Report

Fortification Assessment Coverage Tool (FACT) Survey in Two Nigerian States: Kano and Lagos, 2015

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1. SUMMARY

In Nigeria, national fortification of salt with iodine began in 1993, and fortification of wheat flour, semolina flour, maize flour, sugar, and oil with multiple micronutrients has been mandated by law since 2002. Currently, there is a lack of information available on how well these programs are performing, household coverage and intake of these 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), and Oxford Policy Management (OPM), conducted a cross-sectional, two-stage, cluster household FACT survey in Nigeria from May to June. The purpose of the survey was to assess the coverage and potential contribution of fortified foods to the micronutrient intake of the population in two States: Kano and Lagos.

The survey was designed to be representative of Kano and Lagos States. The study population consisted of households and women of reproductive age (15-49 years). Based on sample size calculations and anticipated non-response, 1,902 households were invited to participate (951 each in Kano and Lagos). 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 salt, wheat flour, semolina flour, maize flour, sugar, and oil. Food samples of salt, wheat flour, semolina flour, maize flour, sugar, and oil were collected from participating households and analyzed quantitatively to determine fortification levels of select nutrients: iron (wheat flour, semolina flour), vitamin A (maize flour, sugar, oil), or iodine (salt).

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 vehicle 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 known to be fortified, confirmed by quantitative analyses of the household sample or, if no sample was available, analyses of samples from the reported brand used by the householdTwo indicators of risk were used to assess the relationship between coverage and risk; they were poverty (defined by the Multidimensional Poverty Index (MPI)) and lower women's dietary diversity (defined as less than the population median in each State 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, semolina flour, maize flour only, an individual assessment of all women of reproductive age was conducted, which asked about frequency of consumption and portion size of flour-containing foods over the past seven days. For all foods, a household assessment method was used, which asked household respondents about the last time they purchased the food, 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 food) 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 94.2% in Kano State and 91.6% in Lagos State. In Kano, household consumption of salt, wheat flour, maize flour, sugar, and oil was high (96.9%, 83.9%, 77.1%, 94.5%, and 98.4%, respectively) while household consumption of semolina flour was lower (13.1%). In Lagos, household consumption of salt, semolina flour, sugar, and oil was high (98.4%, 86.1%, 88.8%, and 98.6%, respectively) while household consumption of wheat flour and maize flour was lower (14.2% and 12.2%, respectively). The pattern of consumption of fortifiable salt, wheat flour, semolina flour, and sugar was very similar. However, the consumption of fortifiable maize flour was lower in Kano (11.0%) and Lagos (2.9%), as was the consumption of fortifiable oil (35.9% in Kano and 22.7% in Lagos). This is because much of the maize flour and oil consumed is not industrially produced. The proportion of households consuming a fortified food was lower still. In Kano, the proportion of households consuming a fortified food was 64.1% for salt, 22.7% for wheat flour, 6.9% for semolina flour, 1.7% for maize flour, 21.1% for sugar, and 7.6% for oil. In Lagos, the corresponding proportion of households consuming a fortified food were 87.9% for salt, 5.4% for wheat flour, 69.0% for semolina flour, 0.2% for maize flour, 35.6% for sugar, and 7.2% for oil.

Using the individual assessment method, added iron from wheat flour was estimated to contribute to 2.4% of the iron RNI among women of reproductive age in Kano and 12.6% among women in Lagos. Added iron from semolina flour was estimated to contribute to 10.0% and 6.6% of the iron RNI among women in Kano and Lagos, respectively. Maize flour contributed little additional vitamin A to women's RNI: 0.01% in both States. When households were separated by risk factors in both States, 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. However, neither risk factor influenced women's iron RNI from semolina flour or women's vitamin A RNI from maize flour.

Using the AME household assessment method, among women from households in Kano that reported consuming the foods, salt contributed to 66.6% of the iodine RNI, wheat flour and semolina flour contributed 13.9% and 15.8%, respectively, to the iron RNI, and maize flour, sugar, and oil contributed 0%, 2.2% and 1.5%, respectively, to the vitamin A RNI. In Lagos, salt contributed to 151.7% of the iodine RNI, wheat flour and semolina flour contributed 10.4% and 8.3%, respectively, to the iron RNI, and maize flour, sugar, and oil contributed 3.6%, 1.0% and 1.4%, respectively, to the vitamin A RNI. Women's nutrient RNI from all six foods was not different across the strata based on poverty status or dietary diversity, with a few exceptions. In Kano, the contribution of wheat flour to women's iron RNI was statistically higher in women from poor (15.1% RNI) than non-poor households (12.0% RNI). In Lagos, the iodine contribution from salt was higher in women from non-poor (156.5% RNI) than poor households (92.4% RNI). With respect to women's dietary diversity score, in Kano the contribution of sugar to women's vitamin A RNI was higher in women from households with lower dietary diversity (3.0% RNI) than in households with higher dietary diversity (2.1% RNI). In Lagos, the contribution of semolina flour and sugar to women's vitamin A RNI was higher in women from households with lower dietary diversity than in households with higher dietary diversity.

The fortification quality compared to Nigeria national standards varied greatly depending on the food. In Kano, the proportion of adequately fortified samples (i.e. were fortified to nutrient

levels stated in country or international standards) was 46.9% for oil, 28.0% for salt, 27.3% for wheat flour, 26.1% for semolina flour, 0.8% for sugar and 0% for maize flour. In Lagos, the proportion of adequately fortified samples was 73.3% for wheat flour, 31.2% for oil, 24.0% for semolina flour, 11.8% for salt, 1.5% for sugar and 45.5% for maize flour.

In conclusion, there is high coverage of fortifiable salt (in Kano and Lagos), fortifiable wheat flour (in Kano), fortifiable semolina flour (in Lagos), and fortifiable sugar (in Kano and Lagos), indicating high potential for fortified foods to contribute to nutrient intakes. Coverage of fortifiable maize flour and oil is lower than other foods because the majority is made at home and not industrially processed, indicating a low potential for impact from fortifying these foods. Fortification adequacy may be of concern for all foods in Kano and for semolina flour, maize flour, sugar, and oil in Lagos.

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3. ABBREVIATIONS

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
LGA	Local Government Area
NAFDAC	National Agency for Food and Drug Administration and Control
NPC	National Population Commission
OPM	Oxford Policy Management
PPS	Probability proportional to size
PSU	Primary sampling unit
RNI	Recommended nutrient intake
SON	Standards Organisation of Nigeria
WRA	Women of reproductive age

4. BACKGROUND

A. Introduction

Hunger and malnutrition among Nigerians continue to impair health, quality of life, and survival (Maziya-Dixon 2004). Nutritional deficiencies have long-term implications for health and wellbeing (Bhutta 2008, 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 does not require changes in dietary patterns nor individual decision for compliance (WHO 2009).

In 1993, Nigeria established mandatory fortification of salt with iodine (UNICEF 2005, Busari 2013). By showing improved compliance over the years, the program has obtained international salt iodization certification and resulted in significant health benefits for the population (Egbuta 2003, UNICEF 2005). Continuous monitoring remains essential to retain these benefits and to ensure that risks of iodine overconsumption are minimized.

Mandatory fortification of wheat flour, semolina flour, maize flour, sugar, and vegetable oil began in 2002 when the Ministry of Industry launched the National Policy on Food and Nutrition (Sablah 2013, UNICEF 2006). Different nutrients are required to be added to these foods: vitamins A, B1 (thiamine), B2 (riboflavin), B3 (niacin), B6, B9 (folic acid) and B12, and iron and zinc are added to wheat flour and semolina flour (SON 2015a, SON 2015b); vitamins A and B9 (folic acid) and zinc are added to maize flour (SON 2010); and vitamin A is added to oil and sugar (SON 2000a, SON 2000b, SON 2000c). Most monitoring activities have centered on fortified salt, followed by foods fortified with vitamin A (Busari 2013).

In a recent retail survey of flour (wheat, semolina, and maize), sugar, and vegetable oils, both vitamin A and iron levels were assessed and compared with Nigerian Industrial Standards (Ogunmoyela 2013). Compliance was evaluated by determining if foods had a nutrient level that was within a “feasible fortification range”; the high end of the range was the level required by standards and the low end of the range was the level required by standards minus a percentage of losses during distribution and storage (losses ranged from 15-30%). Compliance ranged from 12.2-33.3%, 11.9-16.7%, 14.9-20.2%, for vitamin A in flour, sugar, and vegetable oil, respectively, and from 1.0-21.0% for iron in flour. These reports suggest that various challenges may exist within the Nigerian context at the point of food fortification as well as during the retail process. They also support the need for more representative studies to evaluate the implementation of fortification

B. The project

In 2015, the Global Alliance for Improved Nutrition (GAIN), with technical support from the Food Fortification Initiative (FFI), the United States Centers for Disease Control and

Prevention (CDC), and Oxford Policy Management (OPM), conducted a sub-national fortification assessment survey in Kano and Lagos States in Nigeria. The survey assessed program coverage of fortified staple foods, as well as their contributions 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.

5. RATIONALE

There is limited information on the coverage and consumption of fortified staple foods such as wheat flour, semolina flour, maize flour, sugar and vegetable oil at population level since food fortification began in Nigeria. The survey is representative of Kano and Lagos States. The rationale for conducting the survey in these States is threefold. Firstl, they are the two most populous States in Nigeria, which maximizes the proportion of the country's population that will be covered by the survey. Second, these States are the commercial nerve centers of the country, where the majority of industries involved with food fortification are located. The two States represent entry points for new food products into the north and south, which have strong implications for elsewhere in Nigeria. Finally, both States have benefited from strong inputs by the National Food Fortification Program especially on strengthening large-scale food fortification through compliance assessments, social marketing campaigns, and communication strategies. Thus, the survey will provide important feedback to program stakeholders about barriers and enhancers that could be applied to other States.

The findings of this survey provide population-representative data on program coverage and performance in Kano and Lagos States. It is hoped that results from this survey will further guide programming efforts and nutrition policy recommendations in Nigeria.

6. 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 women of reproductive age (15 to 49 years) in Kano and Lagos States in Nigeria.

B. Specific objectives

The specific objectives of the project were:

a) To assess the coverage of fortified salt, wheat flour, semolina flour, maize flour, sugar, and vegetable oil among households;

b) To measure levels of select nutrients in samples of salt (iodine), wheat flour (iron), semolina flour (iron), maize flour (vitamin A), sugar (vitamin A), and vegetable oil (vitamin A) gathered at the household;
c) To estimate the consumption of salt, wheat flour, semolina flour, maize flour, sugar, and vegetable oil among households and women of reproductive age (15 to 49 years);
d) To assess the contribution of fortified salt, wheat flour, semolina flour, maize flour, sugar, 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:
    - Multidimensional Poverty Index
    - Women's dietary diversity.

7. 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 WRA 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 was conducted in Kano and Lagos States. The survey was representative at the State level.

To select a representative probability sample of households, a two-stage stratified random sampling strategy was applied. At the first stage of sampling, census enumeration areas (EAs) served as the primary sampling units (PSUs) and were selected within each State. The most recent population census data in Nigeria are from 2006. Consultation with the Nigeria Population Commission (NPC) confirmed that while there are population projection estimates through 2015, these estimates would be considered highly variable if applied to the list of enumeration areas (EAs) identified by the 2006 census. In other words, the population estimates at the EA level are considered unreliable, which created issues with using probability proportional to population size (PPS) sampling techniques for the first stage of sampling. To overcome this issue, a simple random sample technique was used to randomly select the 30 clusters (EAs) per State from the total list of 36,359 and 25,424 EAs in Kano and Lagos, respectively (i.e. so that all EAs had an equal selection probability for inclusion). A mini-census was conducted among the selected clusters to obtain data on the total population and the population of women of reproductive age (WRA). This approach allowed for a post-stratification weighting of the FACT survey sample to be representative of the mini-census

population. During field operations, three EAs in Lagos were replaced due to refusal. Also, adjoining EAs were added to the selected EAs for five EAs in Kano and one in Lagos, because the selected EAs were relatively small and the household listed was below the threshold for the survey.

The second sampling stage was the selection of households within the sampled PSUs. The required number of households were selected at random from the mini-census using computer-assisted personal interviewing (CAPI). The total sample size for the survey was 1,884 households and the total number of households to be visited in each EA was 31.

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, wheat flour, semolina flour, maize flour, sugar, and vegetable oil were collected if available. A sample was not collected if no sample was available or the respondent reported that the food was produced at home.

D. Questionnaires and supporting tools

Questionnaires

GAIN and CDC initially revised questionnaires developed from previous GAIN FACT surveys for this survey, and then OPM further revised and adapted them to the Nigerian context. Modifications were reviewed by GAIN and CDC prior to survey implementation. The final English copies of these questionnaires [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 in English, Hausa, or Yoruba and the interview took place in the respondents' own homes, in any of the programmed languages. Translation was done in two stages. The final English questionnaire was translated to Hausa and Yoruba by an experienced translator. Each of the translated versions was then back-translated to English to double check the accuracy of the translation. This step was done by an independent translator who had not seen the original English questionnaire. Any discrepancies between the final English questionnaire and the back-translated English questionnaire were resolved working closely with the translators. In this way, the intended meaning of the questionnaires was preserved throughout the translation process.

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

Before testing the CAPI data-entry program in the field, OPM 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: for 7 day food frequency questionnaire, photo grid for foods made from wheat flour, semolina flour, and maize flour

Wheat flour, semolina flour and maize flours are staple food vehicles that are often purchased by households from markets in the form of already prepared products (e.g. bread made from wheat flour is purchased from bakeries). To assess consumption of these vehicles, the FACT survey instrument includes an individual assessment of consumption over a seven day recall period among WRA of foods containing wheat flour, semolina flour, and maize flour. A comprehensive list of all food items made with these vehicles and their recipes was developed. Based on a protocol developed by GAIN, portion size photo grids were developed for foods made with these vehicles that are consumed in Kano and Lagos. A local nutritionist was contracted to assist in the development of the food grids through individual visits to markets and stores. She also generated a standard recipe for each of the foods included in the food picture grid. Portions of the foods were re-created from the largest portion (e.g. 5 servings of a plain puff puff) to the smallest (e.g. ¼ serving of a plain puff puff). Each typical portion was measured and recorded as a proportion of the largest portion (e.g. ½ serving of a plain puff puff). Color photographs of each portion size were used to create one-page grids per food item. 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 for each food. Examples of the photo grids are found in **Annex B**.

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 at household level;
c) WRA questionnaire: asked questions on dietary diversity and consumption of fortified foods by WRA;
d) Photo grid: Pictures of foods in the WRA questionnaire were used to help WRA estimate consumption of wheat flour, semolina flour, and maize flour foods frequently eaten in previous 7 days;
e) Field guide: provided field staff detailed steps in data collection;
f) Mini-census form: provided information on the total number of household members and WRA in all households in selected EAs;
g) Checklists for team leaders and enumerators: provided detailed daily checklists to follow in the field;
h) 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;
i) Phone lists of team members and authorities: facilitated coordination between teams and informing relevant authorities.

E. Field staff recruitment, field team structure, and management

OPM recruited for three roles: listing team, survey enumerators, and supervisors. Recruitment considered several criteria including previous experience with OPM, previous experience with large-scale surveys using CAPI, experience working in Kano and Lagos, and fluency in Yoruba and Hausa. OPM investigated the optimal gender balance of the team; this was particularly important for the Kano team as often only women are allowed to enter households in Hausa-speaking communities.

OPM recruited and trained 15% more interviewers than were required for the data collection. This was to enable the selection of the best-performing interviewers at the end of the training program and also to ensure that replacement enumerators were available should there be issues with enumerators during survey implementation. Final selection of field teams was based on a mastery of the study tools, test scores and performance during in-class and in-field pilots.

The training for the main FACT survey was conducted from 18-23 May 2015 at a hotel conference center in Abuja (**Annex C**). Training was led by OPM personnel while bringing in subject specialists from GAIN, CDC, and the Federal Ministry of Health (FMOH) as needed. The listing team underwent a two-day training, the survey team (enumerators and supervisors) a six-day training, and supervisors the six-day training with an additional day of training.

Fieldwork took place over a 20-day period beginning 25 May 2015. Four listing teams (two per State) composed of two enumerators each completed the listing. Each state had three survey teams; each team consisted of three enumerators and one supervisor.

F. Training and data collection procedures

<u>Household listing training</u>

The listing team underwent a two-day training. It consisted of classroom training, a pilot in a nearby community, and debriefing. Enumerators were recruited on the basis that they were skilled and experienced mappers and cartographers who have several years of experience in geographical interpretations as well as in conducting surveys; this is in addition to their relationship with the agency that conducts the national census.

<u>Household listing procedures in each enumeration area</u>

The main roles of the listing team were to conduct advocacy, gain community/enumeration area consent, and conduct a mini census. This was accomplished by visiting each EA in advance of the survey team. The listing team also updated the EA maps with more detailed description and established contact with a local guide in every EA which made locating households easier for the survey team. After compiling a list of all households eligible for the survey within the sampled EA, this list was used by the supervisor to draw a random sample of 31 households. The list of selected households was then given to the survey team to implement.

FACT survey training

The training consisted of a rigorous six-day classroom and field-based training, facilitated by OPM and drawing on subject specialists as required. All technical topics in both questionnaires were covered. Training also educated enumerators on the purpose of the study, understanding and reading the enumeration area map, listing and selection of eligible households, the importance of informed consent, how to collect food samples, how to administer the consent forms and how to administer the questionnaires. CAPI was introduced to the team on the first day of training so the enumerators became comfortable and conversant with CAPI as quickly as possible. They were trained on how to handle the CAPI, switch between languages, and trouble-shoot in cases of minor technical issues during data collection.

The training also included two pilots to give the interviewers an opportunity to practice in the field. The pilots also ensured comprehension of the listing and data-collection procedure. Each pilot was followed by a debrief session to follow up on any issues that arose.

Additional training for supervisors

Data collectors who demonstrated superior understanding of the survey protocols and leadership skills were appointed as supervisors. The supervisor was responsible for overall management of the survey 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 training day was added to the survey team training, outlined above. It focused on sampling, fieldwork plans, advocacy, monitoring tools, data-transmission protocols, and roles and responsibilities in the field.

FACT survey procedures in each enumeration area

The survey team was responsible for survey implementation. On arrival to assigned EAs, after a courtesy and advocacy call, the team, with the aid of a local guide traversed the community to familiarize themselves with the areas covered by the listing team. The supervisors located the first listed household with the aid of maps and assigned households to individual data collectors. Thereafter, the supervisor made spot checks to witness and assess the interviewer's skills and later re-visit households to administer a back-check questionnaire.

Upon arriving at each sampled household, the interviewer provided information on the study and asked to interview the eligible respondent(s). Verbal consent was required from each respondent (**Annex D**). Upon receipt of informed consent, interviewers administered the household and WRA questionnaires. The person who primarily purchases and prepares food for the household was identified as the respondent for HH1 and HH2. If this person 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 flour, semolina flour, maize flour, and sugar 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.

Quality monitoring by supervisors in each enumeration area

Each day, supervisors completed a monitoring sheet, which gave details on challenges encountered in the field, the number of households listed and the number of interviews conducted. Additionally, supervisors carried out spot checks and observed the interview process in the field (e.g. how the questions were being asked, how responses were being recorded, how the respondent was being treated). Supervisors were also responsible for going back to 10% of the completed households to administer a shorter version of the questionnaire using CAPI. The supervisor's and enumerator's answers were checked via CAPI, a log of differences was kept, and any systematic issues were reported to the relevant team. Finally, the supervisor led daily meetings with enumerators where the day's experiences were discussed and corrections made.

G. Data entry and management

Data processing

Data collected were transferred electronically from CAPI by the supervisors to the data-processing staff at the OPM office on a daily basis. The supervisors retrieved all the tablets and reviewed the data retrieved from each for completeness. After verification, the supervisor uploaded and synchronized the data to a main server. From here, the data manager at OPM downloaded the data, undertook additional consistency checks, and saved the data in a central data base at OPM and a back-up stored in the OPM 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 built-in checks for unlikely data points and dynamically adjusted drop-down menu options to reduce the scope for errors. The supervisors checked for any errors every evening after completion of fieldwork and before uploading the files to the main server. At the OPM office, the 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 reviewed by OPM. 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 four different data sets;

1. Household listing from the mini census
2. Questionnaire 1 dataset (Household questionnaire 1)
3. Questionnaire 2 dataset (Household questionnaire 2)
4. Questionnaire 3 dataset (Women of reproductive age questionnaire)

Data storage

All data collected from the survey were stored on computers at OPM 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 OPM staff, managed by a project manager, and supported by a data manager. Final datasets were submitted to GAIN and CDC in July 2015.

Storage, shipment, and analysis of food samples

Food samples were collected from the field in batches and sent to the OPM office in Abuja to ensure that samples did not deteriorate under field conditions or get misplaced. They were stored in a cool room until final preparation and shipment to BioAnalyt 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; maize flour, sugar and oil for vitamin A; and wheat and semolina flour for iron (**Annex E**).

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 by State. Differences between categorical and fortification coverage of variables were assessed using Rao-Scott chi-square, 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.

Post-stratification weighting

Probability proportional to size (PPS) sampling was not feasible due to lack of recent census data. As a result, a post-stratification sampling weighting scheme was used, employing the

household mini census data. This was a two-stage process that generated final sample weights for the study population to be representative of the listing population of the study EAs.

In the first stage, the study sample was expressed as a weighted proportion of the household census total population size in each EA. In the second stage, the sampling weight for each respondent and or /household was further weighted for random selection probability of each EA (i.e. 1/30) within a State and summarized by the expression:

$$Final\ Sampling\ weight = \frac{\sum_{ea=1}^{30} FACT\ Household\ Size}{\sum_{ea=1}^{30} Household\ Census} \times \frac{1}{30}.$$

A post-stratification weighting check indicated that the cumulative post-stratified weights for all households and respondents were identical to household census totals at each stage as expected. The estimated post-stratification sampling weight was then applied to the population-based analyses (e.g. analyses using data from household questionnaires 1 and 2 and the WRA questionnaire; the weights were not applied to the food sampling and fortification quality data).

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

Key outcome variables were fortification coverage followed by nutrient intakes from fortified food. Nutrient intakes were estimated for WRA using two different methods: 1) an individual assessment using a photo grid method for wheat flour-, semolina flour- and maize flour-containing foods consumed over the past seven days, and 2) a household assessment using the adult male equivalent (AME) method for all food vehicles based on reported amounts purchased and duration they lasted in the household. Additionally, two risk 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 vehicle 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 because 1) it is confirmed by quantitative analyses of the household sample or 2) if no sample was available, it is confirmed by quantitative analyses of samples from the brand reported by the household. Refers to analyzed foods confirmed to contain nutrients above the fortification threshold (i.e. at the level of inadequately fortified or higher) as follows:
    - In households where a food sample was taken and laboratory-analyzed, if the sample met the fortified criteria (i.e., salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 3710 IU/kg of vitamin A, sugar > 750 IU/kg vitamin A, oil with > 10,000 IU/kg vitamin A), then the household was classified as "yes" for consumes fortified food. 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 State 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 food vehicle 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.

Determination of intrinsic nutrient content of food vehicles

The *iCheck* test kit for quantitative determination of micronutrients measured the total nutrient content in a food matrix which is comprised of both intrinsic (naturally occurring) nutrient levels, and the nutrient levels added through fortification (**Annex E**). To determine the amount added by fortification alone, intrinsic nutrient correction was conducted for wheat flour and semolina flour. This was achieved by first measuring the nutrient content of unfortified food samples (e.g. wheat flour) to obtain the average intrinsic content. This amount was then subtracted from every *iCheck*--tested food to obtain the amount contributed by fortification. Intrinsic iron determinations for wheat and semolina flour were conducted on 2 and 3 unfortified samples, respectively. For maize flour, background fluorescence in maize flour was measured. This was done for two reasons: (1) the corresponding *iCheck* method for vitamin A measures fluorescence in samples and components in the flour can fluoresce; these intrinsic values need to be adjusted for and (2) maize flour does not contain intrinsic vitamin A; therefore there is no need to adjust for intrinsic vitamin A levels. One unfortified maize flour sample was measured for fluorescence. For vitamin A in oil, iodine in salt, and vitamin A in sugar, it was assumed that none of these foods have intrinsic vitamin A or iodine. Therefore, no adjustments needed to be made by measuring unfortified samples of these foods.

Daily wheat flour, semolina flour, and maize 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, semolina flour and maize flour, herein referred to as “flour”. This method targeted only women who completed the WRA questionnaire and included 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 27 flour-containing foods on the list in the last seven days (see WRA 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 amount of flour consumed by women per week, and then divided by seven to calculate intake/day. A cumulative total of flour consumed in grams per day was obtained by summing all food items containing flour for women per day, separately for wheat, semolina and maize. For any of the 27 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 nutrient contributed by the fortified flour consumed by WRA. The grand median of the added nutrient content of all flour samples was the pooled median of the analyzed nutrient content from all households that provided a food sample for laboratory testing within each State. The derived State median content for each food vehicle (E.g. State median vitamin A in maize flour), was then multiplied with the amount of flour (in grams) each woman consumed daily to estimate the daily amount of nutrient consumed. In this way, iron intake in milligrams/day was estimated for wheat flour and semolina flour, and vitamin A intake in µg RE/day was estimated for maize flour.

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). For vitamin A, WHO RNIs for women are as follows: 600 µg RE/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women), (WHO/FAO 2004).

Daily apparent food consumption (using the AME method) and micronutrient contribution to 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 food vehicles (salt, wheat flour, semolina flour, maize flour, sugar, vegetable oil) 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 or milliliters/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 1** 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 1. 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 semolina 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 in the State was used in that State.
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 State 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 (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg 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 of 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, 2011) and Ballard 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 a 10 point score (FAO 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 the State 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; and for iron rich foods and for zinc rich foods group 5.

I. Ethical considerations

Ethical approval for the FACT survey was granted by the National Health Research Ethics Committee (**Annex G**). 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. Oral informed consent was obtained from the participants (**Annex D**). 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) Laboratory testing was conducted on all food samples collected in the households; however for wheat flour in Lagos (n=15), semolina flour in Kano (n=23) and for maize flour in Kano (n=33) and Lagos (n=2), a small number of samples were available which limits the reliability of the information. Analysis of samples collected at market level may have been more representative of fortification levels in food however that was beyond the scope of this survey.

