



FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

Methods Guide

Needs Assessment and Design Methodology to Guide Large-Scale Food Fortification and Broader Programming to Improve Diets

Tool 2 of 3 in the LSFF Methodology Series



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September 2023

About USAID Advancing Nutrition

USAID Advancing Nutrition is the Agency's flagship multi-sectoral nutrition project, led by JSI Research & Training Institute, Inc. (JSI), and a diverse group of experienced partners. Launched in September 2018, USAID Advancing Nutrition implements nutrition interventions across sectors and disciplines for USAID and its partners. The project's multi-sectoral approach draws together global nutrition experience to design, implement, and evaluate programs that address the root causes of malnutrition. Committed to using a systems approach, USAID Advancing Nutrition strives to sustain positive outcomes by building local capacity, supporting behavior change, and strengthening the enabling environment to save lives, improve health, build resilience, increase economic productivity, and advance development. This project contributes to the goals of the U.S. Government's Feed the Future initiative by striving to sustainably reduce hunger and improve nutrition and resilience.

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This report was produced for the U.S. Agency for International Development. It was prepared under the terms of contract 7200AA18C00070 awarded to JSI Research & Training Institute, Inc. (JSI). The contents are the responsibility of JSI, and do not necessarily reflect the views of USAID or the U.S. Government.

Recommended Citation

USAID Advancing Nutrition. 2023. *Methods Guide: Needs Assessment and Design Methodology to Guide Large-Scale Food Fortification and Broader Programming to Improve Diets*. Arlington, VA: USAID Advancing Nutrition.

Cover photo: Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING)

USAID Advancing Nutrition

JSI Research & Training Institute, Inc.
2733 Crystal Drive
4th Floor
Arlington, VA 22202

Phone: 703-528-7474
Email: info@advancingnutrition.org
Web: advancingnutrition.org

Contents

| | |
|---|----|
| Acknowledgments | iv |
| Abbreviations and Acronyms..... | v |
| Glossary of Terms | vi |
| Introduction to the Methods Guide..... | 1 |
| How do you use the Methods Guide?..... | 1 |
| Step 1. Needs Assessment | 2 |
| Information need: Adequacy of micronutrient intake/supply..... | 2 |
| Step 2. Design/Redesign | 7 |
| 2.1 Information need: Fortifiable food consumption..... | 7 |
| 2.2 Information need: Availability of fortifiable and fortified foods in markets | 11 |
| 2.3 Information need: Predicted contribution of food fortification to micronutrient adequacy..... | 15 |
| Optional Step. Modeling Diet Cost and Affordability..... | 19 |
| Information need: Cost and affordability of an adequate diet without/with LSFF | 19 |
| References | 21 |
| Annex 1 EAR and UL cut-point methods, full probability approach, usual intake, and dietary reference values | 25 |
| Annex 2 Detailed description of needs assessment analysis steps by data source..... | 29 |
| Annex 3 Detailed description – estimation of fortifiable food consumption by data source | 37 |
| Annex 4 Estimated micronutrient adequacy per AFE and nutrient density approaches..... | 40 |
| Annex 5 Detailed description of analysis of market data | 41 |
| Annex 6 Detailed description of the analysis of the contribution of fortification to micronutrient adequacy | 44 |
| Annex 7 Fortifiable foods | 49 |
| Annex 8 Cost of the Diet Tool..... | 51 |

Acknowledgments

This detailed methods document was produced by Monica Woldt from the USAID Advancing Nutrition project; Katherine P. Adams and Emmanuel Gyimah from the University of California Davis; Svenja Jungjohann and Liezel Engelbrecht from the Global Alliance for Improved Nutrition, and USAID Advancing Nutrition consultant Jacky Hems. The following individuals provided valuable feedback and suggestions on draft versions of the guide: Ingrid Weiss, Rebecca Egan, Tim Quick, and Omar Dary from the U.S. Agency for International Development; Reina Engle-Stone from the University of California Davis; Mduduzi Mbuya, Penjani Mkumbula, and Valerie Friesen from the Global Alliance for Improved Nutrition; USAID Advancing Nutrition consultants Olufolakemi Mercy Anjorin and Musonda Mofu; and Jennifer Yourkavitch, Silvia Alayón, Heather Danton, and Noni Alexander from USAID Advancing Nutrition. The work of Kevin Tang from the London School of Hygiene and Tropical Medicine and the Cost of the Diet work by Save the Children UK and the World Food Programme provided valuable inputs for the methodology.

Abbreviations and Acronyms

| | |
|--------|---|
| AFE | adult female equivalent |
| AME | adult male equivalent |
| CotD | Cost of the Diet |
| EAR | estimated average requirement |
| EFSA | European Food Safety Authority |
| FACT | Fortification Assessment Coverage Toolkit |
| FAO | Food and Agriculture Organization of the United Nations |
| FCT | food composition table |
| FBS | food balance sheet(s) |
| GAIN | Global Alliance for Improved Nutrition |
| H-AR | harmonized average requirement |
| H-UL | harmonized tolerable upper intake level |
| HCES | household consumption and expenditure survey |
| IOM | Institute of Medicine |
| kcal | kilocalorie |
| LSFF | large-scale food fortification |
| RDA | recommended dietary allowance |
| RNI | recommended nutrient intake |
| SNUT | staple-adjusted nutritious (diet) |
| SQ-FFQ | semi-quantitative food frequency questionnaire |
| UL | tolerable upper intake level |
| USAID | U.S. Agency for International Development |
| WFP | World Food Programme |
| WHO | World Health Organization |

Glossary of Terms¹

Adult female equivalent (AFE): A unit of measure to serve as a reference value based on the Food and Agriculture Organization of the United Nations (FAO) estimate of individual energy requirements for an adult non-pregnant, non-lactating woman. For example, the energy requirement of a 55-kilogram 18- to 29-year-old non-pregnant, non-lactating woman, based on a moderate activity level, would be 2,100 kcal/day, which would then be an AFE of 1. This would then be the reference value and other age and sex groups would be weighted accordingly based on their corresponding estimated energy needs.

Adult male equivalent (AME): A unit of measure to serve as a reference value based on the FAO estimate of individual energy requirements for an adult man. For example, the energy requirement of a 60-kilogram 18- to 29-year-old man, based on a moderate activity level, would be 2,550 kcal/day, which would then be an AME of 1. This would then be the reference value and other age and sex groups would be weighted accordingly based on their corresponding estimated energy needs.

Agri-food information system: For the purpose of this guide agri-food information systems refer to information systems that provide data (either primary or aggregated data) related to the agri-food system. FAO food balance sheets (FBS) fall under this definition, as do other publicly available data bases on food supply.

Apparent intake: The approximated amount of a food (and its nutrients) that a person is assumed to have ingested as estimated using non-direct measures of food intake. It is calculated through secondary analysis of national food balance sheets, household economic surveys, and similar data sources using national or household-level data on food availability, access, acquisition, and/or consumption. The estimates can be expressed as per capita or, if assuming intake proportional to energy requirement, per adult male equivalent or per adult female equivalent (WHO 2021).

Brand/brand products: Refers to a unit defined as a specific food product that can be identified in the market that would typically have a product description (e.g., Supermaize meal or Maize grit) and the brand name (e.g., ACE). Often these can also be connected to their supplier. The product description could also just be the food type, or include additional descriptive words (e.g., triple refined sunflower oil). Different brands/brand products can be categorized by food types.

Commercial monitoring: The process of collecting and analyzing food samples and reviewing product packaging at retail stores and other food distribution sites to confirm that the product follows specifications, such as micronutrient content and labeling requirements, as outlined in the fortification standards. Also referred to as retail or market monitoring (WHO 2021).

Consumption monitoring: Refers to procedures and actions aimed to assess, in individuals and populations, the change in nutrient intake that can be attributed to the consumption of fortified foods and the additional content of nutrients incorporated to them. The objectives are to track fortified food coverage, micronutrient provision, fortified food utilization, and micronutrient intake. Formerly known as household/individual monitoring (WHO 2021).

Coverage: The proportion of the surveyed population that consumes a fortifiable or fortified food during a predetermined period of time. Coverage may be disaggregated by criteria such as age, sex, economic situation, geographical area, ethnic group, and others (WHO 2021).

Critical nutrient density: The critical nutrient density is a reference value that consists of a dietary reference intake for a specific nutrient as the numerator and daily energy requirements as the

¹ Source: USAID, 2021, USAID Large-scale Food Fortification Guide, unless otherwise noted.

denominator, considering sex- and age-specific nutrient requirements. It is the amount of a nutrient, typically per 1,000 kcal, that would achieve the nutrient requirement, assuming energy requirements are also being met (Vossenaar et al. 2019).

Critical upper density: The critical upper density is an age- and sex-specific reference value that consists of a tolerable upper intake level for safe consumption for a specific nutrient as the numerator and daily energy requirements as the denominator, typically expressed per 1,000 kcal. It is the highest nutrient density unlikely to pose risk of adverse health effects to almost all (97.5 percent) of apparently healthy individuals, assuming energy requirements are being met (Adapted from Vossenaar et al. 2019).

Dietary reference intake (DRI): A quantitative value of daily nutrient intake that is used as a reference value for planning and assessing nutrient adequacy of diets for apparently healthy people. Examples include estimated average requirements (EARs), recommended nutrient intakes (RNIs), which have been replaced in some countries with recommended daily allowances (RDAs), and tolerable upper intake levels (ULs).

Estimated average requirement (EAR): The median daily nutrient intake level estimated to meet the needs of half the healthy individuals in a particular age and sex group. The EAR is used to derive the recommended nutrient intake (RNI). The EAR is the reference value to determine the adequacy of nutrients in the diet of populations, while the RNI is used to assess at the individual level.

External monitoring: Activities carried out by government inspectors to make sure that the food industry complies with food standards. In the case of fortified foods, that they a) are produced in a manner that should achieve the specifications of the fortification standard and b) conform to the other specifications mentioned in the food standard. The two components of external monitoring include technical audits and factory inspections.

Equitable market supply (in LSFF): The market availability of fortifiable or fortified foods is similar between socioeconomic groups, for example, between urban and rural areas and wealth groups within urban and rural areas.

Food balance sheets (FBS): A source of secondary data used to provide information on the quantity of foods available to consumers in a specified reference period in a country and determine national-level food consumption patterns (adapted from Coates et al. 2012).

Food type: Refers to a sub-category of food and defines the type of food category such as sunflower oil, palm oil, cottonseed oil OR cake flour, bread flour, whole wheat flour OR fine or coarse salt OR brown or white sugar. Different brands/brand products can be categorized by food types.

Fortifiable food: In this document, refers to foods produced by formal and centralized industries that could be fortified according to national/regional/local legislation and standards, and that meet threshold estimates for what constitutes “large-scale” in low- and high-income countries—see Annex 7 in the [USAID LSFF Programming Guide](#).

Fortified food: Refers to a food that is definitively fortified according to qualitative or quantitative tests (adapted from WHO 2021).

Fortification: The practice of increasing the content of micronutrients (vitamins and minerals) and other minerals required in relatively large amounts such as calcium, as well as essential amino acids and essential fatty acids, in a food so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.

Fortification vehicle: A staple food or condiment that is fortifiable and regularly consumed by the target population(s).

Harmonized average requirement (H-AR): Estimated average requirements (EARs) for micronutrients that can be applied on a global scale to assess intakes across populations. The H-AR

values were selected from standards set by the European Food Safety Authority (EFSA) and the Institute of Medicine (IOM), giving priority to the EARs published most recently (Allen et al. 2019).

Harmonized tolerable upper intake level (H-UL): Estimated tolerable upper intake levels for micronutrients that can be applied on a global scale to assess intakes across populations. The H-UL values were selected from standards set by the European Food Safety Authority (EFSA) and the Institute of Medicine (IOM), giving priority to the ULs published most recently (Allen et al. 2019).

Household food consumption module of the household consumption and expenditure survey (HCES): The household food consumption module of the HCES is used to collect data on the amount of food consumed by the household or the amount of food acquired by the household in a specific reference period (Coates et al. 2012, Imhoff-Kunsch et al. 2012). The HCES usually collects information on the food consumed/acquired by households. Attempts are also ongoing to assess foods consumed by household members outside the household.

Implementing partner: An organization or individual with which/whom USAID collaborates to achieve mutually agreed upon objectives. Partners include host-country governments, private voluntary organizations, indigenous and international nongovernmental organizations, universities, other U.S. Government Agencies and Departments, the United Nations and other multilateral organizations, professional and business associations, and private businesses and individuals (USAID 2021).

Import monitoring: The actions taken by government inspectors and customs personnel at border entry points to ensure that fortified foods entering a country adhere to labeling requirements and are fortified according to the country's fortification and food standard.

Internal monitoring: The actions taken by food processing operators to ensure that a) foods are manufactured in a manner that should comply with the specifications of the fortification standard and b) the final product adheres to all the other requirements mentioned in the food standard. It includes both quality assurance and quality control procedures.

Large-scale food fortification (LSFF): Large-scale food fortification is the addition of vitamins and minerals during processing of commonly consumed staple foods and condiments in formal and centralized industries. It has also been known as industrial food fortification. For the purposes of the USAID LSFF Programming Guide and USAID's initiative, LSFF refers to those food processors that are of sufficient size and sophistication to implement this practice with efficiency and low cost.

Linear programming: A mathematical technique that minimizes or maximizes a linear function of a set of variables to generate optimal solutions while simultaneously satisfying multiple constraints (Van Dooren 2018; Briend et al. 2001). It can be used to identify the lowest cost diet, while fulfilling constraints introduced to ensure it is nutritionally adequate or comes as close as possible to being nutritionally adequate.

Monitoring: The continuous collection and review of data and information on program implementation activities for the purposes of identifying problems (such as non-compliance) and taking corrective actions so that the program fulfills its stated objectives.

Normal distribution: In statistics, a normal distribution means that data points fall symmetrically around the mean in a classic "bell curve;" there is no skew (distortion or asymmetry). Under this condition, the mean (average) equals the median (the middle value of a series of numbers arranged in order of size) and the mode (the most frequent value in a set of values) (Oxford Reference 2023a).

Nutrient adequacy: This refers to a diet that supplies sufficient quantities of nutrients that satisfies the recommended nutrient intakes for humans.

Nutrient deficiency: Insufficient metabolic use of essential nutrients required to support basic physiologic processes necessary for health and which is caused by low intake, impaired absorption,

alterations due to diseases or infection/inflammation, parasitism, or metabolic imbalances or a combination of them.

Nutrient density: Nutrient density, as defined and used in this document, is the ratio of the amount of a nutrient in the diet to the energy provided by the same diet. It is frequently expressed as the amount of the nutrient per 1,000 kcal of energy (Vossenaar et al. 2019).

Nutrient inadequacy: This refers to a diet that is unable to supply sufficient quantities of specific nutrients and therefore fails to support good nutrition and health.

Production capacity: The maximum output of fortifiable food that can be produced by a production facility over a given period of time. Production capacity shows the potential output, or theoretical upper limit of fortifiable food able to be produced with installed machines, labor, and resources (adapted from MRPeasy 2023).

Production volume: The reported actual volume of fortifiable food produced per a given time period by a producer.

Quantitative, open 24-hour dietary recall: A structured interview intended to capture detailed information about the quantities of all foods and beverages (and possibly, dietary supplements) consumed by a respondent in the previous 24 hours, most commonly, from midnight to midnight the previous day (National Cancer Institute 2022a; FAO 2018). The term “open” refers to the dietary recall using open-ended questions regarding food consumption, in contrast to closed-ended questions regarding consumption of specific foods or from specific food groups.

Reach: The proportion of households consuming fortifiable foods (either fortified or not) (Omar Dary, personal communication, June 23, 2023).

Recommended dietary allowances (RDAs): Defined by the United States Food and Nutrition Board and conceptually the same as the recommended nutrient intake (RNI) but may have slightly different values for some micronutrients, for example, iron and zinc based on bioavailability in relation to the habitual national diet (Gibson 2005). It is set at the estimated average requirement (EAR) plus two standard deviations (i.e., satisfying the requirements of nearly all [97–98 percent] of healthy individuals). This is the reference value to determine the adequacy of nutrients in the diet of individuals and is the average daily level of intake sufficient to meet nutrient requirements.

Recommended nutrient intake (RNI): Defined by the World Health Organization (WHO), the daily intake that meets the nutrient requirements of almost all apparently healthy individuals in an age- and sex-specific population group. It is set at the estimated average requirement (EAR) plus two standard deviations (i.e., satisfying the requirements of nearly all [97–98 percent] of healthy individuals). This is the reference value to determine the adequacy of nutrients in the diet of individuals.

Regulatory monitoring (in the context of LSFF): Actions taken by government inspectors to ensure that fortified foods comply with the specifications of the food standards. It includes external monitoring at food processors, import monitoring at border entry points, and commercial monitoring at retail and food distribution locations.

Retinol activity equivalent (RAE): A measure of the amount of vitamin A that is available to a person either in the form of vitamin A or precursors (i.e., pro-vitamin A compounds). The RAE takes into consideration more recent data on the bio-efficacy of carotenoids as precursors of vitamin A. Conversion factors for RAE include, e.g., 1 microgram RAE = 1 microgram preformed retinol, 12 micrograms of beta carotene, or 24 micrograms of other pro-vitamin A carotenoids (Oxford Reference 2023b).

