TECHNICAL REPORT

Development of Simplified Dietary Assessment Tools to Inform the Design of Nutrition Interventions

September 2017

Technical report submitted by GAIN under USAID Grant # GHA-G-00-06-00002.

For additional information, please contact:

Lynnette Neufeld
Director, Monitoring, Learning and Research Unit
GAIN
Rue de Vermont 37-39
CH-1202 Geneva, Switzerland
Tel: +41 22 749 1512
E: lneufeld@gainhealth.org

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID), through a Grant to the Global Alliance for Improved Nutrition (GAIN) No. GHA-G-00-06-00002, and amendments. The contents are responsibility of GAIN and do not necessarily reflect the views of USAID or the United States Government.

Development of Simplified Dietary Assessment Tools to Inform the Design of Nutrition Interventions

Technical Report

Project implementation team

Christine Hotz, PhD, Consultant, Toronto, Canada

Abdelrahman Lubowa, MSc, Consultant, Kampala, Uganda

Prof. Archileo Kaaya, Schoold of Food Technology, Nutrition and Bio-Enginerring, Makerere University, Kampala, Uganda

Global Alliance for Improved Nutrition, Geneva Switzerland

School of Food Technology, Nutrition and Bio-Engineering, Makerere University, Kampala

Table of Contents

Table of Abbreviations

24HR	24-Hour Dietary Recall
EA	Enumeration Area
EAR	Estimated Average Requirement
FACT	Fortification Assessment Coverage Toolkit
FCT	Food composition table
FRAT	Fortification Rapid Assessment Tool
g	Grams
GAIN	Global Alliance for Improved Nutrition
ml	Milliliter
SFGCT	Sub-food group composition table
SQ-FFQ	Semi-quantitative food frequency questionnaire
USAID	United States Agency for International Development

Executive Summary

Introduction and aim: Dietary assessment is essential to determine nutrient intake gaps in the diet and associated food intakes. Information derived from dietary intake surveys is needed to inform the design of appropriate nutrition interventions, and to evaluate those interventions. However, investments in conducting representative dietary intake surveys are still lacking in many countries. A major concern is that dietary methods typically used for designing and evaluating nutrition interventions, especially the 24-hour dietary recall (24HR), are methodologically complex and time consuming, while those that are relatively simple and less time consuming, such as dietary diversity scores, do not provide sufficient information for these purposes.

Wider use of dietary assessment requires that assessment methods strike a balance between being practical to implement without unnecessary detail, while still being sufficiently valid for the desired purpose. The goal of this study was to develop and test two methods of quantitative dietary assessment that are less technically challenging and less expensive to implement than the standard 24HR dietary recall procedure, but still capable of identifying nutrient gaps with acceptable precision. One simplified method was based on a simplification of the 24HR dietary recall format, and the other was based on a semi-quantitative food frequency (SQ-FFQ) survey design, two of the most commonly used dietary assessment methods.

The main research activities were to: (1) design methods to collect necessary input data (food listing, usual portion sizes, usual recipes) needed to implement the survey tools and convert food intakes into nutrients; (2) implement field surveys to compare the two test methods with a standard reference method (full 24HR recall approach), and; (3) compare the results of the test survey methods to those of the standard 24HR recall reference method, focusing on four key outcomes (mean/median nutrient intakes per day; nutrients for which the mean/median is <100% of the Estimated Average Requirement (EAR); percentage of individuals with nutrient intakes <100% of the EAR; and the foods that provide >5% of the EAR for selected nutrients). In addition, we assessed the technical and resource requirements for each of the three survey designs, and tested a condensed version of a food composition table (using food subgroup-level average content) on the same four key outcomes. The study was conducted in a selected population of reproductive age women in rural Uganda.

Results: The input data collection activities were designed for use in areas where previous quantitative dietary intake is not available to inform survey tools and methods. The food listing exercise, which used a combination of key informant

interviews and focus group discussions, was a useful approach to prepare food lists and dietary assessment tools for all three surveys. This approach identified 100% of the foods listed in the exercise, 91% of which were ranked with a low, moderate, or high likelihood of being consumed.

The portion size estimation activity was designed to establish an appropriate range of portion sizes to include in a food photo atlas, as a simplified approach to portion size estimation in the two test survey methods. We employed a quantitative design to develop a food photo atlas with a series of five portion sizes for all foods and dishes included. While data collection was not technically challenging, it did require a moderate degree of coordination, moderate to high amount of preparation time, and exceeded the cost of the survey data collection phase of the two test methods. This approach may be feasible for large scale surveys, but would not be practical for smaller surveys.

We also employed a simplified approach to collecting standard recipe data, compared to the reference method. The proportion of ingredients and nutrient content was very comparable between methods, with the major exception of green leafy vegetable dishes and meat-based soups. Using our initial approach, the cost of data collection was similar between methods; however, the simplicity and speed of data collection using the simplified method indicates it is feasible to double the amount of information derived from each participant, which would result in a lower cost. The chosen approach may be a matter of preference by survey coordinators based on their experience and skill level of enumerators.

The results of the dietary surveys indicate a high level of conformity between the Standard 24HR reference method and the SQ-FFQ method, particularly with respect to the mean energy and nutrient intakes, identification of nutrients with a mean/median <100% of the EAR, and the percentage of individuals with intakes below the EAR. Less conformity was found in identifying specific foods contributing >5% of the EAR, although this is likely attributed at least in part to the longer recall period of the SQ-FFQ method.

In contrast the Simplified 24HR method resulted in a substantial, systematic underestimation of energy and nutrient intakes, with low conformity for the key outcome indicators. This appears to have resulted from a combination of lower portion size estimations and less frequent mention of foods consumed; both may be related to interview skills and degree of probing employed by the enumerators suggesting that more in-depth training on these aspects may be required to improve

the method. Based on these comparisons, it is not clear whether the food photo atlas functioned well in this population; additional studies would be useful to validate this approach in these types of populations as it has been in other settings, and to improve the design of the atlas.

Our attempt to develop a food composition table representing average nutrient contents for food subgroups resulted in relatively large, significant differences in nutrient intake estimates when substituted for a standard food composition table. This approach does not appear to be a viable option to simplify the resource burden of dietary data collection. Rather, it may be advisable to produce regionally relevant and complete FCTs, following international guidelines, that are freely accessible to users.

While the cost of survey field data collection was substantially lower for the two test methods, particularly for the Simplified 24HR method, the total cost of implementing these methods was equalized by the cost of the portion size estimation input data activity. If a less quantitative approach to portion size estimation were validated, the total cost, and technical burden, of implementing these alternative dietary assessment approaches would be lower in comparison to the Standard 24HR method, as conducted in this setting.

Based on the present findings and methodological approaches adopted in this study, the selection of either the SQ-FFQ method or the Standard 24HR may result in similar key outcomes; given the relatively similar costs, the main decision factors may include the technical expertise available in-country, preference and perhaps previous experience of the survey coordinators, and other survey co-objectives that might make one method more appropriate than the other. Any future reduction of the cost of valid, portion size estimation methods would make the SQ-FFFQ a more favorable option. Nonetheless, this approach should first be tested, and costed, in additional settings with different dietary intake patterns, food sources and food preparation practices, and different levels of experience of coordinators and enumerators.