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 and sex (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 flour-based foods were not validated. For some foods, the amount purchased was reported in non-metric units (e.g. milk tin) and the estimate of the grams or milliliters in that unit may not be reliable.

c) 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.

d) 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. The same is true for semolina flour and maize flour.

e) 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 to dominate responses.

f) The term ‘fortified’ for wheat, semolina and maize flour was based on the content above the ‘intrinsic value’ for wheat, semolina and maize flour. The intrinsic iron content was measured from three (3) unfortified wheat flour samples and two (2) unfortified semolina flour samples. The intrinsic iron content of flour can change from growing season to growing season based on the wheat variety grown, the soil it was grown in, fertilizer application and other factors. Similarly, intrinsic fluorescence was determined from only one (1) laboratory analyzed maize specimen. The intrinsic iron and fluorescence identified during this survey may vary from the intrinsic content measured at another time. Further, the results are limited by the small sample size used to determine intrinsic content.

g) In some households, no food sample was provided but the vehicle brand name was known, thus a State median nutrient values of branded samples was used in deriving fortified ‘yes’ or ‘no’. Additional analysis results indicated that between 1.4-45.6% of samples were evaluated by this ‘no specimen but brand known’ approach. These proportions varied by vehicle (highest (in crude %): semolina flour (45.6%), wheat flour (33.1%), sugar (27.2%) and salt (20.2%) all in Lagos state) and by State. This might have introduced disproportion levels of misclassification in coverage estimates.

h) Other limitations affect the representativeness of the data. First, the data are specific to Kano and Lagos States and thus are not nationally representative. Second, the replacement of enumeration areas in Lagos did not follow the rules of randomization and may have potentially biased the estimates.

i) The coverage estimates for all foods were available for four types of households: households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; households that could not be classified because no sample or reported brand was available; and households that did not consume a fortifiable food. Coverage was further stratified by State, poverty risk, or dietary diversity. This may have contributed to unstable estimates due to low sample sizes/cell counts, especially for foods with coverage at the extremes.

8. RESULTS

The response rate for household questionnaire 1 was 94.2% in Kano State and 91.6% in Lagos State (**Table 1**). In total, 1,902 households were invited to participate in the survey and 1,767 households were interviewed (896 in Kano and 871 in Lagos). In these households, 825 women were interviewed in Kano and 703 were interviewed in Lagos. .

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

Component	Sample size					
	KANO			LAGOS		
	Planned[1]	Interviewed	Response rate (%)	Planned[1]	Interviewed	Response rate (%)
Household Roster and demography questionnaire 1[2]	951	896	94.2	951	871	91.6
Women's questionnaire	921	825	89.6	921	703	76.3

[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.

The median household size was 6.2 in Kano and 3.6 in Lagos (**Table 2**). The household dependency rate was 1.2 for Kano, indicating higher dependents (those below 15 years and above 64 years) per independents (those between 15 and 64 years of age) in households. The household dependency ratio of 0.9 in Lagos indicated fewer dependents per independents in households. Female-headed households were 38.0% in Kano and 36.6% in Lagos. The mean age of the household head was 41.1 years in Kano and 33.5 years in Lagos.

Table 2. Summary of household characteristics.[1]

Characteristic	KANO		LAGOS	
	n	Median (25%, 75%), % (95% CI), mean (95% CI)	n	Median (25%, 75%), % (95% CI), mean (95% CI)
Household size[2]	896	6.2 (3.7, 9.2)	871	3.6 (2.2, 4.9)
Household dependency ratio[2,3]	896	1.2 (0.8, 1.9)	871	0.9 (0.5, 1.4)
Female-headed household[4]	896	38.0 (24.7, 51.3)	871	36.6 (29.7, 43.6)
Age of head of household[5]	896	41.1 (27.5, 58.1)	871	33.5 (24.5, 53.0)

Abbreviation: CI, confidence interval
[1] All values are median, percent or mean as indicated, 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)
[5] Mean (95% CI)

Women who participated in the WRA questionnaire were on average 28.5 years in Kano and 31.9 years in Lagos (**Table 3**). Among the respondents, 16.9% were pregnant in Kano and 7.9% were pregnant in Lagos. The proportion of women breastfeeding was 40.2% in Kano and 19.8% in Lagos.

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

Characteristic	KANO		LAGOS	
	n	Mean (95% CI), % (95% CI)	n	Mean (95% CI), % (95% CI)
Age in years[2]	845	28.5 (29.1, 27.9)	735	31.9 (32.5, 31.3)
Pregnant[3]	845	16.9 (14.4, 19.5)	735	7.9 (5.9, 9.8)
Lactating[3]	845	40.2 (36.8, 43.5)	735	19.8 (16.9, 22.7)

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).

An estimated 68.3% of Kano households and 8.8% of Lagos households were classified as at risk of acute poverty based on the MPI (**Table 4).** MPI is constructed from three domains: living standards, household education, and health and nutrition. For example, 52.5% of Kano households and 1.0% of Lagos households lacked electricity, a component of living standards. School attendance is a component of the education domain; 40.5% of Kano households and 1.9% of Lagos 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 young child died recently. In Kano, 21.1% of households had a child that died in the past five years; this was the case for 1.8% of Lagos households.

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

MPI and domains	KANO		LAGOS	
	n	% (95% CI)	n	% (95% CI)
At risk of acute poverty (MPI ≥0.33)[2]	896	68.3 (65.3-71.4)	871	8.8 (7-10.7)
Living standards component				
No electricity	896	52.5 (49.2-55.8)	871	1.0 (0.4-1.7)
Inadequate cooking fuel sources[3]	896	92.6 (90.9-94.2)	871	7.3 (5.5-9)
Inadequate flooring[4]	896	31.4 (28.3-34.4)	871	1.1 (0.4-1.9)
Unimproved drinking water source[5]	896	58.4 (55.1-61.6)	871	32.9 (29.8-36.1)
Inadequate toilet sanitation[6]	896	28.4 (25.4-31.4)	871	11.5 (9.4-13.6)
< 2 household assets[7]	896	12.9 (10.7-15.2)	871	0.5 (0.1-1)
Education component				
Head of household with less than five years of education	896	98 (97.1-98.9)	871	81.5 (78.9-84)
Any household member 5-14 years NOT currently attending school	896	40.5 (36.7-44.2)	871	1.9 (0.6-3.2)
Health and nutrition component				
Moderate to severe household hunger	896	10.1 (8.1-12.1)	871	20.2 (17.5-22.9)
Child 0-59 months who died in past 5 years	896	21.1 (18.3-23.8)	871	1.8 (0.9-2.7)
Poor access to health services[8]	896	36.2 (33-39.4)	871	14.2 (11.9-16.6)

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 (radio; television; mobile telephone; non-mobile telephone; watch; electric iron; bicycle or tricycle; motorcycle, scooter, auto-rickshaw; car, truck, jeep, tractor; refrigerator, dish washer, washing machine; electric or gas cooker; air condition; generating set; cable television).

[8] When the travel duration to the nearest health facility exceeds 60 minutes, the household is termed as having poor access to health services.

Median dietary diversity scores for women of reproductive age were 2.8 for Kano and 3.6 for Lagos (**Table 5**). Correspondingly, 74.5% of women in Kano and 64.8% of women in Lagos were classified as having a higher dietary diversity score. More than 90% of women in both States consumed vitamin-A rich sources of plant and animal origin. In Kano, approximately 42% of women consumed iron-rich and zinc-rich foods. For Lagos, approximately 84% of women consumed iron- and zinc-rich foods.

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

Dietary diversity score and components	KANO		LAGOS	
	n	Median (25%, 75%), % (95% CI)	n	Median (25%, 75%), % (95% CI)
Dietary diversity score[2]	845	2.8 (2.0-3.8)	735	3.6 (2.5-4.7)
Higher dietary diversity score (at or above the median)[3,4]	845	74.5 (71.5-77.5)	735	64.8 (61.3-68.2)
Consumed plant sources of vitamin A[3,5]	845	98.3 (97.4-99.2)	735	94.3 (92.6-96)
Consumed animal sources of vitamin A[3,5]	845	99.4 (98.9-99.9)	735	98.9 (98.2-99.7)
Consumed iron- or zinc-rich foods[3,5]	845	42.9 (39.5-46.2)	735	85.0(82.3-87.6)

Abbreviation: CI, confidence interval

[1] All values are median or percent as indicated, 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 State.

[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 group 5.

[¥] Categorization of lower and higher dietary diversity was based on an integer median score of 3 and 4 respectively for Kano and Lagos States. Additionally, as the State 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 not statistically significantly different between poor and non-poor households in both Kano and Lagos (**Table 6**). In Kano, a greater proportion of poor households consumed animal sources of vitamin A than non-poor households. For iron- and zinc-rich foods, the opposite trend was observed in Kano: these were consumed in higher proportions by non-poor than poor households. In Lagos, none of the dietary diversity components were different between poor and non-poor households.

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]
KANO	**N=567**	**N=278**	
Higher dietary diversity score (at or above the median)[4]	72.9 (69.2-76.7)	77.8 (72.9-82.7)	0.1311
Consumed plant sources of vitamin A[5]	98.6 (97.6-99.7)	97.6 (95.7-99.4)	0.2692
Consumed animal sources of vitamin A[5]	99.8 (99.5-100)	98.5 (97.1-100)	0.0270†
Consumed iron- or zinc-rich foods[5]	35.2 (31.3-39.2)	58.6 (52.8-64.5)	< 0.0001
LAGOS	**N=48**	**N=687**	
Higher dietary diversity score (at or above the median)[4]	60.5 (46.4-74.5)	65 (61.4-68.6)	0.5262
Consumed plant sources of vitamin A[5]	90.5 (82.4-98.6)	94.5 (92.8-96.2)	0.2372
Consumed animal sources of vitamin A[5]	100 (100-100)	98.9 (98.1-99.7)	-[6]
Consumed iron- or zinc-rich foods[5]	77.2 (65.1-89.3)	85.5 (82.8-88.2)	0.1252

Abbreviation: CI, confidence interval

[1] All values are percent 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. Complex survey chi-square test was used to compare percentages.

[4] Dietary diversity score greater than or equal to the population median in each State.

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

[6] It is not possible to calculate a p-value due to 100% prevalence.

¥ Categorization of lower and higher dietary diversity was based on an integer median score of 3 and 4 respectively for Kano and Lagos States. Additionally, as the State 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 for the overall dietary diversity and related component variables.

†Complex survey chi-square test was used to compare percentages. Further, test of independent proportions with Yates Chi-square continuity correction for small binomial proportions yields consistent results (Yates 1934).

The number of household food samples that were laboratory analyzed is summarized in **Table 7**. The food with the largest number of samples analyzed was salt: 731 in Kano and 645 in Lagos. Over 500 samples each of sugar and oil were analyzed, as well. There were fewer wheat flour, semolina flour and maize flour samples available for analysis. Results from the food sample analysis can be found in **Figure 4** and **Annex H**.

Table 7. Summary of food samples analyzed.

Food samples	KANO (N)	LAGOS (N)
Salt	731	645
Wheat flour	110	15
Semolina flour	23	233
Maize flour	33	2
Sugar	238	264
Oil	256	247

The household coverage of foods is noted in **Figure 1** and **Annex H**. For salt, 96.9% of Kano households and 98.4% of Lagos households reported consuming salt (**Figure 1A**); the same proportion of households consumed fortifiable salt (i.e. salt that was not made at home and is

assumed to be industrially processed). An estimated 64.1% of Kano households and 87.9% of Lagos households consumed fortified salt.

For wheat flour, 84% of Kano household consumed wheat flour and fortifiable wheat flour, compared with 14% of Lagos households (**Figure 1B**). Only 22.7% of Kano households and 5.4% of Lagos households consumed fortified wheat flour.

Results for semolina flour were the opposite of those for wheat flour (**Figure 1C**). Less than 15% of Kano households consumed semolina flour or fortifiable semolina flour compared with at least 80% of Lagos households. The proportion consuming fortified semolina flour was lower: 6.9% for Kano and 69% for Lagos households.

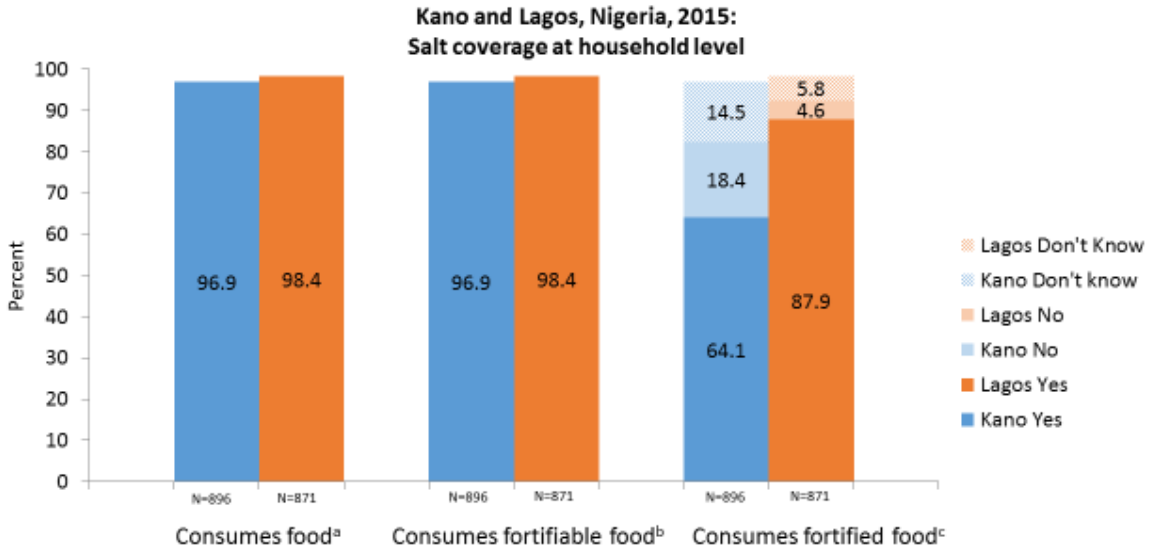
An estimated 77.1% of Kano households consumed maize flour compared with 12.2% of Lagos households (**Figure 1D**). The proportion of households consuming fortifiable maize flour was lower: 11.0% for Kano and 2.9% for Lagos. Fortified maize flour was consumed by 1.7% of Kano and 0.2% of Lagos households.

More than 85% of households consumed sugar and fortifiable sugar in both Kano and Lagos (**Figure 1E**). In comparison, 21.1% of Kano and 35.6% of Lagos households consumed fortified sugar.

For oil, 98% of Kano and Lagos households consumed oil (**Figure 1F**). The proportion who consumed fortifiable oil was lower: 35.9% for Kano and 22.7% for Lagos households. Approximately 7% of households in both States consumed fortified oil.

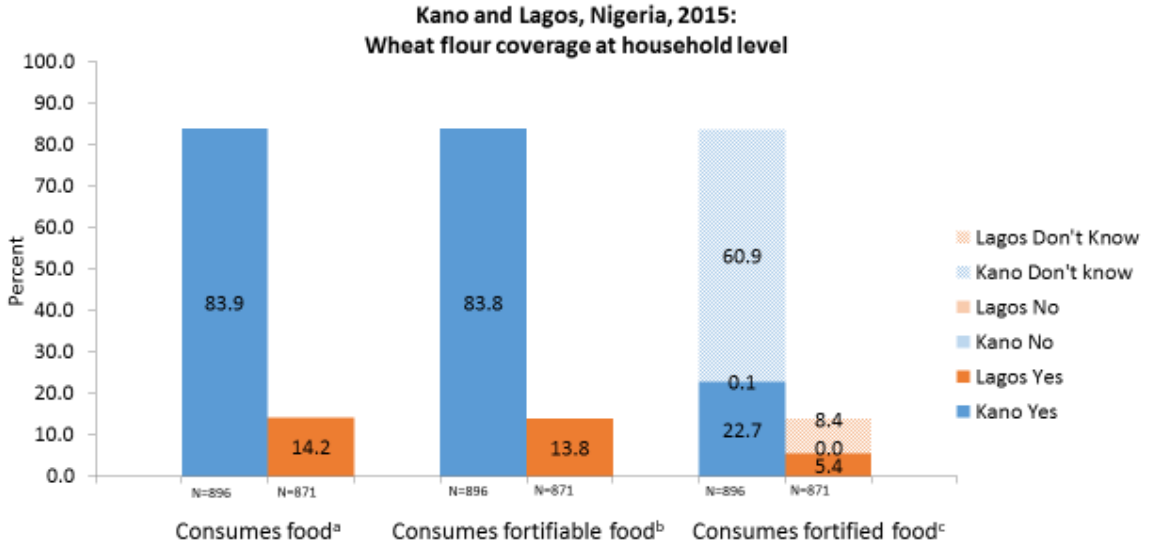
Figure 1. Household coverage of foods.[1,2]

A.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown.

B.



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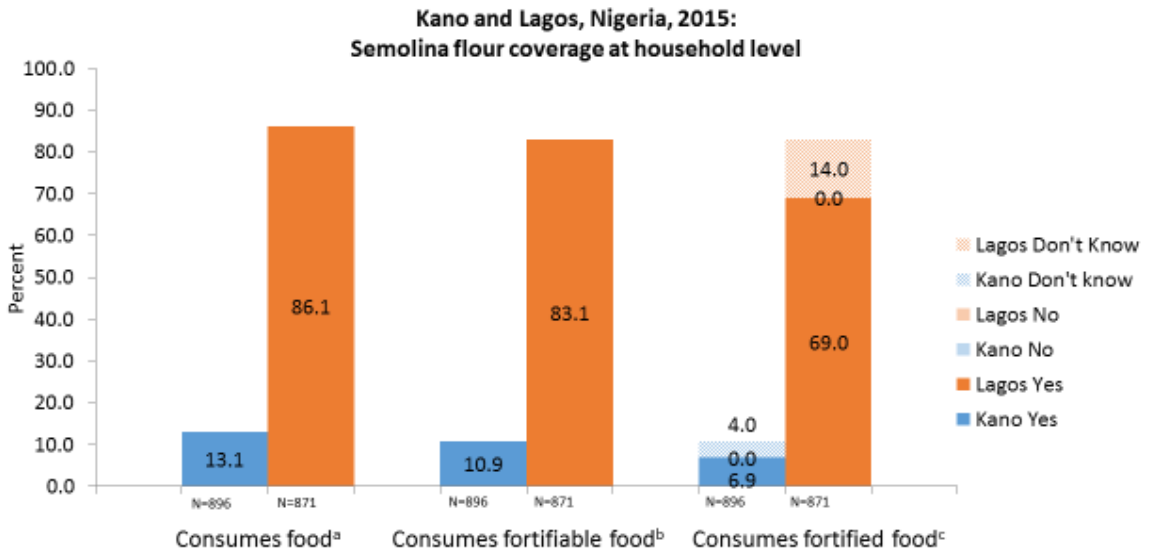
C.



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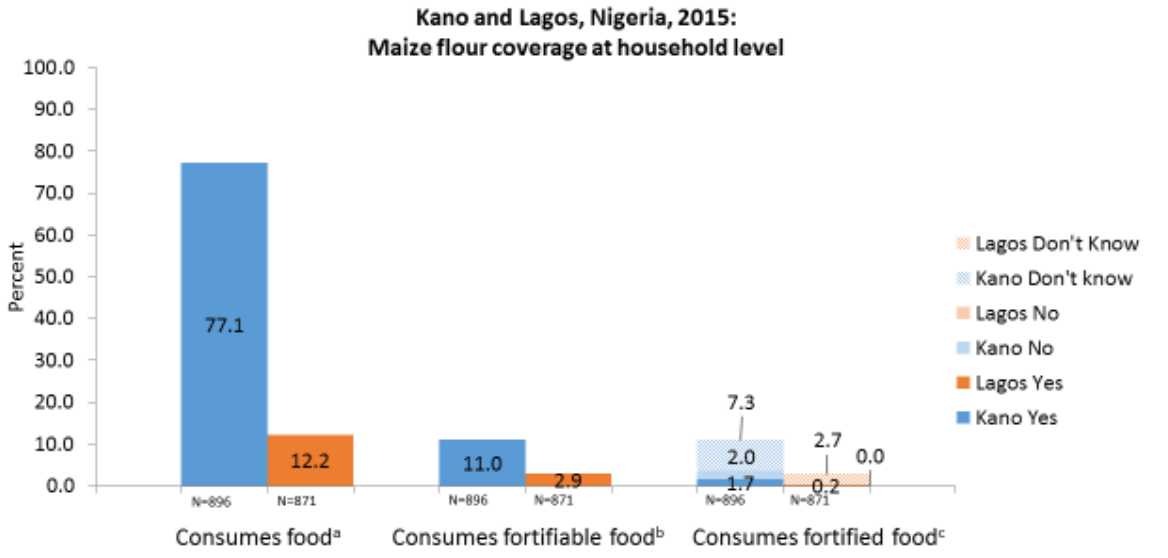

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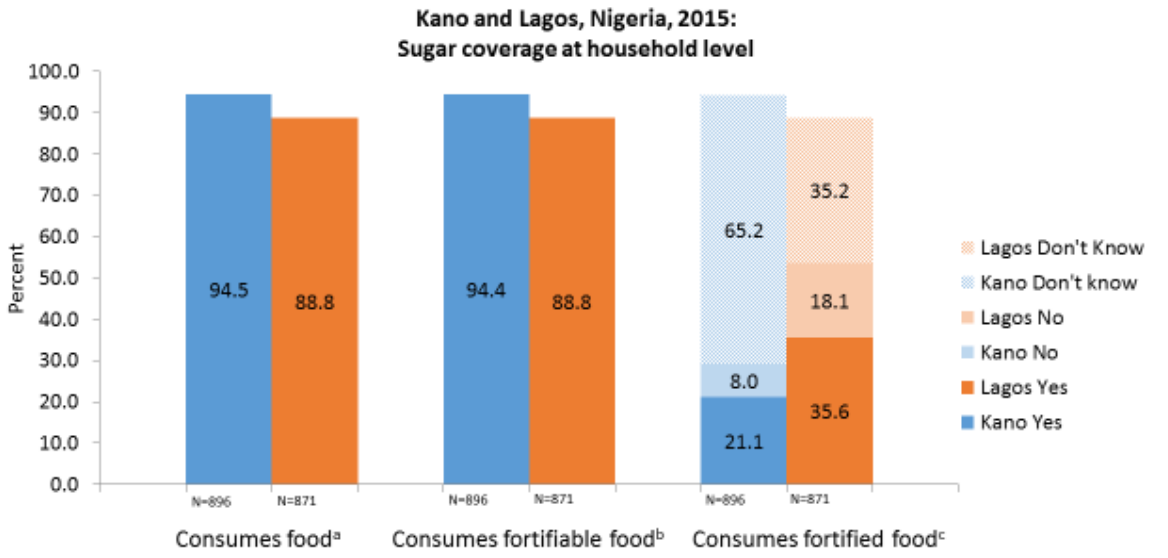
E.



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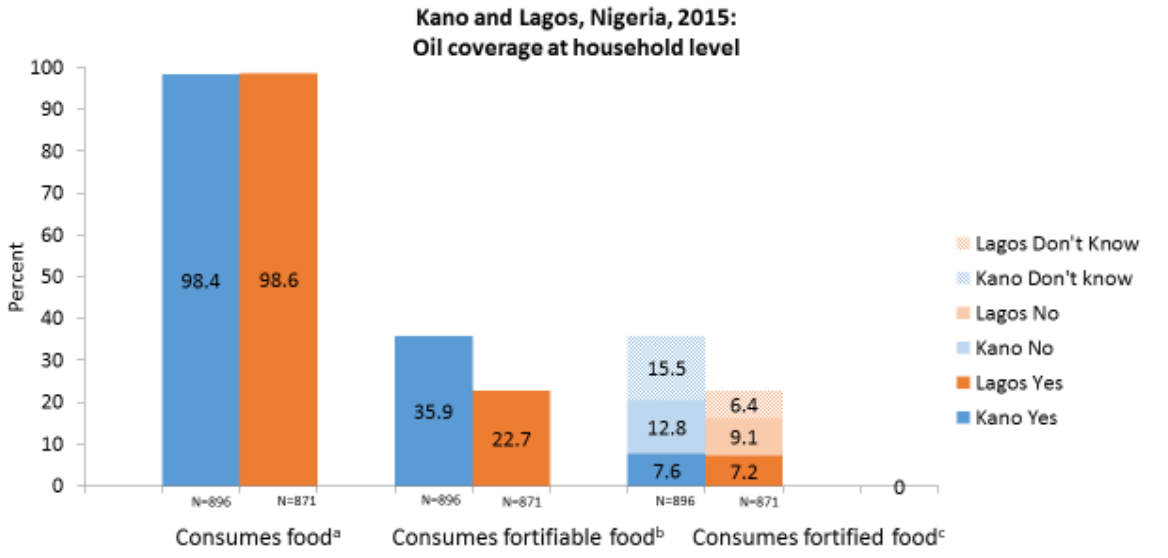
F.



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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: salt ≥ 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 3710 IU/kg vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). "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 within each State 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.

For “consumes fortified food”, the household coverage estimates for all foods were available for four types of households: yes, households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; no, households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; don’t know, households that could not be classified because no sample or reported brand was available; and does not consume fortifiable food, households that did not consume a fortifiable food. Household coverage of foods was stratified by poverty risk for households (**Figure 2** and **Annex H, Table 2**). In Kano, 97% of poor and non-poor households consumed salt and fortifiable salt while 63.3% of poor and 65.8% of non-poor households in Kano consumed fortified salt (**Figure 2A**). There were no statistically significant differences between poor and non-poor by salt consumption category. For example, for “consumes fortified salt-Yes”, the coverage was similar between poor and non-poor households and not statistically different (**Annex H, Table 2: salt)**.

In Kano, a greater proportion of non-poor households consumed wheat flour, fortifiable wheat flour and fortified wheat flour, compared with poor households (**Figure 2B** and **Annex H, Table 2: wheat flour**). .

The consumption of semolina flour, fortifiable semolina flour, and fortified semolina flour was statistically higher in non-poor households in Kano compared with poor households (**Figure 2C** and **Annex H, Table 2: semolina flour**).

There were no statistically significant differences between poor and non-poor Kano households in the proportion that consumed maize flour, fortifiable maize flour, and fortified maize flour (**Figure 2D** and **Annex H, Table 2: maize flour**).

