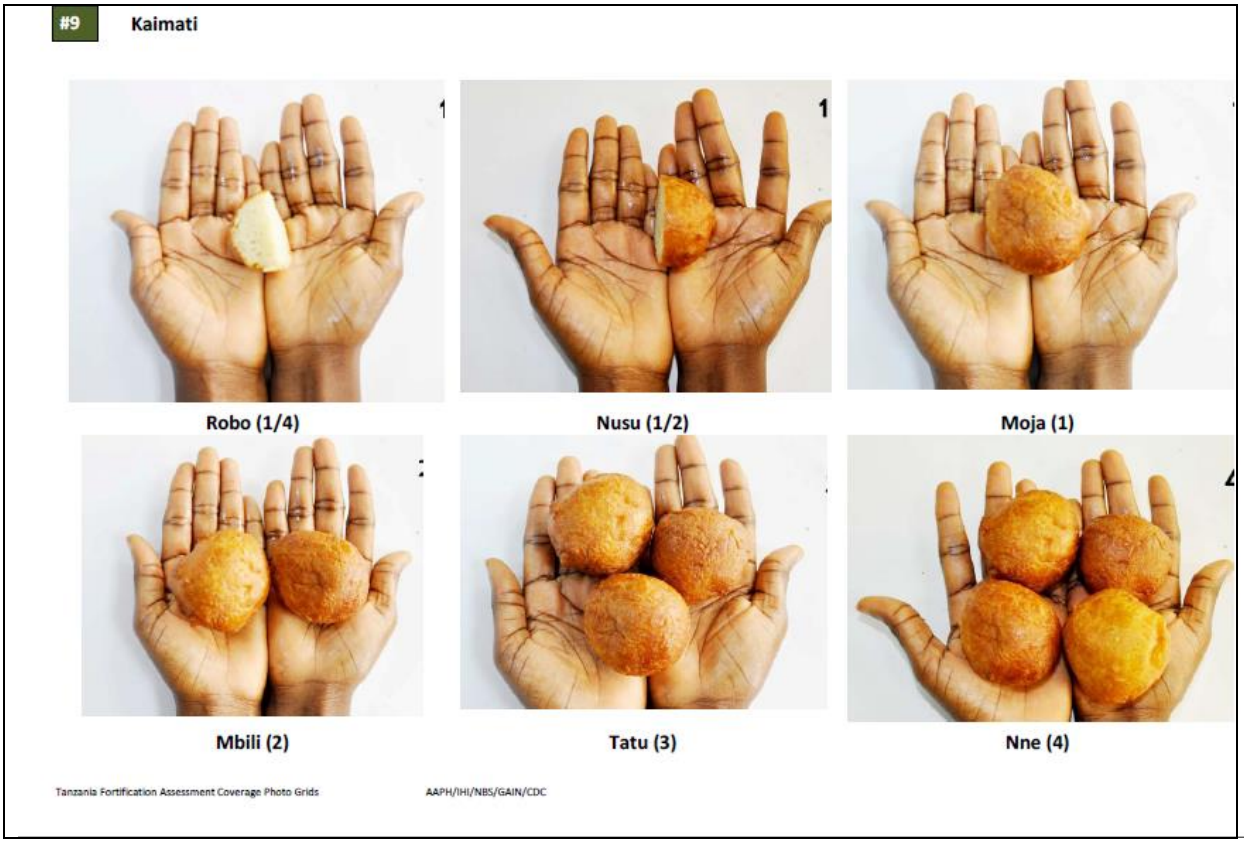
2. Usually how much of [FOOD ITEM] did you eat at one sitting?

(SHOW PICTURES OF PORTIONS AND REPEAT QUESTION FOR EACH FOOD ITEM LISTED BELOW)
(IF FREQUENCY = 00, SKIP THE PORTION SIZE QUESTION)

N°	ITEMS	1. Frequency (# times)	2. Portion size
wfc1	Bread	☐☐	☐
wfc2	Scones	☐☐	☐
wfc3	Cakes	☐☐	☐
wfc4	Cupcake	☐☐	☐
wfc5	Ring donut	☐☐	☐
wfc6	Chapatti	☐☐	☐
wfc7	Chapatti Maji	☐☐	☐
wfc8	Buns	☐☐	☐
wfc9	Visheti	☐☐	☐
wfc10	Samosa	☐☐	☐
wfc11	Kaimati	☐☐	☐
wfc21	Others: _____	☐☐	☐

Annex B: Example photo grid used with WRA questionnaire

A photo grid such as the one below was prepared for each of 12 wheat flour-containing foods and individual assessment of intake of wheat flour-containing foods among WRA over the past seven days.



Annex C: Food measurement guide

Vikopo vya kupimia mafuta

#1a Kiroboi

Mililita hamsini (50mls)

Mililita mia (100mls)

Mililita mia tatu na hamsini (350mls)

Mililita mia tano (500mls)

#1c **Chupa**

Mililita mia tatu na hamsini (350ml)

Mililita mia tatu na hamsini (350ml)

Mililita mia tano (350ml)

Lita moja na nusu (1.5L)

Annex D: Consent forms

Protocol Title:	GAIN's Fortification Coverage Assessment Survey
Principal Investigators:	Ramadhani Abdallah Noor (MD, MPH, MSc), AAPH Tanzania Honorati Masanja (BSc, PGDipl, MSc, PhD), IHI Tanzania Wafaie Fawzi (MBBS, MPH, MS, DrPH), HSPH USA
Description of Subject Population:	Adult Men and Women, including women of reproductive age 15 to 49 years.
Version Date:	Version 1.1, July 10, 2015

INTRODUCTION

The Africa Academy for Public Health (AAPH) in collaboration with Ifakara Health Institute (IHI) and Harvard School of Public Health (USA**), is carrying out a survey to establish** the implementation of the GAIN's Fortification Assessment in Tanzania**, with additional support from the Tanzania Bureau of Statistics**. This survey would help to ensure that the public of Tanzania has access to a wide variety of nutrient rich foods which provide all the vitamins and minerals they need**.**

This is a cross-sectional survey, targeting a population consisting of 1144 households and women of reproductive age in 70 census "urban" and "rural" districts in Tanzania. This survey is designed to capture a representative population at national level. You have been selected because you are a resident in a household within this study's sampling frame. We will be using the Fortification Assessment Coverage Tool (FACT) developed by GAIN and partners, to carry out this coverage assessments survey.

HOW TO PARTICIPATE

You are being asked to take part as a household participant to provide the required information about your household or yourself. Before you decide if you want to participate, we want to explain the purpose of the research, what you will be asked to do, the possible risks and benefits of participation, how we will protect your information, and who to contact if you have any questions or concerns about the project.
If you decide to take part in the study, you will be asked to sign this consent form or make your mark in front of someone, and we will conduct the interview today.

Please note that your participation in this research project is entirely voluntary, and your decision not to participate or to withdraw will not affect your relationship with the study team or district management or any of the collaborating institutions now or in the future.
RISKS and/or DISCOMFORTS

We recognize that you may feel uncomfortable answering some of the interview questions that ask about sensitive topics such as information about death of a relation. We assure you that our study team members are specifically trained to administer these interviews and you may opt not to answer any question. **We may also want to collect small amounts of a few food samples from your home.**

POTENTIAL BENEFITS & REIMBURSEMENTS

There are no direct benefits to you or your household by participating in this survey. However, knowledge gained from this survey will be shared with the local government and regional management, which may in the future help develop intervention strategies and policies for the good of the community in general. You will not be compensated for participating in this survey, though your participation will be highly appreciated.

COSTS TO YOU

Other than your time, you will not incur any direct cost for participating in this survey.

CONFIDENTIALITY

We will take strict precautions to safeguard your personal information throughout the survey to the extent permitted by law. Your information will only be accessible to authorized personnel. You will remain anonymous in

any reports about this study. All responses for interviews conducted with computers are password protected and are secure with access to authorized personnel.