Semi-quantitative food frequency: A diet assessment method where respondents report their usual frequency of consumption of foods, from a food list, over a specific time, e.g., seven days, including

portion sizes, either a standardized portion size or a range of portion sizes (National Cancer Institute, 2022b).

Stock variation/change in stock (FAO food balance sheets): Refers to the stock held by all levels of production, but in practice, data, if available, are usually at government level only. Stock variation refers to amounts sent to (utilization) or withdrawn from (supply) stocks. Thus, e.g., domestic supply = (local production) + (imports) – (exports) – (change in stock) = domestic utilization (adapted from Habimana 2019).

Supplier: Refers to the responsible entity of the product which could be the producer or the distributor/importer/exporter. A supplier can provide multiple brands or brand products.

Tolerable upper intake level (UL): The highest average daily nutrient intake level unlikely to pose risk of adverse health effects to almost all (97.5 percent) of apparently healthy individuals in an age- and sex-specific population group. This value is used to ensure safety of the micronutrient supply to individuals and populations.

Tool: A software program and/or systematically organized set of information and resources, generally designed to be used together to collect, analyze, and/or apply to answer specific questions (Merriam-Webster Dictionary 2023).

Usual intake: The long-run average intake of food, nutrients, or a specific nutrient for an individual (Institute of Medicine 2000).

Introduction to the Methods Guide

The Methods Guide is the second part of a package of three tools for needs assessment and design of large-scale food fortification (LSFF) programs for improved diets. Before using this guide, read the Operational Overview, which gives the basic steps for a needs assessment and a data decision tree for selecting and analyzing existing data to inform LSFF design or redesign. For detailed instructions on how to conduct the analyses for the needs assessment and design, read this Methods Guide. For examples of challenges and lessons learned in applying the methodology, please see the third part of this package: *Case Study Nigeria and Zambia Large-Scale Food Fortification Needs Assessment and Design Pilot: Challenges and Lessons Learned*.

How do you use the Methods Guide?

After using the decision tree in the Operational Overview to determine the most suitable available data, refer to this Methods Guide to conduct the needs assessment and design analysis according to your need:

1. Step 1. Needs Assessment
2. Step 2. Design / Redesign
3. Optional Step. Modeling Diet Cost and Affordability

Read the “Information need,” “Questions answered in this step,” and “Method to conduct the analysis.” Then read the key steps in the analysis for your available data source. More detailed analysis steps can be found in the annexes. Box I provides a key to the icons used in this Methods Guide.

Box I. Icons used in the Methods Guide



Information need



Questions answered in this step



Method to conduct the analysis



Steps in the analysis

Step I. Needs Assessment

Information need: Adequacy of micronutrient intake/supply

Information on micronutrient intake can help identify which micronutrients should be provided through LSFF or other interventions because they are insufficient in the diet, as well as micronutrients that may be excessive in the diet.

Questions answered in this step

- Which micronutrients are consumed in—
 - inadequate amounts?
 - amounts above the tolerable upper intake level (UL) for safe consumption?
- Which population strata are most affected?

Method to conduct the analysis

Estimate micronutrient adequacy using the estimated average requirement (EAR) cut-point method and the tolerable upper intake level (UL) cut-point method for most micronutrients. Compare micronutrient intake to the age-, sex-, and physiologic status-specific EAR and/or UL for the reference group or reference household member selected for the analysis. Determine the prevalence of micronutrient intake below the EAR or above the UL. The following data sources can be used to estimate micronutrient intake:

- quantitative open 24-hour dietary recall for individuals
- semi-quantitative food frequency questionnaire (SQ-FFQ) for individuals
- household consumption and expenditure surveys (HCES) for households.

National-level food balance sheet (FBS) data cannot be used to estimate individual or household micronutrient intake or adequacy. However, nutrient supply analysis of FBS data can be useful to identify nutrients that merit further study through the other data sources noted above because of probable insufficiency.

In the case of iron, because the distribution of requirements is not normally distributed, use the full probability approach. [Annex I](#) describes how to use the EAR and UL cut-point methods and the full probability approach.

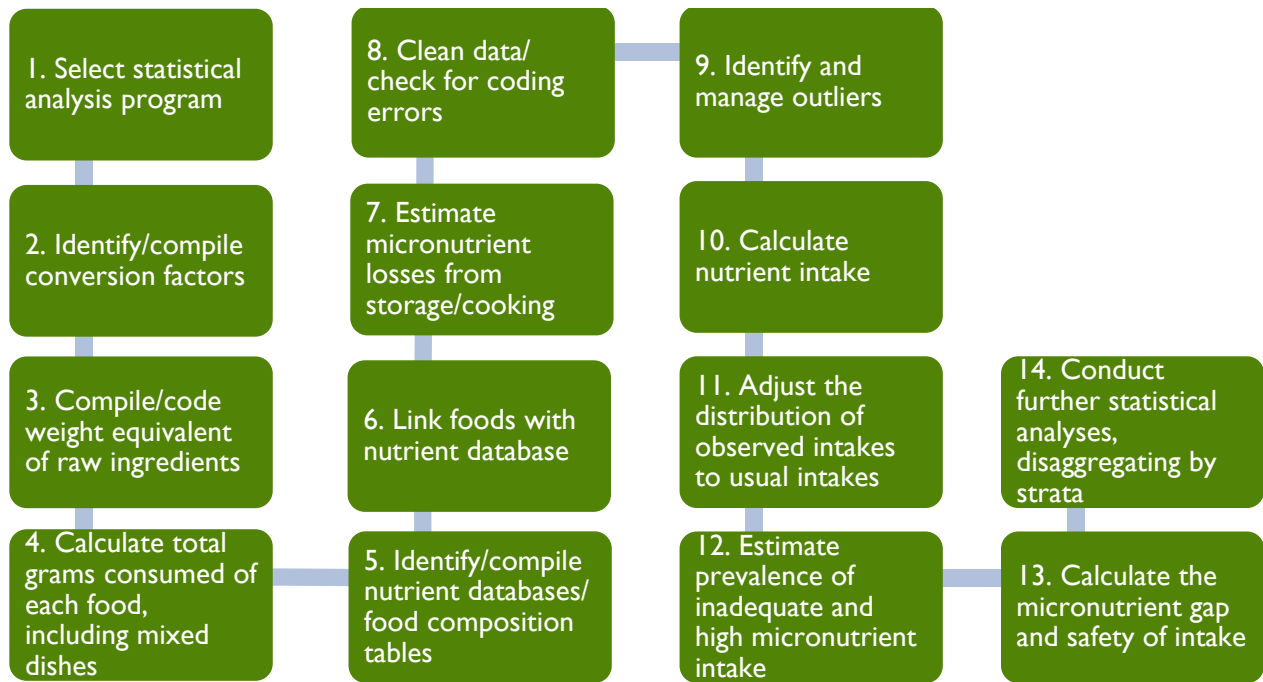


Steps in the analysis by data source

Quantitative open 24-hour dietary recall data

Figure 1 shows the basic data analysis steps for using quantitative open 24-hour dietary recall data for LSFF needs assessment. Detailed methods are described in [Annex 2](#).

Figure 1. Steps in the analysis using quantitative open 24-hour dietary recall data

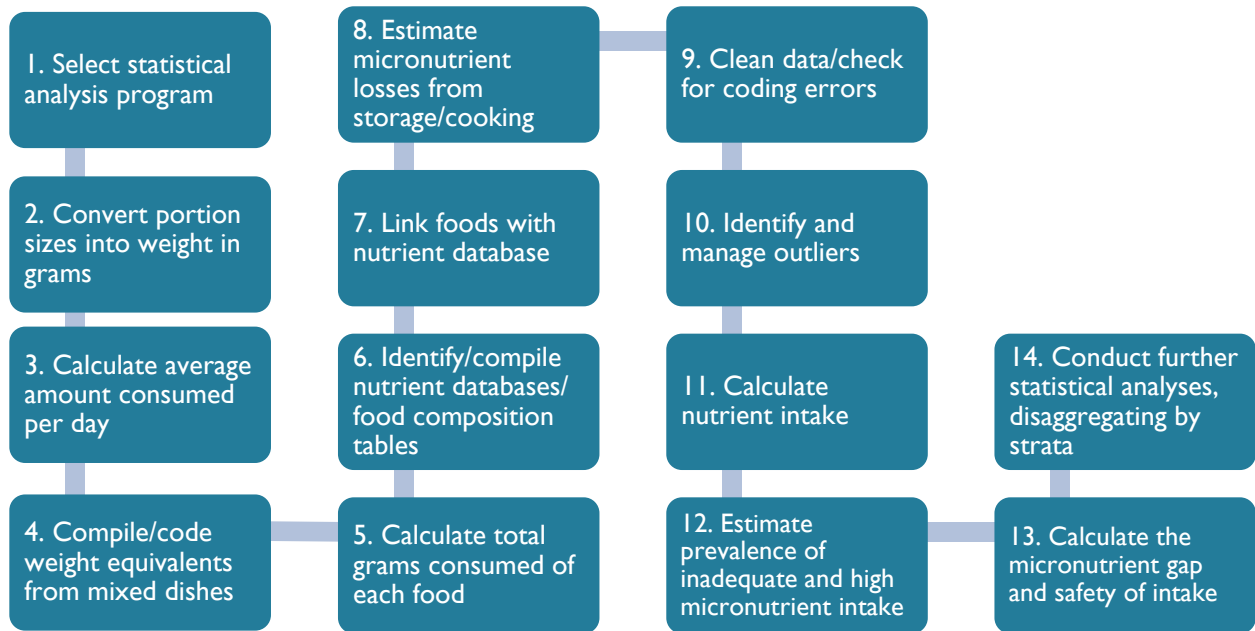


Source: Adapted from Gibson and Ferguson 2008.

Semi-quantitative food frequency data

Figure 2 shows the basic data processing steps for SQ-FFQ data for LSFF needs assessment. The basic steps to analyze the SQ-FFQ data are generally the same as those for the quantitative open 24-hour dietary recall (see above), with the exception that SQ-FFQ data are usually considered to represent “usual” intake, so the statistical adjustment to estimate usual intake distributions is not necessary. As such, analysts can directly calculate descriptive statistics such as mean nutrient intake. Detailed methods are described in [Annex 2](#).

Figure 2. Steps in the analysis using SQ-FFQ data

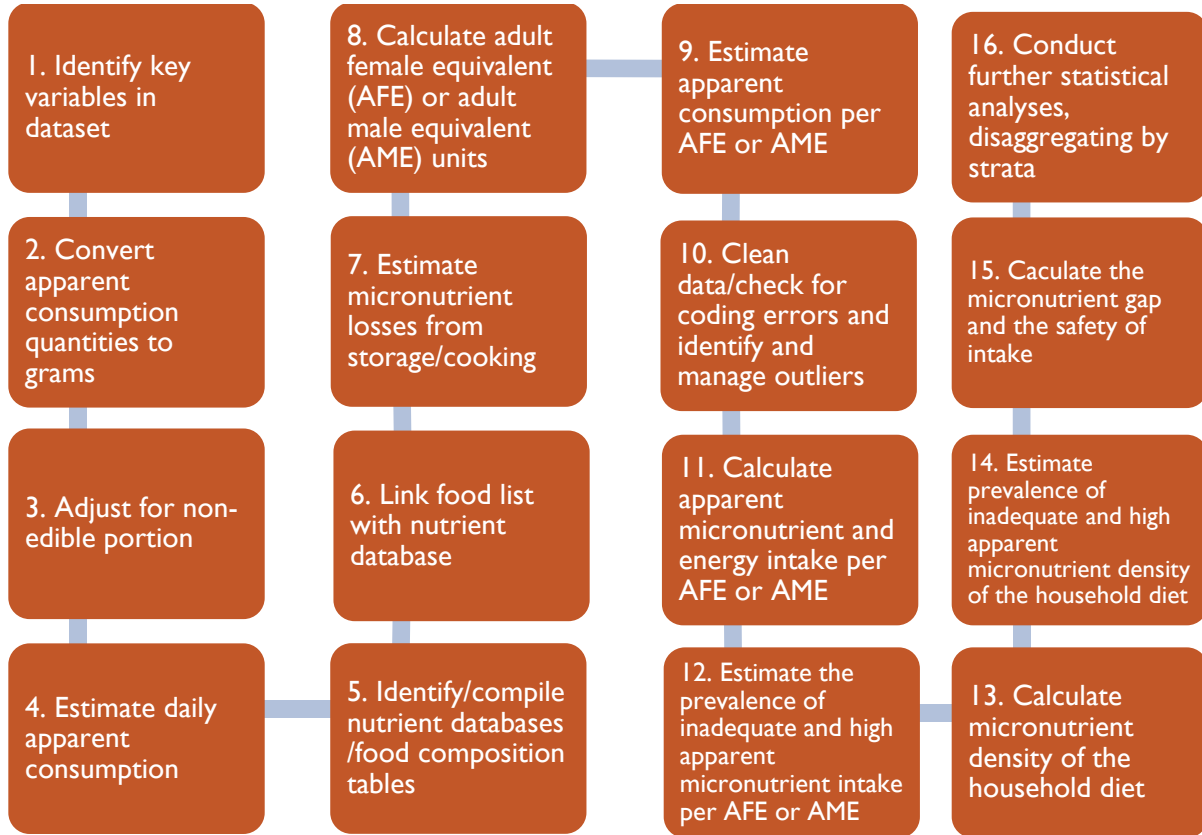


Source: Adapted from National Cancer Institute 2022b.

HCES data

Figure 3 shows the basic analysis steps for HCES data for LSFF needs assessment. Detailed methods are described in [Annex 2](#).

Figure 3. Steps in the analysis using HCES data

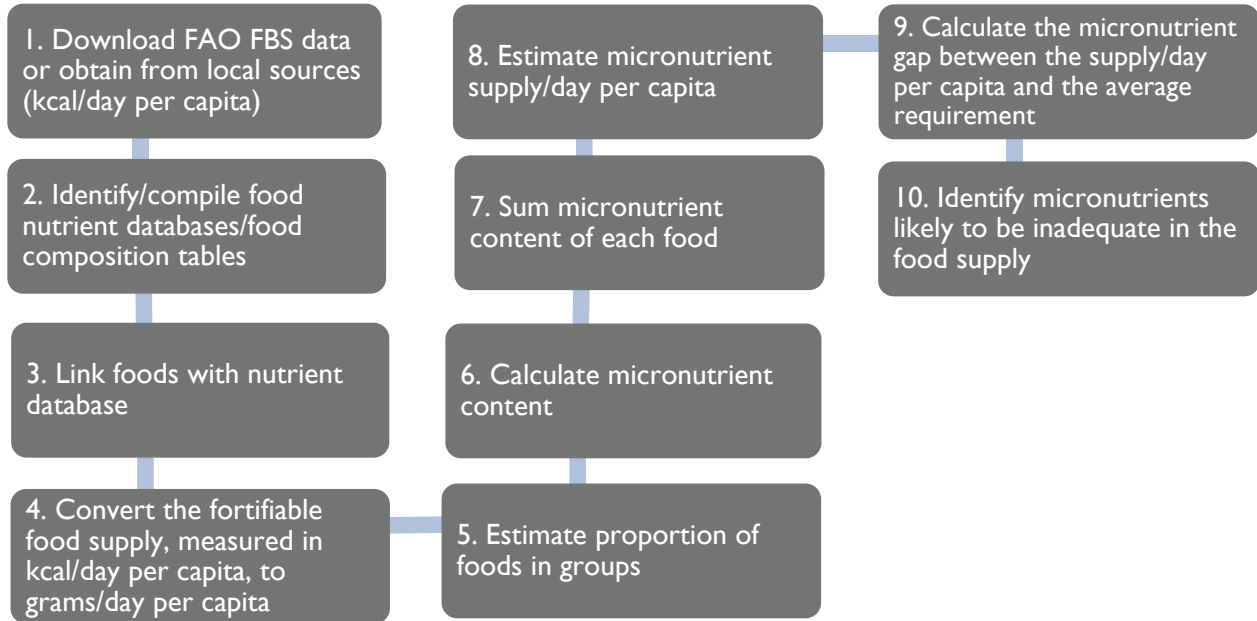


Source: Adapted from Imhoff-Kunsch et al. 2012; Adams et al. 2022.

FBS data

The data from FBSs could be useful to identify micronutrients that are insufficient at the national level and therefore may be inadequate among some population strata. If this is the case, it justifies the application of any of the methodologies mentioned above. However, FBS data are inadequate for needs assessment for LSFF programming. Figure 4 shows the basic analysis steps for the FBS data. Detailed methods are described in [Annex 2](#).

Figure 4. Steps in the analysis using FBS data



Sources: Adapted from Gibson and Cavalli-Sforza 2012; Joy et al. 2014; Mark et al. 2016; Del Gobbo et al. 2015; Arsenault et al. 2015.

Step 2. Design/Redesign

2.1 Information need: Fortifiable food consumption

Food consumption data can help to suggest which centrally processed foods that are consumed could serve as probable food vehicles for fortification with the micronutrients that are inadequate in the diet, especially among populations that are vulnerable to micronutrient inadequacies.

Question answered in this step

- Which fortifiable foods (staples and condiments) have high coverage among target households or individuals, and could serve as a probable food vehicle for fortification with the micronutrients that are inadequate in the current diet?
- Which population strata may be benefited if the identified foods are fortified?