Conclusions: These initial studies indicate that a well-designed SQ-FFQ survey may be a viable option for quantitative dietary intake assessment where the objectives are suited to support the design of food-based nutrition interventions. Additional simplifications to reduce the cost and technical burden of the SQ-FFQ approach may be warranted, as well as further validation in different populations.

1. Introduction

1.1 Introduction and background

Dietary assessment to quantify the adequacy of food and nutrient intakes has several different applications in supporting population health, but is a relatively complex process. At the population or group level, dietary assessment is used to evaluate energy and nutrient intakes for the purposes of identifying relationships between diet and disease, designing nutrition education on food selection, or designing food assistance, food fortification or other nutrition programs that are appropriate for the population needs (FNB & IOM, 2000). If repeated, dietary assessment can be used to evaluate the impact of programs on nutrient intake adequacy, monitor adequacy of the food supply to meet nutritional needs of the population, or identify changes in food intake patterns (FNB & IOM, 2000). However, as dietary assessment surveys of acceptable quality are both technically challenging and resource intensive, the number of large-scale surveys carried out in low-income country populations likely to be at greatest risk of nutritional inadequacy is still limited (Coates et al., 2016); to increase the availability of dietary data for various purposes, efforts to facilitate dietary surveys are warranted, such as through the development of standardized tools or simplified and less resource-intensive methods.

Various dietary assessment approaches are in use, including household-level food consumption or, at individual-level, food records of real-time dietary intakes or recall of foods consumed in the past over a specified period of time (Gibson, 2005). The recall period may be very specific, representing only very recent intakes (e.g., 24-hour dietary recall (24HR) of previous day) or may be less specific, representing usual intake patterns over a longer period of time (e.g., food frequency questionnaire (FFQ) over one week, month or year). Further, any of these methods may be self-administered by the respondent, or administered by a trained interviewer.

Each of these methodological approaches produces information with a different level of validity (i.e., precision, accuracy, representativeness) depending on the application (Coates et al., 2012). In general, the greater the validity desired for food and nutrient intake estimates, the more complex and resource-intensive the dietary assessment method is likely to be. For example, while a standard 24HR method is considered to be

valid for a broader range of applications, it is typically much more expensive to implement than a food frequency approach (Coates et al., 2012; Kristal et al., 2005).

However, for some applications of dietary assessment data, less intensive methods may provide sufficient levels of validity, thus allowing appropriate resources to be allocated. Following a review and consultation process, Coates and colleagues (2012) recommended different methods of dietary assessment according to the stage of the program cycle, with primary focus on food fortification programs. The less intensive and detailed methods (i.e., household consumption surveys or FFQ) were deemed adequate for assessing risk of inadequate nutrient intake during needs assessment, for selecting appropriate food vehicles and fortificant levels, and for assessing reach and coverage of programs. Moderately intensive methods (semi-quantitative FFQ; SQ-FFQ) were considered adequate for quantifying effective and excessive coverage, while the more intensive methods (i.e., 24HR) were recommended for program evaluation of change in nutrient intake adequacy.

It is also important to recognize there will be a wide variation in validity *within* each method depending on the specific data collection and data processing methods used. For example, FFQs commonly assume a single standard portion size for all foods consumed, whereas SQ-FFQs allow the respondent to choose from selected portion size options, and hence offer the opportunity for increased accuracy and precision. Also, in FFQs and SQ-FFQs, or in 24HR where only standard recipes are used, it is assumed that all composite dishes of a particular type contain the same ingredients, the same proportion of ingredients, and hence the same nutrient content, thus potentially reducing validity by not accounting for variation. However, acquiring individual level recipe data from each household, restaurant or vendor, may greatly increase the survey resource requirements. Validity and feasibility must always be balanced.

More complex and precise dietary assessment surveys also impose technical burden. Such surveys require a high level of participation from the respondent and a willingness and ability to either record foods being prepared and consumed at present, or to recall foods consumed in the past, with sufficient detail and accuracy. On the part of the researcher, hard and soft skills are required to facilitate the respondent in providing accurate and precise information, either to easily recall and describe foods in sufficient detail, and to easily visually recall, estimate, and communicate portions sizes consumed.

Interviewers must be literate, numerate, and able to use various tools to facilitate the interview and portion size or ingredient estimates.

1.1.2 Dietary assessment methods

24-hour Dietary Recalls: A multiple 24HR survey is a preferred method for estimating individual-level dietary intakes. However, successful implementation requires a higher degree of technical expertise and data management capacity, relative to other methods such as food frequency methods (Coates et al., 2012). It also requires active participation by the respondent with a need to recall detailed qualitative and quantitative information about foods consumed. Furthermore, even with some technological advancements to ease researcher and respondent burden, the time required for data cleaning and processing can still be lengthy. The latter requirements also make this method less likely to be implemented in different seasons to capture seasonal differences in dietary intakes, which may be substantial for some nutrient-dense foods. To estimate energy and nutrient intakes at the group level, a single 24-hour recall data for each individual in the survey is sufficient. However, to obtain individual-level estimates of intake, and to determine the distribution of intakes and the prevalence of inadequate intakes for nutrients, it is necessary to collect multiple days of recall data for at least a subset of individuals (FNB and IOM, 2000).

Dietary Diversity Scores: Dietary Diversity Scores for infants and young children, and women, have been developed to track progress towards increasing dietary adequacy in populations (Kennedy et al., 2010). However, though simple to implement, these tools were not designed, nor are they appropriate, for identifying specific nutrient intake gaps. Additionally, there is no evidence as to whether they are responsive to a variety of nutrition-specific or -sensitive interventions. They are also not presently designed to track consumption of specific nutrient-dense foods or supplements, but could potentially be adapted for that purpose.

SQ-FFQ: SQ-FFQ methods are common methods that are also used to estimate intakes of specific foods or specific nutrients of interest (e.g., Fortification Rapid Assessment Tool (FRAT)[1] and the Fortification Assessment Coverage Toolkit (FACT) survey method;

[1] Micronutrient Initiative. Fortification Rapid Assessment Tool (FRAT). Adapted from the FRAT guidelines (2000) originally prepared by PATH Canada and commissioned by MI. September, 2003. Accessed online from: https://healthbridge.ca/images/uploads/library/FRATguidelines2003_Nov_20081PKE-1222008-1386.pdf

Aaron et al., 2017), but have also been developed for surveys covering a full spectrum of foods and nutrients (Block et al., 1990). While this approach uses a closed list of foods to determine frequency and portion size category consumed, and is more simplistic than a 24HR recall to administer, it still requires adequate input data to ensure it is both contextually appropriate and valid for the survey context and target group of interest. For example, the food list should cover those food items that contribute the majority of energy and nutrient intakes, and the portion size options should reflect those typically consumed. Further, if portion sizes are to be obtained for the purpose of calculating nutrient intakes, knowledge of the contents of common recipes will also be required. These input data requirements will be relatively simple to compile when focused on a limited number of commonly consumed foods (e.g., staple food fortification vehicles in FACT). However, when a broad range of foods and nutrients are being assessed, the input data requirements for recipes and appropriate portion sizes may be substantial and must be considered in the overall feasibility and resource requirements for conducting surveys.