PERSONS TO CONTACT FOR PROBLEMS OR QUESTIONS

If you have any questions about the study, you should contact the following member of our ethics review committee;

Dr Mwifadhi Mrisho
Ifakara Health Institute
P. O. Box 53
Ifakara, Tanzania
irb@ihi.or.tz
Tel: +255 (0) 23 2625164 or +255 (0) 22 2774714
Fax: +255(0) 22 2771714

PARTICIPANT'S STATEMENT

I have read the information in this consent form including risks and possible benefits, or it has been read to me. All my questions about the research study have been answered to my satisfaction. I consent to participate in the study. I authorize the use and disclosure of my information for this research.

I, _____, have read and understood the contents in this form. My questions have been answered. I agree to participate in this study.

_____ _____
Signature of Participant Date

_____ _____
Signature of Legally Authorized Representative Date
(When applicable)

_____ _____
Signature of Study Representative Date

If participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

*Print name of witness*_____ *AND* *Thumbprint of participant*

Signature of witness _____

Date _____

Annex E: Ethical approval for conduct of study

THE UNITED REPUBLIC OF
TANZANIA

National Institute for Medical Research
3 Barack Obama Drive
P.O. Box 9653
11101 Dar es Salaam
Tel: 255 22 2121400
Fax: 255 22 2121360
E-mail: headquarters@nimr.or.tz
NIMR/HQ/R.8a/Vol. IX/2014

Ministry of Health and Social Welfare
6 Samora Machel Avenue
P.O. Box 9083
11478 Dar es Salaam
Tel: 255 22 2120262-7
Fax: 255 22 2110986

2nd September 2015

Dr. Ramadhani Noor
African Academy for Public Health (AAPH)
Mikocheni Area (B) 802, Old Bagamoyo Road
P O Box 79810,
DAR ES SALAAM

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Fortification Assessment Coverage Tool (FACT) Survey in Tanzania (Noor R et *al*) has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Sites: National Survey in Tanzania.

Approval is for one year: 2nd September 2015 to 1st September 2016.

Name: Dr Mwelecele Malecela

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Dr Margaret E Mhando

Signature
Ag CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL WELFARE

CC: **RMO**
DED
DMO

Annex F: Timeline

Main survey activities were carried out between June 2015 and June 2016

S/N	Activity	Responsible party	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May	June
1	Stakeholder Consultation														
	Planning meeting with GAIN & CDC	GAIN, CDC, AAPH													
	GAIN/CDC share draft protocol with AAPH	GAIN, CDC													
	Stakeholder and planning meetings with GAIN & CDC	GAIN, AAPH													
2	Ethical clearance application														
	GAIN/CDC share finalized protocol with AAPH	GAIN, CDC													
	Applications (3) submitted for ethical approvals (MRCC-NMIR, Harvard IRB, IHI)	AAPH													
	Introduction to community/district authorities	AAPH													
3	Obtain EA sampling frame and draw sample of selected EA														
	Tanzania Bureau of Statistics to draw EA sample based on the finalized protocol	AAPH													
	Development of field maps and forms	AAPH													
4	Local adaptation and translation of study instrument and methodology														
	Review of questionnaire	GAIN, CDC, AAPH													
	Pre-test questionnaire	AAPH													
	Review meeting with GAIN and CDC	GAIN, CDC, AAPH													
	Review and revise tool	GAIN, CDC, AAPH													
	Translation and back translation (Kiswahili)	AAPH													

5	Development of netbook data entry program														
	Netbook programming	AAPH													
	Netbook desk review	AAPH													
	Netbook pretest	AAPH													
6	Recruitment of enumerators														
	Recruitment	AAPH													
7	Preparation for training and data collection														
	Manual and training plan	GAIN, CDC, AAPH													
	Finalize photo-grids for WRA questionnaire	AAPH													
	GAIN to supply food sample collection containers	GAIN													
	Procurement of field material	AAPH													
8	Training of enumerators and study pilot														
	Review meeting with GAIN and CDC	GAIN, CDC, AAPH													
	Enumerator/Supervisor training	GAIN, CDC, AAPH													
	Study pilot	GAIN, CDC, AAPH													
9	Main data collection														
	Data collection	AAPH													
	Field update	AAPH													
	Ship food samples	AAPH													
10	Compilation of database														
	Data cleaning	AAPH													
	Data processing (clean data, code book)	AAPH													
	Summary report	AAPH													
11	Dissemination														
	Present results at a stakeholder workshop	GAIN, CDC, AAPH													

Annex G: List of key variables in analyses and how they were calculated

Variable	Calculation
Household dependency ratio	The "number of household members below 15 years of age and above 64 years of age" divided by the "number of household members between 15 and 64 years of age".
Dietary diversity score	Women were asked about their consumption of 18 food groups. These were distilled into 10 food groups: 1. All starchy staple foods, 2. Beans and peas, 3.Nuts and seeds, 4.Dairy, 5. Flesh foods, 6.Eggs, 7. Vitamin-A rich dark green leafy vegetables, 8. Other vitamin-A rich vegetables and fruits, 9.Other vegetables, and 10. Other fruits. If a woman consumed a food from a food group, she received a score of 1 for the food group and a maximum of 10 if she ate from all of the food groups. This summary score (0-10) was the woman's dietary diversity score. A woman's dietary diversity score less than the population median in each stratum (i.e. rural or urban residence) was classified as "lower dietary diversity (below the median)" and otherwise, it was termed "higher dietary diversity (at or above the median)".
Multidimensional Poverty Index (MPI)	The MPI is derived from three domains: living standards (mpiLS), household education (mpiED), and health and nutrition (mpiHN). The household living standard score was based on 6 variables: no electricity, dirt floor, use of dirty cooking fuel, < 2 key assets owned, unsafe drinking water, and unimproved / shared latrine). If affirmative, each LS variable got a score of 1/18. The household ED dimension was based on 2 variables: household head had less than five years of education and any school age child was not attending school. If affirmative, each ED variable was scored 1/6. For health and nutrition, the domain was based on the 3 variables: hunger, recently born child dead, and poor access to preventative services. All affirmative responses were given a score of 1/9. Next the scores from each domain were summed (i.e. mpiLS + mpiED + mpiHN) to obtain a maximum score of 1. Households with an MPI score greater than or equal to 0.33 were defined as a "poor" while households with an MPI less than 0.33 were classified as "non-poor".
Household hunger	Hunger score was calculated as a household cumulative sum of responses to 3 questions on "lack of food", "insufficient food over the past month", and "insufficient food (day and night)". The maximum household score was 6. Scores between 0-1 were classified as "little or no hunger", 2-3 as "moderate hunger", and 4-6 as "severe hunger".
Fortifiable food consumed	Fortifiable refers to any food that was not made at home and Is assumed to be industrially processed.
Fortified food consumed	"Fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met the "inadequately fortified", "adequately fortified" or "over-fortified" criteria; that is, if they met or exceeded the following criteria: oil with $\geq$3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt $\geq$ 7.6 ppm iodine.) (A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet

Variable	Calculation
	the fortified criteria then the household was classified as “not fortified” for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household’s fortification status could not be determined and the household was classified as “don’t know” for consumes fortified food.
Unfortified food sample	Unfortified foods were those that, upon analysis, had less than the minimum detectable level of a micronutrient (for salt ad oil) or less than the intrinsic iron estimate based on unfortified samples for maize and wheat flour. Specifically, unfortified oil was defined as < 3 mg/kg vitamin A, unfortified wheat flour was defined as ≤29.8 mg/kg total iron , unfortified maize flour was defined as <19.6mg/kg total iron and unfortified salt was defined as ≤ 7.6ppm iodine
Reported positive attributes to logo	Reported that the logo means “fortified / enriched / added micronutrients”, “good for health” or “better quality”.
Percent Recommended Nutrient Intake	Recommended Nutrient Intakes (RNI) from the World Health Organization were used to compare women’s nutrient intake from fortifiable food. The iron RNI for women, assuming 12% bioavailability, is as follows: 25.8 mg/day (15-18 years), 24.5 mg/day (19-50 years), 24.5 mg/day (pregnant women), 12.5 mg/day (lactating women). The vitamin A RNI for women is as follows: 600 micrograms retinol equivalents (mcg RE)/day (15-18 years), 500 mcg RE/day (19-50 years), 800 mcg RE/day (pregnant women), and 850 mcg RE/day (lactating women). The iodine RNI for women is as follows: 150 mcg/day (15-18 years), 150 mcg/day (19-50 years), 200 mcg/day (pregnant women), and 200 mcg/day (lactating women). For women who were both pregnant and lactating, the pregnancy RNI was used for all nutrients. The percent of RNI met was calculated as follows: “amount of nutrient consumed from food per day” divided by “nutrient RNI” multiplied by 100%.
Apparent food consumption	Apparent food consumption is the product of “amount of food consumed per day” and “adult male equivalent (AME) ratio” of an individual based on their sex and age. As a point of reference, males age 18-30 years are assigned an AME ratio of 1.0.