Method to conduct the analysis

Use the following steps to systematically guide you:

- Estimate the supply, acquisition, or consumption of fortifiable foods.
- Determine whether the foods are [fortifiable](#) at large scale using information available in the existing data selected for the analysis, if available.
- If the latter information on fortifiable foods is not available in the dataset, use industry estimates of the percent of the market share of the food that is processed centrally, or discuss with country stakeholders to identify reasonable estimates.

Steps in the analysis by data source

Quantitative open 24-hour dietary recall and SQ-FFQ data

Table I shows the basic steps in the analysis by data source for quantitative open 24-hour dietary recall and SQ-FFQ data. Detailed methods are described in [Annex 3](#). These steps allow estimation of micronutrient inadequacies and consumption of fortifiable foods at the population level considering individual intake.

Table 1. Steps in the analysis of fortifiable food consumption by data source

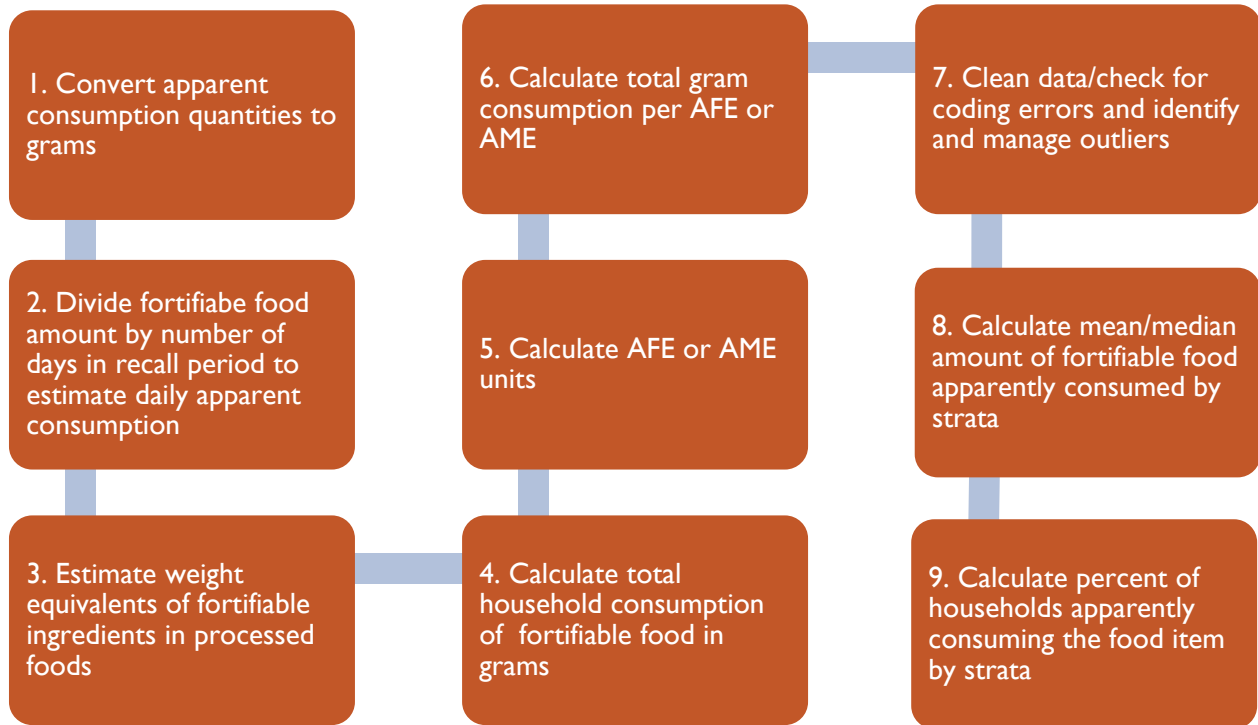
| Steps | Data Source | |
|---|----------------------|--------|
| | 24-HR Dietary Recall | SQ-FFQ |
| 1. Convert fortifiable food portion sizes to grams | ✓ | ✓ |
| 2. Estimate weight equivalents of fortifiable ingredients in processed foods | ✓ | ✓ |
| 3. Estimate average amount consumed per day | | ✓ |
| 4. Compile/code weight equivalents of raw foods in mixed dishes and process recipe data | ✓ | ✓ |
| 5. Calculate total grams consumed of each fortifiable food | ✓ | ✓ |
| 6. Check for coding errors | ✓ | ✓ |
| 7. Identify/manage outliers | ✓ | ✓ |
| 8. Calculate mean/median fortifiable food consumption, including by strata | ✓ | ✓ |
| 9. Calculate percentage of population consuming the fortifiable food by strata | ✓ | ✓ |

Source: Adapted from Gibson and Ferguson 2008; National Cancer Institute 2022b.

Steps in the analysis using HCES data

Figure 5 shows the basic analysis steps for using HCES data to estimate fortifiable food consumption. Detailed methods are described in [Annex 3](#). This methodology allows estimates at the household level using the adult female as the reference household member (i.e., apparent consumption of fortifiable food per AFE), as food consumption of an adult female is expected to be approximately the average in the household, and with high nutritional requirements. The AME could also be used.

Figure 5. Steps in the analysis using HCES data

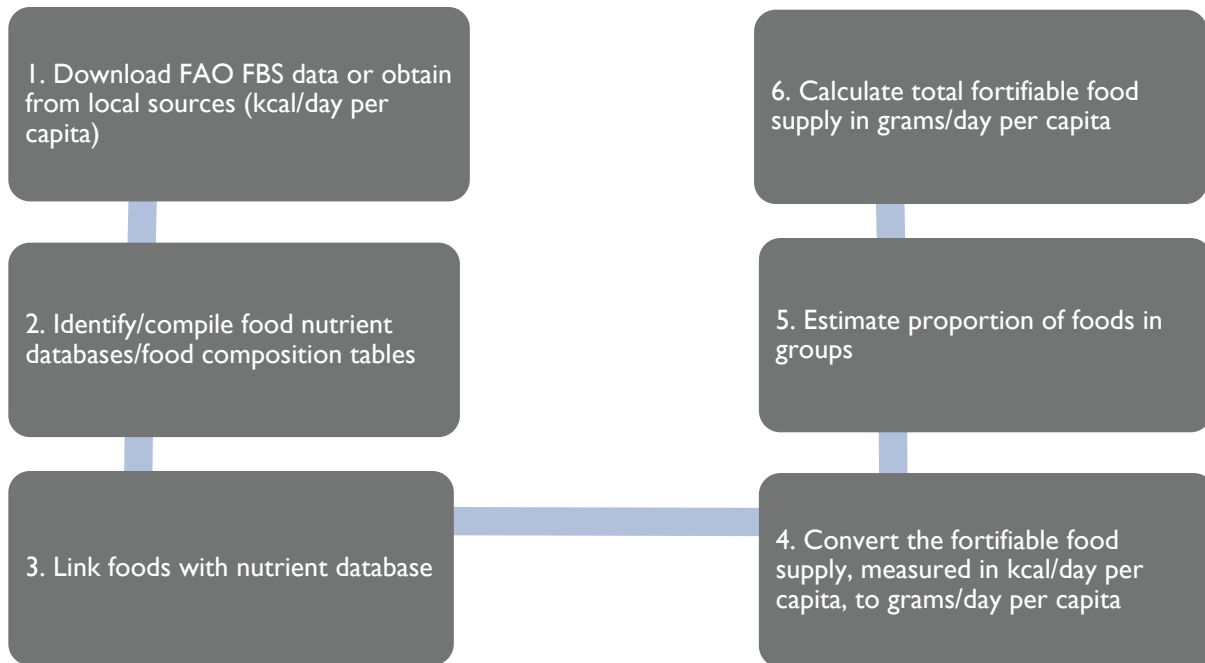


Source: Adapted from information from Imhoff-Kunsch et al. 2012; Adams et al. 2022.

Steps in the analysis using FBS data

Figure 6 shows the basic analysis steps for using FBS data to estimate fortifiable food consumption. Detailed methods are described in [Annex 3](#). Note that if the per capita rate is not available, divide the annual food supply data by the population size to calculate supply per capita.

Figure 6. Steps in the analysis using FBS data



Sources: Adapted from Gibson and Cavalli-Sforza 2012; Joy et al. 2014; Mark et al. 2016; Del Gobbo et al. 2015; Arsenault et al. 2015.

2.2 Information need: Availability of fortifiable and fortified foods in markets

Information on the availability of fortifiable and fortified foods in markets can help stakeholders to better understand if these foods are available to populations vulnerable to inadequate micronutrient intake. Local markets include markets in different regions, and within the regions, different market types, including outdoor markets, grocery/retail shops, supermarkets, bakeries, and wholesale markets. Information on availability by brand of fortifiable and fortified food is useful to be able to identify which brands of fortifiable and fortified foods produced at large scale are available to various strata of the population, such as those in urban and rural areas. The findings from the analysis in this step can be discussed with various stakeholders, including industry, during the LSFF design/redesign stage, particularly to identify and overcome barriers to improving availability to fortifiable and fortified foods.

Questions answered in this step

The kinds of questions that can be answered in this step will depend on the available data. Table 2 summarizes examples of the questions that can be answered with specific kinds of data. More detailed data by geographic region and market type may be available depending on data sources in each country. Start with the data available via the agri-food information system. If market assessment data are available, use them to obtain more detailed information.

Table 2. Data sources and questions that can be answered with the data source

| Data source | Questions that can be answered |
|--|---|
| Agri-Food Information System Data | |
| Food balance sheets | <ul style="list-style-type: none"> • What is the domestic supply of potential food vehicles? • What is the origin of the domestic supply (imported and local volumes)? |
| Digital Logistics Capacity Assessment (DLCA) website (Dlcalogcluster.org) | <ul style="list-style-type: none"> • Who are the food suppliers in the country? (Names of suppliers can be used for searches on availability below.) |
| Industry searches/media articles Supplier, producer, and retailer websites, Facebook pages, LinkedIn posts, and online store data | <ul style="list-style-type: none"> • What are the domestic and producer/supplier volumes of fortifiable and fortified foods? • What is the percentage of the domestic supply from each identified producer/supplier? • What volume and/or proportion of the domestic supply comes from fortifiable sources/producers |

| | |
|--|---|
| Purchased market research data | <p>suitable for LSFF? (See threshold production estimates for “large-scale”, and thus “fortifiable” in Table 2 and Annex 7 of the USAID LSFF Programming Guide and producer/retailer websites for production volumes.)</p> <ul style="list-style-type: none"> • What are the food types of the fortifiable foods available in the country? • What is the percentage of the different food types that make up the total food vehicle supply? (Note: particularly useful for edible oil). • What are the brands of fortifiable foods available in the country? |
| Market Assessment Data | |
| Market assessments (specifically designed to respond to these questions) | <ul style="list-style-type: none"> • What are the food types of each potential food vehicle? • What are the brands of each potential food vehicle? • What is the number and percentage of brands of each food vehicle by origin (local versus imported; large-scale producer versus those that are smaller than “large scale”), nationally, by geographic region, and by market type? • What is the percentage of the production volume of each potential food vehicle by origin (local versus imported; large-scale producer versus those that are smaller than “large scale”), nationally, by geographic region, and by market type? • What is the percentage of the production volume of each potential food vehicle with a fortification logo, statement, or nutrient label showing fortification, by geographic region and market type? |

Source: USAID Advancing Nutrition experience piloting the methodology. “Fortifiable” food defined according to threshold production estimates for “large-scale.” and thus “fortifiable” in Table 2 and Annex 7 of the [USAID LSFF Programming Guide](#).



Method to conduct the analysis

Use the following steps to systematically guide your process:

- Estimate the national-level supply of food fortification vehicles (imported and local).
- Estimate the volume and proportion of the domestic supply of the food vehicle that is fortifiable.
- Estimate the volume and proportion of the domestic supply of the food vehicle that is fortified, if feasible given existing data.
- Estimate the availability of fortifiable and fortified foods by geographic region and/or market type, if feasible given existing data.

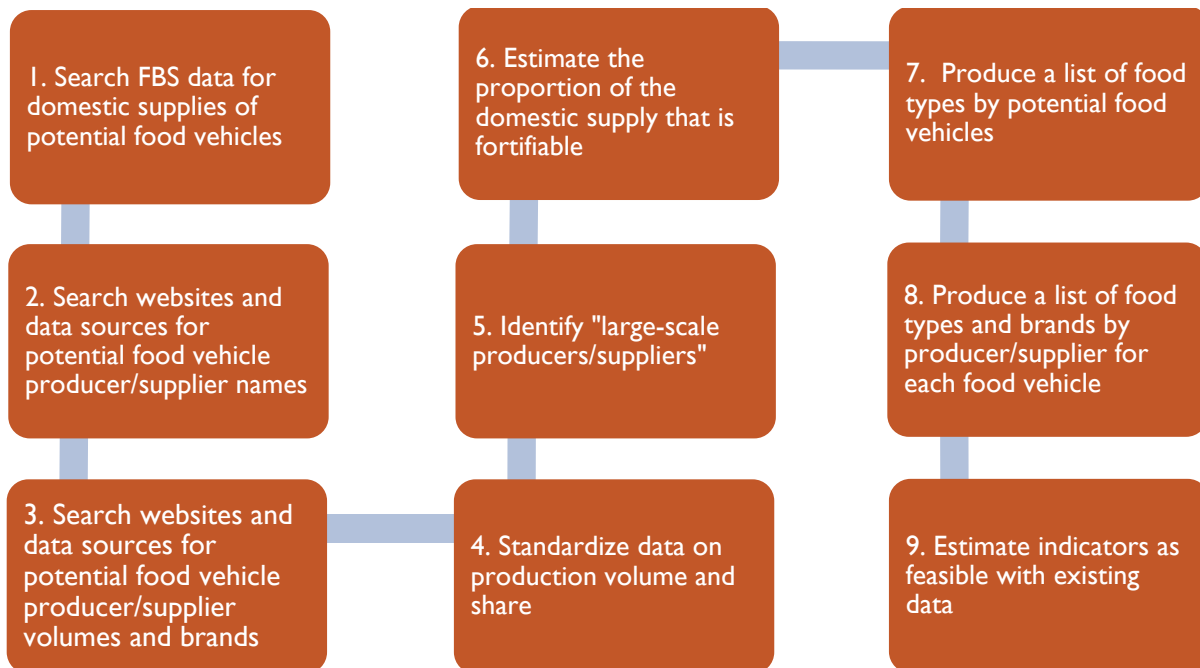


Steps in the analysis by data source

Steps in the analysis using agri-food information system data

Figure 7 shows the basic analysis steps for agri-food information system data to estimate market availability of fortifiable foods. Detailed methods are described in [Annex 5](#).

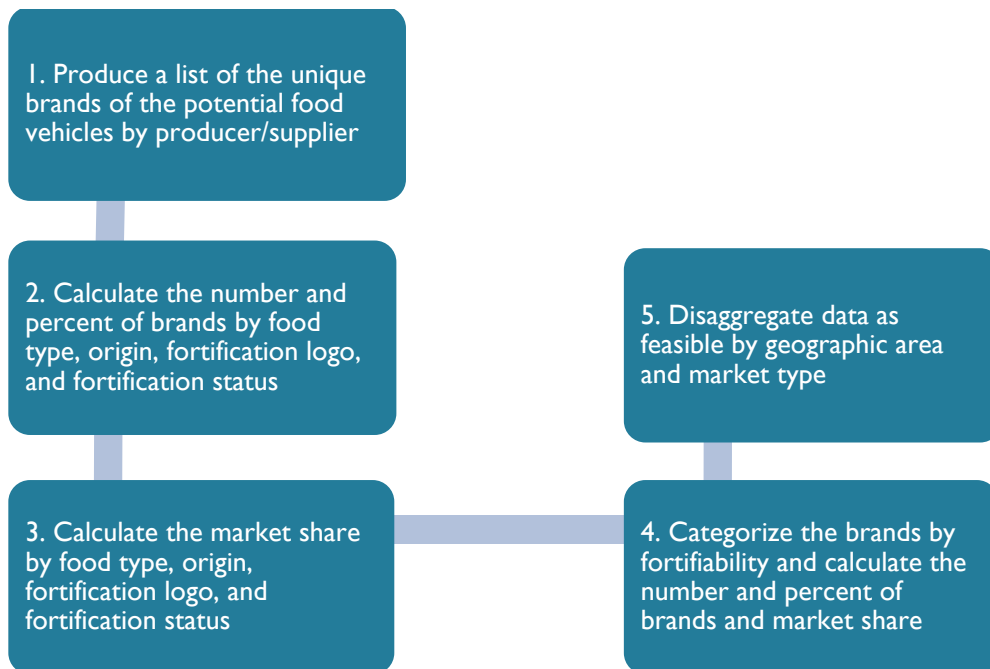
Figure 7. Steps in the analysis using agri-food information system data



Steps in the analysis using market assessment data

Figure 8 shows the basic analysis steps for market assessment data to estimate market availability of fortifiable and fortified foods. Detailed methods are described in [Annex 5](#).

Figure 8. Steps in the analysis using market assessment data



Consult with in-country stakeholders with market experience to identify the best sources to provide market-level data on fortifiable and fortified foods. Additional research could include consulting with industry experts; government or industry associations; and individual producers, wholesalers, or supermarkets. Other options include purchasing market research data or conducting additional market assessment fieldwork to fill data gaps. Ask if there is recent data available from the market assessment component of the [Fortification Assessment Coverage Toolkit \(FACT\)](#), or check the [online dataset](#) search. The market assessment component of FACT provides a standardized approach to assess availability of fortifiable foods at market level (Friesen et al. 2019).