A higher proportion of non-poor households in Kano consumed sugar, fortifiable sugar, and fortified sugar than poor households (**Figure 2E** and **Annex H, Table 2: sugar**).

Oil was consumed by 98% of poor and 99.1% of non-poor households in Kano; this was a non-statistically significant difference (**Figure 2F and Annex H, Table 2: oil**). Fortifiable oil was consumed by 35.0% of poor and 37.9% of non-poor Kano households; this difference was not statistically significant. A higher proportion of non-poor households (17.2%) reported not consuming fortified oil than poor households (10.7) in Kano.

In Lagos, approximately 100% of poor and non-poor households consumed both salt and fortifiable salt (**Figure 2G** and **Annex H, Table 2: salt**). The proportion of Lagos households consuming fortified salt was statistically lower (79.7%) in poor relative to non-poor (88.7%) households. Due to a zero cell, , it was not possible to statistically compare between poor and non-poor households the proportion consuming salt and fortifiable salt

The proportion of poor and non-poor households in Lagos that consumed wheat flour, fortifiable wheat flour, and fortified wheat flour was low (<15%) and not statistically different based on poverty risk (**Figure 2H** and **Annex H, Table 2: wheat flour**).

Between poor and non-poor households in Lagos, there was no difference in the proportion consuming semolina flour or fortifiable semolina flour (**Figure 2I** and **Annex H, Table 2:**

semolina flour). However, a greater proportion of non-poor households (70.9%) consumed fortified semolina flour than poor households (50.4%) in Lagos.

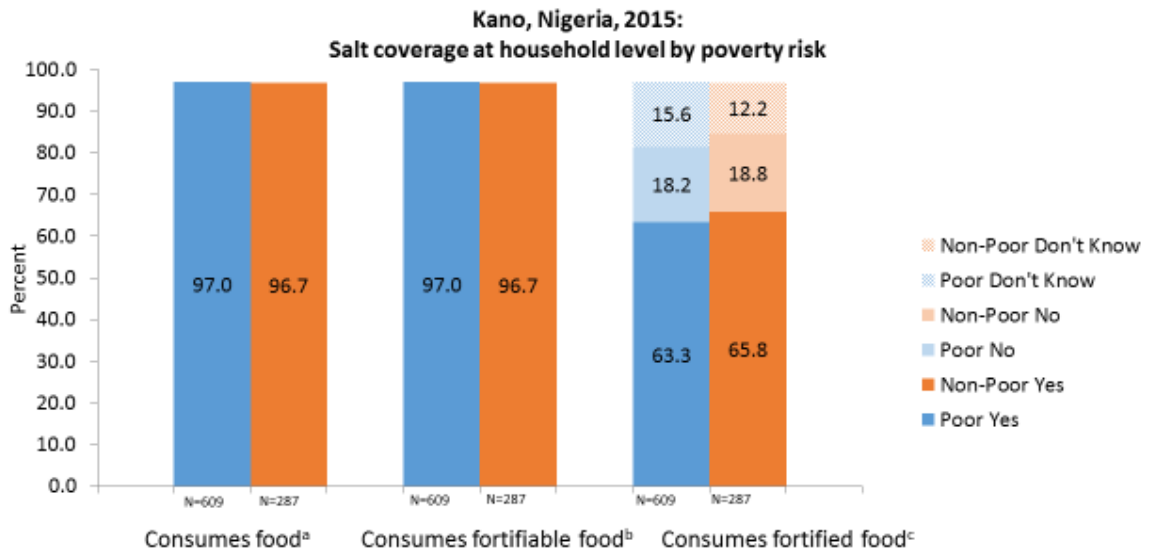
Maize flour consumption varied statistically between poor and non-poor households in Lagos (**Figure 2J** and **Annex H, Table 2: maize flour**). Specifically, 32.7% of poor and 10.2% of non-poor households consumed maize flour in Lagos. In this State, 6.0% of poor and 2.6% of non-poor households consumed fortifiable maize flour; this was a non-statistically significant difference. The proportion consuming fortified maize flour was 0% for poor and 0.2% for non-poor households; statistical testing of these values could not be completed, due to a zero cell counts (as shown in **Annex H Table 2: maize flour**).

The proportion of non-poor households consuming sugar, and fortifiable sugar, and fortified sugar was statistically higher than for poor households in Lagos (**Figure 2K**).

Nearly 100% of poor and non-poor households consumed oil in Lagos; these proportions could not be statistically tested due to zero cell counts (**Figure 2L** and **Annex H, Table 2: oil**). Almost 18% of poor households consumed fortifiable oil compared with 23.2% for non-poor Lagos households; these proportions were not statistically different. Finally, there was no difference in the proportion of poor and non-poor Lagos households that consumed fortified oil.

Figure 2. Household coverage of foods by poverty risk.[1,2,3,4]

A.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

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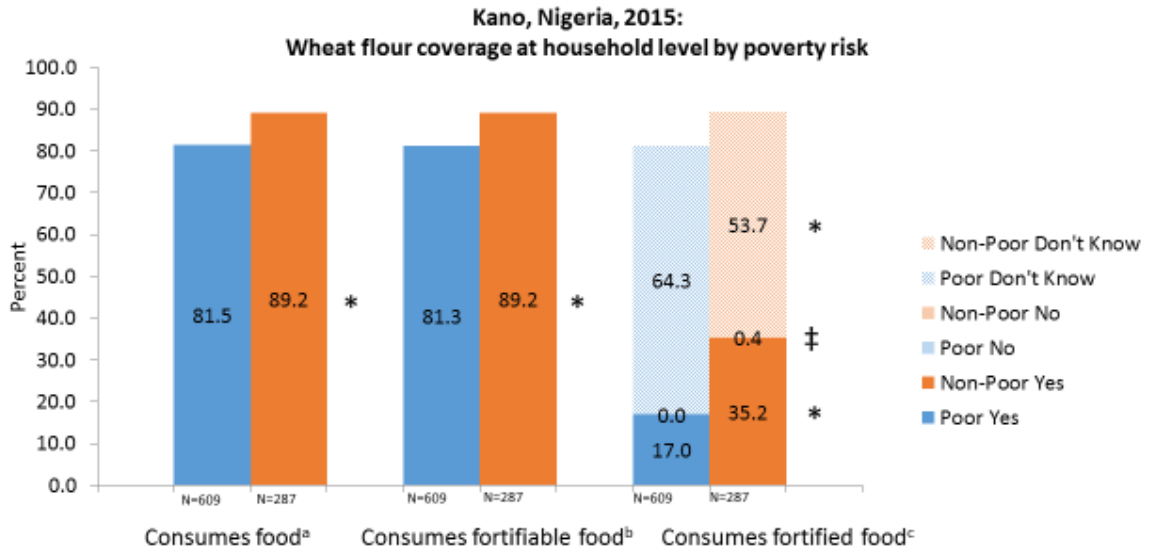

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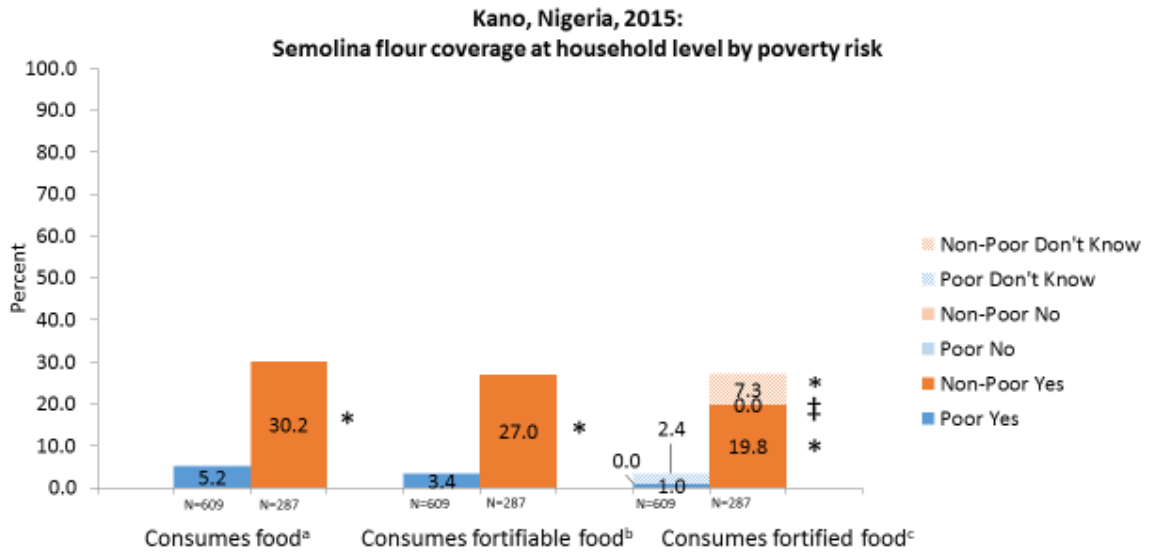

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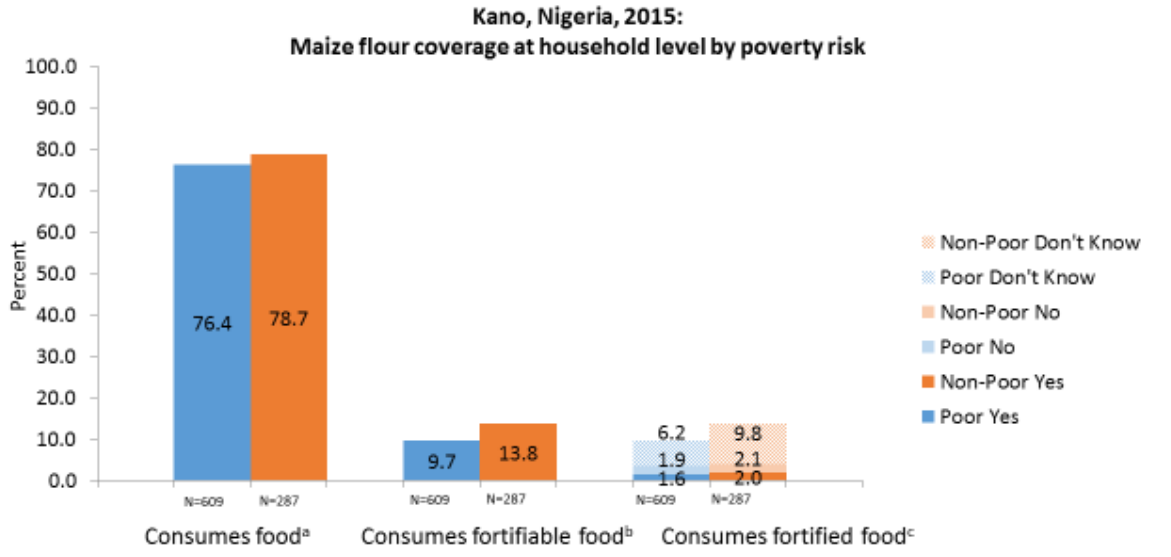

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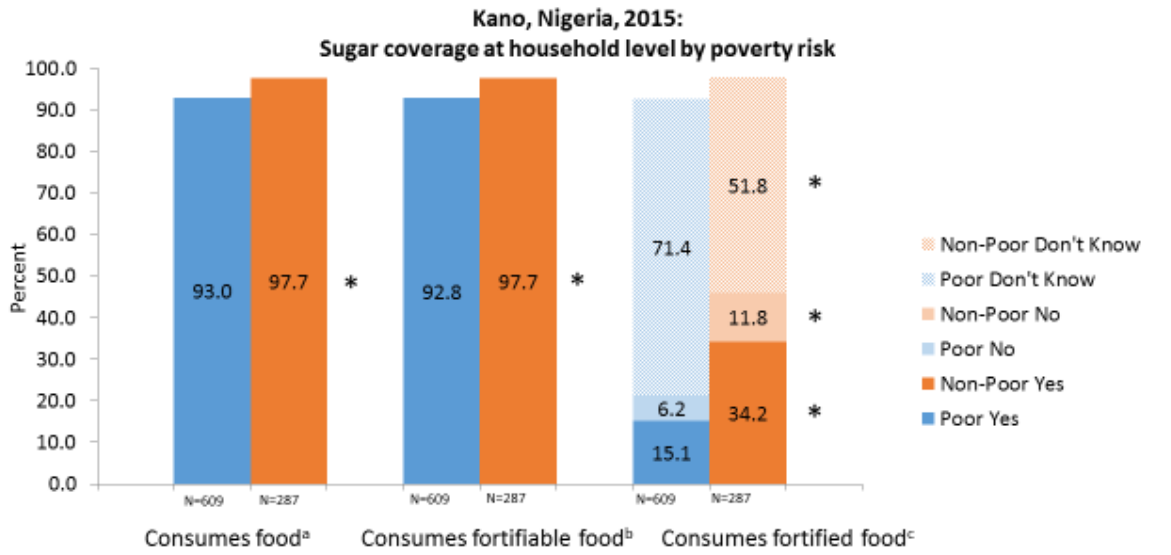

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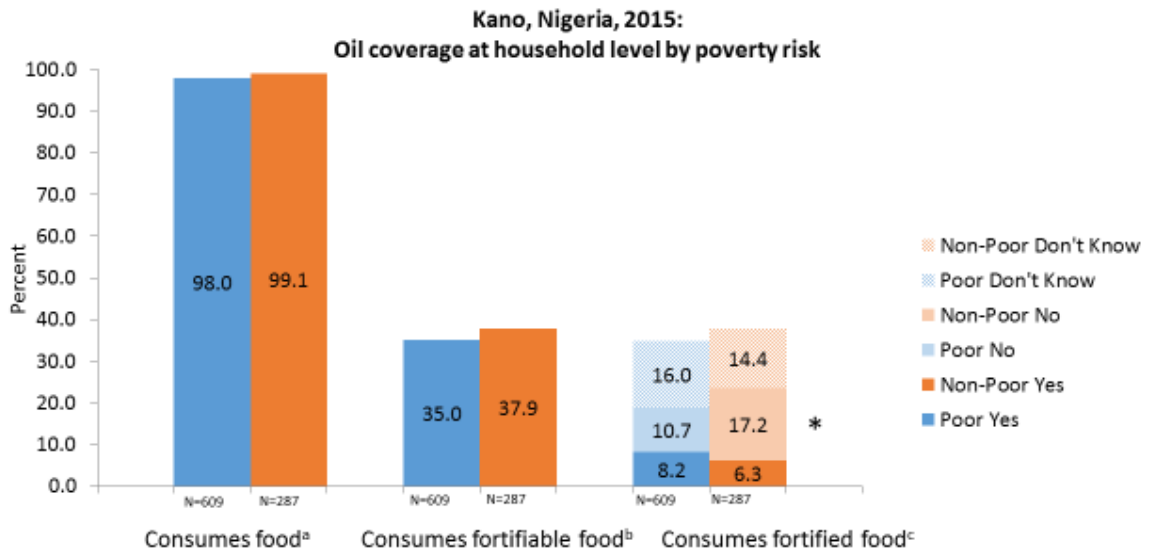

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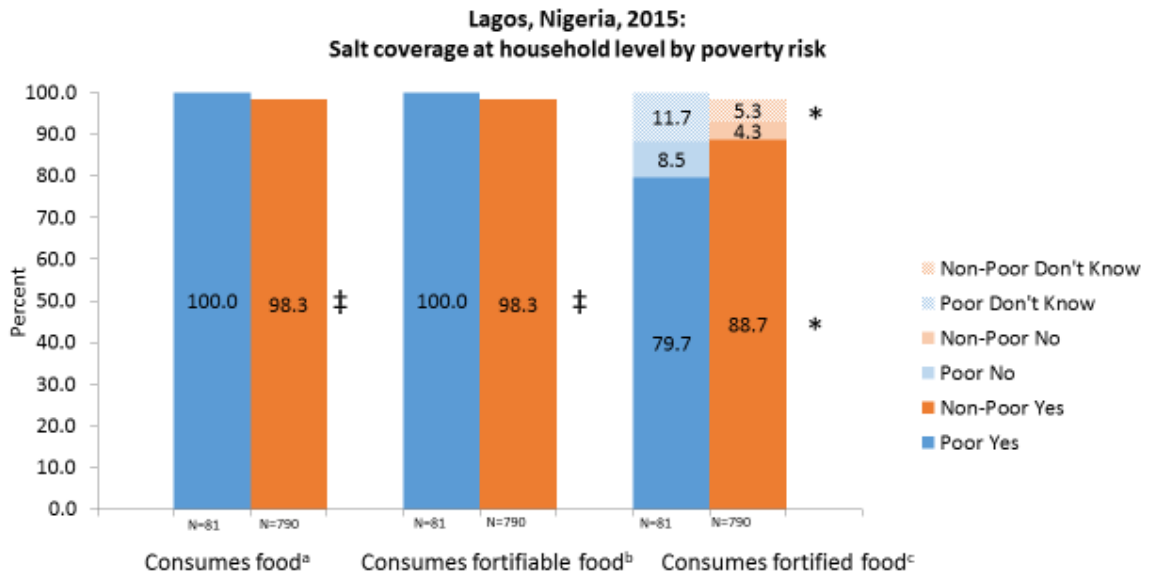
G.



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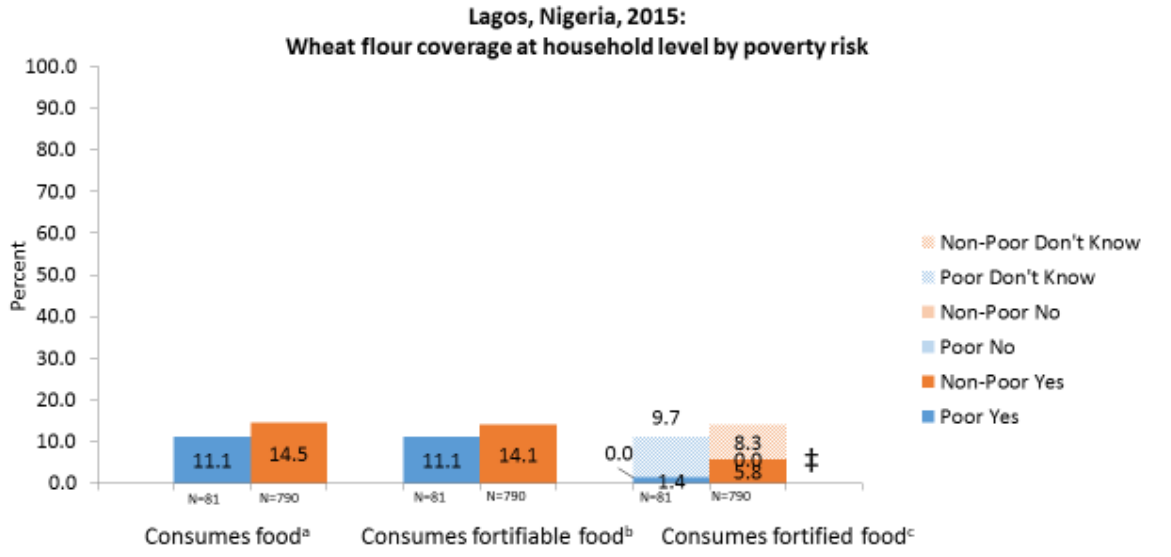
H.



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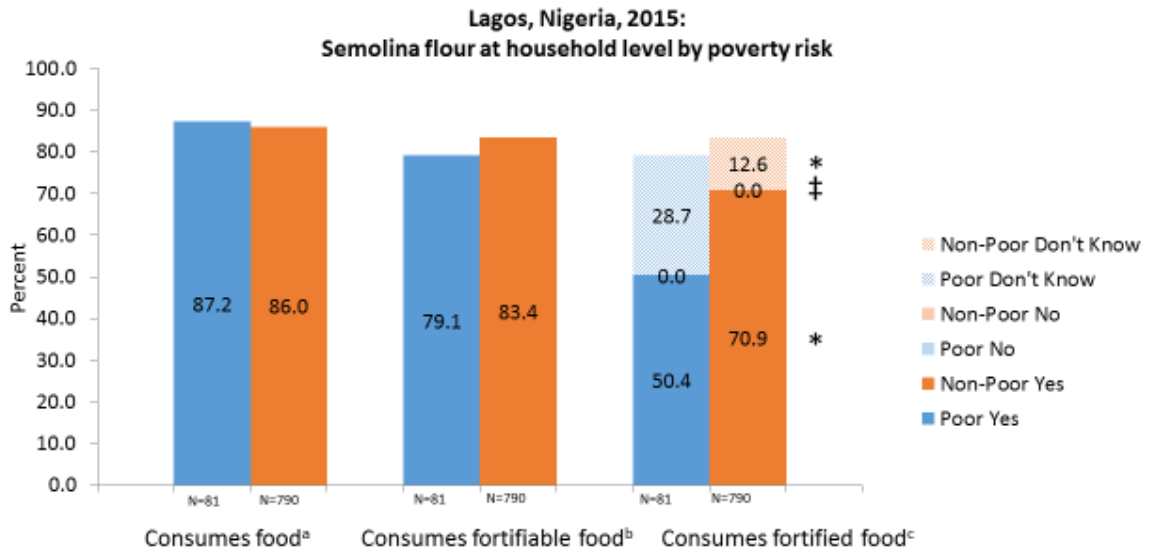
I.



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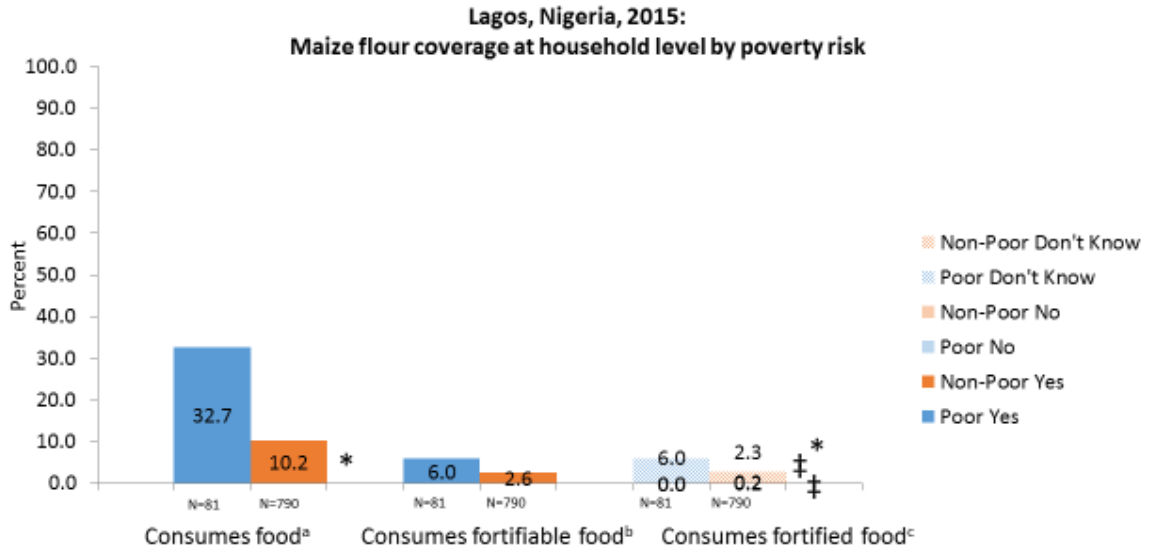
J.



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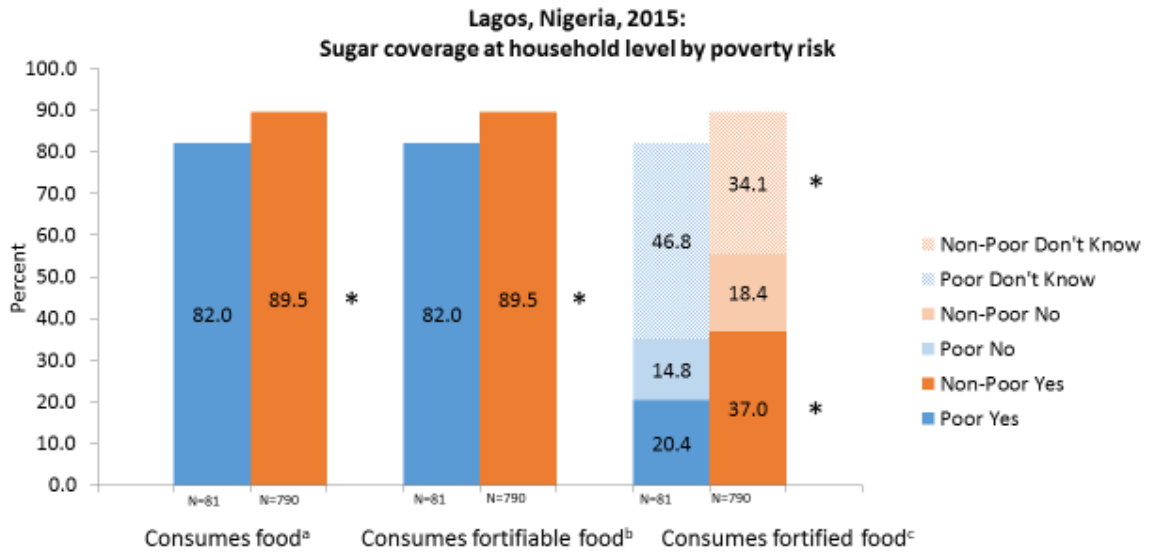
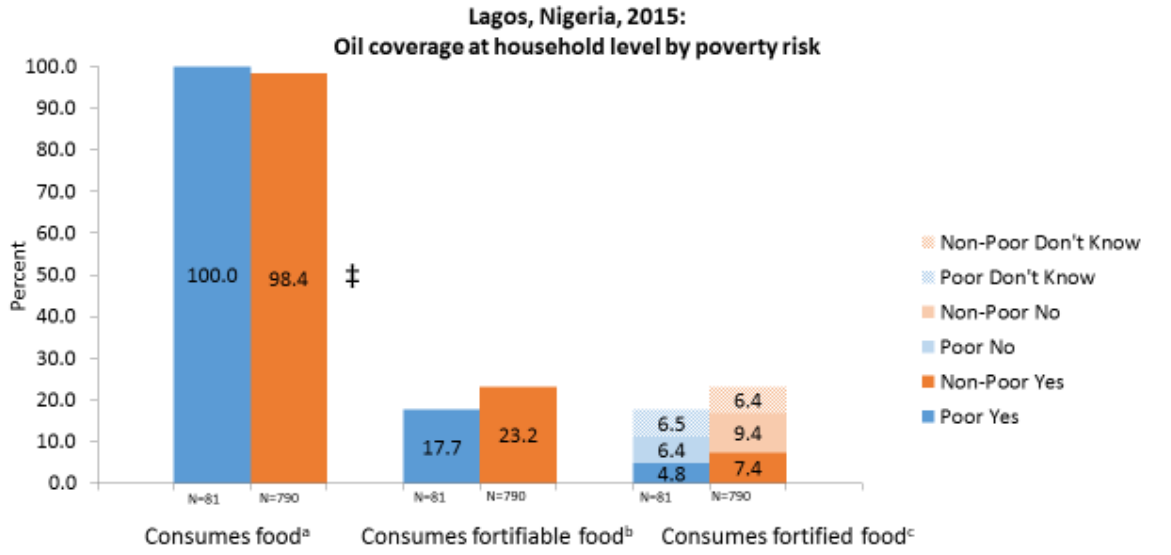
K.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

L.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

[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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 3710 IU/kg vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). "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 within each State 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".