Annex H. In-depth description of analytical methods applied to food samples

Authors: Dr. Anna Zhenchuk and Dipl. BioChem. Katrin Steinbrenner, BioAnalyt GmbH

1. Introduction

GAIN collected samples of staple foods from markets and households in Tanzania to assess the coverage of fortified foods and the levels of micronutrients in these foods. The samples of salt, sugar, oil and flour were sent to BioAnalyt for the measurement of iodine, vitamin A and iron levels. Salt, sugar and oil were analyzed for added micronutrient content using the iCheck technology.

2. Technology

iCheck is a test kit for the quantitative determination of micronutrients. It consists of two units, a portable photometer or fluorimeter (iCheck) and the disposable reagent vials in which the reaction is performed.

The validation protocol for each iCheck and matrix combines assessment of precision, trueness and a comparison to a reference method. iCheck and iCheck reagent vials are produced according to quality management system (DIN EN ISO 9001:2008) certified by TÜV Nord in Germany.

3. Methodology

3.1 Analysis of Vitamin A in Edible Oil

iCheck Chroma 3 was used for the determination of vitamin A in cooking oil. The determination of vitamin A is based on a color reaction in which the reagents in the vial turn a brilliant blue (Carr-Price reaction), the intensity of which is dependent on retinol concentration. The device measures the absorption of the color in the reagent vial at 3 different wavelengths, over the course of 30 seconds. The device then calculates the vitamin A content through a sophisticated algorithm and displays the result in mg Retinol equivalents/kg. The linear range of the device is 3 –30 mg retinol equivalents (RE)/kg of oil. This method has been validated against the reference method of HPLC (1,2).

Liquid oil samples were directly injected into the reagent vial and measured with iCheck Chroma 3 according to the user manual. Solidified oil samples were warmed to 40°C in an incubator and shaken for 5 minutes to ensure that they were homogeneous, before analysis.

A number of the individual oil samples were pooled according to customer specifications to make 5 composite samples. To make composite samples exactly 1 g of each individual oil sample, mentioned in the sample list to be pooled, was used to make the composite sample. The composite sample is then continuously mixed for 7 minutes to ensure homogeneity, and analyzed using iCheck Chroma 3.

As a quality control, the emitter and receptor of the iCheck Chroma 3 device were controlled by using a standard density glass filter (Chroma 3 Standard) at the beginning of each set of measurements. Additionally, a standard oil sample spiked with a known concentration of retinol palmitate was run every ten measurements as a control.

3.2 Analysis of Iodine in Salt

iCheck Iodine was used for the measurement of iodine in salt. The principle of this colorimetric method is based on the reaction of potassium iodate from a salt sample with potassium iodide in the reagent vial added in excess. Chemically, iodide (I–) forms iodine (I2) and triiodide (I3–), resulting in a blue-purple complex in a starch solution. The absorption of the blue color is dependent on the

concentration of the solution and is measured at 565 nm in the iCheck device. The method has been validated against the reference method of iodometric titration (3).

The salt samples were analyzed individually and part of them were pooled according to customer specifications. The samples were diluted 1:10 with water to ensure that the iodine concentration of the final solution was within the linear range of iCheck Iodine (1.0 - 13.0 mg/L). Before weighing in, the salt samples were mixed thoroughly to ensure homogeneity. Exactly 4 g of salt was dissolved completely in 36 mL of water. The salt solutions were injected and analyzed according to iCheck Iodine user manual. Salt samples with concentration of iodine above iCheck Iodine linear range (>13.0 mg/L) were reanalyzed with higher dilution factor of 1:20.

The composite samples were prepared by weighing in exactly 0.5 g of each individual salt sample and mixing together for 5 minutes to ensure homogeneity. The composite samples were also diluted 1:10 with water. Exactly 2 g of salt was dissolved completely in 18 mL of water. The salt solutions were injected and analyzed according with iCheck Iodine.

As a quality control, a standard density glass filter (Iodine Standard) was measured to control emitter and receptor before each set of measurements. Additionally, a standard iodized salt sample was analyzed to control the measurement process at regular intervals.

3.1 Analysis of Vitamin A in Edible Oil

iCheck Chroma 3 was used for the determination of vitamin A in cooking oil. The determination of vitamin A is based on a color reaction in which the reagents in the vial turn a brilliant blue (Carr-Price reaction), the intensity of which is dependent on retinol concentration. The device measures the absorption of the color in the reagent vial at 3 different wavelengths, over the course of 30 seconds. The device then calculates the vitamin A content through a sophisticated algorithm and displays the result in mg Retinol equivalents/kg. The linear range of the device is 3 –30 mg retinol equivalents (RE)/kg of oil. This method has been validated against the reference method of HPLC (1,2).

Liquid oil samples were directly injected into the reagent vial and measured with iCheck Chroma 3 according to the user manual. Solidified oil samples were warmed to 40°C in an incubator and shaken for 5 minutes to ensure that they were homogeneous, before analysis.

A number of the individual oil samples were pooled according to customer specifications to make 5 composite samples. To make composite samples exactly 1 g of each individual oil sample, mentioned in the sample list to be pooled, was used to make the composite sample. The composite sample is then continuously mixed for 7 minutes to ensure homogeneity, and analyzed using iCheck Chroma 3.

As a quality control, the emitter and receptor of the iCheck Chroma 3 device were controlled by using a standard density glass filter (Chroma 3 Standard) at the beginning of each set of measurements. Additionally, a standard oil sample spiked with a known concentration of retinol palmitate was run every ten measurements as a control.

3.2 Analysis of Iodine in Salt

iCheck Iodine was used for the measurement of iodine in salt. The principle of this colorimetric method is based on the reaction of potassium iodate from a salt sample with potassium iodide in the reagent vial added in excess. Chemically, iodide (I–) forms iodine (I2) and triiodide (I3–), resulting in a blue-purple complex in a starch solution. The absorption of the blue color is dependent on the concentration of the solution and is measured at 565 nm in the iCheck device. The method has been validated against the reference method of iodometric titration (3).

The salt samples were analyzed individually and part of them were pooled according to customer specifications. The samples were diluted 1:10 with water to ensure that the iodine concentration of the final solution was within the linear range of iCheck Iodine (1.0 - 13.0 mg/L). Before weighing in, the salt samples were mixed thoroughly to ensure homogeneity. Exactly 4 g of salt was dissolved completely in 36 mL of water. The salt solutions were injected and analyzed according to iCheck Iodine user manual. Salt samples with concentration of iodine above iCheck Iodine linear range (>13.0 mg/L) were reanalyzed with higher dilution factor of 1:20.

The composite samples were prepared by weighing in exactly 0.5 g of each individual salt sample and mixing together for 5 minutes to ensure homogeneity. The composite samples were also diluted 1:10 with water. Exactly 2 g of salt was dissolved completely in 18 mL of water. The salt solutions were injected and analyzed according with iCheck Iodine.

As a quality control, a standard density glass filter (Iodine Standard) was measured to control emitter and receptor before each set of measurements. Additionally, a standard iodized salt sample was analyzed to control the measurement process at regular intervals.

3.4 Analysis of Iron in Wheat Flour

An external laboratory (SGS INSTITUT FRESENIUS GmbH) measured the iron content in individual as well as in pooled flour samples. The expected type of iron in these samples is electrolytic iron. This iron type cannot be reliable measured using iCheck technology. The external laboratory analyzed the flour samples according to DIN EN 15510 mod. ICP/OES method.