2.3 Information need: Predicted contribution of food fortification to micronutrient adequacy

Modeling to assess the potential contribution of food fortification to micronutrient adequacy is necessary during the LSFF program design stage to help define and set the fortification program goals. Use the modeling during a program review stage to reassess the contribution of LSFF to micronutrient adequacy. The analysis will help to clarify and quantify the potential contribution of LSFF to micronutrient adequacy for different strata of the population, for example, in different geographic areas or urban/rural settings, or by socioeconomic status, season, and if possible, sex and age, depending on the type of data available.

Questions answered in this step

Considering current consumption patterns, what would be the potential contribution of LSFF to micronutrient adequacy of the diet for different strata of the population?

Method to conduct the analysis

Use the following steps to systematically guide your process:

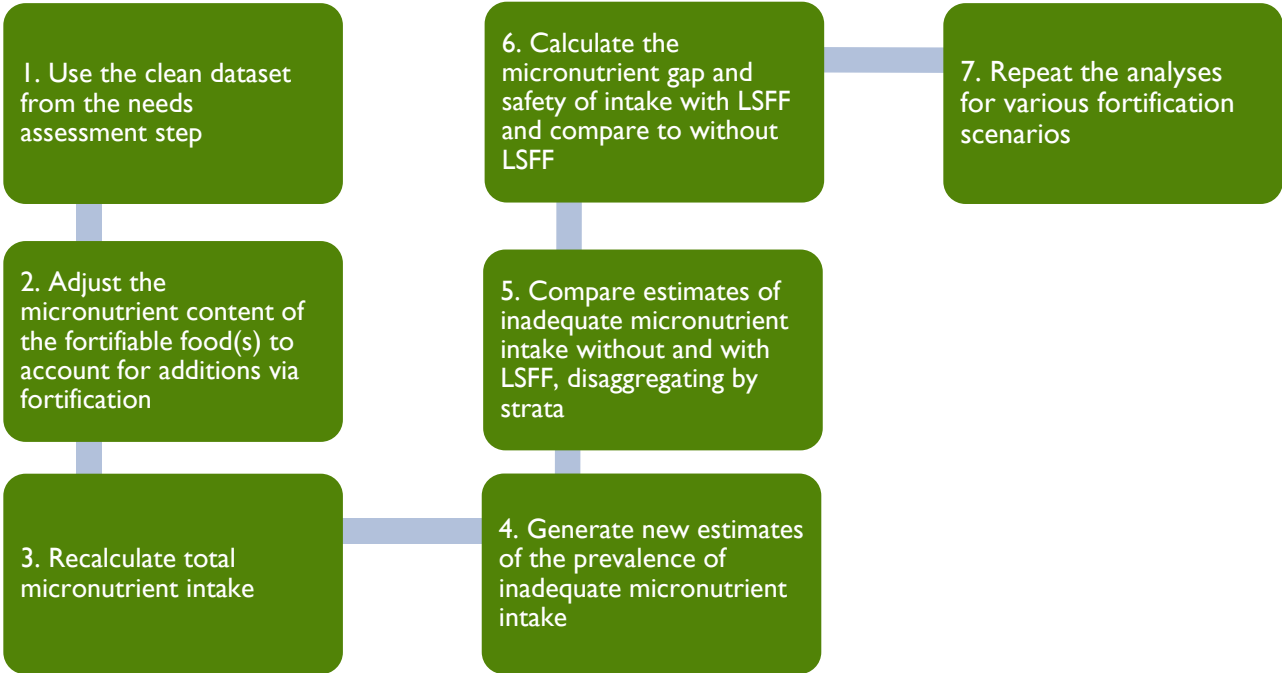
- Create scenarios in which different fortifiable foods include different levels of added micronutrients.
- Consult with in-country stakeholders to discuss and agree on the modeling parameters.
- Assess adequacy with LSFF using the same method as noted above for estimation of micronutrient adequacy and risk of high intakes in the needs assessment step—the EAR cut-point method and the UL cut-point method for most micronutrients, and the full-probability method for micronutrients when the distribution of requirements is not normally distributed.

Steps in the analysis by data source

Quantitative open 24-hour dietary recall and SQ-FFQ data

Figure 9 shows the basic data analysis steps for using quantitative open 24-hour dietary recall data and SQ-FFQ data for modeling the contribution of fortification to micronutrient adequacy. Detailed methods are described in [Annex 6](#).

Figure 9. Steps in modeling the contribution of fortification to micronutrient adequacy using quantitative open 24-hour dietary recall data and SQ-FFQ data

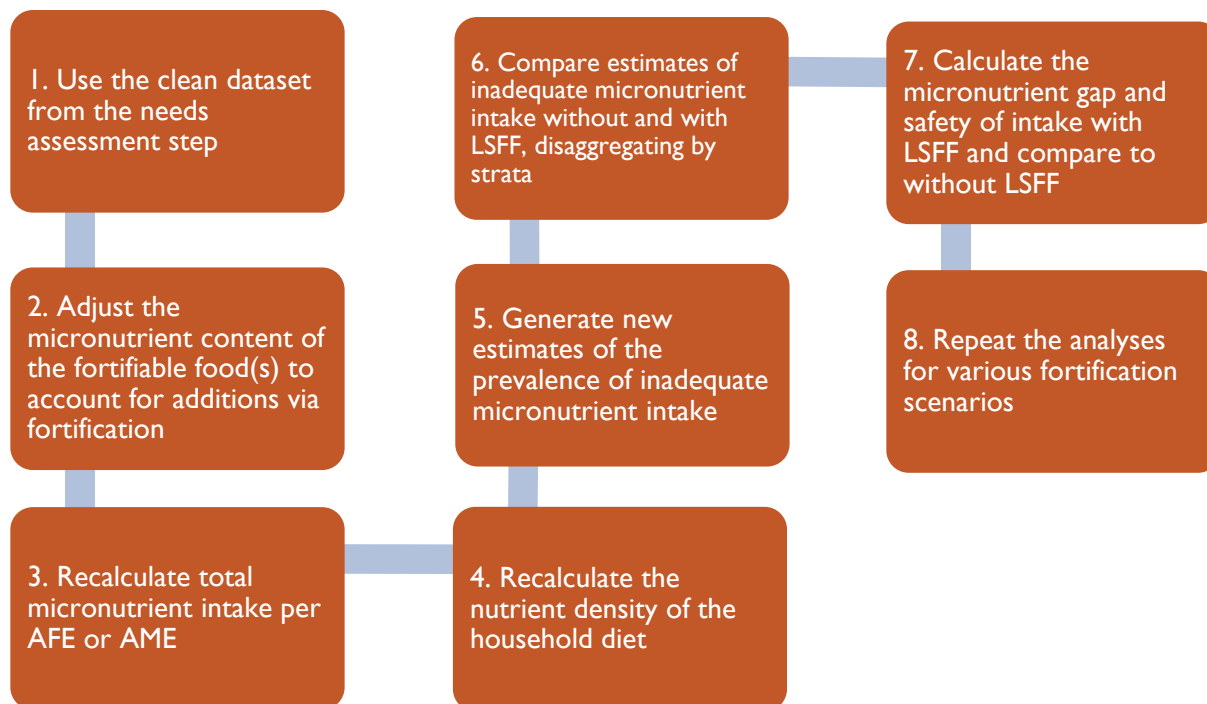


Source: Adapted from USAID Advancing Nutrition 2022.

HCES data

Figure 10 shows the basic analysis steps for using HCES data for modeling the contribution of fortification to micronutrient adequacy. Detailed methods are described in [Annex 6](#).

Figure 10. Steps in modeling the contribution of fortification to micronutrient adequacy using HCES data

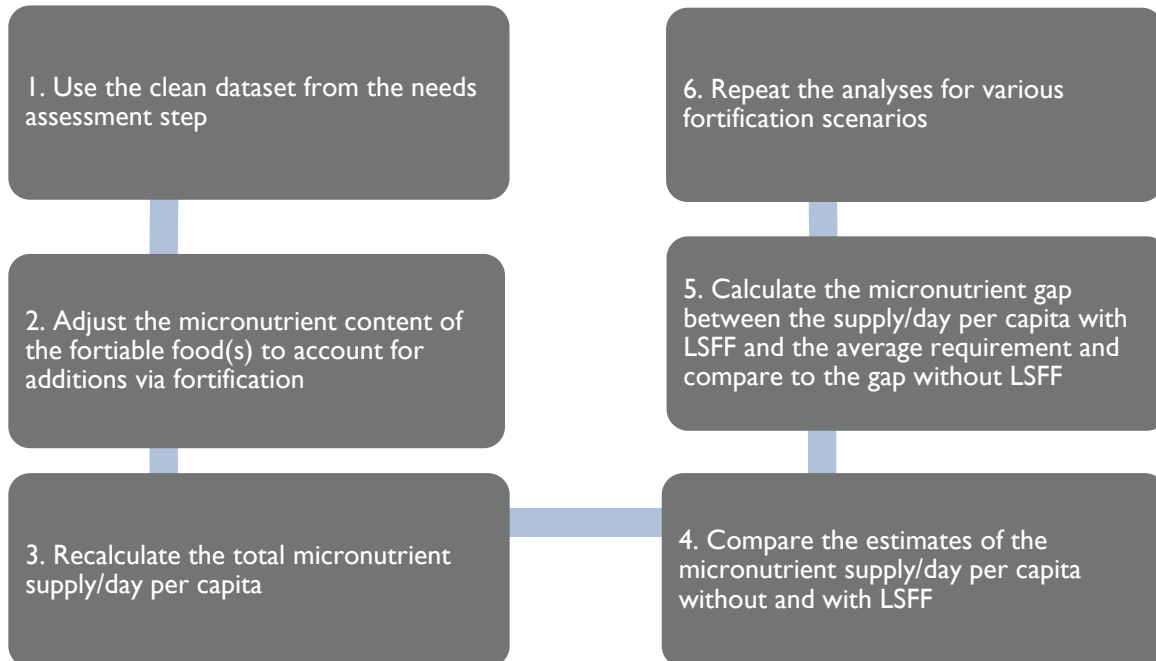


Source: Source: Adapted from USAID Advancing Nutrition 2022. Adapted from Imhoff-Kunsch et al. 2012; Adams et al. 2022.

FBS data

In the absence of quantitative open 24-hour dietary recall, SQ-FFQ, or HCES data, FBS data may be used to have an initial appraisal of the potential contribution of fortifiable foods, whose pertinence should be confirmed by other means, as, for example, a short field study using the food consumption module of the HCES questionnaire. Figure 11 shows the basic analysis steps for modeling the contribution of fortification to micronutrient adequacy using FBS data. Detailed methods are described in [Annex 6](#).

Figure 11. Steps in modeling the contribution of fortification to micronutrient adequacy using FBS data



Sources: Adapted from Gibson and Cavalli-Sforza 2012; Joy et al. 2014; Mark et al. 2016; Del Gobbo et al. 2015; Arsenault et al. 2015.

Optional Step. Modeling Diet Cost and Affordability

Information need: Cost and affordability of an adequate diet without/with LSFF

Modeling and assessing the contribution of a fortified food on the cost of an adequate diet can help demonstrate how a fortified food may affect the affordability and accessibility of a micronutrient adequate diet compared to a diet without food fortified through LSFF. This information is not critical as an input into the design of an LSFF program but is useful for advocacy for the LSFF program, as well as broader programming to improve diets, so is considered an optional analysis, selected based on local need.

Questions answered in this step

- What is the cost of an adequate diet without and with LSFF?
- What percent of the population in different geographic areas and/or socioeconomic strata cannot afford an adequate diet without and with LSFF?

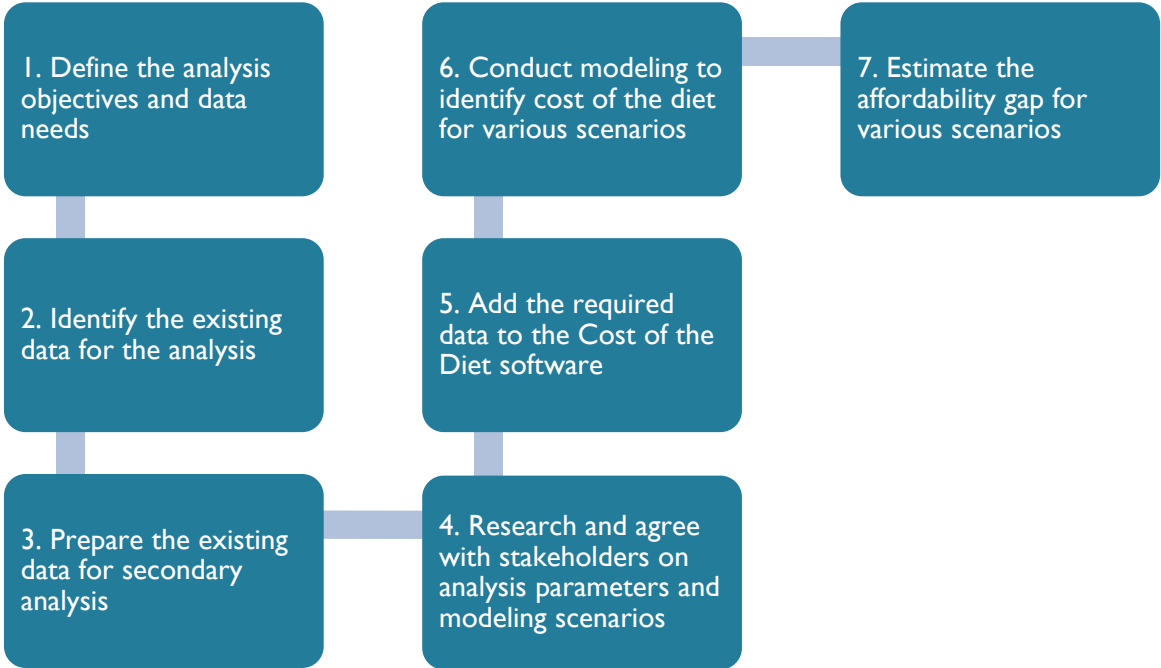
Method to conduct the analysis

Model the cost and affordability of an adequate diet without and with LSFF using the Cost of the Diet (CotD) linear programming tool. See [Annex 8](#) for more information about CotD and linear programming.

Steps in the analysis

Figure 12 shows the analysis steps for CotD without and with LSFF. Detailed methods are described in [Annex 8](#).

Figure 12. Steps in the analysis for Cost of the Diet



Source: Save the Children UK 2018.

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Annex I EAR and UL cut-point methods, full probability approach, usual intake, and dietary reference values

EAR and UL Cut-Point Methods

The U.S. Institute of Medicine provides a detailed description of the EAR and UL cut-point methods in its publication [Dietary Reference Intakes Applications in Dietary Assessment](#) (Institute of Medicine 2000) and WHO also provides a discussion in the publication [Guidelines on Food Fortification with Micronutrients](#) (WHO and FAO 2006).

EAR cut-point method. With the EAR cut-point method, the population prevalence of inadequate intakes is the proportion of the population with intakes below the median requirement (EAR). To use the EAR cut-point method, the only information required is each individual's usual intake of the nutrient and the EAR of the group; individual requirements are not needed.

The method has the following assumptions:

- Intakes are accurately measured.
- Actual prevalence of inadequate intake is neither very low nor very high, no smaller than 8 to 10 percent or no larger than 90 to 92 percent.
- Estimated usual intakes of individuals are independent of each individual's requirement, i.e., individuals with higher intakes are not more likely to have higher requirements.
- The distribution of requirements is approximately symmetrical around the EAR, believed to be true for all nutrients except iron.
- Variability in intakes among individuals in the group is greater than the variability in requirements of the individuals (variance in intakes is larger than the variance of requirements).

Small departures from the assumptions will likely have a small effect on the result, except when—

- Intakes and requirements are highly correlated, like energy.
- The requirement distribution is highly skewed, like iron requirements for menstruating women.

To estimate micronutrient adequacy for iron it is necessary to use the full probability approach, which is described below. Determination of usual intake is also described below.

UL cut-point method. The procedure for applying the UL in assessing the proportion of individuals in a group who are potentially at risk of adverse health effects from excess nutrient intake is similar to the EAR cut-point method for assessing nutrient adequacy. With the UL cut-point method, the population prevalence of excess nutrient intakes is the proportion of the population with intakes above the UL. To use the UL cut-point method, the only information required is each individual's usual intake of the nutrient and the UL of the group. The UL cut-point method can be used for iron.

Full-Probability Approach

The U.S. Institute of Medicine provides a detailed description of the full probability approach in its publication [Dietary Reference Intakes Applications in Dietary Assessment](#) (Institute of Medicine 2000) and WHO and FAO also provide a very useful discussion in the publication [Guidelines on Food Fortification with Micronutrients](#) (WHO and FAO 2006). The probability approach relates individual intakes to the distribution of requirements. The probability approach applies a continuous risk-probability function to each individual's estimated intake and then averages the individual probabilities across the population or group.

Often it is assumed that requirements have a normal distribution. However, iron requirements are an exception, especially for menstruating women. The distribution of requirements is not normally distributed because women can have very large menstrual losses of iron. For this reason, the distribution of requirements is positively skewed, that is, some women have higher requirements than indicated by a normal distribution. It is necessary to use the full probability approach when the distribution of requirements is not normally distributed. This may also be the case for children 1-3 years, children 4-8 years, and menstruating adolescent girls 14-18 years.