[3] An asterisk (*) between the poor and non-poor bars indicates that these values are statistically significantly different from each other (p < 0.05). Complex survey chi-square test was used to compare percentages. As figure is missing one of the response categories, see Annex H, Table 2 for the complete statistical analyses.

[4] The symbol ‡ indicates that it was not possible to calculate a p-value because one of the groups had a missing value.

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 H, Table 3**). For several foods, there was no statistically significant difference by dietary diversity in terms of the proportion of households consuming these foods, fortifiable foods, and fortified foods, or the proportions could not be statistically tested as shown in **Annex H, Table 3**. This was the case for salt in Kano (**Figure 3A**) and Lagos (**Figure 3G**), semolina flour in Lagos (**Figure 3I**), maize flour in Kano (**Figure 3D**) and Lagos (**Figure 3J**), sugar in Kano (**Figure 3E**), and oil in Kano (**Figure 3F**) and Lagos (**Figure 3L**).

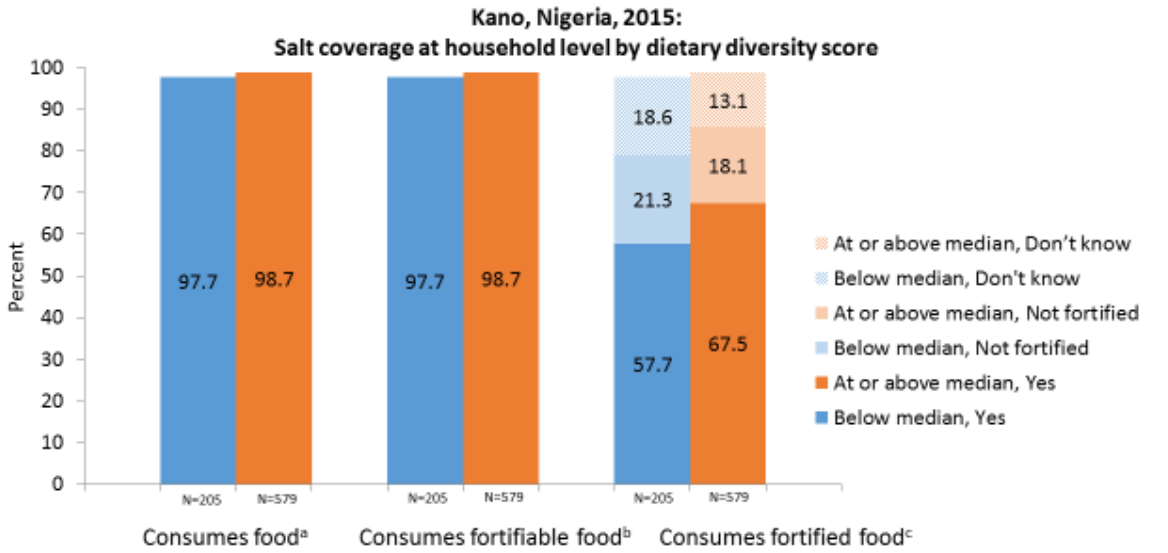
In Kano state, there was no difference in the proportion of households consuming wheat flour or fortifiable wheat flour by dietary diversity score (**Figure 3B** and **Annex H, Table 3: wheat flour**). The proportion of Kano households consuming fortified wheat flour was statistically higher in households with a higher dietary diversity score (27.3%) compared to households with a lower score (14.8%).

The results for semolina flour in Kano (**Figure 3C** and **Annex H, Table 3: semolina**) indicate that the proportion of households consuming semolina flour and fortifiable semolina flour was higher among households with a higher dietary diversity score compared to a lower diversity score. The proportion of households consuming fortified semolina flour did not differ statistically based on dietary diversity scores. For wheat flour in Lagos, 12.9% of households with a woman having a lower dietary diversity score consumed wheat flour compared with 19.2% of households with a woman displaying a higher dietary diversity score; this difference was statistically significant (**Figure 3H** and **Annex H, Table 3: wheat flour**). Similarly, there was a statistically significant difference in the proportion of Lagos households consuming fortifiable wheat flour: 12.4% in households with a woman having a lower dietary diversity score and 18.7% in households with a woman having a higher dietary diversity score. However, the proportion of Lagos households consuming fortified wheat flour did not differ by dietary diversity score: 5.6% in households with lower dietary diversity score and 6.8% in households with higher dietary diversity score..

For Lagos, the proportion of households consuming sugar and fortifiable sugar did not differ based on dietary diversity score (**Figure 3K**). There was no statistically significant differences in the proportion of households consuming fortified sugar based on dietary diversity score (p=0.919).

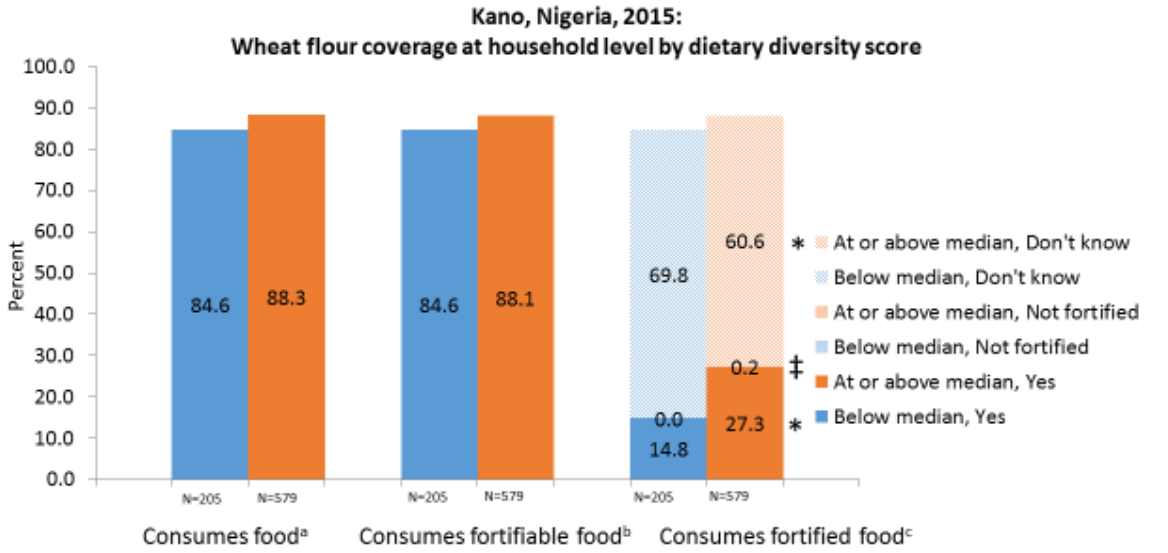
Figure 3. Household coverage of foods by women's dietary diversity score.[1,2,3,4]

A.



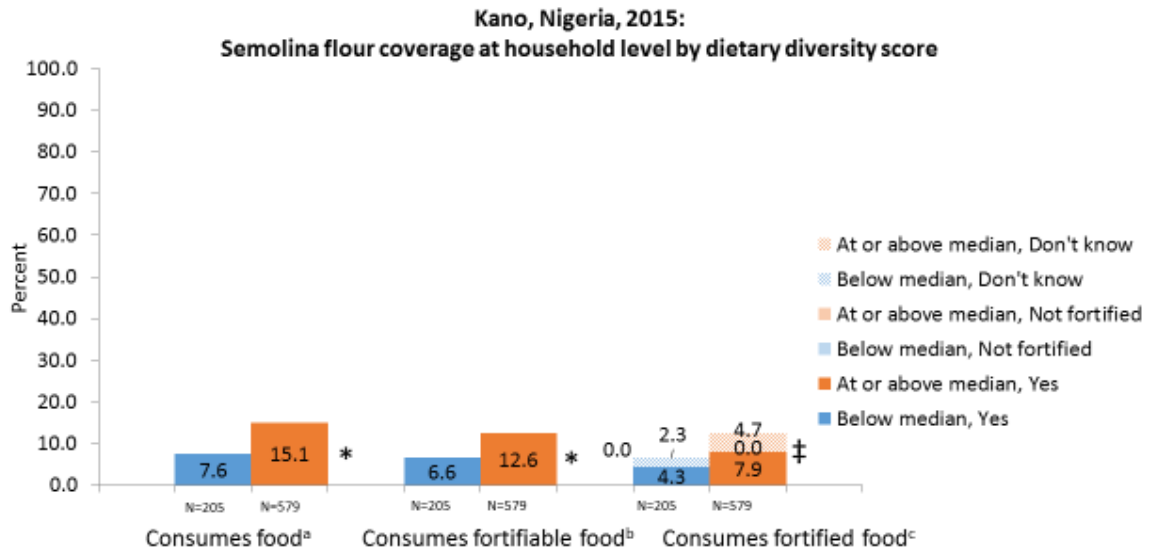
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

B.



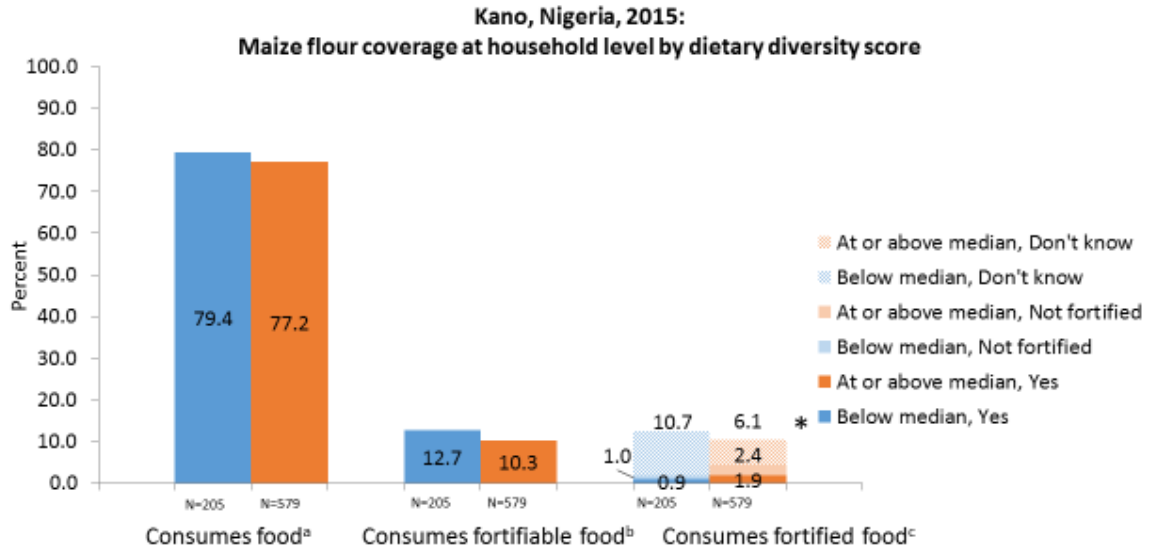
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

C.



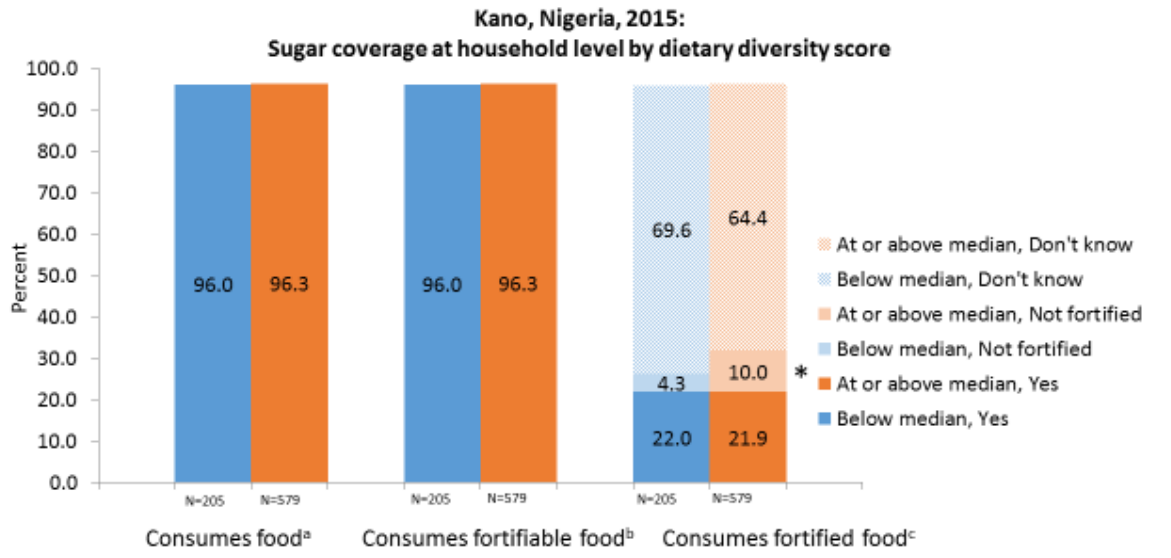
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

D.



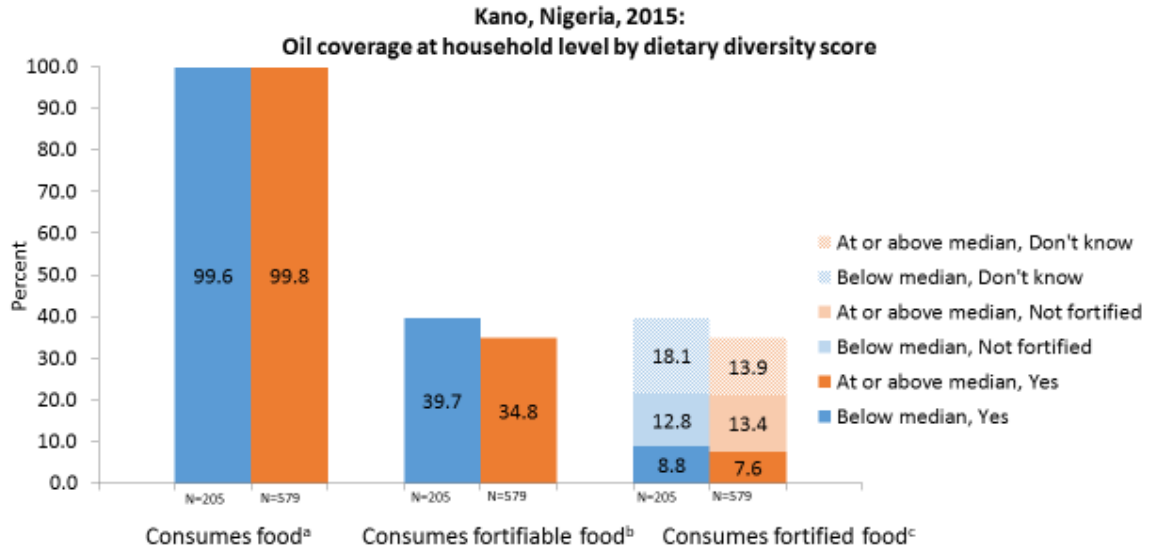
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

E.



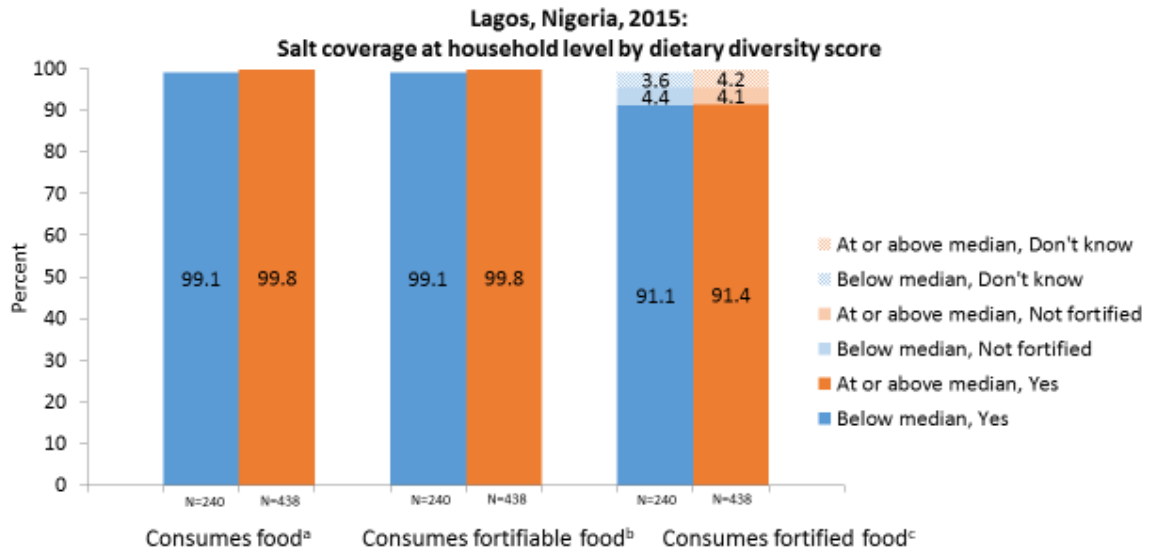
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

F.



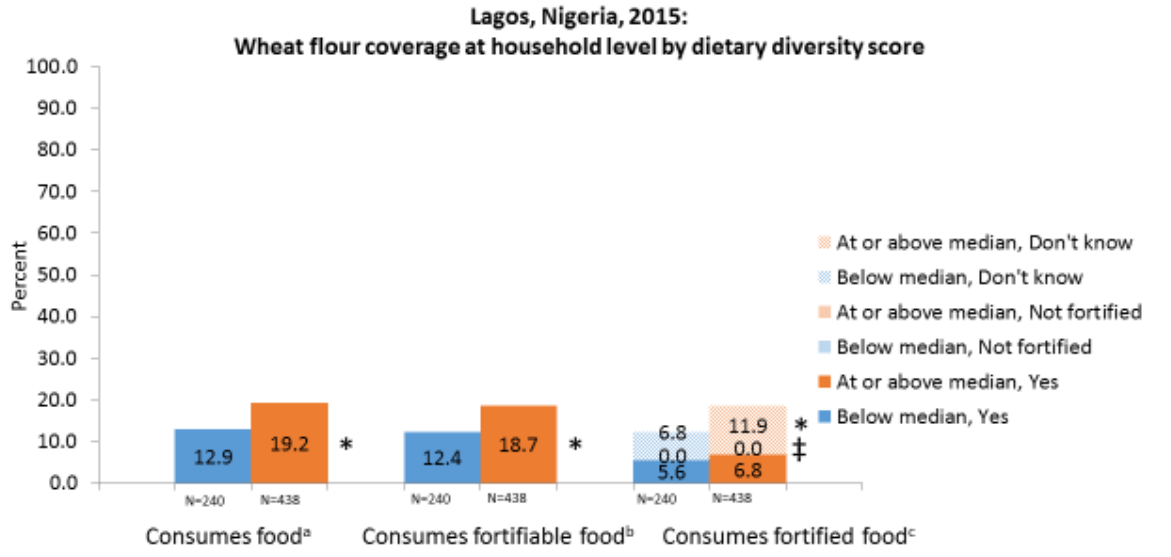
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

G.



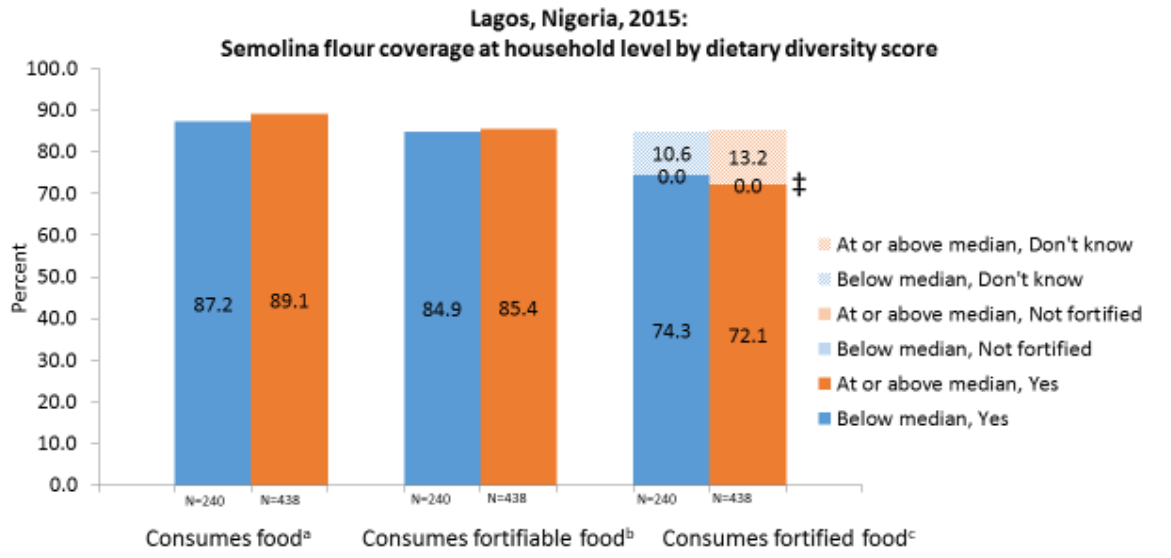
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

H.



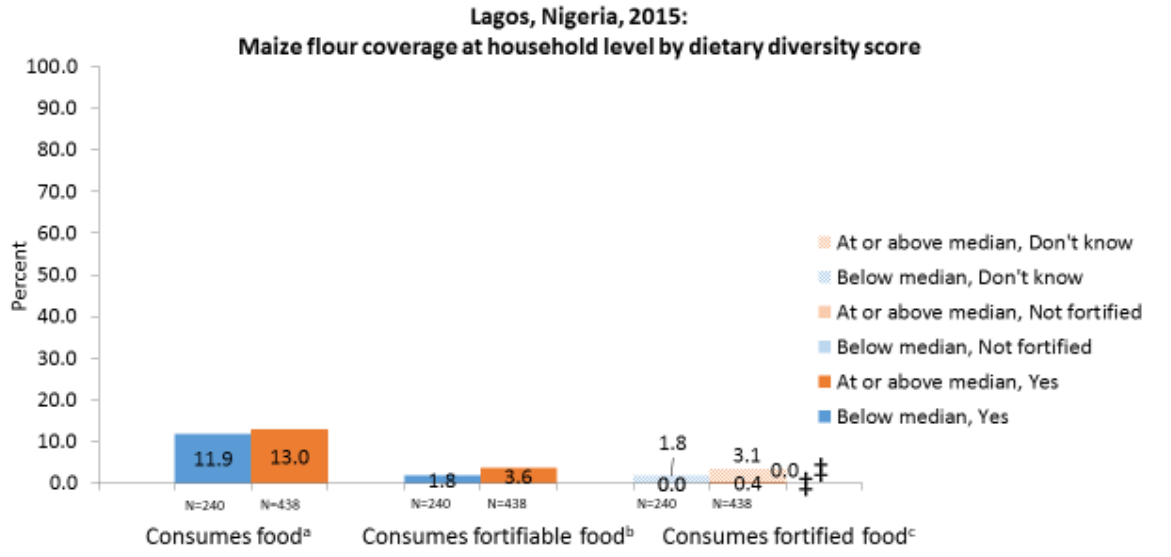
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

I.



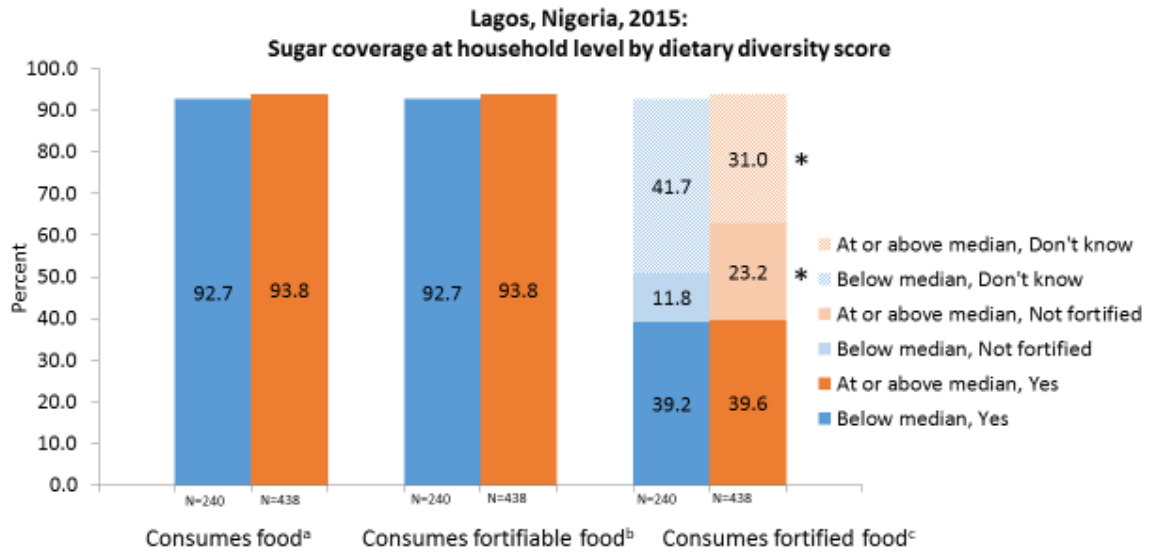
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

J.