With the range of dietary assessment tools available, it is clear that the most appropriate method selected will depend not only technical and resource availability but also on the specific objectives and key outcomes of the survey, and the validity of the method to produce valid estimates of those outcomes. For the design of nutrition programs such as food-based interventions working through food fortification, design and introduction of nutritionally improved processed food products, or increased production and marketing of nutritious foods through agricultural development, several key outcomes may be desired:

(i) identification of major nutrient intake gaps to target;

(ii) identification of foods that can potentially fill those gaps – be it through agricultural or market-based programs, non-staple foods for voluntary fortification, or appropriate staple food vehicles for mass fortification, and;

(iii) estimating safe and adequate amounts of nutrients to be added to fortified staple foods;

For these types of outcomes, a somewhat simplified method of obtaining quantitative dietary intake data may be sufficient, and therefore, possibly applied more widely. Efforts to identify and test such methods for their ability to serve these purposes are

needed to identify and design appropriate nutrition interventions. However, any simplification to reduce resource and technical requirements may result in loss of accuracy and precision, and the magnitude of that loss should be quantified.

1.1.3 Supporting (input) data requirements for dietary assessment surveys

Different types of input data are required to obtain quantitative group level information on intakes of all or most foods consumed. These may include: a list of foods consumed in the study population, volume/weight conversion factors, portion sizes, and recipes with proportion of ingredients per cooked weight. The availability of locally relevant reference input data such as usual portion sizes or standard recipes is often limited, and the technical and resource requirements for obtaining these data can be significant and overlooked. Approaches to simplifying procedures for collecting input data for dietary surveys also should be considered.

Food listing for design of dietary assessment tools: Prior identification of foods likely to be encountered in a dietary survey is necessary to (1) adequately prepare data collection tools; (2) process the food and recipe intake data obtained during interviews; (3) identify common recipes for standard recipe data collection if those are to be used, and; (4) to prepare the closed-list of relevant foods for inclusion in a FFQ. Ideally, these food listings are derived from pre-existing dietary intake survey data of the same population (Nelson & Haraldsdóttir, 1998) but this is often not available, and other sources are required. In the absence of pre-existing data, researchers have used consultation with food service professionals, local cook books, or household interviews (Turconi et al., 2005; Tueni et al., 2012; Amougou et al., 2016). While these are relatively low-cost methods, it is not clear how complete and representative they are, and simple but more standardized approaches (e.g., structured key informant interviews and focus group discussions) may be more complete.

Food portion size estimation aids for dietary assessment: Portion size estimation in 24HR methods is often done using a variety of visual aids, which include graduated models, household measures, volume measurements, photographs depicting single or series of portion sizes, or direct weighing of real foods (Gibson and Ferguson, 1999; Slimani et al., 2000; Wrieden et al., 2003). The use of different portion size estimation tools for different foods and drinks is to allow the most realistic visualization and measurement for that food type based on its physical form and how it is consumed. A large number of dietary assessment surveys are using series of photos depicting a range of portion sizes of real

foods for portion size estimation, and this is a promising approach for simplification of methods. Photo series provide a convenient way to estimate portion sizes and there is some evidence that this produces less estimation error than other traditional estimation methods (Foster et al., 2009; Thoradeniya et al., 2012; Bernal-Orozco et al., 2013; Kirkpatrick et al,. 2016). Evidence on the validity of photo series as portion size estimation tools is encouraging but many information gaps remain, particularly for their validity in low-income country settings, how to improve their use for some problematic food types (e.g., slices, amorphous foods, spreads), and the optimal number of portion sizes to depict.

The gram weight amounts depicted in photographs, ideally will reflect the range of amounts of foods typically consumed in the study population and a study among children suggested that using age appropriate portion size options greatly reduced error in portion size estimation using photo series. However, in the absence of such pre-existing data, other means are required to develop appropriate portion size estimation tools. In practice, portion size ranges have been deduced by various means, such as by direct weighing in households, adapting from local reference data (eg, dietary guidelines), consulting experts in the catering industry, or qualitative consultation with households (Abu Dhabi Food Control Authority, 2014; Turconi et al., 2005; Lazarte et al., 2012). In two African studies (Lombard et al., 2013; Amougou et al., 2016) portion sizes were determined in 'dishing up' sessions, or small surveys in which householders were asked to demonstrate usual portion sizes for different types of foods for specific age groups. This may be an innovative way to collect portion size data for dietary survey tool design, but the cost and validity of this approach has not yet been determined.

Recipes: Estimation of the content of mixed dishes and collection of recipe data: To estimate food intakes from mixed dishes (i.e., those with multiple ingredients), the ingredient composition and preparation methods must be known. The recall of recipes requires estimation of the amounts of all ingredients and the yield, or total amount of cooked dish prepared. If total yield is not well-estimated, a large amount of error can be introduced. Surprisingly little attention has been paid in dietary assessment research to the error introduced in determining the proportion of ingredients, and nutrient content, in mixed dishes. Collection of recipe data at the household-level is prone to error, time consuming, and technically challenging. As a result, household recipe data collection is not practical for use in simplified dietary assessment surveys and standard recipe data must be used.

However, preferred methods for collecting representative, quantitative standard recipe data are also resource intensive, particularly if there are many recipes. Experimentation with simplified standard recipe data collection is limited; innovation is required and validation studies should be conducted to identify acceptable, simplified methods.

1.2 Rationale

The development of simplified methods of dietary assessment and associated tools will require careful examination of various components of current methods and consideration of modified approaches. These components encompass the process of obtaining information on dietary intakes from respondents, as well as the various types of supporting information or 'input data' needed to convert foods, recipes and estimated portion sizes into gram weight intakes of foods, and individual ingredients, and then to energy and nutrient intakes.

Some simplified dietary assessment methods have previously been developed and used in low income country settings. However, some of these are focused on a limited number of foods of interest (e.g., FACT for identifying fortifiable foods), or a specific nutrient (e.g., Helen Keller International Vitamin A Semi-Quantitative 24-hour recall focused on food sources of vitamin A; De Pee et al., 2006). The Dietary Diversity Score data collection method does not attempt to estimate intake of nutrients, hence portion sizes or recipe data are not needed. The relatively narrow focus of objectives of these methods affords them the opportunity for simplification.

However, any simplified method that aims to estimate intakes of a wide range of food items and nutrients, will need to consider: (1) how a sufficiently complete listing of foods consumed, portion sizes and the ingredient composition of recipes, can be obtained with relative ease during a survey; (2) how the collection of information from respondents can be simplified; (3) how the management of input data and data processing can be simplified to reduce both technical and resource requirements, and reduce the time needed to produce reports of results. Given the stated objectives for this methodological development activity, each of the latter will need to be considered.