The steps in the full probability approach for iron include—

1. Consult the tables on iron requirements published by the [Institute of Medicine Dietary Reference Intakes](#) (Institute of Medicine 2001, page 703). The tables specify the probability that iron intake within specified ranges is inadequate for the individuals in the age and sex group consuming that intake.
2. Determine assumptions around bioavailability of iron from the usual diet for the population. This may be determined through discussions with the stakeholder/technical working group that has been formed to provide expertise and advice for the analysis, as well as review of information on dietary intake in the country.
 - a. Note that the Institute of Medicine table assumes 18 percent bioavailability, which may be high for many low- and middle-income countries. The probability of inadequacy can be adjusted by multiplying the usual iron intake (mg/day) in the Institute of Medicine's table by the user-specified percentage bioavailability and then dividing by 18 percent (see supplementary materials for [Luo et al. 2021](#)).
 - b. The 2006 WHO and FAO guidelines provide a table of probabilities of inadequate iron intake for various population subgroups considering 5 percent, 10 percent, and 15 percent bioavailability.
 - c. For more information about iron bioavailability, please see the section below on "Dietary Reference Intake."
3. Calculate the probability of inadequacy as a weighted average of the risk of inadequacy at each potential level of intake using the following steps:
 - a. Determine the probability of inadequacy in a selected population subgroup, e.g., menstruating women 18-49 years of age, at different ranges of usual intake (mg/day) as determined from, e.g., the table on page 158 of the 2006 WHO and FAO [Guidelines](#).
 - b. Multiply the percentage of the group with intakes in that range, from your data source, by the probability of inadequacy.
 - c. Sum the prevalence of inadequacy in each intake range to obtain an estimate of the total prevalence of inadequacy for the population group of interest.

Statistical programs such as Stata, R, SAS or similar software can be used to conduct the analyses.

Note that two key assumptions underlie the probability approach:

- Intakes and requirements are independent.
- Distribution of requirements is known.

Adjusting the Distribution of Observed Intakes to Usual Intake

Why is it necessary to adjust observed intakes to usual intakes when using 24-hour dietary recall data?

The U.S. Institute of Medicine's [Dietary Reference Intakes Applications in Dietary Assessment](#) (Institute of Medicine 2000) states that although the mean of the distribution of observed intakes in a group is an unbiased estimate of the mean usual intake in that group, the variance of the distribution of observed

intakes is almost always too large, because it includes both the within-person (day-to-day) variation and the individual-to-individual variation. This results in estimates of prevalence of inadequacy (or excess) that are likely to be higher than the true prevalence. If you do not apply appropriate statistical methods for estimating usual intake distributions you will get distributions of nutrient intakes with inflated variance, which will bias estimates of the prevalence of inadequate or high nutrient intakes. To obtain accurate prevalence estimates when using 24-hour dietary recall data, the distribution of observed intakes must be adjusted to better reflect only the individual-to-individual variability in intakes.

How do you adjust the distribution of observed intakes to usual intakes?

There are a few methods that can be applied to estimate usual intake distributions from quantitative open 24-hour dietary recall data. We recommend that you refer to a recent review by [Laureano and colleagues](#) (2016) that compared four methods to estimate usual daily consumed nutrient intake and select the method that works best for you and your team, given the strengths and limitations of each method:

- [Iowa State University \(ISU\)](#)
- [National Cancer Institute \(NCI\)](#)
- [Multiple Source Method \(MSM\)](#)
- [Statistical Program to Assess Dietary Exposure \(SPADE\)](#)

The [Simulating Intake of Micronutrients for Policy Learning and Engagement \(SIMPLE\) Macro](#) is a user-friendly tool written in the SAS programming language that helps users implement the NCI method to facilitate estimation of usual intake distributions for food and nutrients consumed “nearly-daily.” The tool can also be used to model the contribution of fortified foods or supplements to usual nutrient intake.

To apply the methods of adjusting intake distributions it is usually necessary to have a dataset with at least two 24-hour recalls obtained on non-consecutive days for at least some individuals in the group, or at least three days when data are collected over consecutive days. However, for micronutrients consumed almost daily, the NCI one-day (1-d) method allows for use of a single-day of dietary data and an external within-person to between-person variance ratio to estimate population distributions of usual intake (see [Luo et al. 2019](#)).

Dietary reference intake (DRI)

Expert groups in different countries and at different times have developed specific dietary reference values, for example, the Institute of Medicine (IOM) for the United States and Canada and the European Food Safety Authority (EFSA) for Europe. We recommend using the harmonized average requirements (H-AR) as the EAR value and the harmonized upper limit (H-UL) for the UL value (Allen et al. 2019). The harmonized values provide a common basis for establishing food and nutrition policies and evaluating and comparing the adequacy of nutrient intakes across target population groups and countries (Allen et al. 2019). The H-AR and H-UL were selected from standards set by EFSA and IOM, giving priority to those published most recently. If a country wishes to use values other than the H-AR and H-UL, this can be discussed with the team of in-country stakeholders. Note that although in this guide we use the terms “EAR cut-point method” and “UL cut-point method,” we are recommending the use of the H-AR and the H-UL. This means that the population prevalence of inadequate intake will be the proportion of the population with intakes below the H-AR, the median requirement, for a specific age and sex group. The population prevalence of intake in excess of the tolerable upper intake level will be the proportion of the population with intakes above the H-UL.

The H-AR for iron provides the option of selecting a harmonized average requirement for diets with high, moderate, or low absorption of iron. The characteristics of diets with high, moderate, and low iron absorption are described as follows:

- High absorption of iron (15 percent): Characteristics of diets with high absorption are diets that are diverse and contain greater amounts of meat, fish, poultry, and/or foods high in ascorbic acid, compared to diets of moderate or low absorption.
- Moderate absorption of iron (10 percent): Characteristics of diets with moderate absorption are diets of cereals, roots, or tubers, with some foods of animal origin (meat, fish, or poultry) and/or containing some ascorbic acid (from fruits and vegetables), which enhances iron absorption from plant-based sources.
- Low absorption of iron (5 percent): Characteristics of diets with low absorption of iron are simple, monotonous diets based on cereals, roots, or tubers, with negligible amounts of meat, fish, poultry, or ascorbic acid-rich foods. The diet is high in foods that inhibit iron absorption such as maize, beans, whole wheat flour, and sorghum.

The H-AR for zinc provides the option of selecting a harmonized average requirement for refined, semi-refined, semi-unrefined, and unrefined diets based on phytate intake. Phytate can be found in plants, especially cereal grains, and can form insoluble complexes with zinc and decrease the body's absorption of zinc. The H-ARs define the following for each diet type:

- Refined diet: These diets have a phytate intake of 300 mg/day, are low in cereal fiber, and the primary protein source is animal protein such as meat, poultry, and fish.
- Semi-refined diet: These diets have a phytate intake of 600 mg phytate/day, are somewhat higher in cereal fiber intake and lower in animal protein intake than the refined diet.
- Semi-unrefined diet: These diets have a phytate intake of 900 mg/day, are relatively higher in cereal fiber and unrefined cereal grain intake and lower in animal protein intake than the semi-refined diet.
- Unrefined diet: These diets have a phytate intake of 1,200 mg/day, are high in unrefined, unfermented, and ungerminated cereal grains, and the primary protein source is plant-based, while the animal protein intake is very low.

For some nutrients, the form of the nutrient used to assess adequacy and excess differs. For example, vitamin A adequacy is assessed using the unit of retinol activity equivalents which includes vitamin A as preformed retinol (from animal products and fortified foods) and pro-vitamin A carotenoids (from plants); however, the UL is applied only to preformed retinol. In addition, for some micronutrients, such as thiamine, riboflavin, and vitamin B12, the UL is unknown.

Annex 2 Detailed description of needs assessment analysis steps by data source



Steps in the needs assessment analysis using quantitative open 24-hour dietary recall data

[Gibson and Ferguson](#) describe the steps to process data to obtain nutrient intakes and analyze the nutrient intake data (2008). Basic processing steps include—

1. Select a statistical analysis program, such as Stata, SAS, or R.
2. Identify and compile all relevant conversion factors (e.g., cups of a beverage, pieces of fruit, monetary value of commercial or street foods) and convert all food portion sizes to grams.
3. Compile and code weight equivalents for raw ingredients of mixed dishes and if using recipes, process recipe data to calculate the amount of each ingredient consumed.
4. Calculate the total grams consumed of each food, including mixed dishes.
 - a. As a part of this step, identify foods that may serve as potential fortification vehicles. The list of potentially fortifiable food vehicles will vary by country but may include wheat flour and wheat flour-containing foods like breads and pasta, maize flour, rice, vegetable oil, sugar, salt, bouillon cubes, and margarine.
5. Identify or compile appropriate nutrient databases or food composition tables for analysis of nutrient content of foods consumed (see [FAO/INFOODS food composition databases](#)).
6. Link foods with the nutrient composition database.
7. Estimate micronutrient losses from storage and/or cooking.
 - a. Adjust for losses during cooking by matching the food item with the cooked version of the food in the food composition table where appropriate. If food composition tables only provide the raw form and the food is usually consumed cooked, calculate nutrient retention using nutrient retention factors. See [Bognar 2002](#), [USDA Table of Nutrient Retention Factors \(USDA 2007\)](#), and the [FAO/INFOODS Food Composition Table for Western Africa](#) (Vincent et al. 2019).
 - b. Adjust quantities based on the yield factor from cooking. For more information on yield factors see [Bognar 2002](#) and the [FAO/INFOODS Food Composition Table for Western Africa](#) (Vincent et al. 2019).
8. Clean data/check for coding errors including incorrect adjustment of portion sizes to weight equivalents, wrong or improbable weights of foods eaten, and insufficient information for coding ingredients of mixed dishes.
9. Identify and manage outliers. Outliers can be detected visually by plotting the observations using a scatterplot, or you can establish statistical thresholds or cut points based on the study sample distributions. An example may include intakes above or below the 25th and 75th percentiles plus two or three times the interquartile range, or a priori cut points established based on extremes of the distribution, such as above or below the 99th or 1st percentiles, respectively. The analysis team should be cautious about excluding values. Sensitivity analyses with and without the identified outliers can help to determine if the results are changed significantly by their presence in the dataset. Identification and management of outliers should be discussed with a statistician and with the stakeholder/technical working group formed to support the analysis (National Cancer Institute 2022c).
10. Calculate nutrient intake from information on grams of food consumed and food composition table data, multiplying the nutrient value for each food by the amount of food consumed per day for each food item and nutrient of interest and summing the results by nutrient.

11. Adjust the distribution of observed intakes to usual intakes (see [Annex I](#)).²
12. Estimate the prevalence of inadequate and high micronutrient intakes in relation to the H-AR and H-UL. For iron and zinc, you will need to consider the appropriate nutrient reference values given the bioavailability of these nutrients in the diet, e.g., high, moderate, or low absorption for iron, and refined (low phytate) versus unrefined (high phytate) diet for zinc. Phytate can bind zinc, which increases the zinc requirement (see [Annex I](#)).
13. Calculate the micronutrient gap for each micronutrient at the 25th percentile of intake. The micronutrient gap at the 25th percentile is calculated by comparing the 25th percentile of micronutrient intake for the population group to the H-AR for the reference group, to estimate the difference in micronutrient intake and the average requirement among those at greater risk of inadequate intake. The gap for iron can be estimated by comparing iron intake to the H-AR for iron assuming either high, moderate, or low absorption. Note that for iron, the estimated gap will be an approximation only, given there is not one specific requirement with which to compare intake, but rather a distribution of requirements with associated probabilities of inadequacy. The micronutrient gap is expressed as the amount of the micronutrient in micrograms or milligrams per day.
14. The safety of intake is calculated by comparing the 75th percentile of micronutrient intake for the population group to the H-UL for the reference group. The difference between the H-UL and apparent intake at the 75th percentile should be positive (i.e., the H-UL minus the 75th percentile should be a positive number). If it is negative, it means that apparent intake is higher than the H-UL value, and therefore risk of high intake is a concern.
15. Conduct further statistical analysis, if desired, disaggregating results by strata (e.g., urban/rural, socioeconomic strata), and compare results across groups (e.g., mean intakes of two or more groups, proportion at risk of inadequate micronutrient intake among two or more groups).
 - a. Note that for large, population-based surveys, all estimates should be statistically weighted, as appropriate—weighting variables should be available in the datasets.

Steps in the needs assessment analysis using SQ-FFQ data

The basic steps to process SQ-FFQ data include—

1. Select a statistical analysis program, such as Stata, SAS, or R.
2. Convert all portion sizes into standard measures of weight in grams.
3. Multiply the portion size in standard units by the frequency of consumption and divide by the recall period to determine the average amount consumed per day.
4. Compile and code weight equivalents for raw ingredients of mixed dishes, if relevant.
5. Calculate the total grams consumed of each food.
 - a. As a part of this step, identify foods that may serve as potential fortification vehicles. The list of potentially fortifiable food vehicles will vary by country but may include wheat flour and wheat flour-containing foods like breads and pasta, maize flour, rice, vegetable oil, sugar, salt, bouillon cubes, margarine, and others.
6. Identify or develop a nutrient database with food composition table data, including values for SQ-FFQ food categories (e.g., food groups) composed of aggregate food items.
7. Link foods with the nutrient composition database.

² If nutrient supplements are included, it is recommended to include these in the usual intake distribution using the “add then shrink” method. See [Bailey et al. 2019](#) for more information on this method.

8. Estimate micronutrient losses from storage and/or cooking, as appropriate. See step #7 above under the basic processing steps for the 24-hour dietary recall.
9. Clean data/check for coding errors including incorrect adjustment of portion sizes to weight equivalents, wrong or improbable weights of foods eaten, and insufficient information for coding ingredients of mixed dishes.
10. Identify and manage outliers. Outliers can be detected visually by plotting the observations using a scatterplot, or you can establish statistical thresholds or cut points based on the study sample distributions. An example may include intakes above or below the 25th and 75th percentiles plus two or three times the interquartile range, or a priori cut points established based on extremes of the distribution, such as above or below the 99th or 1st percentiles, respectively. The analysis team should be cautious about excluding values. Sensitivity analyses with and without the identified outliers can help to determine if the results are changed significantly by their presence in the dataset. Identification and management of outliers should be discussed with a statistician and the stakeholder/technical working group formed to support the analysis (National Cancer Institute 2022c).
11. Calculate nutrient intake from information on grams of food consumed and food composition table data, multiplying the nutrient value for each food by the amount of food consumed per day for each food item and nutrient of interest and summing the results by nutrient.
12. Estimate the prevalence of inadequate and high micronutrient intakes in relation to the H-AR and H-UL. For iron and zinc, you will need to consider the appropriate nutrient reference values given the bioavailability of these nutrients in the diet, e.g., high, moderate, or low absorption for iron, and refined (low phytate) versus unrefined (high phytate) diet for zinc. Phytate can bind zinc, which increases the zinc requirement (see [Annex I](#)).
13. Calculate the micronutrient gap for each micronutrient at the 25th percentile of intake. The micronutrient gap at the 25th percentile is calculated by comparing the 25th percentile of micronutrient intake for the population group to the H-AR for the reference group, to estimate the difference in micronutrient intake and the average requirement among those at greater risk of inadequate intake. The gap for iron can be estimated by comparing iron intake to the H-AR for iron assuming either high, moderate, or low absorption. Note that for iron, the estimated gap will be an approximation only, given there is not one specific requirement with which to compare intake, but rather a distribution of requirements with associated probabilities of inadequacy. The micronutrient gap is expressed as the amount of the micronutrient in micrograms or milligrams per day.
14. The safety of intake is calculated by comparing the 75th percentile of micronutrient intake for the population group to the H-UL for the reference group. The difference between the H-UL and apparent intake at the 75th percentile should be positive (i.e., the H-UL minus the 75th percentile should be a positive number). If it is negative, it means that apparent intake is higher than the H-UL value, and therefore risk of high intake is a concern.
15. Conduct further statistical analysis, if desired, disaggregating results by strata (e.g., urban/rural, socioeconomic strata), and compare results across groups (e.g., mean intakes of two or more groups, proportion at risk of inadequate micronutrient intake among two or more groups).
 - a. Note that for large, population-based surveys, all estimates should be statistically weighted, as appropriate—weighting variables should be available in the datasets.

Note that SQ-FFQ data are usually considered to represent “usual” intake, so the statistical adjustment to estimate usual intake distributions is not necessary as it is when using the 24-hour dietary recall data. Analysts could directly calculate descriptive statistics such as mean nutrient intake.