The samples were pooled according to customer specification by BioAnalyt. Samples were shaken briefly to ensure homogeneity and 10 g of each individual samples was used to make the composite sample. The resulting composite samples were shaken vigorously for 2 minutes to ensure homogeneous mixing. Unfortified samples were also measured to assess the level of intrinsic iron, since the methodology does not allow for differentiation of added and natural iron. The intrinsic iron content of the non-fortified wheat flour measured in one sample was 29.8 ppm (mg Fe/kg). The average intrinsic iron content of the non-fortified maize flour samples measured in eight samples was 19.6 ppm (mg Fe/kg).

4. Summary

In interpreting the fortification levels of the food samples, it is recommended to express the result as a range instead of an absolute value, thus taking into consideration uncertainty of the method and also the distribution of the target analyte in the sample.

The analysis of over 2105 food samples was successfully accomplished. Such a coverage study could easily be replicated using iCheck equipment, with the right control parameters, in country by local analysts upon proper training and close supervision by BioAnalyt approved trainer.

References

1. Renaud et al. "Quantification of vitamin A in fortified rapeseed, groundnut and soya oils using a simple portable device: comparison to high performance liquid chromatography." International Journal for Vitamin and Nutrition Research, vol. 83, no. 2, 2013.
2. Rohner et al. "Quantification of Vitamin A in Palm Oil Using a Fast and Simple Portable Device: Method Validation and Comparison to High-Performance Liquid Chromatography." International Journal for Vitamin and Nutrition Research, vol. 81, no. 5, 2011.
3. Rohner et al. "Validation of a user-friendly and rapid method for quantifying iodine content of salt." Food and Nutrition Bulletin, vol. 33, no. 4 (suppl.), 2012.
4. Laillou et al. "Assessment of a portable device to quantify vitamin A in fortified foods (flour, sugar, and milk) for quality control." Food and Nutrition Bulletin, vol. 35, no. 4, 2014.

Annex I. Results from Figures 1-4 in table format

Table 1. Results from Figure 1: household coverage of foods.[1]

Coverage[2]	National	Rural	Urban	Zanzibar
	N=1036 % (95% CI)	N=606 % (95% CI)	N=430 % (95% CI)	N=159 % (95% CI)
Consumes oil	96.2(93.2,99.2)	95.0(90.6,99.5)	98.6(97.4,99.8)	86.1(74.5,97.8)
Consumes fortifiable oil	92.6(89.0,96.3)	90.4(85.0,95.8)	97.2(95.6,98.9)	86.1(74.5,97.8)
Consumes fortified oil				
Yes	53.6(46.4,60.8)	51.4(41.2,61.5)	58.0(49.6,66.4)	8.9(4.2,13.6)
Not fortified	30.3 (24.0,36.6)	30.4 (21.8,39.0)	30.1 (21.5,38.7)	70.8 (57.5,84.2)
Don't know	8.8(6.3,11.2)	8.6(5.3,11.9)	9.1(5.8,12.4)	6.4(1.8,10.9)
Does not consume fortifiable oil	7.4 (3.7,11.0)	9.6 (4.2,15.0)	2.8 (1.1,4.4)	13.9 (2.2,25.5)
Consumes wheat flour	51.5(44.5,58.5)	41.6(32.0,51.2)	71.5(63.2,79.9)	87.1(80.3,93.8)
Consumes fortifiable wheat flour	50.5(43.3,57.7)	40.3(30.5,50.1)	71.3(62.6,79.9	87.1(80.3,93.8)
Consumes fortified wheat flour				
Yes	33.1(27.5,38.7)	25.2(17.9,32.6)	49.0(41.2,56.9)	71.3(61.4,81.3)
Not fortified	1.7 (0.5,2.8)	1.0 (0.0,2.1)	3.1 (0.3,6.0)	2.5 (0.2,4.8)
Don't know	15.7(12.6,18.9)	14.1(10.3,17.9)	19.1(13.3,24.9)	13.2(3.9,22.6)
Does not consume fortifiable wheat flour	49.5 (42.3,56.7)	59.7 (49.9,69.5)	28.7 (20.1,37.4)	12.9 (6.2,19.7)
Consumes maize flour	93.0(89.7,96.4)	91.9(87.3,96.4)	95.4(90.9,99.8)	76.9(63.1,90.6)
Consumes fortifiable maize flour	36.6(29.2,44.0)	20.8(12.0,29.6)	68.4(56.3,81.1)	76.3(62.5,90.0)
Consumes fortified maize flour				
Yes	2.5(1.3,3.7)	1.5(0.4,2.6)	4.6(1.7,7.5)	0.0 (0.0,0.0)
Not fortified	27.0 (21.4,32.5)	14.8 (8.2,21.4)	51.5 (41.9,61.2)	47.1 (33.2,61.0)
Don't know	7.2 (5.2,9.1)	4.5 (2.4,6.5)	12.6 (8.5,16.8)	29.2 (12.2,46.1)
Does not consume fortifiable maize flour	63.4 (56.0,70.8)	79.2 (70.4,88.0)	31.3 (18.9,43.7)	23.7 (10.0,37.5)
Consumes salt	99.6(99.3,100.0)	99.7(99.3,100.0)	99.5(98.7,100.0)	95.1(88.4,100.0)
Consumes fortifiable salt	95.8(93.2,98.5)	94.5(90.7,98.4)	99.8(96.1,100.0)	92.0(83.4,100.0)
Consumes fortified salt				
Yes	69.6(62.5,76.8)	61.6(51.4,71.8)	85.9 (79.5,92.3)	55.8(46.8,64.7)
Not fortified	19.5 (13.0,26.0)	27.0 (17.5,36.5)	4.5 (0.7,8.3)	11.9 (5.6,18.1)
Don't know	6.7(4.7,8.6)	6.0(3.6,8.4)	8.0(4.5,11.5)	24.4(13.8,35.0)
Does not consume fortifiable salt	4.2 (1.5,6.8)	5.5 (1.6,9.3)	1.6 (0.0,3.9)	8.0 (0.0,16.6)

Abbreviation: CI, confidence interval

[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection.

[2] "Consumes food" refers to households that report preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed. "Consumes Fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine.). "Consumes fortified food" was determined as follows:

(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food were classified as "Does not consume fortifiable food".

Table 2. Results from Figure 2: household coverage of foods by poverty risk.[1]

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-values[4]
National	**N=414**	**N=622**	
Consumes oil	93.3(87.5,99.0)	98.6(97.6,99.6)	<.0001[5]
Consumes fortifiable oil	89.4(82.7,96.1)	95.3(92.9,97.7)	0.0145
Consumes fortified oil			
Yes	55.0(44.4,65.5)	52.5(44.7,60.3)	0.0196
Not fortified	24.7 (15.9,33.5)	34.9 (28.0,41.8)	
Don't know	9.7(6.4,13.1)	8.0(5.0,10.9)	
Does not consume fortifiable oil	10.6 (3.9,17.3)	4.7 (2.3,7.1)	
Consumes wheat flour	36.7(27.6,45.8)	63.6(55.4,71.7)	<.0001
Consumes fortifiable wheat flour	35.6(26.5,44.6)	62.7(54.3,71.2)	<.0001
Consumes fortified wheat flour			
Yes	21.6(14.6,28.6)	42.5(35.7,49.3)	<.0001
Not fortified	1.2 (0.0,2.5)	2.1 (0.3,3.8)	
Don't know	12.8(9.6,15.9)	18.2(13.9,22.4)	
Does not consume fortifiable wheat flour	64.4 (55.4,73.5)	37.3 (28.8,45.7)	
Consumes maize flour	89.2(83.6,94.9)	96.1(93.4,98.9)	0.0047[5]
Consumes fortifiable maize flour	23.8(14.6,33.0)	47.1(36.9,57.3)	<.0001
Consumes fortified maize flour			
Yes	2.8(0.9,4.7)	2.3(1.0,3.6)	<.0001
Not fortified	15.8 (9.0,22.6)	36.1 (27.9,44.2)	
Don't know	5.3 (2.7,7.8)	8.7 (5.9,11.5)	
Does not consume fortifiable maize flour	76.2 (67,85.4)	52.9 (42.7,63.1)	
Consumes salt	99.7(99.2,100.0)	99.6(99.1,100.0)	0.7119
Consumes fortifiable salt	93.0(87.8,98.2)	98.1(96.5,99.8)	0.0062
Consumes fortified salt			
Yes	55.5(45.1,65.8)	81.2(75.4,87.1)	<.0001
Not fortified	31.2 (20.7,41.8)	10.3 (5.8,14.1)	
Don't know	6.3(3.7,8.9)	6.9(4.6,9.3)	
Does not consume fortifiable salt	7.0 (1.8,12.2)	1.9 (0.2,3.5)	