Processes to collect and utilize input data, such as listings of foods consumed by the population of interest, portion sizes usually consumed, and recipes for mixed dishes, are

quite variable, and sometimes more qualitative approaches are used leaving validity and representativeness to question. Apart from portion size estimation aids, very little description of how valid and appropriate the input data are has been described and hence there is little empirical basis for the specific design of tools or how they might be modified to minimize estimation error. Both a simplified 24HR method and a SQ-FFQ approach could be developed to make use of simple portion size estimation tools, such as photo series, and standard recipe data, which may reduce both the resource and technical burden of dietary surveys. Any reduction of validity for different applications should be determined.

1.3 Aims and Objectives

The aim of this study is to design and test simplified dietary assessment tools appropriate for use in low income country settings, which provide adequate quantitative data at population level on nutrient intake amounts, their relative adequacy compared to nutrient requirements, and their food sources. The work will focus on designing and testing two common dietary assessment methods: a Simplified 24HR Dietary Recall method and an SQ-FFQ method. These methods and tools are intended to be comparable in utility to the multiple pass 24-hour recall, considered as the reference method, but with lower labor and resource requirements.

We chose to conduct this study in Uganda given the experience of local researchers in conducting large dietary assessment surveys using both the Standard 24HR method and an SQ-FFQ method as part of a FACT survey. Among women residing in a selected study population in Uganda, the objectives of the study were to:

Objective 1: Design and field test methods and tools for collecting dietary 'input data', including: (i) the foods and recipes usually consumed, (ii) the distribution of usual portion sizes for foods consumed, and (iii) the variation in ingredients and quantitative proportion of ingredients in recipes consumed.

> ***Sub-objective 1.1:*** Compare the results of the input data collection tools to standard reference methods for listing of foods consumed, estimation of portion sizes of consumed foods, and collection of standard recipe data.

Sub-objective 1.2: Summarize and compare the technical and resource requirements for collecting the input data (i - iii above) and compare the requirements for the input data to be used in the two test methods and in the Standard 24HR (reference) method.

Objective 2: Design and field test two modified dietary data collection methods and tools using (i) a Simplified 24HR recall format and (ii) a SQ-FFQ format.

Sub-objective 2.1: Compare key results of each of the two simplified dietary assessment methods with results from the Standard 24HR method conducted in the same study population: (i) mean intake of energy and 13 nutrients; (ii) nutrients for which mean intake is <100% of the Estimated Average Requirement (EAR); (iii) the proportion of individuals with intakes <100% of the EAR (iv) Foods providing >5% of the EAR for selected nutrients.

Sub-objective 2.2: Using data collected by the Standard 24HR (reference) method, compare the key results (i-iv in sub-objective 2.1) when food composition data for individual food items is applied to the data *vs* when food composition data are aggregated by food sub-group and applied to the data.

Sub-objective 2.3: Determine and compare the time and resource requirements for implementing each of the test survey methods and the Standard 24HR (reference) method.

2. Methods

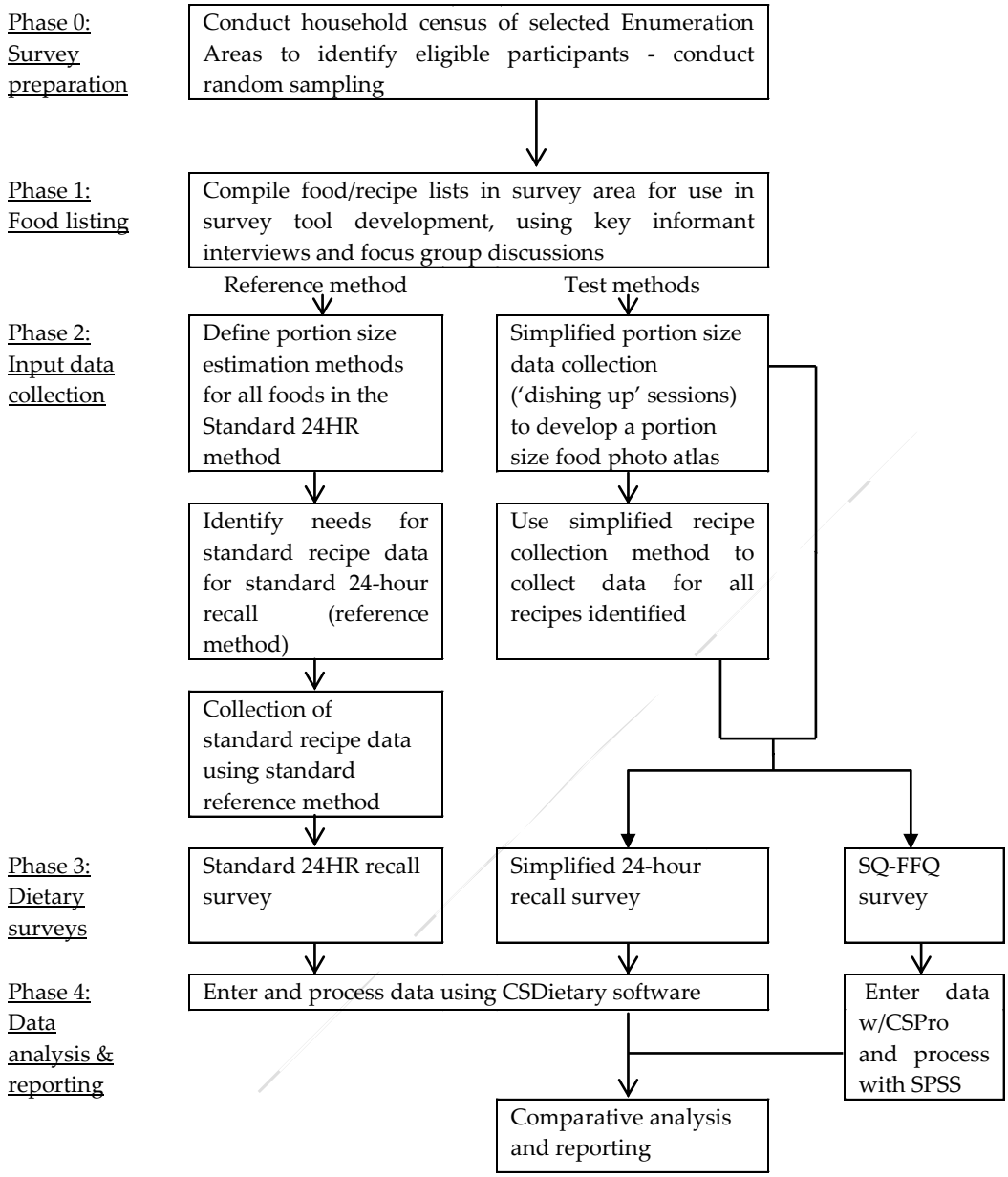
Two dietary assessment approaches were designed and field tested: (1) a 24HR method, with use of simplified input data and data collection methods, and: (2) a 7-day SQ-FFQ tool estimating usual portion sizes for most/all foods, representing an expansion of the FACT survey SQ-FFQ module.