Steps in the needs assessment analysis using HCES data

[Imhoff-Kunsch \(et al. 2012\)](#) and [Adams et al. 2022](#) provide steps in the use of household food consumption or acquisition data from HCES to estimate household-level apparent food consumption and micronutrient intake. The basic steps are—

1. Identify key variables in the dataset to estimate household food consumption, including quantity of each food in the foods list consumed (or acquired) and associated units, demographic variables, and other variables needed to disaggregate results by subpopulation (e.g., urban/rural, geographic area, and/or variables to categorize households by socioeconomic strata).
 - a. Note that stratifying by sex and/or age using household consumption and expenditure survey data requires assuming foods, including fortifiable foods, are consumed in proportion to energy requirements.
 - b. As a part of this step, identify purchased foods that may serve as potential fortification vehicles, and the quantity and units of measure. The list of potentially fortifiable food vehicles will vary by country but may include wheat flour and wheat flour-containing foods like breads and pasta, maize flour, rice, vegetable oil, sugar, salt, bouillon cubes, and margarine (see [Annex 7](#)).
 - c. Note that HCES are large, population-based surveys so all estimates should be statistically weighted, as appropriate—weighting variables should be included in the datasets.
2. Use standard conversion factors to convert all units of measure to grams. If nonstandard measures such as loaves, satchels, bags, and sacks are reported in the data, use country-specific conversion factors to estimate their weight in grams.
3. Adjust food consumption quantities for the nonedible portion of foods (e.g., banana skins).
4. Divide the food amount by the number of days of the recall period in the survey to produce estimates of daily apparent consumption.
 - a. Note that for some HCES surveys, the number of days of the recall period is not consistent across all foods/food groups in the list. For example, the 2015 Zambia HCES collected data on apparent consumption of maize-based foods, salt, spices, and cooking oil over a 28-day period, and for other foods on the food list, over 14 days.
5. Identify or compile appropriate nutrient databases or food composition tables for analysis of nutrient content of foods consumed (see [FAO/INFOODS food composition databases](#)).
6. Match food items to data from food composition tables.
7. Estimate micronutrient losses from storage and/or cooking, as appropriate.
 - a. Adjust for losses during cooking by matching the food item with the cooked version of the food in the food composition table (FCT) where appropriate, e.g., matching potato with “boiled potato” in the FCT, beans with “boiled beans,” leafy greens with “cooked leafy greens,” etc. There will be some error, given you will not know the actual cooking methods. Decisions regarding food matching and common cooking methods can be discussed with the stakeholder/technical working group providing expertise for the analysis. If food composition tables only provide the raw form and the food is usually consumed cooked, calculate nutrient retention using nutrient retention factors. See [Bognar 2002](#), [USDA Table of Nutrient Retention Factors](#) (USDA 2007), and the [FAO/INFOODS Food Composition Table for Western Africa](#) (Vincent et al. 2020).
 - b. Adjust quantities based on the yield factor from cooking. For more information on yield factors please see [Bognar 2002](#) and the [FAO/INFOODS Food Composition Table for Western Africa](#) (Vincent et al. 2020).

8. Calculate the adult female equivalent (AFE) or adult male equivalent (AME) units to be able to estimate the food intake per adult equivalent and the micronutrient intake per adult equivalent. This will allow comparisons across households of varying size (Weisell and Dop 2012).
 - a. AFE or AME units are constructed based on the [FAO WHO UNU estimates of individual energy requirements](#), which are weight-, age-, sex-, and physical activity level-specific, to serve as a reference value. For example, for AFE, energy requirements for a population of 18- to 29.9-year-old women, where the average weight of women 18-29.9 years is 55 kilograms, and their physical activity level is moderate, is 2,100 kcal/day, which would then be an AFE of 1. This would be the reference value and other age and sex groups would be weighted accordingly based on their estimated energy needs. For example, the AFE of a man 30-59.9 years of age with an average weight of 60 kilograms and moderate activity level would be 1.19 (2,500/2,100 kcal/day). HCES instruments do not collect data on individual body weight or physical activity level, so an average weight and physical activity level is used for age- and sex-specific population groups. Average weight can be estimated from available survey data, for example demographic and health surveys, or other sources identified by the stakeholder/technical working group supporting the analysis. Average physical activity level can also be determined from available information and/or discussions with the stakeholder/technical working group. A weight, or adjustment factor, is assigned to each person in the household, and these individual weights are summed to provide an estimate of household AFE units. The age and sex of each household member are needed to construct AFE or AME units. AFE or AME units are used under the assumptions that the FAO, WHO, and UNU energy requirements are true for the population of interest and that food is shared in proportion to energy requirements.³
9. Generate estimates of apparent food consumption per AFE or AME for each household for each food item by dividing daily household consumption/acquisition of each food item in grams or milliliters by household AFE or AME units.
10. Clean the data and check for coding errors, such as use of incorrect conversion factors to convert from nonstandard units to grams of apparent consumption.
11. Determine a methodology for identifying and managing outliers in the food consumption data. Note that the identification of outliers in apparent food consumption should be based on apparent consumption per AFE, AME, or per capita to normalize across households of different sizes. Examples of methods for identifying and managing outliers employed by researchers using HCES data to model LSFF include—
 - a. Identify values more than three times the interquartile range ($Q3 + [3 \times IQR]$). For HCES that collect data on household food acquisition, amounts that are possible outliers can be cross checked by comparing the amount purchased with the price paid. This two-step process of managing unrealistic values relies on two data points and is a more conservative approach than managing outliers based on using a formula alone (Imhoff-Kunsch et al. 2012). Imhoff-Kunsch et al. suggest that extreme outliers can be deleted. We suggest consulting with a statistician to consider various options and their strengths and limitations, including those described below.
 - b. Normalize each food item's consumption quantity per AFE, per AME, or per capita distribution through logarithmic transformation and define outliers as extreme consumption quantity values, or values greater than five standard deviations above the mean of the logarithmically transformed consumption quantities. For each food item,

³ Weisel and Dop (2012) provide additional explanations of the use of the AME.

replace outliers with the population median consumption quantity per AFE, per AFE, or per capita among consumers (Tang et al. 2022).

- c. Identify consumption per AFE (or AME) per day above the 95th percentile of apparent consumption per AFE (or AME) per day. Replace extreme outliers with the 95th percentile value (Adams et al. 2021).
12. Estimate the prevalence of inadequate apparent micronutrient intake per AFE or AME. Compare the adequacy of the household micronutrient supply per AFE or AME to the appropriate nutrient reference values to assess adequacy among population groups with relatively higher requirements, such as adult women. We recommend using the H-AR nutrient reference values (Allen et al. 2019). This will provide an estimate of the percent of households with adequate apparent micronutrient supply based on micronutrient consumption/acquisition per AFE or per AME. For estimation of iron intake use the full-probability approach, given the skewed nature of the requirement distribution (National Research Council 1986). For iron and zinc, you will need to consider the appropriate nutrient reference values given the bioavailability of these nutrients in the diet (see [Annex 1](#)).
 13. Estimate the prevalence of high intakes per AFE or AME, that is, the prevalence of intakes above the H-UL for each micronutrient with a UL.
 14. Calculate the micronutrient density of the household diet for the micronutrient of interest. The micronutrient density of the diet is the ratio of apparent micronutrient intake to energy intake, expressed per 1,000 kcal.
 15. Estimate prevalence of inadequate apparent intake by micronutrient density. Compare the micronutrient density of the household diet to the critical micronutrient density for any household member. The critical micronutrient density is the ratio of the H-AR for an age-, sex-, and physiologic status-specific group to their daily average energy requirement, expressed per 1,000 kcal (Vossenaar et al. 2019). Use the full probability approach to estimate the adequacy of iron densities. The following provides guidance to interpret the micronutrient density calculations.
 - a. If the micronutrient density of the household diet meets the critical micronutrient density needs of household members with the highest micronutrient requirements relative to their energy requirements, the household diet is likely adequate to meet all members' micronutrient requirements, if household members are meeting their energy requirements and food consumption within the household is in proportion to energy needs.
 - b. A diet is inadequate when its micronutrient density falls below the critical nutrient density threshold, assuming that energy requirements are being met through the diet. The population prevalence of inadequate micronutrient density is the proportion of the population with micronutrient densities that fall below the critical micronutrient density threshold.
 - c. See [Annex 4](#) for a comparison of the uses of the estimated micronutrient intake per AFE approach and nutrient density approach.
 16. Estimate the prevalence of high intakes based on nutrient density, that is, the prevalence of nutrient density of household diets above the critical upper density for each micronutrient with a UL. The critical upper density is the ratio of the H-UL for an age-, sex-, and physiologic status-specific group to their daily average energy requirement expressed per 1,000 kcal.
 17. Calculate the micronutrient gap for each micronutrient at the 25th percentile of apparent intake per AFE or AME and/or of the nutrient density of the household diet.
 - a. For apparent intake, the micronutrient gap is calculated by comparing the 25th percentile of apparent micronutrient intake per AFE or AME for the population group to the H-AR for the reference group, to estimate the difference in micronutrient intake and the average requirement among those at greater risk of inadequate apparent intake.

- b. For nutrient density, the micronutrient gap is calculated by comparing the 25th percentile of the nutrient density of the household diet for the population group to the critical nutrient density, based on the H-AR, for the reference group.
 - c. For iron, the gap can be estimated by comparing apparent iron intake per AFE or AME to the H-AR for iron assuming either high, moderate, or low iron absorption (or, likewise, the iron density of the household diet to the critical iron density assuming either high, moderate, or low absorption). Note that the estimated gap for iron will be an approximation only based on the H-AR, given there is not one specific requirement with which to compare intake, but rather a distribution of requirements with associated probabilities of inadequacy.
 - d. The micronutrient gap is expressed as the amount of micronutrient in micrograms or milligrams—
 - i. per day per AFE or AME
 - ii. per 1,000 kilocalories for the nutrient density approach.
16. The safety of intake is calculated by comparing the 75th percentile of apparent intake per AFE or AME for the population group to the H-UL for the reference group. For nutrient density, the safety of intake is calculated by comparing the 75th percentile of the nutrient density of the household diet for the population group to the critical upper density for the reference group. The difference between the H-UL and apparent intake or nutrient density at the 75th percentile should be positive (i.e., the H-UL minus the 75th percentile should be a positive number). If it is negative, it means that apparent intake or nutrient density is higher than the H-UL value, and therefore risk of high intake is a concern.
17. Conduct further statistical analysis, if desired, disaggregating results by strata (e.g., urban/rural, socioeconomic strata), and compare results across groups (e.g., mean intakes of two or more groups, proportion at risk of inadequate micronutrient intake among two or more groups).
- a. Note that for large, population-based surveys, all estimates should be statistically weighted, as appropriate—weighting variables should be available in the datasets.

Steps in the needs assessment analysis using FBS data

Basic steps for using FBS food availability data to estimate which micronutrients may be inadequate in the national food supply include—⁴

1. Download from the [FAO website](#) or obtain from local sources FBS data on availability of food items in kcal/day per capita for the country. Kcal/day per capita is recommended instead of grams/day per capita to account for inedible portions, given FAO weights represent the market weight, which includes inedible portions, and FAO does not provide information on the weight conversions for inedible portions. Kcal/day per capita represents the edible portion of the food items.
2. Identify/compile food nutrient databases/food composition tables.
3. Link foods with nutrient databases.
4. Convert the fortifiable food supply, measured in kcal/day per capita, to grams/day per capita using energy estimates from the food composition table data.

⁴ Please see Gibson and Cavalli-Sforza 2012; Joy et al. 2014; Mark et al. 2016; Del Gobbo et al. 2015; and Arsenault et al. 2015.

5. For foods grouped in one FBS category, estimate the proportion of the total weight attributed to each food in the aggregate commodity considering three potential options: equal weighting; weighting based on food consumption data from national dietary surveys; and weighting based on available production and trade statistics on the FAO website.
6. Calculate the micronutrient content of the daily available supply of the food item.
7. Sum the micronutrient content of each food item to obtain the total amount in the food supply per day per capita.
8. Estimate the micronutrients most likely to be inadequate in the country's available food supply using the EAR cut-point method. Compare the micronutrient content of the daily available food supply/day per capita with the appropriate nutrient reference values to assess adequacy among population groups with relatively higher requirements, such as adult women (see [Annex I](#)).
9. Calculate the micronutrient gap in the available food supply for each micronutrient. The micronutrient gap for FBS data is calculated by comparing the estimated amount of micronutrient available in the food supply/day per capita to the H-AR for the reference group. The micronutrient gap is expressed as the amount of micronutrient in the food supply in micrograms or milligrams per day per capita. Note that the safety of intake is not calculated for FBS data, given that for FBS data we only have average supply/day per capita.
10. Please note that estimates cannot be made for iron, which requires use of the full probability approach. FBS do not provide information on the distribution of usual intake that is necessary to be able to use the full probability approach (Beal et al. 2017).

As a reminder, the data from FBS could be useful to identify micronutrients that are insufficient in the food supply at the national level and therefore creating inadequacies in some population strata. If this is the case, the FBS results justify the application of any of the methodologies mentioned above. FBS data are inadequate for needs assessment for LSFF programming.

Annex 3 Detailed description – estimation of fortifiable food consumption by data source



Steps in the estimation of fortifiable food consumption using quantitative open 24-hour dietary recall data

1. Identify and compile all relevant conversion factors and convert all fortifiable food (or foods that contain fortifiable food equivalents) portion sizes to grams. (See [Annex 7](#) for more information about fortifiable foods).
2. Estimate weight equivalents of fortifiable ingredients in processed foods, e.g., wheat flour or oil in purchased breads, cakes, and crackers. These are referred to as fortifiable food equivalents (e.g., wheat flour equivalents or oil equivalents, respectively) and are estimated to account for the amounts of fortified foods in processed foods containing those ingredients. Fortifiable food equivalents are calculated by multiplying the quantity of the processed food item in grams by the proportion of fortifiable food in the food item. The information to estimate the weight equivalents of fortifiable ingredients in processed foods typically comes from local recipes.
3. Compile and code weight equivalents for raw fortifiable food ingredients of mixed dishes and if using recipes, process recipe data to calculate the amount of the fortifiable foods consumed.
4. Calculate the total grams consumed of each fortifiable food.
5. Check for coding errors including incorrect adjustment of portion sizes to weight equivalents, wrong or improbable weights of foods eaten, and insufficient information for coding ingredients of mixed dishes.
6. Identify and manage outliers (see information above in [Annex 2](#) on identification and management of outliers).
7. Calculate the mean and median amount of fortifiable food consumed.
8. Calculate the percent of the population consuming the fortifiable food by strata and the usual daily amounts. Note that for quantitative open 24-hour dietary recall data, it is not possible to identify usual consumers or usual non-consumers based on one or two days of data, but you can still report mean intake among those who consumed the food on the previous day versus the overall population.



Steps in the estimation of fortifiable food consumption using SQ-FFQ data

1. Identify and compile all relevant conversion factors and convert all fortifiable food (or foods that contain fortifiable food equivalents) portion sizes into standard measures of weight in grams.
2. Estimate weight equivalents of fortifiable ingredients in purchased processed foods (see #2 under “Quantitative open 24-hour dietary recall” above).
3. Multiply the portion size in standard units by the frequency of consumption and divide by the recall period to determine the average amount consumed per day.
4. Compile and code weight equivalents for raw fortifiable food ingredients of mixed dishes, if relevant.
5. Calculate the total grams consumed of each fortifiable food.
6. Check for coding errors including incorrect adjustment of portion sizes to weight equivalents, wrong or improbable weights of foods eaten, and insufficient information for coding fortifiable food ingredients of mixed dishes.
7. Identify and manage extreme values (see information above in [Annex 2](#) on identification and management of outliers).

8. Calculate the mean and median amount of fortifiable food consumed.
9. Calculate the percentage of the population that consumed the food item, by relevant strata, and the usual daily amounts.

Steps in the estimation of fortifiable food consumption using HCES data

1. Use standard conversion factors to convert all units of measure for fortifiable foods to grams. If nonstandard measures such as loaves, satchels, bags, and sacks are reported in the data, use the conversion factors for nonstandard units provided as part of the HCES (if available) to estimate the weight in grams.
2. Divide the fortifiable food amount by the number of days of the recall period in the survey to produce estimates of daily apparent consumption.
3. Estimate weight equivalents of fortifiable ingredients in purchased processed foods (see #2 under “Quantitative open 24-hour dietary recall” above).
4. Calculate the total grams consumed of fortifiable food in the household.
5. Calculate the AFE or AME units to be able to determine the food consumption per adult equivalent (see #8 above under HCES analysis in [Annex 2](#)).
6. Determine the total gram consumption per AFE or per AME per day. You can use the consumption of the adult female to represent the “average” household member, that is, somewhere between consumption of adult males and children, to express fortifiable food consumption.
 - a. Distinguish between estimates of apparent consumption by consumers and consumers plus non-consumers.
 - i. To estimate consumption among those who consumed or acquired more than “0” grams or milliliters of a specific food (“consumers”), exclude households that reported consuming or purchasing “0” grams or milliliters of a specific food.
 - ii. Inclusion of the “zeros” (those who consumed “zero” because they did not consume or acquire the food) provides an estimate that incorporates both coverage (percentage of the population purchasing the food item) and apparent consumption.
7. Identify and manage extreme outliers (see #11 above under HCES data in [Annex 2](#)).
8. Calculate the mean and median amount of fortifiable food apparently consumed and the proportion of households that apparently consumed the food item, by relevant strata.

Steps in the estimation of fortifiable food consumption using FBS data

1. Determine if information on the fortifiable food vehicles of interest is available on the FAO FBS website or from local sources, in kcal/day per capita for the country. Kcal/day per capita is recommended instead of grams/day per capita to account for inedible portions, given FAO weight represents the market weight, which includes inedible portions, and FAO does not provide information on the weight conversions for inedible portions. Kcal/day per capita represents the edible portion of the food items.
 - a. Note that the FAO definitions of food may differ significantly from what you may need and may require additional analysis to be used. For example, “maize and products” would include corn consumed on the cob (not fortifiable) and as maize flour. To use this information, you will need to estimate the proportion of “maize and products” that is maize flour and fortifiable at large scale.