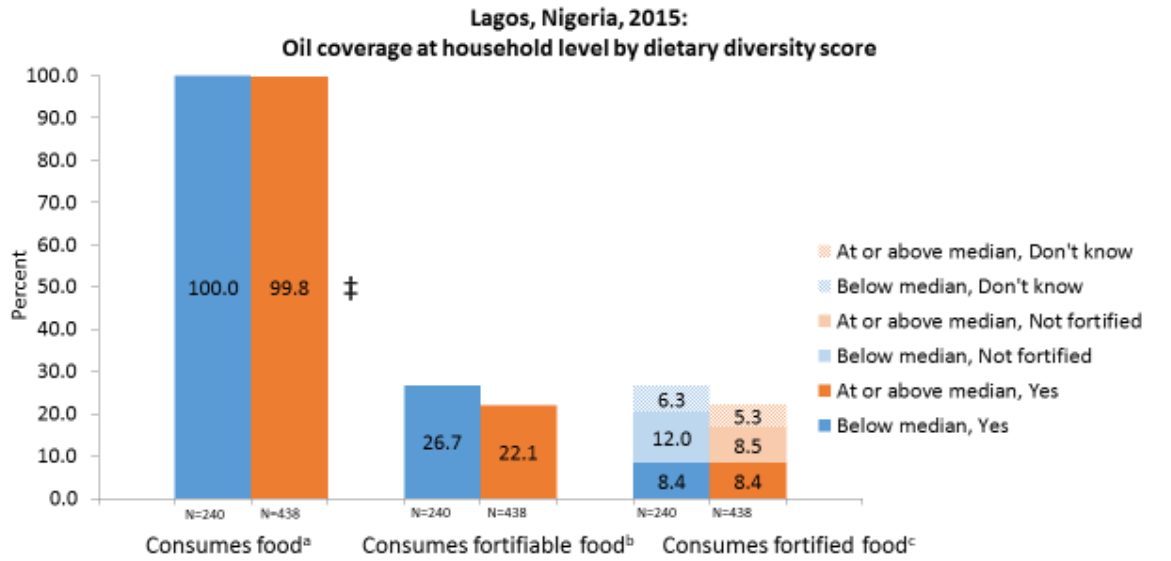
[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

K.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

L.



[a]Households prepare the food at home; [b]Food was not made at home and is assumed to be industrially processed; [c]"Yes" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses to contain the nutrient above the intrinsic level; "Not fortified" refers to households that provided a sample or, if not available, reported consuming a brand that was confirmed by laboratory analyses not to contain the nutrient above the intrinsic level; "Don't know" refers to households that could not be classified because no sample or reported brand was available. Households that did not consume a fortifiable food are not shown. * $p < 0.05$; ‡ p-value could not be estimated.

[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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 3710 IU/kg vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). "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 within each State 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 State. At or above median refers to a dietary diversity score greater than or equal to the population median in each State. 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.

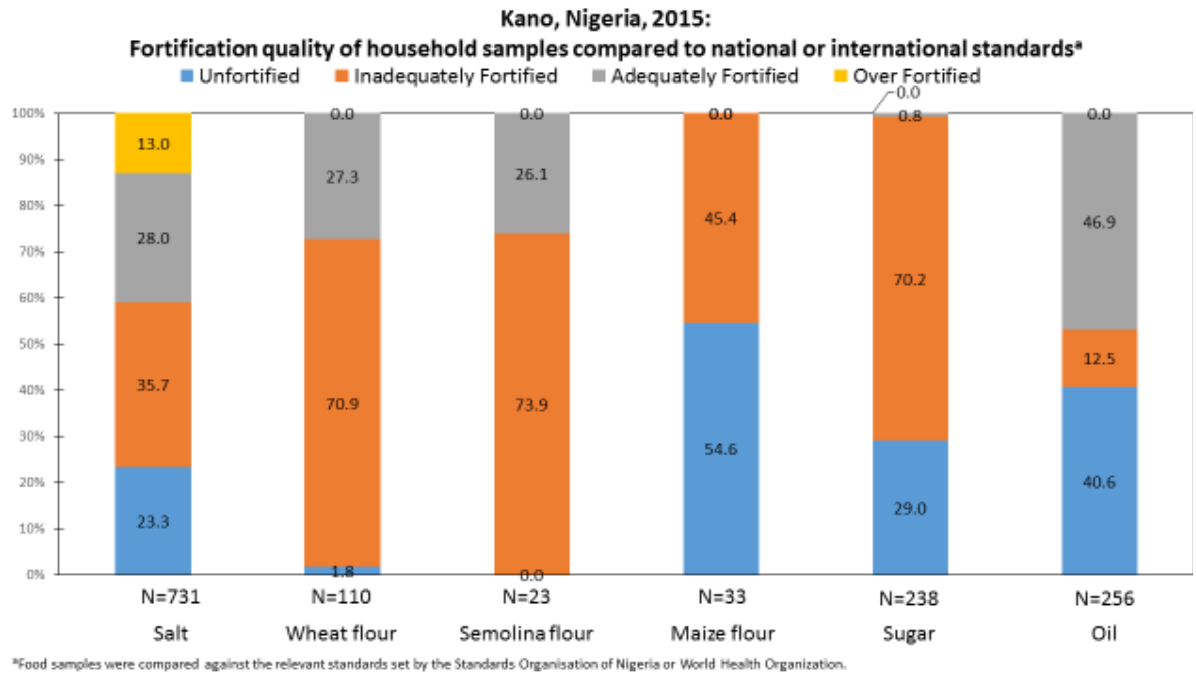
[3] An asterisk (*) between the "at or above median" and "below median" bars indicates that these values are statistically significantly different from each other ($p < 0.05$). Complex survey chi-square test was used to compare percentages. As figure is missing one of the response categories, see Annex H, Table 3 for the complete statistical analyses.

[4] The symbol ‡ indicates that it was not possible to calculate a p-value because one of the groups had a 0 proportion value.

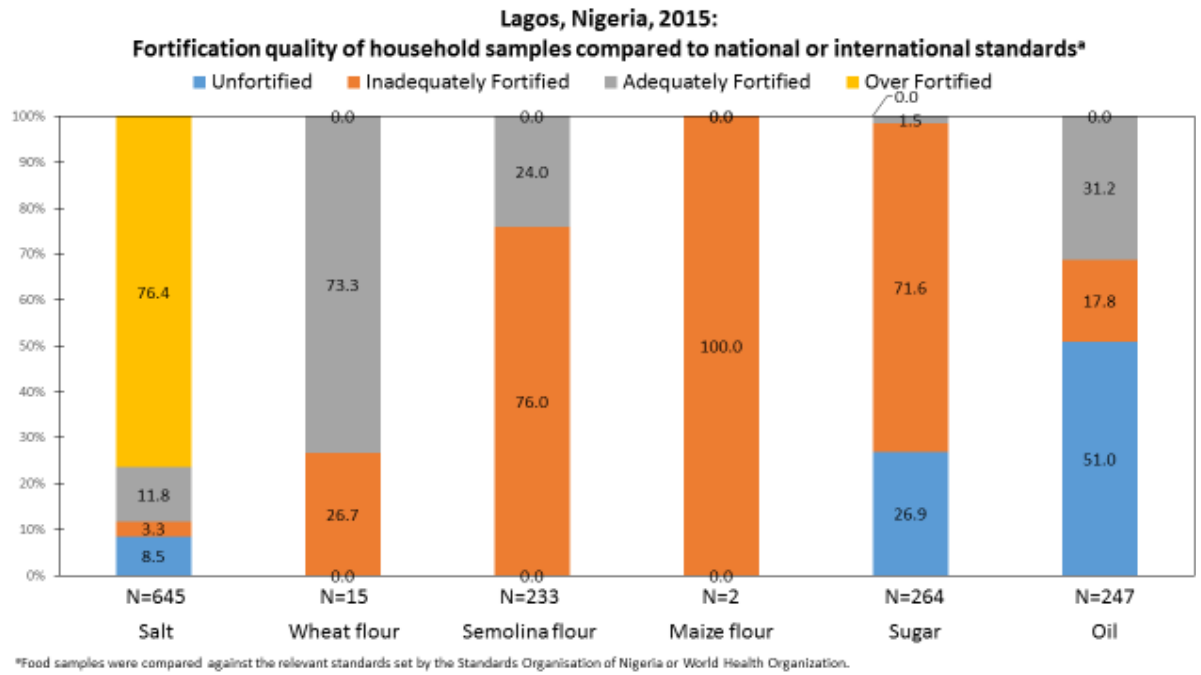
The fortification quality compared to national or international standards varied greatly depending on the food (**Figure 4** and **Annex H**). We caution interpretation of these results due to the low sample sizes and non-representativeness. As these pertained to a subset of the households that provided food samples, it is meant to be for descriptive purposes only. In Kano, the proportion of adequately fortified samples was 46.9% for oil, 28.0% for salt, 27.3% for wheat flour, 26.1% for semolina flour, 0.8% for sugar and 0% for maize flour (**Figure 4A** and **Annex H, Table 4**). In Lagos, the proportion of adequately fortified samples was 73.3% for wheat flour, 31.2% for oil, 24.0% for semolina flour, 11.8% for salt, 1.5% for sugar and 0% for maize flour (**Figure 4B**).

Figure 4. Fortification quality of household food samples compared to Nigeria national standards for wheat flour, semolina flour, maize flour, sugar, and oil, and international standards for salt.[1,2,3,4,5,6,7,8]

A.



B.



[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 salt was determined by analyzing the iodine levels in samples taken from households. "Unfortified" had ≤ 10 mg/kg iodine, "inadequately fortified" had > 10-< 15 mg/kg iodine, "adequately fortified" had ≥ 15-< 40 mg/kg iodine, and "over fortified" had ≥ 40 mg/kg iodine.

[3] Fortification quality for wheat flour was determined by analyzing the iron levels in samples taken from households. "Unfortified" had ≤ 17 mg/kg iron, "inadequately fortified" had > 17-< 40.7 mg/kg iron, "adequately fortified" had ≥ 40.7 mg/kg iron. There was no "over fortified" category as there are no maximums in country standards.

[4] Fortification quality for semolina flour was determined by analyzing the iron levels in samples taken from households. "Unfortified" had ≤ 4 mg/kg iron, "inadequately fortified" had > 4-< 40.7 mg/kg iron, "adequately fortified" had ≥ 40.7 mg/kg iron. There was no "over fortified" category as there are no maximums in country standards.

[5] Fortification quality for maize flour was determined by analyzing the vitamin A levels in samples taken from households. "Unfortified" had ≤ 3710 IU/kg vitamin A, "inadequately fortified" had > 3710-< 30,000 IU/kg vitamin A, "adequately fortified" had ≥ 30,000 IU/kg added vitamin A. There was no "over fortified" category as there are no maximums in country standards.

[6] Fortification quality for sugar was determined by analyzing the vitamin A levels in samples taken from households. "Unfortified" had ≤ 750 IU/kg vitamin A, "inadequately fortified" had > 750-< 25,000 IU/kg vitamin A, and "adequately fortified" had ≥ 25,000 IU/kg vitamin A. There was no "over fortified" category as there are no maximums in country standards.

[7] Fortification quality for oil was determined by analyzing the vitamin A levels in samples taken from households. "Unfortified" had ≤ 10,000 IU/kg vitamin A, "inadequately fortified" had > 10,000-< 20,000 IU/kg vitamin A, and "adequately fortified" had ≥ 20,000 IU/kg vitamin A. There was no "over fortified" category as there are no maximums in country standards.

8 There was no "over fortified" category in the country standards for all foods; there was an "over fortified" category in the international standards for salt only.

Nigeria has two fortification logos: one for vitamin A and one for iodine. Among household respondents in Kano, 13.3% reported ever seeing the vitamin A fortification logo, 4.8% reported positive attributes to this logo, and 18.3% reported that the logo influences their decision to buy a food (**Table 8**). In Lagos, 27.9% reported ever seeing the vitamin A fortification logo, 17.2% reported positive attributes to this logo, and 12.4% reported that the logo influences their decision to buy a food.

For the iodine logo, 32.6% of Kano interviewees reported ever seeing the iodine fortification logo, 6.5% reported positive attributes to this logo, and 22.7% reported that the logo influences their decision to buy a food. In Lagos, 35.3% reported ever seeing the iodine fortification logo,

16.4% reported positive attributes to this logo, and 13.6% reported that the logo influences their decision to buy a food.

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

Characteristic	KANO		LAGOS	
	N	% (95% CI)	N	% (95% CI)
Vitamin A fortification logo				
Reported ever seeing fortification logo	896	13.3 (11.1, 15.6)	871	27.9 (24.9, 30.9)
Reported positive attributes[2] to logo[3]	129	4.8 (3.4, 6.2)	261	17.2 (14.7, 19.8)
Reported that logo influences decision to buy[3]	129	18.3 (15.7, 20.8)	261	12.4 (10.2, 14.6)
Iodine fortification logo				
Reported ever seeing fortification logo	896	32.6 (29.5, 35.7)	871	35.3 (32.1, 38.5)
Reported positive attributes[2] to logo[3]	320	6.5 (4.8, 8.1)	335	16.4 (14, 18.9)
Reported that logo influences decision to buy[3]	320	22.7 (20, 25.5)	335	13.6 (11.3, 15.9)

Abbreviation: CI, confidence interval

[1] All values are percent as indicated, and are weighted to correct for unequal probability of selection. Since the estimates are weighted, the percentage will not equate to arithmetic proportions of N.

[2] Reported that the logo means "fortified / enriched / added micronutrients", "good for health" or "better quality".

[3]This question was only asked if the person responded affirmatively to ever seeing a fortification logo.

Based on individual dietary assessment, the wheat flour, semolina flour and maize flour intake was estimated for women of reproductive age (**Table 9**). In Kano, women consumed 36.5 grams per day of wheat flour which contributed 2.4% of their daily iron recommended nutrient intake (RNI). They also consumed 70.4 grams per day of semolina flour and 75.4 grams per day of maize flour; these contributed 10.0% to women's daily iron RNI and 0.01% to women's daily vitamin A RNI, respectively. In Lagos, women consumed 78.3, 58.9 and 45.4 grams per day of wheat flour, semolina flour, and maize flour, respectively. Wheat flour and semolina flour contributed an estimated 12.6% and 6.6%, respectively, to women's daily iron RNI in Lagos. Maize flour contributed 0.01% to Lagos' women's daily vitamin A RNI.

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

Food	KANO		LAGOS	
	N	Median (25%, 75%)	N	Median (25%, 75%)
Wheat flour consumed[2] (grams/day)	845	36.5 (13.7, 93.8)	735	78.3 (35.7, 159.3)
Added iron from wheat flour (% RNI[3])	845	2.4 (0.8, 5.3)	735	12.6 (5.9, 27.1)
Semolina flour consumed[2] (grams/day)	845	70.4 (30.7, 142.4)	735	58.9 (30.0, 119.1)
Added iron from semolina flour (% RNI[3])	845	10.0 (3.4, 19.9)	735	6.6 (3.3, 13.1)
Maize flour consumed[2] (grams/day)	845	75.4 (34.7, 153.2)	735	45.4 (25.0, 89.9)
Added vitamin A from maize flour (% RNI[3])	845	0.01 (0.01, 0.02)	735	0.01 (0.0, 0.01)

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, semolina flour, and maize 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 samples analyzed in a State 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 recommended nutrient intake (RNI) for the women based on World Health Organization guidelines.

[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). The vitamin A RNI for women, per the World Health Organization, is as follows: 600 micrograms retinol equivalents (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The percent of RNI met was calculated as follows: amount of nutrient consumed from flour / nutrient RNI x 100%.

The contribution of wheat flour, semolina flour and maize flour to women's nutrient RNIs was stratified by households' poverty risk (**Table 10**). In Kano and Lagos, there was a statistically significant difference in the contribution of wheat flour to iron RNI based on households' poverty status. However, for both States, there was no difference based on poverty status on the contribution of semolina flour and maize flour to women's iron and vitamin A RNI, respectively,

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%))[2,3]	Non-poor (Median (25%, 75%))[2,3]	p-value[3]
KANO	**n=567**	**n=278**	
Wheat flour consumed[4] (grams/day)	31.6 (9.0, 71.4)	54.1 (25.6, 122.7)	< 0.0001
Added iron from wheat flour (% RNI[5])	1.6 (0.6, 4.6)	3.3 (1.6, 8.1)	< 0.001
Semolina flour consumed[4] (grams/day)	70.1 (30.3, 141.9)	70.9 (33.7, 144.3)	0.7201
Added iron from semolina flour (% RNI[5])	9.8 (3.4, 19.9)	9.7 (3.3, 19.9)	0.6991
Maize flour consumed[4] (grams/day)	76.6 (34.6, 176.7)	73.4 (33.8, 128.7)	0.2600
Added vitamin A from maize flour (% RNI[5])	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	--[6]
LAGOS	**n=48**	**n=687**	
Wheat flour consumed[4] (grams/day)	51.8 (30.6, 110.2)	79.1 (36.2, 164.3)	0.0517
Added iron from wheat flour (% RNI[5])	7.7 (4.5, 18.6)	13.0 (6.2, 27.6)	0.0257
Semolina flour consumed[4] (grams/day)	39.4 (19.3, 102.9)	59.2 (34.0, 119.3)	0.1255
Added iron from semolina flour (% RNI[5])	3.7 (1.9, 10.7)	6.8 (3.5, 13.1)	0.0787
Maize flour consumed[4] (grams/day)	34.3 (23.1, 60.5)	52.4 (25.8, 91.3)	0.4763
Added vitamin A from maize flour (% RNI[5])	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	--[6]

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.

[4] Women were asked to report the frequency in the past 7 days with which they consumed foods containing wheat flour, semolina flour, and maize 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 flour samples analyzed in a State 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 recommended 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 vitamin A RNI for women, per the World Health Organization, is as follows: 600 micrograms retinol equivalents (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The percent of RNI met was calculated as follows: amount of nutrient consumed from flour / nutrient RNI x 100%.

[6] P-values for median differences in % RNI values for added vitamin A in maize flour are not informative due to the high number of ties and not shown.

The contribution of wheat flour, semolina flour and maize flour to women's nutrient RNIs was stratified by individual women's dietary diversity scores (**Table 11**). In Kano and Lagos 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). This was not the case for semolina flour or maize flour in both States.

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 (Median (25%, 75%))[2,3]	Higher dietary diversity (Median (25%, 75%))[2,3]	p-value[3]
KANO	**n=215**	**n=630**	
Wheat flour consumed[4] (grams/day)	24.9 (9.4, 56.6)	41.5 (16.8, 103.0)	0.0082
Added iron from wheat flour (% RNI[5])	1.6 (0.7, 3.7)	2.5 (0.8, 6.3)	0.0144
Semolina flour consumed[4] (grams/day)	67.3 (22.5, 137.6)	70.5 (34.5, 142.8)	0.2095
Added iron from semolina flour (% RNI[5])	9.6 (2.4, 19.4)	10.0 (3.4, 19.9)	0.2934
Maize flour consumed[4] (grams/day)	74.6 (33.6, 181.1)	75.5 (35.1, 143.8)	0.6737
Added vitamin A from maize flour (% RNI[5])	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	--[6]
LAGOS	**N=258**	**N=477**	
Wheat flour consumed[4] (grams/day)	62.8 (28.9, 116.6)	85.7 (42.1, 176.0)	< 0.0001
Added iron from wheat flour (% RNI[5])	11.4 (4.4, 19.7)	13.6 (6.8, 31.8)	< 0.0001
Semolina flour consumed[4] (grams/day)	56.8 (30.0, 114.4)	59.4 (29.9, 119.4)	0.3503
Added iron from semolina flour (% RNI[5])	5.6 (3.4, 12.2)	7.1 (3.3, 13.7)	0.2806
Maize flour consumed[4] (grams/day)	32.7 (22.5, 75.9)	55.6 (25.7, 94.9)	0.5483
Added vitamin A from maize flour (% RNI[5])	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	--[6]

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 State. Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each State.

[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, semolina flour, and maize 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 State 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 recommended 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 vitamin A RNI for women, per the World Health Organization, is as follows: 600 micrograms retinol equivalents (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The percent of RNI met was calculated as follows: amount of nutrient consumed from flour / nutrient RNI x 100%.

[6] P-values for median differences in % RNI values for added vitamin A in maize flour are not informative due to the high number of ties and not shown.

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**). In Kano, women of reproductive age apparently consumed 8.7 grams of fortifiable salt daily which contributed 66.6% of their iodine RNI. For the other foods assessed in Kano, all contributed 16% or less to women's iron and 0% for vitamin A RNI. In Lagos, the trend was the same: the apparent consumption of salt contributed most to women's RNI (151.7% of iodine RNI) and the remaining foods contributed less than 11% to their RNIs for iron and vitamin A.

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	KANO		LAGOS	
	N	Median (25%, 75%)	N=	Median (25%, 75%)
Fortifiable[2] salt apparently consumed[3] (grams/day)	771	8.7 (4.8, 15.6)	643	3.7 (2.1, 5.7)
Iodine from fortifiable[2] salt (% RNI[4])	771	66.6 (22.3, 140.1)	643	151.7 (80.3, 270.5)
Fortifiable[2] wheat flour apparently consumed[3] (grams/day)	681	215.1 (144.8, 315.2)	103	72.1 (20.5, 161.0)
Iron from fortifiable[2] wheat flour (% RNI[4])	681	13.9 (8.2, 22.7)	103	10.4 (3.2, 27.1)
Fortifiable[2] semolina flour apparently consumed[3] (grams/day)	90	95.9 (44.2, 171.9)	559	74.1 (38.3, 148.9)
Iron from fortifiable[2] semolina flour (% RNI[4])	90	15.8 (5.9, 34.4)	559	8.3 (4.0, 17.1)
Fortifiable[2] maize flour apparently consumed[3] (grams/day)	86	185.4 (135.5, 297.2)	18	63.0 (30.3, 80.5)
Vitamin A from fortifiable[2] maize flour (% RNI[4])	86	0.0 (0.0, 0.0)	18	3.6 (1.4, 5.6)
Fortifiable[2] sugar apparently consumed[3] (grams/day)	752	12.9 (8.2, 22.7)	608	7.0 (3.2, 13.9)
Vitamin A from fortifiable[2] sugar (% RNI[4])	752	2.2 (1.3, 4.5)	608	1.0 (0.3, 2.4)
Fortifiable[2] oil apparently consumed[3] (milliliters/day)	761	26.8 (17.4, 43.1)	655	25.5 (14.8, 38.6)
Vitamin A from fortifiable[2] oil (% RNI[4])	761	1.5 (0.8, 5.8)	655	1.4 (0.8, 2.6)

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 within each State 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 State 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 (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is 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. This information was known for the subset of women who answered the women's questionnaire. All non-surveyed women were assumed to be non-pregnant and non-lactating.

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**). For most foods and nutrients in both States, there was no statistically significant difference between poor and non-poor households.

There were a few exceptions for Kano and Lagos. In Kano, among households consuming salt, a women's apparent consumption of fortifiable salt was higher in poor households (9.2 grams/day) than in non-poor households (7.7 grams/day). The same was true for fortifiable wheat flour in Kano: apparent consumption was higher in poor (221.2 grams/day) than non-poor households (188.0 grams/day). This difference extended to the contribution of fortifiable wheat flour to women's iron RNI: it was statistically higher in women from poor (15.1% RNI) than non-poor households (12.0% RNI). The apparent consumption of fortifiable oil was statistically higher in women from non-poor (31.1 milliliters/day) than poor households (25.2 milliliters/day).

In Lagos, the apparent consumption of fortifiable salt was statistically higher in women from non-poor (3.7 grams/day) than poor households consuming salt. (2.8 grams/day). Correspondingly, the iodine contribution from fortifiable salt was higher in women from non-poor (156.5% RNI) than poor households (92.4% RNI). The apparent consumption of fortifiable sugar trended in the opposite direction than salt: it was higher among women from poor households (9.0 grams/day) than non-poor households (6.9 grams/day).

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]
KANO	**n=**	**Median (25%, 75%)[2]**	**n=**	**Median (25%, 75%)[2]**	
Fortifiable[4] salt apparently consumed[5] (grams/day)	515	9.2 (5.1, 16.1)	256	7.7 (4.3, 14.0)	0.0147
Iodine from fortifiable[4] salt (% RNI[6])	515	66.8 (25.2, 138.1)	256	61.8 (18.2, 150.1)	0.2628
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	441	221.2 (160.5, 326.5)	240	188.0 (123.8, 275.2)	0.0010
Iron from fortifiable[4] wheat flour (% RNI[6])	441	15.1 (8.8, 23.7)	240	12.0 (6.6, 19.0)	0.0009
Fortifiable[4] semolina flour apparently consumed[5] (grams/day)	18	70.1 (58.3, 185.1)	72	96.1 (43.1, 168.7)	0.6837
Iron from fortifiable[4] semolina flour (% RNI[6])	18	17.2 (7.3, 44.4)	72	13.7 (5.2, 32.7)	0.1265
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	47	184.2 (134.3, 297.2)	39	185.5 (136.5, 279.3)	0.6837
Vitamin A from fortifiable[4] maize flour (% RNI[6])	47	0.0 (0.0, 0.0)	39	0.0 (0.0, 0.0)	-[7]
Fortifiable[4] sugar apparently consumed[5] (grams/day)	493	12.9 (8.2, 21.8)	259	13.5 (7.9, 24.5)	0.6292
Vitamin A from fortifiable[4] sugar (% RNI[6])	493	2.3 (1.3, 4.5)	259	2.2 (1.1, 4.6)	0.9987
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	508	25.2 (16.5, 40.1)	253	31.1 (19.2, 48.2)	< 0.0001
Vitamin A from fortifiable[4] oil (% RNI[6])	508	1.4 (0.7, 6.2)	253	1.5 (0.8, 4.5)	0.0557
LAGOS					
Fortifiable[4] salt apparently consumed[5] (grams/day)	44	2.8 (1.6, 5.3)	599	3.7 (2.2, 5.7)	0.0391
Iodine from fortifiable[4] salt (% RNI[6])	44	92.4 (37.9, 210.4)	599	156.5 (82.4, 270.7)	0.0032
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	8	105.5 (42.9, 165.4)	95	67.4 (20.1, 146.5)	0.5885

Food	Poor		Non-poor		p-value[3]
Iron from fortifiable[4] wheat flour (% RNI[6])	8	13.5 (5.7, 24.1)	95	9.8 (3.1, 27.3)	0.8699
Fortifiable[4] semolina flour apparently consumed[5] (grams/day)	31	65.1 (49.4, 139.6)	528	74.1 (37.9, 149.3)	0.6166
Iron from fortifiable[4] semolina flour (% RNI[6])	31	6.4 (4.8, 13.1)	528	8.4 (3.8, 17.2)	0.9260
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	3	33.6 (33.3, 47.6)	15	67.8 (19.3, 88.8)	0.3417
Vitamin A from fortifiable[4] maize flour (% RNI[6])	3	2.2 (1.4, 3.4)	15	3.8 (1.3, 5.6)	0.4015
Fortifiable[4] sugar apparently consumed[5] (grams/day)	40	9.0 (4.7, 14.8)	568	6.9 (3.1,13.7)	0.0340
Vitamin A from fortifiable[4] sugar (% RNI[6])	40	1.4 (0.6, 2.5)	568	1.0 (0.3, 2.4)	0.0668
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	42	22.8 (10.0, 30.6)	613	25.5 (15.0, 38.8)	0.0660
Vitamin A from fortifiable[4] oil (% RNI[6])	42	1.2 (0.7, 1.9)	613	1.4 (0.8, 2.7)	0.4439

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 and nutrient apparent 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 do 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 within each State 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 State 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 (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is 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. 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.