2.1 Study design

Overview: The study was carried out in five main phases. In **Phase 0**, a household census was conducted in the selected study area to identify eligible participants for the study activities. In **Phase 1**, a food and recipe list for the study area was compiled to inform the next data collection activities and the final design of the standard and simplified survey

tools. In **Phase 2**, quantitative input data collection was carried out (portion size estimates for the test methods and standard recipe data for the test and reference methods). In **Phase 3**, the final versions of the Simplified 24HR and SQ-FFQ methods were field-tested and the surveys implemented concurrent with the Standard 24HR. **Phase 4** represents the data processing, analysis and reporting phase. A schematic overview of the study activities is given in **Figure 1**, and described below.

Figure 1. Schematic outline of study components to develop and field test simplified dietary assessment tools in Uganda.



2.2 Phase 0: Study preparation, census and participant selection

2.2.1 Study location

Mukono District was selected for convenience as the location for this study. Given its location in Central Uganda, it is situated 30-40 kilometers east of Kampala and was the site of previous 24HR surveys in 2007/2009 (CIP, Kampala / IFPRI, Washington DC).

Despite its relative proximity to Kampala, Mukono District is still largely rural with subsistence farming as the dominant livelihood strategy, but exhibits significant urban characteristics due to proximity to Kampala and being transected by the Kampala-Jinja highway connecting Uganda to the Indian Ocean port of Mombasa, Kenya. Of the five sub-counties in Mukono, Nakisunga sub-county was selected for the study. The sub-county was purposively selected after a field visit and consultation with district authorities based on the criteria of general level of urbanization (rural to semi-rural preferred), cooperation of sub-county and lower-level authorities, absence of serious community-level threats to survey work such as land conflicts, road accessibility, and general socio-cultural homogeneity. Selection of a study area for convenience was justified as this study is focused on methods development and does not aim to draw inferences on a specific population group.

2.2.2 Study Participants

For this methods development study, we focused on a single age group. Adult women in the reproductive age range (18-49 years) were selected for this study as they represent a nutritionally vulnerable group for dietary assessment and nutritional intervention. They can also respond directly for their own intakes and are typically the group that is primarily responsible for the preparation and serving of foods in the household. The following selection criteria were used for women in the study area.

Inclusion criteria:

- Women between 18 and 49 years of age
- Has her principal residence in the selected community
- Is the primary or most senior female caretaker in the household with responsibility for meal preparation
- Consents to participate
- Is available for interviews throughout the study period

Exclusion criteria:

- Women are pregnant (by self-report)
- Women are breastfeeding a child up to 23 months of age

2.2.3 Sample size calculation for the dietary surveys:

The sample size calculation for this study was based on the two-way comparison of key outcomes between each test method and the reference method. This main sample served

as a pool from which to draw smaller samples for the input data collection activities. The sample size was calculated on the basis of one of the main outcome indicators - the percentage of individuals with intakes <100% of the EAR for a nutrient and the ability to detect a difference in percentage predicted by the different methods. For this, a Chi-Square Test for dichotomous outcomes, with a Type I error of $\alpha = 0.05$ and power of $\beta = 0.80$ was used. Calculating the sample size for a range of detectable differences at different proportions of the binomial outcome between methods, we would be able to detect differences in proportions between either test method and the Standard 24HR method of between 19 percentage points (P0 = 0.50 and P1 = 0.69) and 9 percentage points (P0 = 0.90 and P1=0.99) with a sample size of 110 per group (**Table 1**).

Table 1. Summary of detectable differences and sample sizes between dietary recall methods to estimate prevalence of nutrient intakes <100% of the EAR (Chi-square test).

	% women with nutrient intake <100% EAR					
Negative test difference				**Positive test difference**		
Sample size*	Detectable difference[1]	Test method[2]	Reference method	Test method[2]	Detectable difference[1]	**Sample size***
104	-19	31	50	69	+19	**104**
107	-19	36	55	73	+18	**110**
108	-19	41	60	78	+18	**102**
106	-19	46	65	82	+17	**105**
103	-19	51	70	86	+16	**104**
108	-18	57	75	90	+15	**100**
110	-17	63	80	93	+13	**107**
107	-16	69	85	96	+11	**110**
112	-14	76	90	99	+9	**100**
106	-12	83	95	-	-	
100	-9	90	99	-	-	

*The sample size is based on a Chi-Square test of dichotomous outcomes in two prospective, independent case-control groups with equal numbers in each group; $\alpha = 0.05$ and $\beta = 0.80$. The null hypothesis is that the failure rate (i.e., prevalence of intakes <100% of EAR) is equivalent between the control (Standard 24-hour recall) and the case (Simplified method, either 24-hour recall or semi-quantitative food frequency).

[2] The test will be repeated as two, two-way comparisons: (1) Standard *vs* Simplified 24-hour recall, and (2) Standard –hour recall *vs* Semi-quantitative food frequency.

2.2.4 Sampling method

A multi-stage sampling procedure was used to select eligible participants and establish a sampling frame for each component of the study. In the first stage, 4 parishes were

randomly selected from a list of 8 parishes in Nakisunga sub-county. In the second stage, the 2014 Uganda Population and Housing Census sampling frame comprised of predefined Enumeration Areas (EAs) was used. An EA is a Village Local Council 1 (LC1), or subdivision of it, which is the lowest political and administration unit under Uganda's local government system. A Local Council 1 comprises about 100-150 dwelling units with clear boundaries. Using an electronic database obtained from the Uganda Bureau of Statistics, 3 EAs were randomly selected from each of the 4 selected parishes. Following selection of the EAs, a household census was conducted to identify households with eligible participants according to the selection criteria, focusing on the woman identifying as the primary person responsible for meal preparation was selected. Equal numbers of eligible women were randomly selected from the eligible households in each of the four parishes (n=84), for a total of n=336 women. Within each parish, the selection was made from across all EAs, to allow for a population proportionate sample. For the main dietary survey, the selection of participants for all three methods was made from the same EAs, to ensure equivalent representativeness for each method.

2.2.5 Research ethics and informed consent process

This study was reviewed and approved by the Higher Degrees, Research Ethics Committee, Makerere University School of Health Sciences, Kampala, Uganda. It was also registered and approved by the Uganda National Council of Science and Technology. Local consent to access survey communities was obtained from the Mukono District, Nakisunga sub-county government authorities, and from village (Local council) offices following introduction of the study and sensitization meetings.

Women selected to participate in the study were invited to attend an information meeting at village level. A comprehensive briefing about the background, objectives and methods of the study, as per the consent form, was given to ensure understanding of the purpose and nature of the study, what participation in the study would entail, the risks and benefits associated with participation, and the voluntary nature of participation. Opportunity was given to ask questions and to consult with their families and local leaders as necessary. Two copies of the consent form, written in the local language (Luganda), were provided to each participant to sign as confirmation of agreement to participate - one copy was retained by the participant and one by the project staff.