- b. The FAO FBS are intended to include data on all potentially edible commodities. In practice, FBS cover all major food groups, including primary crops up to the first stage of processing and livestock and fisheries products up to the second, and sometimes third stage of processing. Fortification vehicles are often included in this as they are typically not highly processed foods. FAO FBS do not include more highly processed foods as separate food items. However, the wheat flour that goes into producing local bread, for example, would be accounted for earlier in the value chain.
2. Identify/compile food nutrient databases/food composition tables.
3. Link the foods with the nutrient databases.
4. Convert the fortifiable food supply, measured in kcal/day per capita, to grams/day per capita using energy estimates from the food composition table data.
5. For foods grouped into one FBS category, estimate the proportion of the total weight attributed to each food in the aggregate commodity considering three potential options: equal weighting; weighting based on food consumption data from national dietary surveys; and weighting based on available production and trade statistics on the FAO website.
6. Calculate the total fortifiable food supply in grams/day per capita considering the foods grouped into FBS categories.

Note that FBS data may potentially be useful to produce a very rough estimate of fortifiable food consumption, but it will be necessary to either access quantitative open 24-hour dietary recall data, SQ-FFQ, or HCES data, or if the latter are not available, conduct data collection to estimate fortifiable food consumption, for example, using the food consumption module of the HCES or a [FACT](#) survey.

Annex 4 Estimated micronutrient adequacy per AFE and nutrient density approaches

When using HCES data, we recommend you use both the estimated micronutrient adequacy per AFE and the nutrient density approaches to estimate the adequacy of diets without and with LSFF. The two methods provide complementary, useful information. Nutrient density provides information on the overall quality of the diet, and specifically, whether micronutrient intake is adequate if energy intake is adequate. This helps to better understand if there may be inadequate micronutrient intake due to inadequate overall food intake, which is the case when micronutrient density of the diet is adequate, but overall micronutrient intake is still inadequate. Advantages of the nutrient density method are that it is less influenced by age and sex in a population than daily intakes and does not require weighting based on national population distributions (Gibson and Cavalli-Sforza 2012). The method assumes that energy needs are being met.

The estimated micronutrient adequacy per AFE provides information on the adequacy of the diet that takes into consideration estimates of total energy intake for a reference household member, such as an adult female. It provides information on whether micronutrient intake is adequate, considering the whole diet. The approach assumes that calorie intake in the household is distributed according to physiological need.

Annex 5 Detailed description of analysis of market data



Steps in the estimation of market availability of fortifiable and fortified foods using agri-food information systems data

The basic steps in the analysis of agri-food information system data to inform LSFF include:

1. Search food balance sheet (FBS) data, either FAO data or country-specific FBS data, to estimate the domestic supply of potential food vehicles for LSFF.
 - a. Assume that “domestic supply = (local production) – (exports) + (imports) – (change in stock)” as used by FAO for its FBS, or define the specific assumptions relevant for the country. Change in stock refers to stock variation related to amounts sent to utilization or withdrawn from supply stocks (Habimana 2019).
 - b. Although some components informing domestic supply volumes from FAO food balance sheets are not disaggregated, e.g., “maize and products” or “wheat and products,” assume that proportionally they will be the same for flour for the country.
2. Search the “Digital Logistics Capacity Assessment (DLCA)” website (Dlcalogcluster.org) to identify food producers and suppliers of potential food vehicles for LSFF in the country, and/or systematically search for additional data sources for the names of food producers/suppliers.
3. Systematically search industry and media articles and supplier, producer and retailer websites, Facebook pages, LinkedIn posts, and online store data, or purchase relevant market research data, to identify:
 - a. Domestic producer and supplier volumes of potential food vehicles for LSFF
 - b. Food types of each potential food vehicle for LSFF, from each producer or supplier
 - c. Brands of each potential food vehicle for LSFF, from each producer or supplier.
4. Perform calculations to standardize:
 - a. Production volume per year
 - i. Annual production
 - ii. Annual production capacity and percent of capacity used (if available)
 - b. Volume proportions across producers.
5. Based on the production/supply volume data, determine which producers/suppliers are categorized as “large-scale,” considering the threshold production estimates for “large-scale,” and thus “fortifiable” in Table 2 and Annex 7 of the [USAID LSFF Programming Guide](#).
 - a. Estimate the proportion of the domestic supply of the potential food vehicle from each producer/supplier.
 - b. Estimate the proportion of the domestic supply of the potential food vehicle from fortifiable sources/producers.
6. Produce a list of the food types by the potential food vehicles.
 - a. Estimate the percent of each food type for each food vehicle (e.g., the percent of the domestic edible oil supply that is palm oil, soybean oil, sunflower oil, corn oil, and groundnut oil, etc.).
7. Produce a list of the food types by producer/supplier for each potential food vehicle.
8. Produce a list of the brands by producer/supplier for each potential food vehicle.
9. If data are available by geographic area or market type, estimate the proportion of the supply of the potential food vehicle from fortifiable sources/producers that is available by geographic areas and/or market type

10. Throughout the process, ensure that the analysis team:
 - a. is familiar with the definitions used and their implications/limitations, e.g., production volume/year versus production capacity/year; stock variation; food type versus product brand.
 - b. cross checks sources and unit conversions to standardize them where they are different.
 - c. continuously evaluates how the data captured can link to sub-categories that can help to further disaggregate the data to provide answers to more specific questions.
 - d. makes note of assumptions and limitations and where further research or data are needed, for example—
 - i. note if you are assuming that food producer annual production capacities are proportionate to the actual annual production volumes; when production capacity is used, the figures may not represent total volumes available.
 - ii. where production volumes were not available for a producer, one option may be to assume the same capacity or volume produced by the smallest known producer.

Steps in the estimation of market availability of fortifiable and fortified foods using data from market assessments

The following analysis steps assume that the market assessment was conducted specifically to collect market-level data in different geographic areas and different types of retail markets, including information on:

- Food types of potential food vehicles
- Brands of potential food vehicles
- Origin of brands, including imported and locally produced
- Fortification logos, statements, or nutrient labeling showing fortification of brands
- Fortification quality and status through food sampling by brand.

If the market assessment was not conducted for the specific purpose mentioned above, review the data to determine the feasible estimates.

The basic steps in the analysis of data from market assessments to inform LSFF include the following:

1. List the unique brands of the potential food vehicles by producer/supplier. When calculating the percent of brands, this list represents the denominator as it shows the total number of brands of a food vehicle. The list can also be compiled by geographic area and by market type, for example, outdoor market, grocery/retail shop, supermarket, bakery, and wholesaler.
2. Calculate the number and percent of brands by:
 - a. food type
 - b. origin
 - c. fortification logo
 - d. fortification status

The above can also be disaggregated by geographic area and market type.

3. Calculate the market share by:
 - a. food type
 - b. origin
 - c. fortification logo
 - d. fortification status

The above can also be disaggregated by geographic area and market type.

4. Categorize the brands by fortifiability and calculate the number and percent of brands and market share. This would require further categorization of each brand as such, using either the market share estimated from the market assessment, or from other sources. Fortifiability is defined as exceeding the threshold production estimates for “large-scale”, and thus “fortifiable”, which can be found in Table 2 and Annex 7 of the [USAID LSFF Programming Guide](#).
5. Results can be presented in categories as in step #2 and step #3, for example, for origin:
 - a. Percent that is imported and fortifiable
 - b. Percent that is imported and not fortifiable
 - c. Percent that is locally produced and fortifiable
 - d. Percent that is locally produced and not fortifiable

As in step #2 and #3, the results can also be disaggregated by geographic region and by market type.

Annex 6 Detailed description of the analysis of the contribution of fortification to micronutrient adequacy



Steps in the estimation of the contribution of fortification to micronutrient adequacy using 24-hour dietary recall or SQ-FFQ data

1. Use the clean dataset from the needs assessment step above.
2. Calculate the additional micronutrient content provided by the fortified food.
 - a. Generate a variable that has the assumed average fortification content in milligrams or micrograms per gram of food at households, adjusted for expected micronutrient losses in fortified foods from the factory to homes, where needed.
 - i. If this variable is based on analysis of representative samples of the food vehicle collected at households or markets, these values can be used directly to construct the variable (e.g., multiply percent of the food vehicle that is fortified to any extent by the average fortification level among the fortified food vehicle).
 - ii. If this variable is based on analysis of samples from factories or is based on existing or hypothetical fortification standards at point of fortification, adjustments for expected losses may be necessary. The adjustment for expected losses of micronutrients in fortified foods from the factory to the home can be conducted using the Food Fortification Formulator tool (Dary and Hainsworth 2008).
 - b. Discuss data sources and estimates for the following with the in-country stakeholder/technical working group formed to advise on the modeling:
 - i. For food vehicles under mandatory fortification:
 1. Average fortification levels in households under the current status quo scenario and the percent of the fortified food vehicle fortified to any extent
 2. Average fortification levels in households under an improved compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent
 - ii. For food vehicles proposed for fortification (not yet mandatory):
 1. Average fortification levels in households under a realistic compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent, with fortification formulations that are compatible with technical and economical limitations and trade practices.
3. Multiply the average fortification content at households by consumption of the food vehicle to estimate the additional contribution of fortification.
4. Recalculate the total micronutrient intake.
5. Generate new estimates of the prevalence of inadequate micronutrient intake using the EAR-cut point method and the full probability approach for iron.
6. Compare the estimates of micronutrient inadequacy with LSFF to the estimates of micronutrient inadequacy without LSFF to determine the potential contribution of LSFF to meeting micronutrient requirements.

7. Calculate the micronutrient gap at the 25th percentile of intake with LSFF and compare to the gap without LSFF.
8. Calculate the safety of intake at the 75th percentile with LSFF and compare to the safety of intake without LSFF.
9. Repeat the process above for the various fortification scenarios, as agreed upon with the stakeholder/technical working group.



Steps in the estimation of the contribution of fortification to micronutrient adequacy using HCES data

1. Use the clean dataset from the needs assessment step above.
2. Calculate the additional micronutrient content provided by the fortified food.
 - a. Generate a variable that has the assumed average fortification content in milligrams or micrograms per gram of food at households, adjusted for expected micronutrient losses in fortified foods from the factory to homes, where needed.
 - i. If this variable is based on analysis of representative samples of the food vehicle collected at households or markets, these values can be used directly to construct the variable (e.g., multiply percent of the food vehicle that is fortified to any extent by the average fortification level among the fortified food vehicle).
 - ii. If this variable is based on analysis of samples from factories or is based on existing or hypothetical fortification standards at point of fortification, adjustments for expected losses may be necessary. The adjustment for expected losses of micronutrients in fortified foods from the factory to the home can be conducted using the Food Fortification Formulator tool (Dary and Hainsworth 2008).
 - b. Discuss data sources and estimates for the following with the in-country stakeholder/technical working group formed to advise on the modeling:
 - i. For food vehicles under mandatory fortification:
 1. Average fortification levels in households under the current status quo scenario and the percent of the fortified food vehicle fortified to any extent.
 2. Average fortification levels in households under an improved compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent.
 - ii. For food vehicles proposed for fortification (not yet mandatory):
 1. Average fortification levels in households under a realistic compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent, with fortification formulations that are compatible with technical and economical limitations and trade practices.
3. Multiply the average fortification content at households by consumption of the food vehicle to estimate the additional contribution of fortification.
4. Recalculate the total household micronutrient intake per AFE, accounting for changes in the micronutrient content of the fortifiable food.
5. Recalculate the nutrient density of the household diet, accounting for changes in the micronutrient content of the fortifiable food.
6. Compare the total household micronutrient intake per AFE to the harmonized average requirements.
7. Compare the nutrient density of the household diet to the critical nutrient densities for the reference population.

8. Generate new estimates of the prevalence of inadequate micronutrient intake using the EAR-cut point method and the full probability approach for iron.
9. Compare the estimates of micronutrient inadequacy with LSFF to the estimates of micronutrient inadequacy without LSFF to determine the potential contribution of LSFF to meeting micronutrient requirements.
10. Calculate the micronutrient gap at the 25th percentile of apparent intake and/or nutrient density with LSFF and compare to the gap without LSFF.
11. Calculate the safety of intake at the 75th percentile of apparent intake and/or nutrient density with LSFF and compare to the safety without LSFF.
12. Repeat the analyses for the various fortification scenarios, as agreed upon with the in-country stakeholder/technical working group.



Steps in the estimation of the contribution of fortification to micronutrient adequacy using FBS data

1. Use the clean dataset from the needs assessment step above.
2. Calculate the additional micronutrient content provided by the fortified food.
 - a. Generate a variable that has the assumed average fortification content in milligrams or micrograms per gram of food at households, adjusted for expected micronutrient losses in fortified foods from the factory to homes, where needed.
 - i. If this variable is based on analysis of representative samples of the food vehicle collected at households or markets, these values can be used directly to construct the variable (e.g., multiply percent of the food vehicle that is fortified to any extent by the average fortification level among the fortified food vehicle).
 - ii. If this variable is based on analysis of samples from factories or is based on existing or hypothetical fortification standards at point of fortification, adjustments for expected losses may be necessary. The adjustment for expected losses of micronutrients in fortified foods from the factory to the home can be conducted using the Food Fortification Formulator tool (Dary and Hainsworth 2008).
 - b. Discuss data sources and estimates for the following with the in-country stakeholder/technical working group formed to advise on the modeling:
 - i. For food vehicles under mandatory fortification:
 1. Average fortification levels in households under the current status quo scenario and the percent of the fortified food vehicle fortified to any extent.
 2. Average fortification levels in households under an improved compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent.
 - ii. For food vehicles proposed for fortification (not yet mandatory):
 1. Average fortification levels in households under a realistic compliance scenario where at least 80 percent of the fortifiable food vehicle is fortified to any extent, with fortification formulations that are compatible with technical and economical limitations and trade practices.
3. Recalculate the micronutrient supply/day per capita, accounting for changes in the micronutrient content of the fortifiable food.
4. Generate new estimates of the prevalence of inadequate micronutrient intake.

5. Compare the estimates of micronutrient inadequacy with LSFF to the estimates of micronutrient inadequacy without LSFF to determine the potential contribution of LSFF to meeting micronutrient requirements.
6. Calculate the micronutrient gap in the food supply with LSFF and compare to the gap without LSFF.
7. Repeat the analyses for the various fortification scenarios, as agreed upon with the stakeholder/technical working group.

As a reminder, the data from FBS could potentially be useful to provide rough estimates of the contribution of LSFF to the micronutrients in the food supply at the national level, but the results can only be used to justify the application of any of the methodologies mentioned above. FBS data are inadequate for this step in the methodology to inform LSFF programming.

General considerations when estimating the contribution of fortification to micronutrient adequacy

Consider the following fortification scenarios when estimating the contribution of fortification to micronutrient adequacy:

- mandatory fortification at current fortification levels at households or markets (percent of the fortified food vehicle fortified to any extent and average fortification level, if the data are available)
- mandatory fortification expected at households if industry complies with the standard target micronutrient levels (i.e., with “good compliance”⁵ meaning improved yet realistically achievable a) percent of fortifiable foods fortified to any extent and b) average fortification level, estimated from the target content required in the standard minus the expected losses of the micronutrient from factory to households)
- fortification of mandatory or new food vehicles, modifying or varying the formulation of micronutrient addition (and accounting for expected micronutrient losses from factories to households) with fortification formulations that are compatible with technical and economical limitations and trade practices.⁶

Modeling the current situation of compliance

Use the following data sources to inform modeling of the "current" situation of fortification compliance:

- national micronutrient surveys
- FACT surveys.

These surveys may include data on—

- consumption of fortifiable or fortified foods at the household level

⁵ Note that there are no strict definitions for “good compliance”. For the purpose of this guide, we define “good compliance” as a scenario in which at least 80 percent of the fortifiable food vehicle is fortified, and average fortification levels at households are as expected relative to the standard after adjusting for expected losses from point of fortification to households. The values of micronutrient losses from factories to homes vary from micronutrient to micronutrient, as minerals are very stable but vitamins are not, and for the latter the rate of decay also varies from vitamin to vitamin (Omar Dary, personal communication, June 23, 2023; Katherine P. Adams, personal communication, June 20, 2023).

⁶ Omar Dary, personal communication, June 23, 2023; Katherine P. Adams, personal communication, June 20, 2023.

- the percentage of mandatorily fortified food samples taken from households or markets that contained the added micronutrients, as determined from laboratory analysis.
- the average quantity of the added micronutrients in composite samples of the fortified foods, as determined from laboratory analysis.

If a FACT or micronutrient survey is not available, use as an estimation the data presented in the [Global Fortification Data Exchange \(GFDx\)](#). The GFDx is an online dashboard that provides country-level information on fortification at the national level. The GFDx may have information about fortification quality and/or compliance and the data source, which may be useful to find information about the average fortification levels. The LSFF stakeholder/technical working group that was formed to support the analysis, which is described in the Operational Overview, may also be able to provide information regarding sources of data on the amounts of micronutrients present in LSFF products. The data should ideally be relatively recent, e.g., within the past 5 years.

Modeling fortification of mandatory or new food vehicles, varying the content of micronutrient addition

First determine which micronutrients and food vehicles are of interest. Then, for each food vehicle, determine the quantity of each micronutrient to be modeled, considering:

- feasible micronutrient contents based on technical and economical constraints of the fortifiable vehicle⁷
- existing micronutrient gaps (proportion that is going to be corrected by the fortified food)
- safety of the fortification content.