The apparent food consumption and nutrient contributions for women of reproductive age from households that reported consuming the food was stratified by women's dietary diversity score (**Table 14**). For most foods and nutrients in both States, there was no statistically significant

difference between households with lower dietary diversity compared with higher dietary diversity. The exceptions for Kano and Lagos are noted below.

In Kano, the apparent consumption of fortifiable sugar by women in households consuming sugar was statistically higher in households with lower dietary diversity scores (14.5 grams/day) than higher scores (12.5 grams/day). This difference extended to the contribution of fortifiable sugar to women's vitamin A RNI: it was higher in women from households with lower dietary diversity scores (3.0% RNI) than in households with higher scores (2.1% RNI).

In Lagos, the apparent consumption of fortifiable semolina flour by women was statistically higher in household with lower dietary diversity scores (93.7 grams/day) than higher scores (62.6 grams/day). Additionally, the contribution of fortifiable semolina flour to women's vitamin A RNI was higher in women from households with lower dietary diversity scores (10.1% RNI) than in households with higher scores (7.5% RNI). With respect to the contribution of fortifiable sugar to women's vitamin A, it was higher in households with a lower dietary diversity score (1.4% RNI) than in households with a higher score (0.9% RNI).

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[3]**
KANO	**n=**	**Median (25%, 75%)**	**n=**	**Median (25%, 75%)**	
Fortifiable[4] salt apparently consumed[5] (grams/day)	200	8.8 (4.5, 16.5)	571	8.6 (4.8, 15.0)	0.9476
Iodine from fortifiable[4] salt (% RNI[6])	200	58.6 (17.6, 133.8)	571	70.1 (24.5, 141.1)	0.1744
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	173	218.8 (150.8, 342.4)	508	213.3 (143.4, 309.5)	0.2457
Iron from fortifiable[4] wheat flour (% RNI[6])	173	14.1 (8.6, 23.8)	508	13.7 (8.1, 22.0)	0.2521
Fortifiable[4] semolina flour apparently consumed[5] (grams/day)	14	68.9 (56.5, 202.2)	76	95.9 (43.2, 167.0)	0.5221
Iron from fortifiable[4] semolina flour (% RNI[6])	14	11.6 (6.0, 33.3)	76	15.4 (5.8, 34.3)	0.6927
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	28	181.8 (94.2, 344.6)	58	187.0 (156.4, 292.4)	0.4866
Vitamin A from fortifiable[4] maize flour (% RNI[6])	28	0.0 (0.0, 0.0)	58	0.0 (0.0, 0.0)	-[7]
Fortifiable[4] sugar apparently consumed[5] (grams/day)	196	14.5 (10.4, 23.8)	556	12.5 (7.7, 21.9)	0.0022

Food	Lower dietary diversity[2,3]		Higher dietary diversity[2,3]		p-value[3]
Vitamin A from fortifiable[4] sugar (% RNI[6])	196	3.0 (1.7, 5.3)	556	2.1 (1.1, 4.0)	0.0001
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	198	24.4 (17.5, 37.4)	563	28.0 (17.3, 44.)	0.1358
Vitamin A from fortifiable[4] oil (% RNI[6])	198	1.5 (0.8, 11169.3)	563	1.5 (0.8, 4.4)	0.4127
LAGOS					
Fortifiable[4] salt apparently consumed[5] (grams/day)	228	3.4 (2.0, 6.0)	415	3.8 (2.2, 5.7)	0.2407
Iodine from fortifiable[4] salt (% RNI[6])	228	152.0 (80.0, 288.7)	415	151.6 (80.9, 265.3)	0.9027
Fortifiable[4] wheat flour apparently consumed[5] (grams/day)	26	91.6 (17.8, 162.3)	77	65.0 (20.8, 153.2)	0.8169
Iron from fortifiable[4] wheat flour (% RNI[6])	26	14.5 (2.4, 27.1)	77	9.6 (3.3, 25.5)	0.7527
Fortifiable[4] semolina flour apparently consumed[5] (grams/day)	201	93.7 (44.8, 164.0)	358	62.6 (37.1, 138.1)	0.0037
Iron from fortifiable[4] semolina flour (% RNI[6])	201	10.1 (4.5, 19.1)	358	7.5 (3.8, 15.7)	0.0077
Fortifiable[4] maize flour apparently consumed[5] (grams/day)	4	67.7 (11.9, 72.3)	14	46.6 (29.8, 80.6)	0.7906
Vitamin A from fortifiable[4] maize flour (% RNI[6])	4	4.8 (0.9, 5.1)	14	2.9 (1.4, 5.6)	0.6327
Fortifiable[4] sugar apparently consumed[5] (grams/day)	213	7.9 (4.0, 13.5)	395	6.4 (3.0, 14.0)	0.0630
Vitamin A from fortifiable[4] sugar (% RNI[6])	213	1.4 (0.6, 2.6)	395	0.9 (0.3, 2.3)	0.0005[3]
Fortifiable[4] oil apparently consumed[5] (milliliters/day)	228	26.0 (14.7, 44.5)	427	25.1 (15.0, 36.5)	0.2674
Vitamin A from fortifiable[4] oil (% RNI[6])	228	1.4 (0.7, 3.1)	427	1.3 (0.8, 2.3)	0.5716

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 State. Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each State. 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 and nutrient apparent 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 do 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 within each State 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 State 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 (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The iodine RNI for women, per the World Health Organization, is 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. 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.

9. ANNEXES

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

NIGERIA FACT COVERAGE SURVEY 2015 HOUSEHOLD QUESTIONNAIRE 1					
dateint	Date of interview ***CAPI Programmer:*** Take time stamp to signal beginning and end of interview	DD / MM / YY ☐☐/☐☐/☐☐			
teamid	Team identifier	☐☐	intid	Interviewer identifier	☐☐
staid	State	01. Kano 02. Lagos			☐☐
lgaid	LGA	01. AA 02. BB 03. CC 04. DD 05. EE		06. FF 07. GG 08. HH 09. II 10. JJ	☐☐
ea	Enumeration Area ***CAPI Programmer***: Filter list of EA to selected LGA	01. AA 02. BB 03. CC 04. DD 05. EE		06. FF 07. GG 08. HH 09. II 10. JJ	☐☐
areaname	Area / village / town name	_____			
psu	Cluster identifier	☐☐			
structure id	Structure ID	_____			
hh	Household ID	☐☐			
gps	GPS coordinates ***CAPI Programmer****: Please collect GPS coordinates of the structure*	**DDD MM SS L** **Lon** |__|__|__|●|__|__|__|__|__|__|__| **Lat** |__|__|__|●|__|__|__|__|__|__|__|			

My name is _____ _____. I am working for Oxford Policy Management. We are conducting a research, with support from the State Ministry of Health. This enumeration/catchment area has been selected to participate in this study and your household has been selected by chance to participate in this study. This study is interested in learning about feeding patterns of the household 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 will be asking questions about the age, gender and size of the household, birth history, household characteristics, access to healthcare and more generally about their diets and eating practices. We would also like to collect a few small samples of foods.

If the person who is most knowledgeable about purchasing and preparing most of the food *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.*

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

cons	Oral 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 this household.*	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 dwelling.6 Dwelling destroyed.....7 Other: _____.....99	If 3 or 4, return later for a second visit. If 5, 6 or 7,go on to next selected household.

You are about to fill the household roster. Make sure the **head** (or **member**) of household is in a comfortable position to proceed with the interview.

Please make sure the respondent is at least 15 years old.

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

HOUSEHOLD DEFINITION: *A person or group of related or un-related persons that usually live together in the same dwelling unit and share common cooking or eating arrangements. Please record household members in the given order.*

	A. Name	B. Sex	C. Age *(in years OR months)* *Record in months if <5 years or <60 months*		D. Currently attending school or college? ***Instruction for interviewer***: *If child less than 60 months verify if currently attending formal school*	E. Completed primary school education? ***CAPI Programmer:*** Skip if *<5 years or <60 months*
			Years	Months		
1	Head of Household	M / F	☐☐		Yes.....1 No.....2	Yes.....1 No.....2
2		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
3		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
4		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
5		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
6		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
7		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2

8		M / F	☐☐	☐☐	Yes.....1 No.....2	Yes.....1 No.....2
9		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	*Just to make sure that I have a complete listing:* Are there any other persons such as small children or infants that we have not listed? *If YES, add name to table.*					
hh1b	Are there any other people who may not be members of your family, such as domestic servants, lodgers, or friends who usually live here and share common cooking or eating arrangements? *If YES, add name to table.*					
Note: Add a new page if more people in the household						
lnr	Please select the **key** respondent for household questionnaire?					☐☐

Check the roster regarding completion!

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 at birth/delivery ***INSTUCTION FOR INTERVIEWER:*** Include all the live births in this household in the last 5 years whether they are from the same mother are from different mothers *(WRITE IN THE NUMBER.)* *(IF 'NONE', RECORD 00. IF 'DON'T KNOW', RECORD 88.)*	☐☐	
bh2	Is this child / are these children still alive? *(SELECT ONLY **ONE** ANSWER.)*	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? *(SELECT ONLY **ONE** ANSWER.)*	Yes……1 No……2		
hc2	What fuel does your household mainly use for cooking? *(SELECT ONLY **ONE** ANSWER.)*	Electricity.....1 Gas .....2 Kerosene stove.....3 Coal / Lignite / Charcoal .....4 Firewood.....5 Straw / Shrubs / Grass.....6 Animal dung.....7 No food cooked in household.....8 Don't know.....88 Other: _____ 99		
hc3	Does your household or anyone in the household own a ... ? *(TICK FOLLOWING ITEMS OWNED BY HOUSEHOLD OR A HOUSEHOLD MEMBER)* ***PROMPT FOR EACH ITEM**; RECORD ALL ITEMS OWNED BY HOUSEHOLD OR A HOUSEHOLD MEMBER...)*	Radio	☐	
		Television	☐	
		Mobile telephone	☐	
		Non-mobile telephone	☐	
		Watch	☐	
		Electric Iron	☐	
		Bicycle or tricycle	☐	
		Motorcycle, scooter, auto-rikshaw	☐	
		Car, truck, jeep, or tractor	☐	

		Refrigerator	☐
		Dish washer / washing machine	☐
		Electric or Gas Cooker	☐
		Air conditioner	☐
		Generating Set	☐
		Cable TV	☐
hc4	What is the main material of the floor of the dwelling? *(OBSERVATION.)* *(SELECT ONLY **ONE** ANSWER.)*	Earth / sand.....1 Dung.....2 Wood planks.....3 Palm / bamboo.....4 Parquet / polished wood.....5 Vinyl / asphalt strips.....6 Ceramic tiles.....7 Cement.....8 Carpet.....9 Other: _____ 99	
hc5	What is the main material of the roof of the dwelling? *(OBSERVATION.)* *(SELECT ONLY **ONE** ANSWER.)*	No roofing.....1 Thatch / palm leaves.....2 Sod.....3 Rustic mat.....4 Palm / bamboo.....5 Wood planks.....6 Cardboard.....7 Metal.....8 Wood.....9 Calamine / cement fiber.....10 Ceramic tiles.....11 Cement.....12 Roofing shingles.....13 Other: _____ 99	
hc6	What is the main material of the exterior walls of the dwelling? *(OBSERVATION.)* *(SELECT ONLY **ONE** ANSWER.)*	Plastic / Cardboard……..... 1 Mud..... 2 Mud and cement..... 3 Corrugated iron / zinc..... 4 Prefab ..... 5 Bare brick or cement blocks…… 6 Plaster / finished..... 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? *(SELECT ONLY **ONE** ANSWER.)*	Water piped into dwelling.....1 Water piped to yard / plot.....2 Public tap / standpipe.....3 Tube well / borehole.....4 Protected well.....5 Unprotected well.....6 Protected spring.....7 Unprotected spring.....8 Rainwater.....9 Tankertruck.....10 Cart with small tank.....11 Surface water (river / dam / lake / pond / stream / canal / irrigation channel).....12 Bottled / sachet water.....13 Don't know.....88 Other: _____ 99	If **1, 2 9**,**10**, or **11** skip to **W4** If **13** skip to **W6**
w2	Where is that water source located?	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? *(WRITE IN THE NUMBER.)* *(IF 'DON'T KNOW', RECORD 888.)*	Minutes…… ☐☐☐	
w4	Do you **usually** do anything to your drinking water to make it safer to drink? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……2	If **no**, skip to **w6**
w5	What do you **usually** do to the water to make it safer to drink? *(DO **NOT** PROMPT. PROBE "ANYTHING ELSE?")* *(TICK ALL METHODS MENTIONED*	Boil ☐ Add bleach / chlorine ☐ Strain through a cloth ☐ Use a water filter ☐ Solar disinfection ☐ Let it stand and settle ☐	

		Add water guard	☐	
		Add Aluminum Sulphate (Alum)	☐	
		Other _____	☐	
		Don't know	☐	
w6	What kind of toilet facility do members of your household usually use? *(DO **NOT** PROMPT.)* *(SELECT ONLY **ONE** ANSWER.)*	Flush to septic tank/piped sewer.....1 Flush to pit latrine.....2 Ventilated improved pit latrine.....3 Pit latrine with slab.....4 Pit latrine without slab / open pit.....5 Composting toilet.....6 Bucket toilet.....7 Hanging toilet / hanging latrine.....8 No facilities / bush / field.....9 Don't know.....88 Other: _____ 99		
w7	Do you share this toilet facility with other households? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……2		

HEALTH SERVICES ACCESS			
N°	QUESTIONS	ANSWERS	SKIPS
hs1	How long would it take to walk to the nearest health care facility on a one way journey? *(A. SELECT THE APPROPRIATE RESPONSE.)* *(IF 'DON'T KNOW', RECORD 88.)*	0 minutes to less than 30 minutes……1 30 minutes to less than 60 minutes……..2 1 hour to less than 2 hours……3 More than 2 hours……..4 Don't know……..……88	

***** CHECK THE QUESTIONNAIRE & THANK THE RESPONDENT *****

NIGERIA FACT COVERAGE SURVEY 2015

HOUSEHOLD QUESTIONNAIRE 2

dateint	Date of interview ***CAPI Programmer:*** Take time stamp to signal beginning and end of interview	DD / MM / YY ☐☐/☐☐/☐☐			
teamid	Team identifier	☐☐	intid	Interviewer identifier	☐☐
staid	State	03. Kano 04. Lagos			☐☐
lgaid	LGA	11. AA 12. BB 13. CC 14. DD 15. EE		16. FF 17. GG 18. HH 19. II 20. JJ	☐☐
ea	Enumeration Area ***CAPI Programmer***: Filter list of EA to selected LGA	11. AA 12. BB 13. CC 14. DD 15. EE		16. FF 17. GG 18. HH 19. II 20. JJ	☐☐
areaname	Area / village / town name	_____			
psu	Cluster identifier	☐☐			
structure id	Structure ID	_____			
hh	Household ID	☐☐			
gps	GPS coordinates ***CAPI Programmer***: *Please collect GPS coordinates of the structure*	**DDD MM SS L** **Lon** |__|__|__|●|__|__|__|__|__|__|__| **Lat** |__|__|__|●|__|__|__|__|__|__|__|			
cons	Oral 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 this household.*	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 dwelling.6 Dwelling destroyed.....7 Other: _____.....99			If 3 or 4, return later for a second visit. If 5, 6 or 7,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? *(WRITE IN THE NUMBER. 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? *(WRITE IN THE NUMBER. 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? *(WRITE IN THE NUMBER. IF 'NONE', RECORD 00.)*	Number of times ☐☐	

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

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? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never …….3	If 1 or 2, continue to the oil module, to ask the questions in the oil module? And, if 3, skip/do not ask the questions in the oil module?.
mf1	Now, I would like to talk with you about maize flour. Does your household prepare foods using maize flour (e.g. porridge, pap)? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never …..……..3	If 1 or 2, continue to the maize flour module, to ask the questions in the maize flour module? And, if 3, skip/do not ask the questions in the maize flour module?
wf1	Now, I would like to talk with you about wheat flour. Does your household prepare foods using wheat flour, such as bread or other wheat flour products? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never ……...……..3	If 1 or 2, continue to the wheat module, to ask the questions in the wheat module? And, if 3, skip/do not ask the questions in the wheat module?

lf1	Now, I would like to talk with you about semolina flour. Does your household prepare foods using semolina flour (e.g. pasta, pudding)? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never ……..……..3	If 1 or 2, continue to the semolina module, to ask the questions in the semolina module? And, if 3, skip/do not ask the questions in the semolina module?
sf1	Now, I would like to talk with you about sugar. Does your household use sugar? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never ……..……..3	If 1 or 2, continue to the sugar module, to ask the questions in the sugar module? And, if 3, skip/do not ask the questions in the sugar module?
si1	Now, I would like to talk with you about salt. Does your household use salt? *(SELECT ONLY **ONE** ANSWER.)*	Yes, regularly……...1 Yes, sometimes ……..……2 No, never …..……..3	If 1 or 2, continue to the salt module, to ask the questions in the salt module? And, if 3, skip/do not ask the questions in the salt module?
	Instruction to CAPI Programer: Based on response above program the prompt below for the interviewer. ***Please I would like you to bring the following food items: 'OF1, if=1or 2', 'MF1, if=1or 2', 'WF1, if=1or 2', 'LF1, if=1or 2', 'SF1, if=1or 2', 'SI1, if=1or 2' if you have them available in the household.***		

OIL FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
of2	What is the **main** type of cooking **oil** that is used in your household for most meals on most days? *(SELECT ONLY **ONE** ANSWER.)*	Groundnut oil……..……1 Palm oil……..……2 Sunflower oil……3 Coconut oil……..……4 Palm kernel oil……5 Soya bean oil……..……6 Rape seed oil……..……7 Cottonseed oil……..8 Maize oil……9 Sesame seed oil……...10 Don't know / Don't remember.....88 Other: _____.....99	
of3	Can you show me this **main** cooking **oil**? *(SELECT 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? *(SELECT ONLY **ONE** ANSWER.)*	Purchased……..1 Made it at home.....2 Received from relative/friend or 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? *(IF MAIN OIL TYPE IS NOT AVAILABLE):* The **last time** your household got [MAIN OIL TYPE], how was it packaged? *(READ **ALL** RESPONSES)* *(SELECT ONLY **ONE** ANSWER.)*	Original package……..1 Re-packaged……2 My own container.....3 Don't know .....88 Other: _____.....99	
of6	*(IF MAIN OIL TYPE IS AVAILABLE):* When your household got this [MAIN OIL TYPE], what quantity did you get? *(IF MAIN OIL TYPE IS NOT AVAILABLE):* The **last time** your household got [MAIN OIL TYPE], what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐☐ B. Units l.....1 cl……2 ml.....3 Spoon measure ……4 Milk tin……5 Quarter bottle……6 Half bottle……7 One bottle……8 Two bottles……9 Gallon (4 liters)……..10 Other: _____.....99 CAPI Programmer : Only allow the units that apply to oil to be active	

of7	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	
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]? *(SELECT ONLY **ONE** ANSWER.)*	Brand 1.....1 Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 Don't know .....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]? *(SELECT ONLY **ONE** ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **oil is not available,** skip to **maize flour** module.
of10	***LOOK FOR FORTIFICATION LOGO**.* *(SELECT 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	**If 2 skip to mf2**
of12	Please enter the **4-digit ID Label** You will be ask to enter the figure twice to confirm		

MAIZE FLOUR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
mf2	Can you show me what **main maize flour** your household uses? *(SELECT 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? *(SELECT ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from relative/friend or 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)* *(SELECT ONLY **ONE** ANSWER.)*	Original package…….....1 Re-packaged……..2 My own container.....3 Don't know .....88 Other: _____.....99	
mf5	*(IF MAIZE FLOUR IS AVAILABLE):* When your household got this maize flour, what quantity did you get? *(IF MAIZE FLOUR IS NOT AVAILABLE):* The **last time** your household got maize flour, what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐ ☐ B. Unit Kg.....1 g.....2 Spoon measure……..3 Tin Tomato……..4 Milk tin……..5 Chakwal small……..6 Chakwal……7 De rica (Gongoni)……8 Rabi Kwanu……..9 Kwanu……10 Baban Kwanu……11 Other: _____.....99 CAPI Programmer : Only allow the units that apply to Maize flour to be active	
mf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	

mf7	*(IF MAIZE FLOUR IS AVAILABLE):* ***OBSERVE BRAND**.* *(IF MAIZE FLOUR IS NOT AVAILABLE, **ASK THE RESPONDENT**):* What is the brand of this maize flour? *(SELECT ONLY **ONE** ANSWER.)*	Brand 1.....1 Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 Don't know .....88 Other: _____.....99	
mf8	*(IF MAIZE FLOUR IS AVAILABLE):* ***OBSERVE PRODUCER**.* *(IF MAIZE FLOUR IS NOT AVAILABLE, **ASK THE RESPONDENT**):* Who is the producer of this maize flour? *(SELECT ONLY **ONE** ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **maize flour is not available,** skip to **wheat flour** module.
mf9	***LOOK FOR FORTIFICATION LOGO**.* *(SELECT ONLY **ONE** 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	**If 2 skip to wf2**
mf11	Please enter the **4-digit ID Label** You will be ask to enter the figure twice to confirm		

WHEAT FLOUR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
wf2	Can you show me what **main wheat flour** your household uses? *(SELECT 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? *(SELECT ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from relative/friend or food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **semolina flour** 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)* *(SELECT ONLY **ONE** ANSWER.)*	Original package……....1 Re-packaged……..2 My own container.....3 Don't know .....88 Other: _____.....99	
wf5	*(IF WHEAT FLOUR IS AVAILABLE):* When your household got this wheat flour, what quantity did you get? *(IF WHEAT FLOUR IS NOT AVAILABLE):* The **last time** your household got wheat flour, what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐☐ B. Unit Kg.....1 g.....2 Spoon measure……..3 Tin tomato……..4 Milk tin……..5 Chakwal small……..6 Chakwal……7 De rica (Gongoni)……8 Rabi Kwanu……..9 Kwanu……..10 Baban Kwanu……11 Other: _____.....99 CAPI Programmer : Only allow the units that apply to wheat flour to be active	
wf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	
wf7	*(IF WHEAT FLOUR IS AVAILABLE):*	Brand 1.....1	

	OBSERVE BRAND. *(IF WHEAT FLOUR IS NOT AVAILABLE,* ***ASK THE RESPONDENT****):* What is the brand of this wheat flour? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 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? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **wheat flour is not available,** skip to **semolina flour** module.
wf9	***LOOK FOR FORTIFICATION LOGO***. *(SELECT 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	**If 2 skip to If2**
wf11	Please enter the **4-digit ID Label** You will be ask to enter the figure twice to confirm		

SEMOLINA FLOUR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
lf2	Can you show me what **main semolina flour** your household uses? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
lf3	*(IF SEMOLINA FLOUR IS AVAILABLE):* When your household got this semolina flour, where did you get it from? *(IF SEMOLINA FLOUR IS NOT AVAILABLE):* The **last time** your household got semolina flour, where did you get it from? *(SELECT ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from relative/friend or food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **sugar** module.
lf4	*(IF SEMOLINA FLOUR IS AVAILABLE):* When your household got this semolina flour, how was it packaged? *(IF SEMOLINA FLOUR IS NOT AVAILABLE):* The **last time** your household got semolina flour, how was it packaged? *(READ **ALL** RESPONSES)* *(SELECT ONLY **ONE** ANSWER.)*	Original package……....1 Re-packaged……..2 My own container.....3 Don't know .....88 Other: _____.....99	
lf5	*(IF SEMOLINA FLOUR IS AVAILABLE):* When your household got this semolina flour, what quantity did you get? *(IF SEMOLINA FLOUR IS NOT AVAILABLE):* The **last time** your household got semolina flour, what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐☐ B. Unit Kg.....1 g.....2 Spoon measure……..3 Tin Tomato……..4 Milk tin……..5 Chakwal small……6 Chakwal……7 De rica (Gongoni)……8 Rabi Kwanu……..9 Kwanu……..……10 Baban Kwanu……11 Other: _____.....99 CAPI Programmer : Only allow the units that apply to semolina to be active	
lf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	
lf7	*(IF SEMOLINA FLOUR IS AVAILABLE):*	Brand 1.....1	

	OBSERVE BRAND. *(IF SEMOLINA FLOUR IS NOT AVAILABLE,* ***ASK THE RESPONDENT****):* What is the brand of this semolina flour? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 Don't know .....88 Other: _____.....99	
lf8	*(IF SEMOLINA FLOUR IS AVAILABLE):* ***OBSERVE PRODUCER***. *(IF SEMOLINA FLOUR IS NOT AVAILABLE,* ***ASK THE RESPONDENT****):* Who is the producer of this semolina flour? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **semolina flour is not available,** skip to **sugar** module.
lf9	***LOOK FOR FORTIFICATION LOGO***. *(SELECT ONLY* ***ONE*** *ANSWER.)*	Logo not observed (labelled)……..……1 Logo not observed (no label)……..……2 Logo observed……..…….....3	
lf10	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK SEMOLINA FLOUR LABEL ON SAMPLE CONTAINER.)*	Sample taken……1 No sample taken……..……2	**If 2 skip to sf2**
lf11	Please enter the **4-digit ID Label** You will be ask to enter the figure twice to confirm		