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-values[4]
Rural	**N=348**	**N=258**	
Consumes oil	92.8(86.2,99.5)	98.3(96.5,100.0)	0.0001[5]
Consumes fortifiable oil	88.4(80.8,96.1)	93.2(88.8,97.5)	0.1547
Consumes fortified oil			
Yes	53.0(41.0,65.4)	49.0(36.0,32.0)	0.1397
Not fortified	25.8 (15.7,35.9)	37.1 (26.3,47.9)	
Don't know	9.6(5.9,13.3)	7.1(2.4,11.8)	
Does not consume fortifiable oil	11.6 (3.9,19.2)	6.8 (2.5,11.2)	
Consumes wheat flour	33.8(23.6,43.9)	53.0(40.0,66.0)	0.0030
Consumes fortifiable wheat flour	32.5(22.4,42.0)	51.6(38.1,65.2)	0.0036
Consumes fortified wheat flour			
Yes	19.2(11.4,27.1)	34.0(23.7,44.3)	0.0005
Not fortified	1.3 (0.0,2.8)	0.5 (0.0,1.4)	
Don't know	12.0(8.6,15.3)	17.2(10.8,23.5)	
Does not consume fortifiable wheat flour	67.5 (57.4,77.6)	48.4 (34.8,61.9)	
Consumes maize flour	88.4(82.0,94.7)	97.0(94.3,99.6)	<.0001[5]
Consumes fortifiable maize flour	18.1(8.7,27.5)	24.6(13.6,35.7)	0.1922
Consumes fortified maize flour			
Yes	1.6(0.2,3.0)	1.4(0.0,2.9)	0.3685
Not fortified	12.9 (5.6,20.2)	17.6 (9.6,25.7)	
Don't know	3.7 (1.3,6.0)	5.6 (2.2,9.0)	
Does not consume fortifiable maize flour	81.9 (72.5,91.3)	75.4 (64.3,86.4)	
Consumes salt	99.7(99.1,100.0	99.8(99.5,100.0)	0.6981
Consumes fortifiable salt	92.5(86.6,98.4)	97.5(94.5,100.0)	0.0792
Consumes fortified salt			
Yes	51.6(40.1,63.1)	76.2(66.2,86.2)	<.0001
Not fortified	34.6 (22.8,46.5)	15.8 (8.6,22.9)	
Don't know	6.3(3.4,9.2)	5.5(2.6,8.4)	
Does not consume fortifiable salt	7.5 (1.6,13.4)	2.5 (0.0,5.5)	
Urban	**N=66**	**N=364**	
Consumes oil	96.6(92.0,100.0)	99.0(97.8,100.0)	0.1533
Consumes fortifiable oil	96.6(92.0,100.0)	97.4(95.5,99.2)	0.7487
Consumes fortified oil			
Yes	69.6(61.2,78.1)	55.8(46.5,65.4)	0.0459
Not fortified	16.3 (7.6,25.0)	32.7 (23.6,41.9)	
Don't know	10.7(3.5,17.8)	8.8(5.2,12.5)	
Does not consume fortifiable oil	3.4 (0,8)	2.6 (0.8,4.5)	

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-values[4]
Consumes wheat flour	58.9(46.8,71.0)	73.9(64.8,83.0)	0.0215
Consumes fortifiable wheat flour	58.9(46.8,71.0)	73.6(64.1,83.1)	0.0271
Consumes fortified wheat flour			
Yes	39.5(30.2,48.9)	50.8(42.4,59.3)	0.0062
Not fortified	0.3 (0.0,1.1)	3.6 (0.3,6.9)	
Don't know	19.0(10.0,28.1)	19.1(13.0,25.2)	
Does not consume fortifiable wheat flour	41.1 (29,53.2)	26.4 (16.9,35.9)	
Consumes maize flour	95.9(90.7,100.0)	95.3(90.2,100.0)	0.8401
Consumes fortifiable maize flour	67.1(47.3,86.8)	69.1(57.0,81.0)	0.7819
Consumes fortified maize flour			
Yes	11.9(1.5,22.3)	3.2(1.1,5.3)	0.0073
Not fortified	37.8 (23.3,52.4)	54.1 (43.8,64.4)	
Don't know	17.3 (6.3,28.3)	11.7 (15.9,30.9)	
Does not consume fortifiable maize flour	32.9 (13.2,52.7)	30.9 (18.9,43)	
Consumes salt	100.0(100.0,100.0)	99.4(98.4,100.0)	0.6981
Consumes fortifiable salt	96.6(89.9,100.0)	98.7(97.2,100.0)	0.0792
Consumes fortified salt			
Yes	85.1(73.6,96.6)	86.1(79.9,92.3)	0.3474
Not fortified	5.4 (0.0,11.4)	4.3 (0.7,7.9)	
Don't know	6.1(0.3,11.9)	8.3(4.4,12.2)	
Does not consume fortifiable salt	3.4 (0,10.1)	1.3 (0,2.8)	
Zanzibar	**N=46**	**N=113**	
Consumes oil	76.3(53.0,99.6)	90.3(80.6,100.0)	0.0690
Consumes fortifiable oil	76.3(53.0,99.6)	90.3(80.6,100.0)	0.0690
Consumes fortified oil			
Yes	11.2(4.2,18.2)	7.9(0.7,15.1)	0.0743
Not fortified	56.0 (34.8,77.1)	77.2 (67.2,87.2)	
Don't know	9.1(0.6,17.6)	5.2(0.10.4)	
Does not consume fortifiable oil	23.7 (0.4,47)	9.7 (0.0,19.4)	
Consumes wheat flour	89.8(79.5,100.0)	85.9(76.4,95.4)	0.5798
Consumes fortifiable wheat flour	89.8(79.5,100.0)	85.9(76.4,95.4)	0.5798
Consumes fortified wheat flour			
Yes	71.0(41.7,100.0)	71.5(63.3,79.4)	0.8731
Not fortified	4.0 (0.0,10.6)	1.8 (0.0,4.3)	
Don't know	14.7(0.0,34.3)	12.6(4.0,21.2)	
Does not consume fortifiable wheat flour	10.2 (0,20.5)	14.1 (4.6,23.6)	

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-values[4]
Consumes maize flour	67.7(38.1,97.3)	80.8(69.7,91.9)	0.2264
Consumes fortifiable maize flour	65.7(36.9,94.5)	80.8(69.7,91.9)	0.1413
Consumes fortified maize flour			
Yes	0.0 (0.0,0.0)	0.0 (0.0,0.0)	0.3356
Not fortified	40.1 (23.9,56.4)	50.1 (32.9,67.3)	
Don't know	25.6 (0.0,52.3)	30.7 (12.1,49.2)	
Does not consume fortifiable maize flour	34.3 (5.5,63.1)	19.2 (8.1,30.3)	
Consumes salt	100.0(100.0,100.0)	92.9(83.3,100.0)	-[5]
Consumes fortifiable salt	89.9(72.2,100.0)	92.9(83.3,100.0)	0.7031
Consumes fortified salt			
Yes	60.2(48.6,71.9)	53.8(40.2,67.4)	0.8046
Not fortified	8.4 (0.0,18.9)	13.4 (5.9,20.8)	
Don't know	21.3(12.0,30.7)	25.7(11.9,39.6)	
Does not consume fortifiable salt	10.1 (0,27.8)	7.1 (0,16.2)	

Abbreviations: CI, confidence interval

[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection.