2.3 Phase 1 - Data Collection: Food Listing

The identification of foods likely to be encountered in a population-based dietary intake survey is necessary to adequately prepare for data collection, and prepare to process the food and recipe intake data obtained during interviews into the gram weight of foods consumed and nutrient intakes per person per day. While the need for this preparatory activity is more obvious for development of FFQs that use a predetermined, closed-list of foods, it is also important to prepare for 24HR methods that use open listing of foods with respondents. As the methods or visual aids used to estimate portion sizes may be specific for different foods or food types, available foods must be known in advance to facilitate training and data collection protocols. There are nutritionally relevant details for foods that must be distinguished during interviews, such as whether cereal flours are refined or unrefined, or whether sweet potatoes are white (no beta-carotene) or orange (beta-carotene-rich); these details must be clearly included in training materials for enumerators to elicit relevant details during interviews, and in the food composition table and other data processing tools. Finally, if standard recipe data are to be used, common recipes must also be identified so that data collection can be conducted for relevant recipes and their variants. The food listing is thus an important base on which the survey tools are locally adapted, and allow data processing to proceed efficiently.

For this project, we used the same food listing exercise to inform the details of all three dietary assessment methods. We used a combination of key informant interviews and focus group discussions to elicit information on the foods and recipes usually consumed in the study area. We identified four key informants, two at the District-level (District Crop Production Officer, and Assistant District Health Officer) and two at sub-county level (Sub-County Crop Production Officer and Sub-County Fisheries Production Officer) who were knowledgeable about the availability of local foods, diets, and seasonality. These interviews were done to compile an initial list of foods available, a ranking of the likelihood of their availability at the time of the dietary surveys, and the main processing methods (eg, drying, milling, fermenting,). For these interviews, foods were discussed by food groups. The data collection guide is given in (**Appendix 3.1**). After consolidating the information from the two key informant interviews, this listing was used to guide the focus group discussions.

Four focus group discussions were held with 6-12 women who were randomly selected from the sample list (8-10 women from each of 4 parishes). Two pairs of interviewers

conducted the discussions, each covering half of the food groups with two focus groups. The interview guide included the food list prepared from the key informant interviews, organized by food group. A structured guide (Appendix 3.1) was used to probe and record specific details on food types (e.g., local name(s), color, variety, commercial products), processing and preparation methods (e.g., whole or milled; mashed or chopped and boiled, steamed, fried, etc.), the likelihood of the food being consumed in the household during the survey period (i.e., high, medium, low, not likely at all), and recipes prepared including the 'obligatory' or optional ingredients added and a likelihood ranking for their inclusion in recipes. During the second focus group discussion covering the same food groups, the same data collection form was used to record the same information, noting any additions or differences using a different colored pen.

Following the focus group discussions, the information from the two interviews on the same food groups was entered in a spread sheet and summarized. For the ranking of frequency of foods, where different rankings were given by the different groups, an average was taken and rounded to the higher frequency category. For the final selection of foods, any foods on the initial list from the key informants, but where both focus groups indicated it was not likely to be consumed, were eliminated from the listing. Any foods that were ranked as rarely consumed were also eliminated. For those foods ranked as being of high or medium likelihood of being consumed were retained for inclusion in the simplified dietary tools (i.e., for portion size determination for the food photo atlas). All foods ranked with a high, medium or low frequently were retained for consideration in the Standard 24HR tool. A similar process was used for the selection of mixed dishes and their ingredient combinations to be used in portion size estimation, and recipe data collection using the simplified tools and the standard recipe data collection methods.

2.4 Phase 2 - Data Collection: Input Data

2.4.1 Portion size estimation

A growing number of dietary assessment surveys are making use of photo series of foods for estimating portion sizes of foods consumed, and this is a promising approach for simplification of survey methods. Once developed, they provide a convenient way to estimate portion sizes during surveys. However, this requires knowledge of the usual range of portion sizes to depict in the photo series. In this study, usual portion sizes for different foods were determined through one-on-one, interactive interviews with women from the study area, similar to the 'dishing up' sessions described by Lombard et al.,

(2013) in South Africa and Amougou et al., (2016) in Cameroon. The data collection form is given in **Appendix 3.2**.

The food listing exercise identified 65 foods (41 individual raw or cooked food items and 24 dishes) likely to be consumed and thus for inclusion in the portion size estimation exercise. Mixed dishes for which primary ingredients are substitutable (e.g., leafy greens of different types, different types of common beans) were used to represent a mixed dish 'type', rather than having separate examples of very similar composite dishes. It was assumed that portion sizes would not differ measurably for mixed dishes with or without minor ingredients (e.g., onion, tomato, cooking oil). For each of the 65 foods or dishes surveyed, 56 women were interviewed[2], for a total of up to 3,640 observations, with each woman asked to recall portion sizes for 13 foods or dishes. A total of n=280 women (70 per parish) were randomly selected from the sample list.

The portion size estimation sessions were organized in a central location of each parish. All foods and dishes were prepared by locally hired assistants in the form typically consumed and available at the study site; a total of 26 foods or dishes were surveyed per day (13 foods in each half-day session). These foods were arranged in 3 stations at each data collection site with 4-5 foods at each station. One interviewer and one recorder managed each station.

For each food item, women were asked by the interviewer to recall the amount of food that they consumed the last time they ate that food item. They were prompted by the enumerator to recall first if that food may have been consumed on the previous day, week, or months. If they could not recall the last time they ate that food, or they never eat that food, no information was collected for that food. If they could recall the last time they ate that food, they were asked to recall the amount consumed; if they couldn't recall specifically the amount consumed, they were asked to estimate how much they think they would have eaten of that particular food type. We chose to ask about the amount

[2] There is no simple way to estimate adequate sample size for portion sizes of the large variety of foods, each of which have different means and variances. We calculated a sample for a range of different foods using existing portion size data from a dietary survey conducted in central and eastern Uganda using the equation: $[Z\alpha/2 \cdot \delta / E]^2$, where $Z\alpha/2 = 1.96 = 95\%$ confidence, δ = known SD and E = acceptable error in measurement units. The error (E) was set at the equivalent of a coefficient of variation (SD/Mean x 100%) of 15%. This resulted in sample sizes ranging from n= 13 to 135, and 80% of the 15 sample sizes calculated were n<60. We rationalized that n=55 would be adequate for most foods.

last consumed, rather than only asking about 'usual' portion size, as the latter would likely result in a narrower distribution of portion sizes, whereas the former approach is more likely to capture portions that were smaller or larger than the 'usual' and produce a wider, more representative distribution.

The respondent was then asked to serve up an amount of food from the real foods provided that represents the amount she consumed (excluding any difference between amounts served but not eaten). Plates (small, large), bowls, and cups (3 types) were available for the women to choose the one most like what she ate the food from. Different ladles and serving spoons were also available as these may aid the recall of amounts served. For some individual food items, different size options were made available (e.g., small, medium, large) according to market availability. Some portions of foods such as some fruits were peeled and pre-sliced for selection and also left uncut for women to cut portions according to what they ate. The cup/plate/bowl with the foods from that station were then weighed to the nearest gram on a digital dietary scale. All plates, bowls and cups were weighed in advance and the average weight subtracted from the total weight of dish plus food recorded during data processing. Information on the inclusion of waste factors in the weighed amounts was recorded (e.g., peel, seeds, bones) for foods such as fruits, meats, and large fish. This was done as for some foods it may be easier to recall how much was consumed if the food item is typically served with waste included (e.g., large fish with bones, watermelon slices with peel and seeds, maize on cob). Recorders also noted the size of items chosen where this was relevant.