SUGAR FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
sf2	Can you show me what **main sugar** your household uses? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……2	
sf3	*(IF SUGAR IS AVAILABLE):* When your household got this sugar, where did you get it from? *(IF SUGAR IS NOT AVAILABLE):* The **last time** your household got sugar, where did you get it from? *(SELECT ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from relative/friend or food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **salt** module.
sf4	*(IF SUGAR IS AVAILABLE):* When your household got this sugar, how was it packaged? *(IF SUGAR IS NOT AVAILABLE):* The **last time** your household got sugar, how was it packaged? *(READ **ALL** RESPONSES)* *(SELECT ONLY **ONE** ANSWER.)*	Original package……..……...1 Re-packaged……..……..2 My own container.....3 Don't know .....88 Other: _____.....99	
sf5	*(IF SUGAR IS AVAILABLE):* When your household got this sugar, what quantity did you get? *(IF SUGAR IS NOT AVAILABLE):* The **last time** your household got sugar, what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐☐ B. Unit Kg.....1 g.....2 Spoon measure……..3 Tin Tomato……..4 Milk tin……..5 Chakwal small……6 Chakwal……7 De rica (Gongoni)……8 Rabi Kwanu……..9 Kwanu……..……10 Baban Kwanu……11 Other: _____.....99 CAPI Programmer : Only allow the units that apply to Sugar to be active	
sf6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	
sf7	*(IF SUGAR IS AVAILABLE):*	Brand 1.....1	

	OBSERVE BRAND. *(IF SUGAR IS NOT AVAILABLE,* ***ASK THE RESPONDENT****):* What is the brand of this sugar? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 Don't know .....88 Other: _____.....99	
sf8	*(IF SUGAR IS AVAILABLE):* ***OBSERVE PRODUCER***. *(IF SUGAR IS NOT AVAILABLE,* ***ASK THE RESPONDENT****):* Who is the producer of this sugar? *(SELECT ONLY* ***ONE*** *ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **sugar is not available,** skip to **salt** module.
sf9	***LOOK FOR FORTIFICATION LOGO***. *(SELECT ONLY* ***ONE*** *ANSWER.)*	Logo not observed (labelled)……1 Logo not observed (no label)……2 Logo observed……..…….....3	
sf10	May I take a small sample? *(IF 'YES', TAKE SAMPLE AND STICK SUGAR LABEL ON SAMPLE CONTAINER.)*	Sample taken……1 No sample taken……..……2	**If 2 skip to si2**
sf11	Please enter the 4-digit ID Label You will be ask to enter the figure twice to confirm		

SALT IODIZATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
si2	Can you show me what **main salt** your household uses? *(SELECT 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? *(SELECT ONLY **ONE** ANSWER.)*	Purchased…….....1 Made it at home.....2 Received from relative/friend or food aid.....3 Don't know / Don't remember.....88 Other: _____.....99	If **2,** skip to **bouillon cube** 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)* *(SELECT ONLY **ONE** ANSWER.)*	Original package……..……....1 Re-packaged……..……..2 My own container.....3 Don't know .....88 Other: _____.....99	
si5	*(IF SALT IS AVAILABLE):* When your household got this salt, what quantity did you get? *(IF SALT IS NOT AVAILABLE):* The **last time** your household got salt, what quantity did you get? *(SHOW EXAMPLES OF COMMONLY USED CONTAINERS AND MEASURES.)* *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Quantity ☐☐☐☐ B. Unit Kg.....1 g.....2 Spoon measure……..3 Tin Tomato……..4 Milk tin……..5 Chakwal small……6 Chakwal……7 De rica (Gongoni)……8 Rabi Kwanu……..9 Kwanu……..……10 Baban Kwanu……11 Other: _____.....99 CAPI Programmer : Only allow the units that apply to salt to be active	
si6	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	
si7	*(IF SALT IS AVAILABLE):* ***OBSERVE BRAND***.	Brand 1.....1 Brand 2.....2	

	*(IF SALT IS NOT AVAILABLE, **ASK THE RESPONDENT**):* What is the brand of this salt? *(SELECT ONLY **ONE** ANSWER.)*	Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 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? *(SELECT ONLY **ONE** ANSWER.)*	Producer 1.....1 Producer 2.....2 Producer 3.....3 Producer 4.....4 Producer 5.....5 Producer 6.....6 Producer 7.....7 Don't know.....88 Other: _____.....99	If **salt is not available,** skip to **bouillon cube** module.
si9	***LOOK FOR FORTIFICATION LOGO**.* *(SELECT 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	**If 2 skip to bcf1**
si11	Please enter the 4-digit ID Label You will be ask to enter the figure twice to confirm		

BOUILLON CUBE FORTIFICATION COVERAGE			
N°	QUESTIONS	ANSWERS	SKIPS
bcf1	What is the **main** brand of **bouillon cube** used in most meals on most days in your household? *(SELECT ONLY **ONE** ANSWER.)*	Brand 1.....1 Brand 2.....2 Brand 3.....3 Brand 4.....4 Brand 5.....5 Brand 6.....6 Brand 7.....7 Brand 8.....8 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 bouillon cubes how many did you get? *(WRITE IN THE NUMBER.)*	Quantity ☐☐☐☐ Unit A. Single cube B. Double cube C. 6g sachet D. 10g sachet E. Rectangle	
bcf3	How long does this amount usually last in your household? *(A. WRITE IN THE NUMBER.)* *(B. SELECT THE UNIT.)*	A. Duration ☐☐ B. Day(s).....1 Week(s).....2 Month(s).....3	

FORTIFICATION LOGO KNOWLEDGE AND INFLUENCE			
lk1_1	*(SHOW **VITAMIN A** FORTIFICATION LOGO.)* Have you ever seen this logo? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……..2	
lk2_1	What does this logo mean? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(SELECT **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……88 Other: _____.....99	
lk3_1	Does this logo influence your decision to buy? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(SELECT 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.....88 Other: _____.....99	
Lk1_2	*(SHOW **IODINE** FORTIFICATION LOGO.)* Have you ever seen this logo? *(SELECT ONLY **ONE** ANSWER.)*	Yes……..1 No……..2	
Lk2_2	What does this logo mean? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(SELECT **ALL** RESPONSES THAT APPLY.)*	Fortified / enriched / added micronutrients ……1 Good for mental and physical development……...2 Better quality ……..3 Bad quality……4 More expensive……...5 No meaning ……6 Don't know……88 Other: _____.....99	
Lk3_2	Does this logo influence your decision to buy? *(DO NOT READ RESPONSES TO RESPONDENT.)* *(SELECT 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.....88 Other: _____.....99	

***** CHECK THE QUESTIONNAIRE & THANK THE RESPONDENT *****

NIGERIA FACT COVERAGE SURVEY 2015 FEMALE RESPONDENT QUESTIONNAIRE					
dateint	Date of interview ***CAPI Programmer:*** Take time stamp to signal beginning and end of interview	DD / MM / YY ☐☐/☐☐/☐☐			
teamid	Team identifier	☐☐	intid	Interviewer identifier	☐☐
staid	State	05. Kano 06. Lagos			☐☐
lgaid	LGA	21. AA 22. BB 23. CC 24. DD 25. EE		26. FF 27. GG 28. HH 29. II 30. JJ	☐☐
ea	Enumeration Area ***CAPI Programmer***: Filter list of EA to selected LGA	21. AA 22. BB 23. CC 24. DD 25. EE		26. FF 27. GG 28. HH 29. II 30. JJ	☐☐
areaname	Area / village / town name	_____			
psu	Cluster identifier	☐☐			
structure id	Structure ID	_____			
hh	Household ID	☐☐			
Woman_id	Line number of respondent *Write in the number from the household roster in household questionnaire 1.*				☐☐
cons	Oral 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 this household.*	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 dwelling...6 Dwelling destroyed.....7 Other: _____.....99			

HEALTH DATA			
N°	QUESTIONS	ANSWERS	SKIPS
hd1	Are you currently pregnant? *(CIRCLE ONLY **ONE** ANSWER.)*	Yes……..1 No……2 Don't know……88	
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. Please 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. TICK ALL FOOD CATEGORIES THAT APPLY.)*

N°	ITEMS	
dd1	Any bread, rice noodles, spaghetti, biscuits, or any other foods made from millet, sorghum, maize, rice, corn, rye, wheat, or any flour?	☐
dd2	Any potatoes, sweet potato, yams, cocoyam, cassava or any other foods made from roots or tubers?	☐
dd3	Any food made from vegetables or root crops with yellow or orange flesh such as tomato, cabbage, pepper, okra, garden egg/eggplant, squash, carrots, pumpkin,?	☐
dd4	Any food made from dark green leafy vegetables such as kuka, lettuce, spinach, ewedu leaves, ugwu leaves, cassava leaves, potato leaves, kale, and other locally available dark green leafy vegetables?	☐
dd5	Any other vegetables?	☐
dd6	Any food made from fruits with yellow or orange flesh such as mango, guava, water melon, date palm, and papaya/pawpaw?	☐
dd7	Any other fruits?	☐
dd8	Any beef, pork, lamb, goat, rabbit wild game, chicken, turkey, guinea fowl, duck, or other birds?	☐
dd9	Any liver, kidney, heart, or other organ meats?	☐
dd10	Any eggs?	☐
dd11	Any fresh or dried fish or shellfish?	☐
dd12	Any cowpea, groundnut, locust bean, pigeon pea, soya bean, or other foods made from beans, peas, lentils, or legumes?	☐
dd13	Any cashew, walnut, kola nut, sesame, shea nut, almond or other foods made from nuts?	☐
dd14	Any tinned milk, powdered milk, fresh animal milk, cheese, yoghurt or other foods made from milk or other milk products?	☐
dd15	Any foods made with oil, fat, or butter?	☐
dd16	Any sugar or honey?	☐
dd17	Any other foods, such as condiments, coffee, tea?	☐
dd18	Red palm oil	☐

INDIVIDUAL WHEAT AND MAIZE FLOUR CONSUMPTION

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

(IF FREQUENCY = 00, DON'T ASK THE PORTION SIZE)

Usually how much of [FOOD ITEM] did you eat at one sitting? *(SHOW PICTURES OF PORTIONS!)*

(REPEAT QUESTIONS FOR EACH FOOD ITEM LISTED BELOW.)

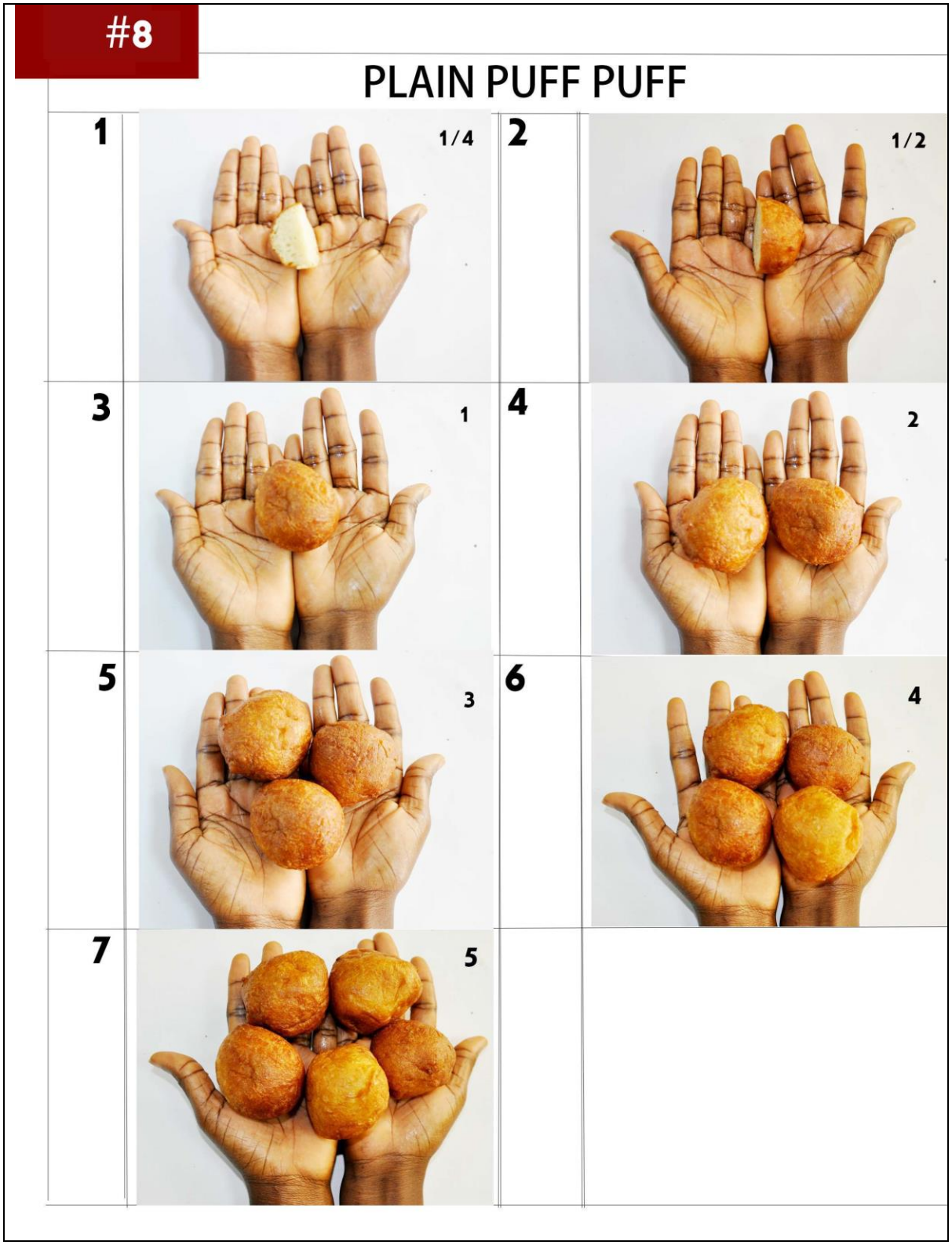
N°	ITEMS	1. Frequency (# times)	2. Portion size
wmfc 1	Noodles	☐☐	☐
wmfc 2	Spaghetti	☐☐	☐
wmfc 3	White Bread Loaf	☐☐	☐
wmfc 4	Sliced Bread	☐☐	☐
wmfc 5	Tuwo Masara	☐☐	☐
wmfc 6	Semolina Meal	☐☐	☐
wmfc 7	Whole Wheat Meal	☐☐	☐
wmfc 8	Plain Puff Puff	☐☐	☐
wmfc 9	Sausage Roll	☐☐	☐
wmfc 10	Beef Burger with Egg	☐☐	☐
wmfc 11	Chicken Pie	☐☐	☐
wmfc 12	Round Doughnut	☐☐	☐
wmfc 13	Fried Fish Roll	☐☐	☐
wmfc 14	Scotch Egg	☐☐	☐
wmfc 15	Buns	☐☐	☐

wmfc 16	Cup Cake	☐☐	☐
wmfc 17	Egg Roll	☐☐	☐
wmfc 18	Pepper Puff Puff	☐☐	☐
wmfc 19	Ring Doughnut	☐☐	☐
wmfc 20	Samosa	☐☐	☐
wmfc 21	Spring Roll	☐☐	☐
wmfc 22	Fruit Cake	☐☐	☐
wmfc 23	Plain Cake	☐☐	☐
wmfc 24	Baked Fish Roll	☐☐	☐
wmfc 25	Vegetable Burger	☐☐	☐
Wmfc 26	Vegetable Burger with Egg	☐☐	☐
Wmfc 27	Meat Pie	☐☐	☐

***** CHECK THE QUESTIONNAIRE & THANK THE RESPONDENT *****

Annex B: Example photo grid used with WRA questionnaire

A photo grid such as the one below was prepared for each of 27 wheat flour-, semolina flour- and maize flour-containing foods and individual assessment of intake of wheat flour-containing foods among WRA over the past seven days.



Annex C: Timeline

Main survey activities were carried out between March and July 2015.

S/N	Activity	Deliverable	Responsible party	Deadline[1]	Mar week 2	Mar week 3	Mar week 4	Apr week 1	Apr week 2	Apr week 3	Apr week 4	May week 1	May week 2	May week 3	May week 4	Jun week 1	Jun week 2	Jun week 3	Jun week 4	Jul week 1	Jul week 2	Jul week 3	Jul week 4
1	Stakeholder Consultation with GAIN & CDC							Elections															
	Planning meeting with GAIN & CDC	Signed grant agreement, effective start date of 30 March 2015	GAIN, CDC, OPM																				
	Stakeholder Meeting - NAFDAC, NPC, Development patners		GAIN																				
	GAIN/CDC shares draft protocol with OPM		GAIN, CDC																				
2	Ethical clearance application to relevant national and state ethical committee							Elections															
	Application to National Health Research Ethical Committee (NHREC) for ethic approval		OPM																				
	Application to State ethical boards		OPM																				
	Introduction to the State ministry of health facilitated by GAIN & CDC		OPM																				
		Certificate of ethical approval and country approvals, if needed	OPM																				
3	Obtain EA sampling frame and draw sample of selected EA							Elections															
	GAIN/CDC share finalized protocol with OPM		GAIN/CDC																				
	NPC draw EA sample based on the finalized protocol		OPM																				
	Development of field maps and forms		OPM																				
		List of EAs selected	GAIN, CDC, OPM																				
4	Local adaptation and translation of study instrument and methodology							Elections															
	GAIN to share draft show card for pretest		GAIN																				
	Review of questionnaire		GAIN, CDC, OPM																				
	Scoping Mission and Pretest in Kano and Lagos outside of selected LGA		OPM and GAIN																				
	Review meeting with GAIN and CDC		GAIN, CDC, OPM																				
	Review and revise tool		GAIN, CDC, OPM																				
	Translation and back translation (Hausa and Yoruba)	Translated questionnaire and data collection tools	OPM																				
5	Development of CAPI data entry program and Protocol							Elections															
	CAPI programming		OPM																				
	CAPI desk Review		OPM																				
	CAPI pretest		OPM																				
		Programmed CAPI	OPM																				
6	Recruitment of enumerators							Elections															
	Recruitment	Roster of recruited enumerators	OPM																				
7	Preparation for training and data collection							Elections															
	Manual and training plan	Final training manual	GAIN, CDC, OPM																				
	GAIN to provide template for show card		GAIN																				
	GAIN to supply sample container		GAIN																				
	Procurement of field material	All supplies for training and data collection procured	OPM																				
8	Training of enumerators and study pilot							Elections															
	Review meeting with GAIN and CDC		GAIN, CDC, OPM																				
	Enumerator training		GAIN, CDC, OPM																				
	Supervisor training	All enumerators are trained	GAIN, CDC, OPM																				
	Study pilot	Final pilot-tested questionnaire	GAIN, CDC, OPM																				
9	Main data collection							Elections															
	Data collection	All questionnaires completed	OPM																				
	Field update	Progress and utilization of funds report	OPM																				
	Ship food samples	Food samples shipped to lab	OPM																				
10	Compilation of database							Elections															
	Data cleaning		OPM																				
	Data processing (code book, clean data)	Cleaned dataset and code book	OPM																				
	Summary report	Final report including summarized checklist	OPM																				
11	Dissemination							Elections															
	Present results at a stakeholder workshop	Workshop	GAIN, CDC, OPM	To be determined																			

Annex D: Consent form

The English-language consent form applied to respondents. When administering the survey in another language, enumerators interpreted the consent text to the appropriate language.

My name is _____ _____. I am working for Oxford Policy Management. We are conducting a research, with support from the State Ministry of Health. This enumeration/catchment area has been selected to participate in this study and your household has been selected by chance to participate in this study. This study is interested in learning about feeding patterns of the household 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 will be asking questions about the age, gender and size of the household, birth history, household characteristics, access to healthcare and more generally about their diets and eating practices. We would also like to collect a few small samples of foods.

If the person who is most knowledgeable about purchasing and preparing most of the food *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;*

Annex E: In-depth description of analytical methods applied to food samples

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

1. Introduction

GAIN has collected samples of staple foods from markets and households in Nigeria 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, flour and oil were analyzed for added micronutrient content using the iCheck technology. Students from the University of Potsdam were trained in the use of the iCheck and performed the analysis under supervision from BioAnalyt. The iron content in flour samples were analyzed by an accredited commercial laboratory.

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

For the hands on training for each iCheck analysis method, the student analysts read the user manuals and received a demonstration of the entire analysis procedure. Finally, they independently analyzed a sample 10 times to assess precision and repeatability. The analyst with the most consistent results was then selected to perform the analysis.

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 (I_2) and triiodide (I_3^-), 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.

3.3 Analysis of Vitamin A in Sugar

iCheck Fluoro was used for the measurement of vitamin A in sugar. iCheck Fluoro quantitatively determines the concentration of vitamin A in food based on the measurements of the auto-fluorescence of vitamin A (retinol). Results are displayed in the measuring device iCheck Fluoro in µg retinol equivalents/L. This method has been validated against the reference method of HPLC (4).

The sugar samples were analyzed individually and part of them were pooled according to customer specification. The samples were diluted 1:5 with water to ensure that the vitamin A concentration of the final solution was within the linear range of iCheck Fluoro (50 - 3000 µg RE/L). Before weighing in, the sugar samples were mixed thoroughly to ensure homogeneity. Exactly 5 g of sugar was dissolved completely in 20 mL of water. The sugar solutions were injected and analyzed according to iCheck Fluoro user manual.

The composite samples were prepared by weighing in exactly 1.0 g of each individual sugar and mixing continuously for 5 minutes to ensure homogeneity. The pooled samples were also diluted 1:5 with water. Exactly 5 g of sugar was dissolved completely in 20 mL of water. The sugar solutions were injected and analyzed using iCheck Fluoro.

As a quality control, a standard quinine sulfate (Fluoro Standard) was measured to control the iCheck Fluoro devices.

3.4 Analysis of Iron in Semolina and Wheat

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 (5).

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.

3.5 Analysis of Vitamin A in Maize Flour

iCheck Fluoro was used for the measurement of vitamin A in maize flour. iCheck Fluoro quantitatively determines the concentration of vitamin A in food based on the measurements of the auto-fluorescence of vitamin A (retinol). Results are displayed in the measuring device iCheck Fluoro in µg retinol equivalents/L. This method has been validated against the reference method of HPLC (4).

The flour samples were analyzed individually. The samples were diluted 1:10 with water to ensure that the vitamin A concentration of the final solution was within the linear range of iCheck Fluoro (50 - 3000 µg RE/L). Before weighing in, the flour samples were mixed thoroughly to ensure homogeneity. Exactly 4 g of flour was dissolved completely in 36 mL of water. The flour solutions were injected and analyzed according to iCheck Fluoro user manual.

As noted, iCheck Fluoro used for determination of vitamin A in maize uses auto-fluorescence of vitamin A upon UV activation. In organic samples there are intrinsic components such as plant oils that also fluoresce. To account for the background fluorescence (not intrinsic vitamin A as only animal products can contain retinol), unfortified maize flour was sourced from

Nigeria. And the resulting value (3710 IU/kg of vitamin A) was used to correct the results with samples containing unknown vitamin A concentration.

As a quality control, a standard quinine sulfate (Fluoro Standard) was measured to control the iCheck Fluoro devices.

4. Results

All the measurement results were put into excel files and delivered to the customer.

Oil:

A total of 1001 oil (996 individual and 5 pooled) samples were analyzed. 497 oils had intense red or orange coloration, indicative of unrefined oils and may not be reliably measured with iCheck technology; these oils were classified as unfortified as these unrefined oils are almost always not fortified. iCheck Chroma 3 has been validated for RBD (refined bleached deodorized oils).

Samples with a measured vitamin A concentration of less than 10 000 IU/kg (<3.0 mg RE/kg) were classified as non-fortified; this value represents the limit of quantitation (LOQ): 3.0 mg RE/kg = 10 IU/g = 10,000 IU/kg. The precision, as assessed by triplicate measurement of 4 pooled samples, is 91%±6%. The trueness, as assessed by the recovery with spiked control oil sample, is 104%±8%.

Salt:

A total of 1363 salt (1348 individual and 15 pooled) samples were analyzed individually for iodine content. Samples with measured iodine concentration below 10 ppm were classified as non-iodized. The average precision, as assessed by the triplicate measurement of 15 pooled salt samples, is 99%. The trueness, as assessed by the recovery with iodized salt control sample, is 96%±7%.

Sugar:

A total of 503 sugar (493 individual and 10 pooled) samples were analyzed individually for vitamin A content. Samples with a calculated vitamin A concentration of less than 750 IU/kg were classified as non-fortified. The limit of quantitation for the method is 50 µg RE/L (= 166 IU/kg). However the sugar must be diluted with water for the measurement. The dilution factor applied for these samples was 1:4.5. So 166 x 4.5 = 750 IU/kg. With this dilution factor the cut off for fortification was 750 IU/kg. The average precision, as defined by the triplicate measurement of 10 pooled samples, is 97%±2%.

Semolina:

A total of 266 semolina (256 individual and 10 pooled) samples were analyzed for total iron content. The average intrinsic iron content in the semolina was measured to be 4 ppm (mg Fe/kg). This value was obtained by taking the average tested value of 2 different unfortified samples. For the analysis of electrolytic iron in semolina, the average precision is 90%±7% (assessed by triplicate measurement of 10 pooled samples). The average added iron content in the semolina was measured to be 37 ppm for individual and 27 ppm for pooled samples.

Wheat Flour:

A total of 124 wheat flour samples were analyzed for total iron content. The average intrinsic iron content of the flour was measured to be 17 ppm (mg Fe/kg). This value was obtained by taking the average tested value of 3 different unfortified flours. The average precision, as assessed by measuring 13 wheat flour samples in duplicates is 94%±5%. The average added iron content in the wheat flour was measured to be 23 ppm.

Maize Flour:
A total of 35 maize flour samples were analyzed individually for vitamin A content. One unfortified maize sample was measured to assess the background fluorescence in flour; based on this analysis vitamin A levels greater than 3710 IU/kg were considered fortified. All results with collected maize flour samples were corrected for the background fluorescence effect of the maize matrix. Samples with a calculated vitamin A concentration of less than 3710 IU/kg were classified as non-fortified. The average recovery, as defined by a five-fold measurement of a spiked control samples, is 92%±6%.

5. Summary

The analysis of over 3200 food samples was rapidly and 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.