[2] "Consumes food" refers to households that reported preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed. "Consumes fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine.). "Consumes fortified food" was determined as follows:

(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food were classified as "Does not consume fortifiable food".

[3]Multidimensional Poverty Index (MPI) greater than or equal to 0.33 is "poor" and MPI less than 0.33 is "non-poor".

[4] The P-value tests hypothesis that percent of coverage does not vary by poverty status, OR the difference (i.e. coverage in poor minus non-poor households) is NOT equal to zero. Complex survey chi-square test was used to compare percentages. Also, P-value tests hypothesis that percent of coverage does not vary by dietary diversity, OR the difference (i.e. Coverage in poor minus lower dietary diversity household) is NOT equal to zero. Thus it possible to have overlapping 95%CI but statistically significant p-values (Schenker & Gentleman, 2001) as both computations are independent of each other. Further, test of independent proportions with Yates Chi-square continuity correction for small binomial proportions yield consistent results (Yates, 1934).

[5]Chi square test P values not estimable because at least one table cell has 0 frequency.

Table 3: Results from Figure 3: household coverage of foods by women's dietary diversity score[1,2,3]

Coverage	Lower dietary diversity (% (95% CI))[3]	Higher dietary diversity (% (95% CI))[3]	p-value[4]
National	**N=242**	**N=662**	
Consumes oil	94.8(88.6,100.0)	97.4(95.4,99.4)	0.1306
Consumes fortifiable oil	91.4(84.3,95.8)	93.8(90.8,96.8)	0.3339
Consumes fortified oil			
Yes	50.7(40.2,61.4)	55.4(48.5,62.4)	0.0830
Not fortified	28.5 (19.5,37.4)	31.5 (25.0,38.0)	
Don't know	12.3(7.8,16.7)	6.9(4.3,9.4)	
Does not consume fortifiable oil	8.6 (1.5,15.7)	6.2 (3.2,9.2)	
Consumes wheat flour	45.1(34.3,56.0)	58.3(50.3,66.3)	0.0063
Consumes fortifiable wheat flour	45.1(34.3,56.0)	56.8(48.5,65.1)	0.0160
Consumes fortified wheat flour			
Yes	25.9(17.8,34.0)	38.9(32.2,45.7)	0.0013
Not fortified	0.4 (0.0,1.1)	2.4 (0.6,4.2)	
Don't know	18.9(12.7,25.1)	15.5(12.2,18.7)	
Does not consume fortifiable wheat flour	54.9 (44,65.7)	43.2 (34.9,51.5)	
Consumes maize flour	92.7(87.4,98.0)	93.4(90.0,96.8)	0.7723
Consumes fortifiable maize flour	42.1(31.1,53.2)	35.2(26.1,44.3)	0.0677
Consumes fortified maize flour			
Yes	3.3(0.8,5.8)	2.4(1.1,3.7)	0.2242
Not fortified	29.1 (20.1,38.1)	26.5 (19.3,33.7)	
Don't know	9.7 (5.4,14.0)	6.3 (3.8,8.8)	
Does not consume fortifiable maize flour	57.9 (46.8,68.9)	64.8 (55.7,73.9)	
Consumes salt	99.5(98.5,100.0)	100.0(99.9,100.0)	0.2118
Consumes fortifiable salt	93.8(88.8,99.1)	96.8(94.1,99.5)	
Consumes fortified salt			
Yes	62.1(51.4,72.8)	72.3(64.7,79.9)	0.1226
Not fortified	23.4 (14.1,32.8)	18.8 (11.5,26.0)	
Don't know	8.4(4.4,12.3)	5.7(3.7,7.8)	
Does not consume fortifiable salt	6.1 (0.9,11.2)	3.2 (0.5,5.9)	
Rural	**N=149**	**N=378**	
Consumes oil	92.5(83.5,100.0)	96.6(93.6,99.5)	0.0781
Consumes fortifiable oil	88.0(78.0,98.0)	91.7(87.3,96.2)	0.2676
Consumes fortified oil			
Yes	44.6(30.7,58.5)	55.7(46.0,65.4)	0.0491
Not fortified	30.5 (18.2,42.8)	29.6 (21.0,38.2)	
Don't know	13.0(7.2,18.7)	6.4(3.2,9.7)	

Coverage	Lower dietary diversity (% (95% CI))[3]	Higher dietary diversity (% (95% CI))[3]	p-value[4]
Does not consume fortifiable oil	12.0 (2.0,22.0)	8.3 (3.8,12.7)	
Consumes wheat flour	32.9(20.3,45.5)	50.4(39.9,60.8)	0.0024
Consumes fortifiable wheat flour	32.9(20.3,45.5)	48.3(37.6,59.0)	0.0067
Consumes fortified wheat flour			
Yes	17.0(9.1,25.0)	31.9(23.4,40.3)	0.0040
Not fortified	0.0 (0.0,0.0)	1.5 (0.0,3.3)	
Don't know	15.9(7.8,24.0)	14.8(10.9,18.8)	
Does not consume fortifiable wheat flour	67.1 (54.5,79.7)	51.7 (41,62.4)	
Consumes maize flour	89.9(82.3,97.5)	93.0(88.8,97.2)	0.2839
Consumes fortifiable maize flour	28.0(16.3,39.7)	18.3(9.9,26.7)	0.0022
Consumes fortified maize flour			
Yes	2.2(0.0,4.8)	1.5(0.2,2.8)	0.0929
Not fortified	19.2 (9.1,29.3)	13.5 (7.0,20.0)	
Don't know	6.6 (2.6,10.6)	3.3 (1.2,5.4)	
Does not consume fortifiable maize flour	72 (60.3,83.7)	81.7 (73.3,90.1)	
Consumes salt	99.3(97.8,100.0)	100.0(99.9,100.0)	0.0031
Consumes fortifiable salt	91.7(84.4,99.0)	95.6(91.6,99.6)	0.2433
Consumes fortified salt			
Yes	49.5(36.9,62.0)	65.6(54.9,76.2)	0.0290
Not fortified	32.9 (21.0,44.9)	25.7 (15.4,36.1)	
Don't know	9.3(4.1,14.5)	4.3(1.9,6.6)	
Does not consume fortifiable salt	8.3 (1,15.6)	4.4 (0.4,8.4)	
Urban	**N=90**	**N=281**	
Consumes oil	100.0(100.0,100.0)	99.1(97.9,100.0)	0.6043
Consumes fortifiable oil	98.8(96.4,100.0)	97.9(96.1,99.7)	-[5]
Consumes fortified oil			
Yes	64.1(52.9,75.3)	54.9(46.2,63.7)	0.2033
Not fortified	24.0 (13.0,35.1)	35.3 (25.6,44.9)	
Don't know	10.7(3.7,17.8)	7.7(3.4,11.9)	
Does not consume fortifiable oil	1.2 (0,3.6)	2.1 (0.3,3.9)	
Consumes wheat flour	72.0(60.8,83.1)	73.9(64.0,83.7)	0.7338
Consumes fortifiable wheat flour	72.0(60.8,83.1)	73.5(63.2,83.8)	0.7955
Consumes fortified wheat flour			
Yes	45.3(32.7,58.0)	52.8(43.7,61.9)	0.1944
Not fortified	1.2 (0.0,8.2)	4.0 (0.0,8.2)	
Don't know	25.5(16.2,34.8)	16.7(10.7,22.6)	
Does not consume fortifiable wheat flour	28.0 (16.9,39.2)	26.5 (16.2,36.8)	