Discuss the modeling scenarios with a stakeholder/technical working group in the country that includes individuals from industry. Note that the approach to determine the micronutrient content in fortified foods should start with the technological and economic viability and then to estimate the nutritional contribution in the target population, as frequently it is not realistic to start with theoretical calculations of filling nutrient gaps.⁸

Aim to design the food fortification program so that when it is implemented, the predicted probability of inadequate micronutrient intake is low for population subgroups at risk of inadequate micronutrient intake and the risk of excessive intake in other subgroups in the population is also low.⁹ Balance these two figures as much as feasible—low inadequate micronutrient intake and low risk of excessive intake in population subgroups.

⁷ Before any biological calculation, it is important to determine the maximum amount of each micronutrient that a fortifiable food may contain. There are two main constraints: Compatible with the organoleptic properties (flavor, odor, color, and stability) of the fortifiable food and its products, and cost. The cost should be lower than 1-3 percent of the price and in combination with the other micronutrients that are being considered for the food vehicle. For social programs, this increment could be higher as the cost is assumed by the programs (Omar Dary, personal communication, June 23, 2023).

⁸ Omar Dary, personal communication, June 23, 2023.

⁹ Engle-Stone et al. 2019.

Annex 7 Fortifiable foods

Fortifiable foods are defined as those foods that are centrally processed at large scale and by relatively well-developed industrial facilities and that could be fortified according to national, regional, or local regulations and standards. Foods that are not fortifiable for the purposes of LSFF are those that are processed in the home or in small or medium-sized enterprises. Small and medium-sized enterprises may fortify but the process will be inefficient and difficult for government to monitor and enforce, making fortification through small and medium enterprises unsustainable and unreliable. Table A7.1 below, from the [USAID LSFF Programming Guide](#), provides useful threshold estimates for what constitutes “large-scale” for processors and millers in low- and high-income countries.

Table A7.1 Threshold estimates for what constitutes “large-scale” in fortification in low- and high-income countries

| Commodity | Metric ton/hour | | Metric ton/day | | Metric ton/year | |
|-------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|
| | Low income country | High-income country | Low income country | High-income country | Low income country | High-income country |
| Sugar | 20 | 150 | 500 | 4,000 | 75,000 | 600,000 |
| Wheat flour | 20 | 100 | 150 | 1,000 | 45,000 | 300,000 |
| Rice | 10 | 20 | 100 | 500 | 30,000 | 150,000 |
| Salt | 10 | 15 | 100 | 200 | 30,000 | 60,000 |
| Oil | 5 | 20 | 50 | 150 | 15,000 | 45,000 |

Source: USAID 2022.

To determine if a food is fortifiable for the purposes of LSFF, check industry estimates of the percent of the market share of the food that is industrially, centrally processed and discuss the figures with in-country stakeholders. Note that for some food vehicles, the Global Fortification Data Exchange ([GFDx](#)) and the Food Fortification Initiative ([FFI](#)) also have estimates of the percent of the market share of food that is fortifiable.

Imhoff-Kunsch (et al. 2012) explain that estimates of fortifiable food consumption can include:

- only those individuals or households that consumed or acquired the specific food product (“consumers” also identified as “observed” consumers)
 - Reporting consumption by “consumers” alone provides information about food consumption by the true consumers.
- everyone (“consumers” + “non-consumers”).

Reporting both estimates is helpful because the estimate for “consumers” provides information about what consumption might be if everyone had access to, could afford, and consumed the fortified food,

and estimates for “consumers” + “non-consumers” give a measure of what the program might achieve at a population level if consumption patterns remain unchanged.

Annex 8 Cost of the Diet Tool

The CotD method, developed by Save the Children, uses linear programming software to model and estimate the amount and combination of local foods needed to provide a typical family with a diet that meets their average needs for energy and recommended intakes of protein, fat, and micronutrients at the lowest possible cost to the household (Deptford et al. 2017; Save the Children UK 2018). Based on the locally available foods, their costs, and nutrient content, the CotD software creates lowest-cost hypothetical diets that meet the World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommended nutrient requirements (WHO and FAO 2004).

Linear programming is a mathematical technique that minimizes or maximizes a linear function of a set of variables to generate optimal solutions while simultaneously satisfying multiple constraints (Van Dooren 2018; Briend et al. 2001). Linear programming can be used to identify the lowest cost nutritionally adequate diet while fulfilling constraints. The World Food Programme (WFP) has used linear programming extensively in its Fill the Nutrient Gap approach, together with information from an extensive desk review, to analyze the nutrition situation in a country (Bose et al. 2019). WFP uses the CotD tool to model the contribution of food fortification to the cost of an adequate diet, in addition to modeling the contribution of other interventions on diet cost (WFP 2020). WFP's objective is to use the findings to advocate for interventions, such as LSFF, to improve micronutrient adequacy in populations vulnerable to malnutrition. Results from a CotD analysis can be used by national stakeholders and governments to inform a range of intervention programs to improve nutrition, including LSFF. We recommend that you check to see if a WFP Fill the Nutrient Gap analysis has been conducted in the country, as the findings could be useful for the optional step in the methodology.

Table A8.1 provides the input data needed for CotD linear programming analysis to model diets/diet cost and potential data sources (Briend et al. 2001; Ferguson et al. 2006). Data inputs include—

- **List of foods consumed.** Use quantitative or qualitative open 24-hour dietary recall data from population-based surveys, which is a good source of information. You may also use population-based SQ-FFQ or HCES data, but the utility of these data sources will depend on the extent to which the food lists reflect consumption. Population-based weighed-food records are also a potential data source, but few exist given their cost, resource requirements, and complexity.
- **Nutritional requirements.** You may use FAO and WHO recommended nutrient requirements or recommended nutrient intakes from other official government sources or international bodies, for constraints regarding nutrient intake. Please note that the Cost of the Diet tool uses the FAO and WHO recommended nutrient requirements. For micronutrient intake constraints, we generally recommend in this methods' guide that you use the harmonized average requirements (H-ARs), (Allen et al. 2019), but note that these would need to be added to the Cost of the Diet tool. You can discuss the nutritional requirements with country-level and international stakeholders.
- **Food consumption constraints.** Use quantitative dietary intake data, such as from a quantitative open 24-hour dietary recall and/or SQ-FF questionnaire, to identify food-consumption constraints for the linear programming models. Food frequency data are useful to determine constraints regarding the minimum and maximum servings per week of individual food items.
- **Food prices.** Determine food prices from market surveys, household consumption and expenditure surveys, and/or consumer price index information from official government sources. There is no strong priority in terms of the food cost data options. Data should ideally be from within the past 2 years and cover an appropriate range of foods. Price estimates for foods not currently fortified but with the potential to be fortified, as well as price estimates of currently

fortified foods in their unfortified form, would need to be discussed with the companies that would produce the fortified food and with in-country stakeholders and government officials. Adjust older food price data for inflation.

- **Food composition tables.** Use data on the nutrient composition of foods from country-specific food composition tables or other food composition tables or published information regarding the nutrient content of foods as appropriate/needed.

Discuss all potential data sources with in-country stakeholders to identify the sources considered the most valid and that will be accepted by policymakers, planners, and government officials (Knight et al. 2022).

Table A8.1 Input data needed for the CotD analysis and potential data sources

| Input data needed for linear programming analysis | Potential data sources |
|--|--|
| List of foods, including fortifiable foods | <ul style="list-style-type: none"> • 24-hour dietary recall (quantitative or qualitative, open, population-based data) • SQ-FFQ or food frequency (population-based data) • Household consumption (from HCES) |
| Nutritional constraints on the minimum energy and nutrient content in the diet | <ul style="list-style-type: none"> • FAO, WHO, and UNU recommended energy intakes • H-AR for micronutrients (or others, based on discussions with in-country or international stakeholders) • Other recommended nutrient intake amounts, as appropriate |
| Food-consumption constraints: <ul style="list-style-type: none"> • Maximum acceptable daily portions of individual foods • Minimum and maximum servings per week | <ul style="list-style-type: none"> • 24-hour dietary recall (quantitative, open, population-based data) • SQ-FFQ or food frequency (population-based data) • Household consumption (from HCES) |
| Cost of foods | <ul style="list-style-type: none"> • Market surveys • Household consumption and expenditure surveys • Consumer price index (official government data) |
| Food composition tables | <ul style="list-style-type: none"> • Food composition tables included in the CotD software • Country-specific food composition tables, if available • Additional food composition tables as appropriate/needed |

Source: Adapted from USAID Advancing Nutrition 2022.



Strengths and Limitations

CotD strengths include that it—¹⁰

- Can be used for advocacy, to guide thinking on what drives costs for meeting micronutrient needs and to stimulate debate
- Can be used to create “what if” scenarios to model how the cost of an adequate diet may change given interventions such as food fortification, biofortification, supplementation, and cash transfers
- Can be used for analysis at the individual or household level
- Can identify which micronutrients are the most difficult to achieve from the hypothetical “diet”
- Provides an economic benchmark of the lowest possible cost of a diet that meets nutrient needs.

CotD limitations include—

- The CotD diet is not necessarily a diet that households would consume; it cannot necessarily be used to make a recipe or meal.
- Results do not represent the distribution of dietary patterns within the population.



Steps for use

The Save the Children [Practitioner’s Guide](#) for CotD describes in detail the use of the tool. The basic steps in the use of the tool include—

1. Define the objectives of the analysis and the data needs.
2. Determine whether existing data can be used for secondary analysis. For example, can existing market, HCES, or consumer price index data be used?
3. Prepare existing data for secondary analysis (i.e., clean the data and convert to price per 100 grams).
4. Research and agree with the project team and/or local stakeholder/technical working group on the relevant parameters for the analysis. The process to define the parameters is described below. Parameters may vary according to the specifics of stakeholder and country requirements, and the available data. Data sources and their suitability are outlined in the Operational Overview, Figure I. Steps in the Methodology and Data Decision Tree (Optional Step section) and in Table A8.1 above.
 - a. **Determine family size and composition**, with the specific nutrient requirements for each family member. Base the family or household size and composition on the most appropriate average demographic data for the country or local context studied, usually obtained from recent Demographic and Health Surveys, if available.
 - i. Select from the CotD software the characteristics or specifications for individual family members, for example, age group and weight for adult members, and lactation for an adult woman.
 - I. The specific nutrient requirements for each family member are embedded in the CotD software, based on WHO and FAO recommended nutrient requirements.

¹⁰ Please see Untoro et al. 2017 and Ferguson et al. 2006.

2. Add nutrient requirements to the software from other sources at the scenario modeling stage, if necessary.
- b. **Identify geographic areas** that reflect a representative sample of the country or specific area to be studied based on the secondary data available for food prices. Examples are livelihood zones, provinces and regions; however, these are country-specific. Analyze using urban/rural breakdown, where data and time allow.
 - c. **Identify seasons and months to be modeled.** Analyze all seasons that comprise one year to enable any differences and similarities between seasons and year-round averages to be explored, as feasible. Choose a specific month within each season, using the most recent available food price data.
 - d. **Identify a list of foods consumed and available in markets, with price per 100 grams or per 100 ml.** Develop the food list with local teams who have expertise and knowledge of the country's food systems and market context. Agree and add all items suitable for inclusion to the food list. Remove alcohol, soft drinks, sugar and sweets from the original list due to their low nutritional value. Also remove infant-specific foods. Include these and other foods, for example sugar for LSFF models, at the modeling stage, if required.
 - i. Determine food prices from market surveys, household consumption and expenditure surveys, and/or consumer price index information from official government sources. Determine food prices for the seasonal months selected and convert to price per 100 grams or 100 milliliters.
 - ii. Make a request to local contacts or in-country offices to obtain the required secondary data.
 - e. **Identify household income or expenditure data**, which is needed to estimate the affordability gap (see section below). Non-affordability is a conservative estimate of the proportion of households whose current food expenditure is below the estimated minimum cost of the CotD hypothetical diets. The diet cost is contextualized by placing it in relation to how much money households typically spend on food. Therefore, food expenditure data are preferable if available and considered reliable in the local context.
 - i. Include purchases and the equivalent monetary values for home/own produce and gifts in the food expenditure totals. Make the necessary adjustments to the consumer price index to reflect current food prices if food expenditure data are not recent.
 - ii. If food expenditure data are not available, use 70 percent of total household income or expenditure instead. This is an approximation and the appropriate percentage depends on the local context.
 - iii. The use of government-collected data on income or expenditure gives greater credibility to external stakeholders, for example, household consumption/income and expenditure surveys.
 - f. **Food composition tables** are included in the CotD software, which contains ten embedded food composition tables (FCTs). Match the foods on the agreed food list with the most suitable FCT entry. Create a new food from a relevant country or region-specific FCT if a food does not exist or the nutrient composition is widely different from what is in the CotD FCT.
 - g. **Define food consumption constraints**, the minimum and maximum frequency constraints of weekly portions for staple foods, to create the staple-adjusted nutritious diet (SNUT) for the Standard Analysis diets. It is usually referred to as the “nutritious” diet (not to be confused with the nutritious diet included in the CotD Standard Analysis). You can constrain for a maximum of three staple foods.

5. Add the required data to the CotD software.¹¹ Add the assessment details to the CotD assessment setup screen -- please refer to Section 5.5 “Assessment set up” in the Save the Children Practitioner’s Guide for more details. If new foods need to be included after the initial set up, create the new foods manually, including the price and weight information.
 - a. Add the specified family members, via the standard analysis screen (see Section 5.7.1 “Add family or individuals” in the Save the Children Practitioner’s Guide). The CotD software then calculates the lowest cost Standard Analysis diets. These diets are explained in more detail in the [Save the Children Practitioners’ Guide](#).
 - b. Use the energy-only diet as a benchmark for the nutritious (SNUT) diet cost in the analysis. Do not include the food habits nutritious diet (FHAB) in your analysis. It is used in the Save the Children method only. Instead, make a copy of the standard analysis, via the “Add New” link (see Section 5.8.2 in the Save the Children Practitioner’s Guide), to create the SNUT diet. Click on the “View” link for this new model and rename the FHAB diet as SNUT. Adjust the minimum and maximum constraints in this diet for the staple food(s) chosen.
 - c. Determine the population percentage weight in each geographical area and use these to calculate national average findings in Microsoft Excel from the nutritious and modeled diet results. Use these percentages to calculate the national weighted average for diet cost results.
6. Conduct scenario modeling with the CotD software. The CotD software enables a range of additional analysis or modeling to be undertaken by changing one or more underlying parameters. These can be useful for advocacy and planning purposes by providing hypothetical examples of interventions that could improve the affordability and nutrient quality of a nutritious diet. These will depend on the aim and objectives of a particular assessment or study.
 - a. For LSFF modeling, make a copy of (clone) existing fortifiable foods and modify the nutrient composition according to the fortification requirements. Ensure both the intrinsic micronutrient content and the fortification requirements are included. Be careful not to just replace the existing micronutrients with the new fortification specification.
 - b. If foods to clone do not exist in the database, create new foods with the required fortification specification. Convert all nutrients in the fortification specification to micrograms or milligrams per 100 grams.
 - i. Please note that the software uses retinol activity equivalent for vitamin A and folate for folic acid. Divide the folic acid fortification figure by 0.6 to convert to folate.
 - c. Add the cloned or new food(s) to the food list at the assessment level with either the existing price or an agreed inflated LSFF price per 100 grams for relevant seasons.
 - d. Copy the SNUT diet to create a new model and specify:
 - i. minimum/maximum constraints. For fortified staple foods, set the non-fortified version(s) to zero minimum/maximum constraints and use the original staple food constraints for the fortified version. Check the model requirements for all foods with local teams.
 - ii. the portion size if different to the standard CotD portion size.
 - e. Check that the price has been picked up at the model level—it may be necessary to add it again at this level, via the “Edit prices portions and constraints” link.

¹¹ Note that the World Food Programme has developed an import function to enable an upload of the prepared food list with prices to the CotD software.

- f. The CotD software calculates the new cost for the newly created model.
7. Estimate the affordability gap by estimating the percentage of a population that cannot afford a nutritious diet. Note that the WFP Fill the Nutrient Gap approach uses a different affordability analysis to the Save the Children method. Save the Children's method estimates the non-affordability of diets produced by the CotD software and essential non-food expenditure by comparing these data to household income by wealth group. WFP's Fill the Nutrient Gap method compares household food expenditure to the diet costs produced by the CotD software to estimate non-affordability.
 - a. Conduct the non-affordability calculation outside of the CotD software, usually in Microsoft Excel, to determine the percentage of households that cannot afford a nutritious diet. Compare food expenditure data divided into percentiles to the energy-only, nutritious, and modeled diets daily cost to determine non-affordability by percentage of the typical household size identified for the analysis.
 - b. Contextualize affordability and identify further assistance that may be necessary to close the non-affordability gap by referring to the recent or current position of a country's income and poverty levels and food prices



USAID ADVANCING NUTRITION

Implemented by:
JSI Research & Training Institute, Inc.
2733 Crystal Drive
4th Floor
Arlington, VA 22202

Phone: 703-528-7474
Email: info@advancingnutrition.org
Web: advancingnutrition.org

September 2023

USAID Advancing Nutrition is the Agency's flagship multi-sectoral nutrition project, addressing the root causes of malnutrition to save lives and enhance long-term health and development.

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