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Annex F: 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 State 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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 3710 IU/kg vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). For wheat flour and semolina flour, intrinsic iron levels in unfortified wheat flour and semolina flour were measured. For maize flour, the background fluorescence of an unfortified maize flour sample was measured to adjust for the measurement of vitamin A. For vitamin A in oil, iodine in salt, and vitamin A in sugar, it was assumed that none of these foods have intrinsic

Variable	Calculation
	vitamin A or iodine; the limit of quantitation was used to determine the cutoff for unfortified samples. (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 within each State 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.
Unfortified food sample	Unfortified foods were those that, upon analysis, had less than the criteria for "fortified". Specifically, unfortified salt had $\leq$ 10 mg/kg iodine, unfortified wheat flour had $\leq$ 17 mg/kg total iron (including intrinsic iron), unfortified semolina flour had $\leq$ 4 mg/kg total iron (including intrinsic iron), unfortified maize flour had $\leq$ 0 IU/kg added vitamin A, unfortified sugar had $\leq$ 750 IU/kg vitamin A, and unfortified oil had $\leq$ 10 IU/kg vitamin A.
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 (µg RE)/day (15-18 years), 500 µg RE/day (19-50 years), 800 µg RE/day (pregnant women), and 850 µg RE/day (lactating women). The iodine RNI for women is 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 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 G: Ethical approval for conduct of study

National Health Research Ethics Committee of Nigeria (NHREC)

Promoting Highest Ethical and Scientific Standards for Health Research in Nigeria

Federal Ministry of Health

NHREC Protocol Number NHREC/01/01/2007-23/03/2015
NHREC Approval Number NHREC/01/01/2007-25/04/2015
Date: 25th April, 2015

RE: LAGOS AND KANO, NIGERIA STATES FACT SURVEY

Health Research Ethics Committee (HREC) assigned number: NHREC/01/01/2007

Name of Co-Investigator: Olufemi Adegoke

Contact of Co-Investigator: 8b Winnipeg Close Off Panama Street
Maitama, Abuja Nigeria
Femi.Adegoke@opml.co.uk

Date of receipt of valid application: 23-03-2015

Date when final determination of research was made: 25-04-2015

Notice of Expedited Committee Review and Approval

This is to inform you that the research described in the submitted protocol, the consent forms, advertisements and other participant information materials have been reviewed and *given expedited committee approval by the National Health Research Ethics Committee.*

This approval dates from 25/04/2015 to 24/04/2016. If there is delay in starting the research, please inform the HREC so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study.* In multiyear research, endeavor to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the HREC. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification.

Signed

Clement Adebamowo BMChB Hons (Jos), FWACS, FACS, DSc (Harvard)
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Annex H: Results from Figures 1-4 in table format

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

Coverage[2]	KANO	LAGOS
	N= 896, % (95% CI)	N=871, % (95% CI)
Consumes salt	96.9 (95.8, 98.1)	98.4 (97.6, 99.3)
Consumes fortifiable salt	96.9 (95.8, 98.1)	98.4 (97.6, 99.3)
Consumes fortified salt		
Yes	64.1 (60.9, 67.3)	87.9 (85.8, 90.1)
No	18.4 (15.8, 20.9)	4.6 (3.2, 6.1)
Don't know	14.5 (12.1, 16.8)	5.8 (4.3, 7.4)
Does not consume fortifiable salt	3.1 (1.9, 4.2)	1.6 (0.7, 2.4)
Consumes wheat flour	83.9 (81.5, 86.3)	14.2 (11.8, 16.5)
Consumes fortifiable wheat flour	83.8 (81.4, 86.2)	13.8 (11.5, 16.1)
Consumes fortified wheat flour		
Yes	22.7 (20, 25.5)	5.4 (3.8, 6.9)
No	0.1 (0, 0.3)	0
Don't know	60.9 (57.7, 64.2)	8.4 (6.6, 10.3)
Does not consume fortifiable wheat flour	16.2 (13.8, 18.6)	86.2 (83.9, 88.5)
Consumes semolina flour	13.1 (10.9, 15.4)	86.1 (83.8, 88.4)
Consumes fortifiable semolina flour	10.9 (8.8, 12.9)	83.1 (80.6, 85.6)
Consumes fortified semolina flour		
Yes	6.9 (5.3, 8.6)	69 (66, 72.1)
No	0	0
Don't know	4.0 (2.7, 5.2)	14.0 (11.7, 16.3)
Does not consume fortifiable semolina flour	89.1 (87.1, 91.2)	16.9 (14.4, 19.4)
Consumes maize flour	77.1 (74.4, 79.9)	12.2 (10, 14.4)
Consumes fortifiable maize flour	11 (9, 13.1)	2.9 (1.8, 4)
Consumes fortified maize flour		
Yes	1.7 (0.9, 2.6)	0.2 (0, 0.5)
No	2 (1.1, 2.9)	0
Don't know	7.3 (5.6, 9)	2.7 (1.6, 3.7)
Does not consume fortifiable maize flour	89.0 (86.9, 91.0)	97.1 (96.0, 98.2)
Consumes sugar	94.5 (93, 96)	88.8 (86.7, 90.9)
Consumes fortifiable sugar	94.4 (92.8, 95.9)	88.8 (86.7, 90.9)
Consumes fortified sugar		
Yes	21.1 (18.4, 23.9)	35.6 (32.3, 38.8)

Coverage[2]	KANO	LAGOS
	N= 896, % (95% CI)	N=871, % (95% CI)
No	8.0 (6.2, 9.8)	18.1 (15.5, 20.7)
Don't know	65.2 (62.1, 68.4)	35.2 (32, 38.4)
Does not consume fortifiable sugar	5.6 (4.1, 7.2)	11.2 (9.1, 13.3)
Consumes oil	98.4 (97.6, 99.2)	98.6 (97.8, 99.3)
Consumes fortifiable oil	35.9 (32.7, 39.1)	22.7 (19.9, 25.5)
Consumes fortified oil		
Yes	7.6 (5.9, 9.4)	7.2 (5.5, 8.9)
No	12.8 (10.5, 15)	9.1 (7.2, 11)
Don't know	15.5 (13.1, 17.9)	6.4 (4.8, 8)
Does not consume fortifiable oil	64.1 (60.9, 67.3)	77.3 (74.5, 80.1)

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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 0 IU/kg added vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). "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 within each State 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-value[4]
KANO	**n=609**	**n=287**	
Consumes salt	97 (95.6, 98.4)	96.7 (94.7, 98.7)	0.8162
Consumes fortifiable salt	97 (95.6, 98.4)	96.7 (94.7, 98.7)	0.8162
Consumes fortified salt			
Yes	63.3 (59.4, 67.2)	65.8 (60.3, 71.3)	0.4668
No	18.2 (15.1, 21.3)	18.8 (14.3, 23.3)	0.8320
Don't know	15.6 (12.6, 18.5)	12.2 (8.3, 16.1)	0.1873
Does not consume fortifiable salt	3.0 (1.6, 4.4)	3.3 (1.3, 5.3)	0.8162
Consumes wheat flour	81.5 (78.3, 84.6)	89.2 (85.6, 92.8)	0.0033
Consumes fortifiable wheat flour	81.3 (78.2, 84.4)	89.2 (85.6, 92.8)	0.0027
Consumes fortified wheat flour			
Yes	17 (13.9, 20)	35.2 (29.6, 40.8)	<0.0001
No	0	0.4 (0, 1.1)	-[5]
Don't know	64.3 (60.4, 68.2)	53.7 (47.8, 59.5)	0.0026
Does not consume fortifiable wheat flour	18.7 (15.6, 21.8)	10.8 (7.2, 14.4)	0.0027
Consumes semolina flour	5.2 (3.4, 7)	30.2 (24.9, 35.6)	< 0.0001
Consumes fortifiable semolina flour	3.4 (1.9, 4.9)	27 (21.9, 32.2)	< 0.0001
Consumes fortified[6] semolina flour			
Yes	1.0 (0.2, 1.8)	19.8 (15.2, 24.4)	<0.0001
No	0	0	-[5]
Don't know	2.4 (1.2, 3.7)	7.3 (4.2, 10.3)	0.0007
Does not consume fortifiable semolina flour	96.6 (95.1, 98.1)	73.0 (67.8, 78.1)	<0.0001
Consumes maize flour	76.4 (73.1, 79.8)	78.7 (73.9, 83.4)	0.4570
Consumes fortifiable maize flour	9.7 (7.4, 12.1)	13.8 (9.8, 17.8)	0.0707
Consumes fortified maize flour			
Yes	1.6 (0.6, 2.6)	2 (0.2, 3.7)	0.7269
No	1.9 (0.8, 3)	2.1 (0.4, 3.7)	0.8924
Don't know	6.2 (4.3, 8.1)	9.8 (6.4, 13.2)	0.0535
Does not consume fortifiable maize flour	90.3 (87.9, 92.6)	86.2 (82.2, 90.2)	0.0707
Consumes sugar	93 (90.9, 95)	97.7 (96.1, 99.4)	0.0027
Consumes fortifiable sugar	92.8 (90.7, 94.9)	97.7 (96.1, 99.4)	0.0021
Consumes fortified sugar			
Yes	15.1 (12.2, 18)	34.2 (28.6, 39.7)	<0.0001

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-value[4]
No	6.2 (4.3, 8.2)	11.8 (8, 15.6)	0.0047
Don't know	71.4 (67.8, 75.1)	51.8 (45.9, 57.6)	<0.0001
Does not consume fortifiable sugar	7.2 (5.1, 9.3)	2.3 (0.6, 3.9)	0.0021
Consumes oil	98 (96.9, 99.1)	99.1 (98.1, 100)	0.1907
Consumes fortifiable oil	35 (31.1, 38.8)	37.9 (32.2, 43.6)	0.3956
Consumes fortified oil			
Yes	8.2 (6.0, 10.5)	6.3 (3.5, 9)	0.2964
No	10.7 (8.2, 13.2)	17.2 (12.8, 21.6)	0.0075
Don't know	16.0 (13.0, 19.0)	14.4 (10.3, 18.6)	0.5555
Does not consume fortifiable oil	65.0 (61.2, 68.9)	62.1 (56.4, 67.8)	0.3956
LAGOS	**n=81**	**n=790**	
Consumes salt	100.0 (100.0, 100.0)	98.3 (97.4, 99.2)	-[5]
Consumes fortifiable salt	100.0 (100.0, 100.0)	98.3 (97.4, 99.2)	-[5]
Consumes fortified salt			
Yes	79.7 (71, 88.4)	88.7 (86.5, 90.9)	0.0170
No	8.5 (2.3, 14.8)	4.3 (2.9, 5.7)	0.0879
Don't know	11.7 (5, 18.5)	5.3 (3.7, 6.8)	0.0149
Does not consume fortifiable salt	0	1.7 (0.8, 2.6)	-[5]
Consumes wheat flour	11.1 (3.8, 18.4)	14.5 (12, 17)	0.4300
Consumes fortifiable wheat flour	11.1 (3.8, 18.4)	14.1 (11.6, 16.5)	0.4826
Consumes fortified wheat flour			
Yes	1.4 (0, 4.1)	5.8 (4.1, 7.4)	0.1194
No	0	0	-[5]
Don't know	9.7 (2.8, 16.5)	8.3 (6.4, 10.3)	0.6900
Does not consume fortifiable wheat flour	88.9 (81.6, 96.2)	85.9 (83.5, 88.4)	0.4826
Consumes semolina flour	87.2 (80, 94.5)	86 (83.6, 88.5)	0.7648
Consumes fortifiable semolina flour	79.1 (70, 88.1)	83.4 (80.8, 86)	0.3271
Consumes fortified semolina flour			
Yes	50.4 (39.3, 61.5)	70.9 (67.7, 74)	0.0002
No	0	0	-[5]
Don't know	28.7 (18.6, 38.8)	12.6 (10.3, 14.9)	<0.0001
Does not consume fortifiable semolina flour	20.9 (11.9, 30.0)	16.6 (14.0, 19.2)	0.3271
Consumes maize flour	32.7 (22.4, 42.9)	10.2 (8.1, 12.4)	< 0.0001

Coverage[2]	Poor (% (95% CI))[3]	Non-poor (% (95% CI))[3]	p-value[4]
Consumes fortifiable maize flour	6.0 (1.2, 10.8)	2.6 (1.4, 3.7)	0.0657
Consumes fortified maize flour			
Yes	0	0.2 (0, 0.6)	-[5]
No	0	0	-[5]
Don't know	6.0 (1.2, 10.8)	2.3 (1.3, 3.4)	0.0405
Does not consume fortifiable maize flour	94.0 (89.2, 98.8)	97.4 (96.3, 98.6)	0.0657
Consumes sugar	82.0 (73.6, 90.4)	89.5 (87.3, 91.6)	0.0435
Consumes fortifiable sugar	82.0 (73.6, 90.4)	89.5 (87.3, 91.6)	0.0435
Consumes fortified sugar			
Yes	20.4 (11.5, 29.3)	37.0 (33.6, 40.4)	0.0031
No	14.8 (6.9, 22.7)	18.4 (15.7, 21.1)	0.4316
Don't know	46.8 (35.7, 57.9)	34.1 (30.7, 37.4)	0.0245
Does not consume fortifiable sugar	18.0 (9.6, 26.4)	10.5 (8.4, 12.7)	0.0435
Consumes oil	100.0 (100.0, 100.0)	98.4 (97.6, 99.3)	-[5]
Consumes fortifiable oil	17.7 (9.2, 26.2)	23.2 (20.3, 26.2)	0.2725
Consumes fortified oil			
Yes	4.8 (0.1, 9.6)	7.4 (5.6, 9.3)	0.3965
No	6.4 (0.9, 11.8)	9.4 (7.3, 11.4)	0.3817
Don't know	6.5 (1, 12.1)	6.4 (4.7, 8.1)	0.9708
Does not consume fortifiable oil	82.3 (73.8, 90.8)	76.8 (73.8, 79.7)	0.2725

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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 0 IU/kg added vitamin A, sugar > 750 IU/kg vitamin A, oil with > 10,000 IU/kg vitamin A). "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 within each State 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] Comparing the poor and non-poor values. Complex survey chi-square test was used to compare percentages.

[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]

Coverage[2]	Lower Dietary Diversity (% (95% CI))[3]	Higher Dietary Diversity (% (95% CI))[3]	p-value[4]
KANO	**n=205**	**n=579**	
Consumes salt	96.0 (93.4, 98.6)	96.3 (94.7, 97.9)	0.8484
Consumes fortifiable salt	96.0 (93.4, 98.6)	96.3 (94.7, 97.9)	0.8484
Consumes fortified salt			
Yes	22.0 (16.3, 27.8)	21.9 (18.5, 25.3)	0.1124
No	4.3 (1.5, 7.1)	10.0 (7.5, 12.5)	0.3192
Don't know	69.6 (63.3, 76)	64.4 (60.4, 68.3)	0.0555
Does not consume fortifiable salt	2.3 (0.3, 4.3)	1.3 (0.3, 2.2)	0.3022
Consumes wheat flour	84.6 (79.6, 89.6)	88.3 (85.6, 91)	0.1763
Consumes fortifiable wheat flour	84.6 (79.6, 89.6)	88.1 (85.5, 90.8)	0.1993
Consumes fortified wheat flour			
Yes	14.8 (9.8, 19.7)	27.3 (23.7, 31.0)	0.0004
No	0	0.2 (0, 0.5)	-[5]
Don't know	69.8 (63.5, 76.2)	60.6 (56.6, 64.6)	0.0197
Does not consume fortifiable wheat flour	15.4 (10.4, 20.4)	11.9 (9.2, 14.5)	0.1993
Consumes semolina flour	7.6 (4, 11.2)	15.1 (12.1, 18)	0.0067
Consumes fortifiable semolina flour	6.6 (3.2, 9.9)	12.6 (9.9, 15.3)	0.0169
Consumes fortified semolina flour			
Yes	4.3 (1.6, 6.9)	7.9 (5.7, 10.1)	0.0666
No	0	0	-[5]
Don't know	2.3 (0.1, 4.5)	4.7 (3, 6.5)	0.1564
Does not consume fortifiable semolina flour	93.4 (90.1, 96.8)	87.4 (84.7, 90.1)	0.0169
Consumes maize flour	79.4 (73.8, 85)	77.2 (73.8, 80.6)	0.5230
Consumes fortifiable maize flour	12.7 (8.2, 17.1)	10.3 (7.8, 12.9)	0.3531
Consumes fortified maize flour			
Yes	0.9 (0, 2.2)	1.9 (0.7, 3)	0.3410
No	1.0 (0, 2.4)	2.4 (1.1, 3.6)	0.2397
Don't know	10.7 (6.6, 14.9)	6.1 (4.1, 8.0)	0.0257
Does not consume fortifiable maize flour	87.3 (82.9, 91.8)	89.7 (87.1, 92.2)	0.3531
Consumes sugar	96.0 (93.4, 98.6)	96.3 (94.7, 97.9)	0.8484
Consumes fortifiable sugar	96.0 (93.4, 98.6)	96.3 (94.7, 97.9)	0.8484
Consumes fortified sugar			

Coverage[2]	**Lower Dietary Diversity (% (95% CI))**[3]	**Higher Dietary Diversity (% (95% CI))**[3]	**p-value**[4]
Yes	22.0 (16.3, 27.8)	21.9 (18.5, 25.3)	0.9636
No	4.3 (1.5, 7.1)	10.0 (7.5, 12.5)	0.0123
Don't know	69.6 (63.3, 76.0)	64.4 (60.4, 68.3)	0.1784
Does not consume fortifiable sugar	4.0 (1.4, 6.6)	3.7 (2.1, 5.3)	0.8484
Consumes oil	99.6 (98.9, 100)	99.8 (99.3, 100)	0.7093
Consumes fortifiable oil	39.7 (32.9, 46.5)	34.8 (30.9, 38.7)	0.2112
Consumes fortified oil			
Yes	8.8 (4.8, 12.7)	7.6 (5.4, 9.8)	0.5855
No	12.8 (8.2, 17.5)	13.4 (10.6, 16.2)	0.8471
Don't know	18.1 (12.7, 23.5)	13.9 (11, 16.7)	0.1489
Does not consume fortifiable oil	60.3 (53.5, 67.1)	65.2 (61.3, 69.1)	0.2112
LAGOS	**n=240**	**n=438**	
Consumes salt	99.1 (97.9, 100)	99.8 (99.3, 100)	0.2582
Consumes fortifiable salt	99.1 (97.9, 100)	99.8 (99.3, 100)	0.2582
Consumes fortified salt			
Yes	91.1 (87.5, 94.7)	91.4 (88.8, 94.0)	0.8772
No	4.4 (1.8, 7)	4.1 (2.3, 6.0)	0.8690
Don't know	3.6 (1.3, 5.9)	4.2 (2.4, 6.0)	0.7122
Does not consume fortifiable salt	0.9 (0, 2.1)	0.2 (0, 0.7)	0.2582
Consumes wheat flour	12.9 (8.6, 17.2)	19.2 (15.4, 22.9)	0.0395
Consumes fortifiable wheat flour	12.4 (8.2, 16.7)	18.7 (15, 22.4)	0.0386
Consumes fortified wheat flour			
Yes	5.6 (2.6, 8.6)	6.8 (4.4, 9.2)	0.5521
No	0	0	-[5]
Don't know	6.8 (3.6, 10.0)	11.9 (8.8, 14.9)	0.0384
Does not consume fortifiable wheat flour	87.6 (83.3, 91.8)	81.3 (77.6, 85.0)	0.0386
Consumes semolina flour	87.2 (83, 91.4)	89.1 (86.2, 92)	0.4624
Consumes fortifiable semolina flour	84.9 (80.3, 89.4)	85.4 (82, 88.7)	0.8562
Consumes fortified semolina flour			
Yes	74.3 (68.7, 79.8)	72.1 (67.9, 76.4)	0.5507
No	0	0	-[5]
Don't know	10.6 (6.7, 14.5)	13.2 (10, 16.4)	0.3147
Does not consume fortifiable semolina flour	15.1 (10.6, 19.7)	14.6 (11.3, 18.0)	0.8562

Coverage[2]	Lower Dietary Diversity (% (95% CI))[3]	Higher Dietary Diversity (% (95% CI))[3]	p-value[4]
Consumes maize flour	11.9 (7.8, 16)	13.0 (9.8, 16.1)	0.6958
Consumes fortifiable maize flour	1.8 (0, 3.6)	3.6 (1.8, 5.3)	0.2105
Consumes fortified maize flour			
Yes	0	0.4 (0, 1.1)	-[5]
No	0	0	-[5]
Don't know	1.8 (0, 3.6)	3.1 (1.5, 4.8)	0.3248
Does not consume fortifiable maize flour	98.2 (96.4, 100)	96.4 (94.7, 98.2)	0.2105
Consumes sugar	92.7 (89.4, 96)	93.8 (91.5, 96.1)	0.5841
Consumes fortifiable sugar	92.7 (89.4, 96)	93.8 (91.5, 96.1)	0.5841
Consumes fortified[6] sugar			
Yes	39.2 (33, 45.5)	39.6 (35, 44.2)	0.9192
No	11.8 (7.7, 15.9)	23.2 (19.2, 27.2)	0.0003
Don't know	41.7 (35.4, 48)	31.0 (26.6, 35.3)	0.0053
Does not consume fortifiable sugar	7.3 (4.0, 10.6)	6.2 (3.9, 8.5)	0.5841
Consumes oil	100.0 (100.0, 100.0)	99.8 (99.3, 100.0)	-[5]
Consumes fortifiable oil	26.7 (21.1, 32.3)	22.1 (18.3, 26)	0.1840
Consumes fortified oil			
Yes	8.4 (4.8, 11.9)	8.4 (5.8, 11)	0.9995
No	12.0 (7.8, 16.1)	8.5 (5.9, 11.1)	0.1433
Don't know	6.3 (3.3, 9.3)	5.3 (3.2, 7.3)	0.5619
Does not consume fortifiable oil	73.3 (67.7, 78.9)	77.9 (74.0, 81.7)	0.1840

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: salt > 10 mg/kg iodine, wheat flour > 17 mg/kg iron, semolina flour > 4 mg/kg iron, maize flour > 0 IU/kg added vitamin A, sugar > 750 IU/kg vitamin A, and oil with > 10,000 IU/kg vitamin A). "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 within each State 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 State. Higher dietary diversity refers to a dietary diversity score greater than or equal to the population median in each State. 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.

[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.[1,2,3,4,5,6]

Food	Total N	n (%)			
		Unfortified	Inadequately fortified	Adequately fortified	Over fortified
KANO					
Salt[1]	731	170 (23.3)	261 (35.7)	205 (28.0)	95 (13.0)
Wheat flour[2]	110	2 (1.8)	78 (70.9)	30 (27.3)	NA
Semolina flour[3]	23	0 (0)	17 (73.9)	6 (26.1)	NA
Maize flour[4]	33	0 (0)	18 (54.6)	15 (45.5)	NA
Sugar[5]	238	69 (29.0)	167 (70.2)	2 (0.8)	NA
Oil[6]	256	104 (40.6)	32 (12.5)	120 (46.9)	NA
LAGOS					
Salt[1]	645	55 (8.5)	21 (3.3)	76 (11.8)	493 (76.4)
Wheat flour[2]	15	0 (0)	4 (26.7)	11 (73.3)	NA
Semolina flour[3]	233	0 (0)	177 (76.0)	56 (24.0)	NA
Maize flour[4]	2	0 (0)	2 (100.0)	0 (0)	NA
Sugar[5]	264	71 (26.9)	189 (71.6)	4 (1.5)	NA
Oil[6]	247	126 (51.0)	44 (17.8)	77 (31.2)	NA

Abbreviation: NA, not applicable

[1] Fortification quality for salt was determined by analyzing the iodine levels in samples taken from households and comparing the result to standards adapted from the World Health Organization (WHO 2007) as follows: "Unfortified" had ≤ 10 mg/kg iodine, "inadequately fortified" had > 10-< 15 mg/kg iodine, "adequately fortified" had ≥ 15-< 40 mg/kg iodine, and "over fortified" had ≥ 40 mg/kg iodine.

[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 17.0 mg/kg based on analyses of unfortified wheat flour samples from Nigeria), and comparing the result to the Nigeria standard for wheat flour (SON 2015a) as follows: "Unfortified" had ≤ 17 mg/kg iron, "inadequately fortified" had > 17-< 40.7 mg/kg iron, "adequately fortified" had ≥ 40.7 mg/kg iron. There was no "over fortified" category as there are no maximums in country standards.

[3] Fortification quality for semolina 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 semolina flour (in this study the instrinsic level of iron in the wheat flour was determined to be 4.0 mg/kg based on analyses of unfortified semolina flour samples from Nigeria), and comparing the result to the Nigeria standard for wheat semolina (SON 2015b) as follows: "Unfortified" had ≤ 4 mg/kg iron, "inadequately fortified" had > 4-< 40.7 mg/kg iron, "adequately fortified" had ≥ 40.7 mg/kg iron. There was no "over fortified" category as there are no maximums in country standards.

[4] Fortification quality for maize flour was determined by analyzing the vitamin A levels in samples taken from households and subtracting an estimate of the level of intrinsic fluorescence naturally occuring in maize flour (in this study the instrinsic level of fluorescence in the maize flour was determined to be 3710 IU/kg based on analysis of an unfortified maize flour specimen from Nigeria) comparing the result to the Nigeria standard for maize flour (SON 2010) as follows: "Unfortified" had ≤ 3710 IU/kg vitamin A, "inadequately fortified" had > 3710-< 30,000 IU/kg vitamin A, "adequately fortified" had ≥ 30,000 IU/kg vitamin A. There was no "over fortified" category as there are no maximums in country standards.

[5] Fortification quality for sugar was determined by analyzing the vitamin A levels in samples taken from households and comparing the result to the Nigeria standard for refined white sugar (SON 2000c) as follows: "Unfortified" had ≤ 750 IU/kg vitamin A, "inadequately fortified" had > 750-< 25,000 IU/kg vitamin A, and "adequately fortified" had ≥ 25,000 IU/kg vitamin A. There was no "over fortified" category as there are no maximums in country standards.

[6] Fortification quality for oil was determined by analyzing the vitamin A levels in samples taken from households and comparing the result to the Nigeria standard for ground nut oil (SON 2000a) and soya bean oil (SON 2000b) as follows: "Unfortified" had ≤ 10,000 IU/kg vitamin A, "inadequately fortified" had > 10,000-< 20,000 IU/kg vitamin A, and "adequately fortified" had ≥ 20,000 IU/kg vitamin A. There was no "over fortified" category as there are no maximums in country standards.

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