Coverage	Lower dietary diversity (% (95% CI))[3]	Higher dietary diversity (% (95% CI))[3]	p-value[4]
Consumes maize flour	98.8(96.5,100.0)	94.1(87.8,100.0)	0.0450
Consumes fortifiable maize flour	73.2(58.6,87.8)	68.2(55.5,81.0)	0.4278
Consumes fortified maize flour			
Yes	5.8(0.2,11.4)	4.2(1.3,7.1)	0.6974
Not fortified	51.0 (38.5,63.4)	51.9 (38.5,62.9)	
Don't know	16.5 (6.2,26.7)	12.2 (6.9,17.5)	
Does not consume fortifiable maize flour	26.8 (12.2,41.4)	31.8 (19,44.5)	
Consumes salt	100.0(100.0,100.0)	100.0(100.0,100.0)	-[5]
Consumes fortifiable salt	98.8(96.4,100.0)	99.2(97.5,100.0)	0.1001
Consumes fortified salt			
Yes	90.0(83.3,96.8)	85.4(78.9,91.9)	0.3987
Not fortified	2.5 (0.0,5.9)	5.1 (1.3,8.9)	
Don't know	6.3(0.4,12.2)	8.6(4.6,12.6)	
Does not consume fortifiable salt	1.2 (0,3.6)	0.8 (0,2.5)	
Zanzibar	**N=22**	**N=107**	
Consumes oil	95.6(86.9,100.0)	91.5 (80.0,100.0)	0.4626
Consumes fortifiable oil	95.6(86.9,100.0)	91.5 (80.0,100.0)	0.4626
Consumes fortified oil			
Yes	4.4(0,15.0)	10.5(4.1,16.8)	0.0166
Not fortified	72.4 (53.7,91.0)	76.3 (61.2,91.4)	
Don't know	18.8(4.2,33.4)	4.7(1.2,8.2)	
Does not consume fortifiable oil	4.4 (0,13.1)	8.5 (0,19.2)	
Consumes wheat flour	91.2(80.1,100.0)	92.8(86.2,99.3)	0.7887
Consumes fortifiable wheat flour	91.2(80.1,100.0)	92.8(86.2,99.3)	0.7887
Consumes fortified wheat flour			
Yes	77.6(53.0,100.0)	76.0(66.6,85.3)	-[5]
Not fortified	0.0 (0.0,0.0)	30.7 (0.5,6.8)	
Don't know	13.6(0,31.9)	13.1(3.3,23.0)	
Does not consume fortifiable wheat flour	8.8 (0,19.9)	7.2 (0.7,13.8)	
Consumes maize flour	81.2(59.6,100.0)	78.8(64.7,93.0)	0.7722
Consumes fortifiable maize flour	76.8(58.0,95.5)	78.8(64.7,93.0)	0.7053
Consumes fortified maize flour			
Yes	0.0 (0.0,0.0)	0.0 (0.0,0.0)	0.7475
Not fortified	44.2 (18.9,69.5)	50.8 (37.0,64.7)	
Don't know	32.5 (2.0,63.1)	28.0 (9.4,46.6)	
Does not consume fortifiable maize flour	23.2 (4.5,42)	21.2 (7,35.3)	

Coverage	Lower dietary diversity (% (95% CI))[3]	Higher dietary diversity (% (95% CI))[3]	p-value[4]
Consumes salt	100.0(100.0,100.0)	100.0(100.0,100.0)	-[5]
Consumes fortifiable salt	98.9(96.4,100.0)	99.2(97.5,100.0)	0.3611
Consumes fortified salt			
Yes	90.0(83.3,96.8)	85.4(78.9.91.9)	0.0015
Not fortified	3.7(0,7.8)	6.0(2.0,9.9)	
Don't know	6.3(0.4,12.2)	8.6(4.6,12.6)	
Does not consume fortifiable salt	5.5 (0,18.6)	3.2 (0,8.4)	

Abbreviation: CI, confidence interval

[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection.

[2] "Consumes food" refers to households that reported preparing this food at home. "Consumes fortifiable food" refers to households that reported consuming a food that was not made at home and is assumed to be industrially processed; "Consumes fortified food" refers to households that consumed a food that was confirmed to be fortified by quantitative analyses (i.e. if the sample or brand provided met or exceeded the following criteria: oil with ≥3 mg/kg vitamin A, wheat flour >29.8 mg/kg iron, maize flour > 19.6 mg/kg iron, salt ≥ 7.6 ppm iodine.). "Consumes fortified food" was determined as follows:

(A) In households where a food sample was taken and analyzed: If the sample met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the sample did not meet the fortified criteria, then the household was classified as "not fortified" for consumes fortified food. (B) In households where a food sample was not taken and the brand name was available, the median nutrient value of all samples analyzed from that brand from other households was used. If the value met the fortified criteria then the household was classified as "yes" for consumes fortified food. If the value did not meet the fortified criteria then the household was classified as "not fortified" for consumes fortified food. (C) In households where a food sample was not taken and the brand name was not available, the household's fortification status could not be determined and the household was classified as "don't know" for consumes fortified food. (D) Households that did not consume a fortifiable food were classified as "Does not consume fortifiable food".

[3] Lower dietary diversity refers to a dietary diversity score lower than the population median in each stratum (i.e. rural or urban residence). Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each stratum (i.e. rural or urban residence). The population median is 4 in rural areas and 5 in urban areas. When more than one woman of reproductive age answered the dietary diversity information per household, the dietary diversity score of one woman was randomly selected and applied to the household.

[4] Comparing lower dietary diversity versus higher dietary diversity. Complex survey chi-square test was used to compare percentages. Also, P-value tests hypothesis that percent of coverage does not vary by dietary diversity, OR the difference (i.e. Coverage in poor minus lower dietary diversity household) is NOT equal to zero. Thus it possible to have overlapping 95%CI but statistically significant p-values (Schenker & Gentleman, 2001) as both computations are independent of each other. Further, test of independent proportions with Yates Chi-square continuity correction for small binomial proportions yield consistent results (Yates, 1934).

[5] Chi square test P values not estimable because at least one table cell has 0 frequency.

Table 4. Results from Figure 4: Fortification quality of household food samples compared to national or international standards.

Food	Total N	n (%)	n (%)	n (%)	n (%)
		Unfortified	Inadequately fortified	Adequately fortified	Over fortified
National					
Oil[1]	725	277(38.21)	318(43.9)	118(16.3)	12(1.7)
Wheat flour[2]	191	22 (11.5)	123(64.4)	36(18.9)	10(5.2)
Maize flour[3]	333	294(88.3)	22(6.6)	11(3.3)	6(1.8)
Salt[4]	856	189(22.1)	126(14.7)	537(62.7)	4(0.5)
Salt (WHO)[5]	856	189(22.1)	88(10.0)	370 (43.2)	209(24.4)
Rural					
Oil[1]	400	155(38.8)	164(41)	72(18.0)	9(2.2)
Wheat flour[2]	80	6(7.5)	52 (65.0)	16(20.0)	6(7.5)
Maize flour[3]	83	75(90.4)	4(4.8)	4(4.8)	-[6]
Salt[4]	483	154(31.9)	71(14.7)	255(52.8)	3(0.6)
Salt(WHO)[5]	483	154(31.9)	56(11.6)	165(34.1)	108(22.4)
Urban					
Oil[1]	286	104(36.4)	135(47.2)	45(15.7)	2(0.7)
Wheat flour[2]	94	14(14.9)	60(63.8)	16(17.0)	4(4.3)
Maize flour[3]	192	175(91.1)	12(6.3)	3(1.6)	2(1.0)
Salt[4]	334	24(7.2)	43(12.9)	266(79.6)	1(0.3)
Salt (WHO)[5]	334	24(7.2)	23(6.9)	194(58.1)	93(27.8)
Zanzibar					
Oil[1]	47	32(68.1)	14(29.8)	1(2.1)	-[6]
Wheat flour[2]	30	4(13.3)	21(70.0)	5(16.7)	-[6]
Maize flour[3]	23	23(100.0)	0	0	0
Salt[4]	86	19(22.1)	32(37.2)	34(39.5)	1(1.1)
Salt (WHO)[5]	86	19(22.1)	23(26.7)	31(36.1)	13(15.1)

[1] Fortification quality for oil was determined by analyzing the vitamin A levels in samples taken from households and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" <3 mg/kg vitamin A, "inadequately fortified" 3-<16 mg/kg vitamin A, "adequately fortified" ≥16- 28 mg/kg vitamin A, and "over fortified" >28 mg/kg of vitamin A.