For portion size data that were weighed with or without waste, weights were adjusted to conform to the most common presentation form so that all portion size weights represented a uniform state. For example, if most papaya was weighed with peel and seeds, any entries that were weighed without any peel or seeds were adjusted upwards to include a proportionate amount of waste, using waste factors. Likewise, where the majority were weighed without waste but a few include waste (e.g., meat with bones), those with waste were adjusted downwards by applying an edible portion factor. In some cases, the unusual cases were eliminated if they were few (e.g., $n \leq 7$). The process for collecting waste/edible portion factors is described in **section 2.4.1.2** below.

For each food and dish surveyed, the 5th and 95th percentiles of weights were calculated to represent the smallest and largest portion sizes; the interval between these percentiles was divided into three equal intervals to derive the intermediate portion sizes. The

resulting five portion sizes were used in preparing the photographic food portion size atlas.

2.4.1.1 Food Photo Atlas preparation for portion size estimation

Preparation of the food photo atlas was based on the methods of Nelson & Haraldsdottir (1998), with some modifications. The foods and recipes were prepared in ready-to-eat form and five incremental portion sizes (as described in **section 2.4.1**) were weighed on a digital scale to the nearest gram, where 1 was the smallest and 5 was the largest portion size. In cases where during the portion size estimation exercise inedible portions were typically included in the portion size weights, these foods were weighed and photographed with the waste included. The edible portion was calculated later during data processing.

For some food items that occur in common or standard unit sizes (i.e., bread, buns, eggs), the portion size information confirmed the range of whole units, multiples of whole units, or fractions of units that are typically consumed. In these cases, the gram weight portion size data were used as a guide but units (whole, multiples or fractions) were presented and the weights associated with these were used. This was the case for: bread slices from commercial small (500 g) and large (1 kg) loaves; small (long) buns and large (round) buns; long and square *mandazi* (fried dough); chapatti; round and square biscuits; and hard boiled eggs.

For each food, the portion size amounts were presented on standard sized plates, cups or bowls for photography. A neutral (wood) background was used with a single, standard tablespoon included in the field of view as a fiducial object (a visual gauge of scale). Commonly available melamine bowls, large and small plates, and plastic cups, glass tumblers, and clay mugs were used, depending on the food type. The camera angle was varied depending on the dish. For cups and tumblers a high angle (90^{o}) was used to enable viewing of the height of liquids or porridges inside the cup; for plates, a 70^{o} angle was used to enable a full view of the width of the plate plus its depth; for bowls, a 40^{o} angle was used to ensure a view of the width and the full depth of the external side of the bowl. Lighting was used to ensure consistent exposure and eliminate shadows. A printed label was included in the foreground of each plate to indicate the portion size.

Digital photos were sized to 47 x 66 mm each and all 5 photos for each food item were presented on a single A4 page in landscape orientation in order of increasing size and

printed in color. The photos were compiled into the Food Photo Atlas for use by enumerators during the Simplified 24HR surveys and the SQ-FFQ.

2.4.1.2 Edible portion data for the food photo atlas portion sizes

For food items presented in the food photo atlas with inedible waste included, particularly vegetables, fruits and meats or fish with bones, edible portion/waste factors were determined. Raw food items were purchased and weighed in the state that they were presented in the atlas. Typically, multiple sizes (e.g., small, medium and large) were selected and considered separately as the edible portion factor can vary with size. Meat and fish were cooked before weighing. Then, the inedible portions were removed and the weight of the remaining edible portion determined (in some cases, it was more practical to consume the edible portion and weigh the remaining waste). The mean amount (grams) and proportion of edible portion was then calculated. Unless different sizes of the same food item were presented separately in the food photo atlas (e.g., bananas, mango), the edible portion factor results were averaged across the different food sizes used. A summary of edible portion factors is shown in **Table 2**.

Table 2. Summary of the edible portion fractions for foods in the food photo atlas that included waste (weight of edible portion / weight of whole food item including waste)

Food item	n	Mean Edible Portion Factor (wt/wt)
Orange, average - for eating	30	0.75
Passion, average - for eating	17	0.41
Banana, Bogoya (medium/large)	12	0.64
Banana, Ndizi (small)	11	0.76
Jackfruit	3	0.70
Mango, small	9	0.76
Mango, mediu/large	10	0.86
Papaya - average	10	0.74
Jambula	47	0.80
Watermelon, average	13	0.56
Avocado, average	14	0.67
Beef, kg or 2 kg pieces	2	0.57
Nile Perch, dried, average of all sizes	3	
mid-section		0.84
head		0.54
tail		0.89
Tilapia, fresh, average of all sizes	3	
mid-section		0.86
head		0.61
tail		0.77

2.4.2 Simplified standard recipe data collection

Usual recipes for cooked dishes were determined through one-on-one, interactive interviews with women from the study area. For each recipe, data were collected from twelve participants and each respondent was interviewed on three different recipes. Participants (n=40) for this activity were randomly selected from the sample list for three of the four parishes[3], for a total of n= 120 participants. The total number of recipes

[3] The fourth Parish was not included for planning and logistical reasons. Only 3 teams could be deployed (one for each Parish) and it would have been logistically difficult to transport participants from the fourth Parish to the others sites.

included (n=29) was determined from the food listing exercise. The data collection form is included in **Appendix 3.3**.

Women were invited to a central location in the parish. All ingredients for the recipes being surveyed that day were procured, prepared, and available on site. Ingredients were displayed in raw form (except for boiled beans that are added pre-cooked to some recipes) and for some of these, the inedible portions were removed in advance (e.g., cassava, potatoes and plantain were peeled). As noted above, mixed dishes for which primary ingredients are directly substitutable (e.g., different types of green leafy vegetables or varieties of common beans) used only the most common types.

The interview consisted of two main parts. The first was to determine the ingredients and ingredient amounts typically used (focused on practices over the last 2 months) when preparing that recipe for the household. The second was to estimate the total cooked volume of the recipe after it was prepared from those ingredient amounts. If the selected mixed dish was never or not typically prepared by the respondent, no information was collected for that recipe.

For each recipe, the participant was first asked to identify the pot of the size typically used for that recipe and to show approximately the level in the pot the cooked recipe would come up to after cooking. Participants were asked to bring a pot that they typically cook with at home, or to choose one from a range of pots available on site that is similar to what they usually use at home for that particular dish. Each recipe had obligatory ingredients, that were the basic ingredients required in order to represent that recipe, and optional ingredients that may or may not be added, which were also determined through the food listing exercise. The participant was asked to identify the optional ingredients she typically uses. Then, using the food ingredients provided, the participant transferred the amounts of each ingredient typically used into separate dishes.

The participant was then asked to estimate the total cooked amount that would result from those ingredients after cooking, accounting for the addition or evaporation or drainage of any cooking water. The estimation was done by indicating the level of the total cooked amount in the selected pot using her fingers, and then adding an amount of raw rice to fill the pot to that level. The enumerator then asked the participant to review the amounts of raw ingredients and the estimated cooked volume together to verify that these correctly reflect the amounts of each.