[2]Fortification quality for wheat flour was determined by analyzing the total iron levels in samples taken from households, subtracting an estimate of the level of intrinsic iron naturally occuring in wheat flour. (in this study the instrinsic level of iron in the wheat flour was determined to be 29.8 mg/kg based on analyses of unfortified wheat flour samples from Tanzania), and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" 0 mg/kg added iron, "inadequately fortified" hd >0-<30 mg/kg added iron, "adequately fortified" ≥30- 50 mg/kg added iron, and "over fortified" >50 mg/kg added iron.

[3] Fortification quality for maize flour was determined by analyzing the iron level levels in samples taken from households, subtracting an estimate of the level of intrinsic iron naturally occuring in maize flour. (in this study the instrinsic level of iron in the maize flour was determined to be 19.6 mg/kg based on analyses of unfortified maize flour samples from Tanzania), and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" 0 mg/kg added iron, "inadequately fortified"

>0-<5 mg/kg added iron, "adequately fortified" ≥5- 25 mg/kg added iron, and "over fortified" >25 mg/kg added iron.

[4] Fortification quality for salt was determined by analyzing the iodine levels in samples taken from households and comparing the result to the Tanzania National Standard 2010 as follows: "Unfortified" <7.6 ppm iodine (difficult to detect iodine below 7.6 ppm), "inadequately fortified" 7.6-<25 ppm iodine, "adequately fortified" 25-<70 ppm iodine, and "over fortified" ≥70 ppm of iodine

[5] Fortification quality for salt was determined by analyzing the iodine levels in samples taken from households and comparing the result to the World Health Organization international standard for household samples as follows: "Unfortified" <7.6 ppm iodine (difficult to detect iodine below 7.6 ppm), "inadequately fortified" 7.6-<15 ppm iodine, "adequately fortified" 15-<40 ppm iodine, and "over fortified" ≥40 ppm of iodine

[6] There were no samples in this range of fortification

A number of samples (i.e. 39 oil, 17 wheat flour, 58 maize flour, and 39 salt samples) could not be utilized in rural urban stratified analyses due to missing specimen identifier information, labelling issues, and or could not be linked to the household database. Further, stratification of results by brand is also subject to completeness of the household brand variable data, thus missing brand also affects the sample sizes. As a result, the sum of rural and urban, or by brand, will not equal total the national samples shown.

9. REFERENCES

Aaron GJ, Sarpong D, Strutt N, Siling K, Norris A, Guevarra E, Myatt M (2014a) Coverage of a market-based approach to deliver a complementary food supplement to infants and children in three districts in Eastern Ghana: use of the simple spatial survey method (S3M). Experimental Biology. http://www.fasebj.org/content/28/1_Supplement/255.5 Accessed 2 December 2015.

Aaron GJ, Jacobson M, Manian N, Lunn L, Megazzini K, Rog D, Lo A, Wulfe M, Garrett GS, Neufeld LM, Fairhurst J, Ndiaye S (2014b) National program coverage of fortified wheat flour and oil is high among women of reproductive age in Senegal. Micronutrient Forum. http://micronutrientforum.org/wp-content/uploads/2014/12/0371.pdf Accessed 2 December 2015.

Alkire S, Santos ME, Measuring Acute Poverty in the Developing World : Robustness and Scope of the Multidimensional Poverty Index (OPHI Working Paper 59), Oxford Poverty & Human Development Initiative (OPHI), University of Oxford, March 2013, ISBN 978-1-907194-44-3.

Ballard, T. et al., Household Hunger Scale: Indicator Definition and Measurement Guide, Washington, FANTA-2 Bridge and FHI 360, Washington DC, USA, 2011.

Bhutta Z, (2008) Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? The Lancet , Volume 382 , Issue 9890 , 452 - 477

Busari AK (2013) Two decades of food fortification in Nigeria: situational analysis. Master of Public Health thesis. Emory University: Atlanta, USA. http://www.ffinetwork.org/about/stay_informed/publications/NigeriaAnalysis2013.html Accessed 14 March 2015.

Deitchler M, Ballard T, Swindale A, Coates J, Validation of a Measure of Household Hunger for Cross-Cultural Use, Food and Nutrition Technical Assistance II Project (FANTA-2), AED,Washington DC, USA, 2010.

Deitchler M, Ballard T, Swindale A, Coates J, Introducing a Simple Measure of Household Hunger for Cross-Cultural Use, Food and Nutrition Technical Assistance II Project, AED, Washington DC, USA, 2011

Efron, B.; Tibshirani, R. (1993). An Introduction to the Bootstrap. Boca Raton, FL: Chapman & Hall/CRC

Egbuta J, Onyezili F, Vanormelingen K (2003) Impact evaluation of efforts to eliminate iodine deficiency disorders in Nigeria. Public Health Nutrition 6(2);169-174.

Ezzati M, Lopez AD, Rodgers A, et al. (2002) Selected major risk factors and global and regional burden of disEAse. Lancet 360:1347-1360.

Maziya-Dixon B, Akinyele IO, Oguntona EB, et al. (2004) Nigeria Food Consumption and Nutrition Survey 2001-2003. International Institute of Tropical Agriculture: Ibadan. http://pdf.usaid.gov/pdf_docs/PNADC880.pdf Accessed 14 March 2015.

National Population Commission, ICF International (2013). Nigeria Demographic and Health Survey 2013. NPC and ICF International: Abuja, Nigeria & Rockville, USA.

Nutriview (2003) Mandatory food enrichment. http://www.sahealthinfo.org/nutrition/nutriview2003special.pdf Accessed 14 March 2015.

Ogunmoyela OA, Adekoyeni O, Aminu F, Umunna LO (2013) A critical evaluation of survey results of vitamin A and Fe levels in the mandatory fortified food vehicles and some selected processed foods in Nigeria. Nigerian Food Journal 31(2).

Schenker, N; J F Gentleman. 2001. On judging the significance of differences by examining the overlap between confidence intervals. *American Statistician* 55:182-186

Standards Organisation of Nigeria (2010) Nigerian Industrial Standard NIS 121:2010: Standard for Wheat Flour. SON: Lagos.

Sununtnasuk C (2013) Household Consumption and Expenditure Surveys: A tool for estimating food and nutrient intake. Presentation at Smarter Futures Cost and Economic Benefit Training Workshop, Tanzania. Workshop is described here: http://ffinetwork.org/about/calendar/2013/CostBenefit2013.html Accessed 12 January 2016.

Tanzania Demographic Health Survey 2010. http://dhsprogram.com/pubs/pdf/FR243/FR243%5B24June2011%5D.pdf

UNICEF (2005) Universal Salt Iodization in Nigeria: Processes, successes and lessons. http://www.unicef.org/nigeria/ng_publications_USI_in_Nigeria_Report.pdf Accessed 14 March 2015.

UNICEF (2006) Nutrition information sheet. http://www.unicef.org/wcaro/WCARO_Nigeria_Factsheets_Nutrition.pdf Accessed 14 March 2015.

World Health Organization/FAO (2004). Vitamin and mineral requirements in human nutrition, second edition. World Health Organization: Geneva, Switzerland. http://www.who.int/nutrition/publications/micronutrients/9241546123/en/ Accessed 7 January 2016.

World Health Organization/FAO (2006). Guidelines on food fortification with micronutrients. World Health Organization: Geneva, Switzerland. http://www.who.int/nutrition/publications/guide_food_fortification_micronutrients.pdf Accessed 14 March 2015.

WHO, FAO, UNICEF, GAIN, MI, & FFI (2009) Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. World Health Organization:

Geneva, Switzerland. http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fort.pdf Accessed 14 March 2015.

Yates, F (1934). "Contingency table involving small numbers and the χ2 test". Supplement to the Journal of the Royal Statistical Society 1(2): 217–235

Yusufali R, Sunley N, De Hoop M & Panagides D. Flour fortification in South Africa: post-implementation survey of micronutrient levels at point of retail. Food and Nutrition Bulletin 2012, 33(4Suppl): S321-9