For many ingredients (e.g., free-flowing ingredients such as flours, grains/seeds, liquids, etc., and roots, tubers, and plantain), the weight of each ingredient was determined to the nearest gram using a digital dietary scale and recorded. The raw rice representing the volume of cooked recipe was also weighed on the dietary scale. For some fresh ingredients (fruits and vegetables) that are available in different sizes, a selection of 2-3 sizes (e.g., small, medium and large) were available and the size and number of these used was recorded rather than weight. For optional ingredients that were not used by that participant, the amount was recorded as '0'.

In the case of ingredients counted by size, average weights by size were determined. In the case of ingredients where amounts were more easily visualized when the food includes waste (e.g., bones, peel), the weight of the edible portion by size was determined after removing waste, as per the method described above. Where, the amount of beans added to a recipe was estimated in pre-cooked form instead of raw form (both options were available); the amount of precooked beans was converted to the dry beans equivalent using an available conversion factor. A weight:volume conversion factor was applied to the raw rice weight and used to determine the total volume of cooked recipe. The percent content of each ingredient was then calculated as weight (g) per volume (ml): *raw weight ingredient ÷ total cooked weight*.

2.4.3 Standard recipe data collection - reference method

The cooked dishes for which standard recipe data was collected using the reference method were those more commonly consumed recipes and included some that are more difficult to collect at the household level during the recall interview (eg, those using flour to prepare stiff porridges, leafy vegetables, or other ingredients that are difficult to estimate amounts of). Standard recipe data collected by the reference method were used only for the Standard 24HR survey method.

Participants: A total of 70 women from 5 EAs across the 4 parishes participated in standard recipe data collection at one of two locations. In groups of five, each participant was asked to prepare 3-4 different recipes in a half-day session, and each recipe was replicated by 10 different women.

Process: Women were invited to cook the recipes, and asked to bring the cooking pots or pans that they would normally use at home. All ingredients that are typical of the dishes

to be prepared were provided, and it was emphasized that they must prepare them in the same way, and in the same amounts, they usually would in their homes. Women were asked to estimate the amount of raw ingredients they were likely to use; additional amounts could be requested later if needed. Some of the ingredients were obligatory for the dish, while some were optional (e.g., carrot, green pepper, onion, oil). The weight of all ingredients provided, as well as the weight of the empty cooking pot and lid, were determined on a digital dietary scale and recorded on individual log sheets. Each woman worked at a separate outdoor station (fire pit) where all preparations and (e.g., peeling, chopping) and cooking were done.

After each cooked dish was prepared, the weight of all leftover ingredients, including waste, was weighed and subtracted from the initial ingredient weight. The total weight of the cooked dish in the pot was also determined. The proportion of ingredients per cooked weight (weight/weight) of the dish was calculated for each individual recipe and a mean was calculated by adding up the total weight of each ingredient for all 10 replications and dividing into the total of all cooked weights. For most recipes, additional modified recipes were imputed from the primary recipe. These imputed recipes effectively remove ingredients to replicate similar recipes but with fewer, or different combinations of ingredients. For example, for the maize porridge recipes, most women included milk and sugar along with maize flour in their preparation. To impute a version of the recipe without milk, without sugar, or with neither added, the amounts of these ingredients were removed from the total weight of the recipe, and the proportions of the remaining ingredients per total weight were recalculated. This process was used for most recipes, and generally included versions of dishes with or without ingredients that are generally added in small quantities, including: cooking oil/fat; sugar or milk; and vegetables such as onions, carrots, green pepper, and sometimes tomato. This was done by subtracting the total weight of the ingredient to be removed from the total cooked weight of the recipes and recalculating the proportions of the remaining ingredients.

As the intake of mixed dishes is estimated by volume in the Standard 24HR survey method, it is necessary to derive a volume:weight conversion using density factors (grams/milliliter). The density of each recipe was determined using one of two methods. The total volume of the cooked recipe was estimated by marking the level of the dish in the pot using a marker, and then filling the empty pot with water up to the level of the cooked dish; the volume of water was then measured using a graduated cylinder. The

total weight of the cooked dish was divided by this total volume. Alternatively, a large cup of predetermined volume was filled to the rim with a portion of the recipe; the weight of this amount of cooked dish was measured on a scale. The former method was used for dishes of uneven consistency (e.g., those with large chunks of ingredients) while the latter was used for liquids or dishes of smooth consistency. Women were invited to take the cooked foods home with them.

2.5 Dietary Assessment Survey Methods

Household- and participant-level socio-demographic data were collected during the dietary surveys. This included questions to reconfirm the eligibility of respondents with respect to age, and pregnancy/lactation status and a module to compare socio-demographic status (risk of poverty) using the Progress out of Poverty Index® (PPI). This index is part of an international initiative to develop and validate at national level short, standardized questionnaires focused on household characteristics and asset ownership to quantify the risk of poverty among. This index was chosen as it does not solely rely on a relative comparison of socio-economic status among respondents only but rather is gauged to the national situation and national and international poverty lines. The questions, indicators and scoring methods were downloaded from the PPI website[4]. Each individual indicator or score was compared between the test methods and the reference method, as was the final PPI score.

2.5.1 Standard 24HR survey method

Data collection: The Standard 24HR method used a multiple pass approach Gibson and Ferguson (1999) where participants were asked to recall all of the foods and beverages consumed, and the amounts consumed, over a specified 24 hour period. Due to the short time period for data collection, and pre-scheduled community events, survey data was only collected on weekdays, and we could thus not take day-of-the week effects on dietary intakes into account. This method was developed by for use in low income country settings and employs techniques to enhance the visual impression of the foods consumed, reduce memory lapses, and improve the estimation of portion sizes consumed

[4] http://www.progressoutofpoverty.org/country/uganda

by asking women to: (1) serve food to themselves from individual bowls and plates instead of from the "common" pot; (2) check mark all foods eaten on a picture chart supplied by the investigators; (3) estimate the quantities of main staple food items consumed, and; (4) provide information on ingredient amounts and final cooked amounts of recipes made at home, for which no standard recipe data are available.

Group 'training' sessions were held in central locations in each selected village on the day before the recall interview to prepare respondents. During the session, the purpose of the study, and the methods involved were explained to the women. Respondents were asked to use their own dishes for serving and eating their food on the next day to help them visualize more easily what and how much of each food item they ate on that day. Respondents were given copies of picture charts with a pencil and asked to name each of the foods in the pictures to make sure they could identify them correctly. Then, they were instructed on how to mark on the chart each food that is eaten on the next day. Emphasis was given on the importance of following their *usual* eating pattern on the day to be recalled. Finally, respondents were shown in a participatory demonstration how the amount of different foods eaten would be estimated.

The recall interviews were conducted in the respondents' homes to facilitate recall of foods, recipes and portion sizes where real foods, serving dishes, and pots are available in the home to facilitate the recall and visualization process. The data collection form is given in **Appendix 3.4**. In the first pass, participants were asked to recall all foods and beverages consumed during the previous 24-hour period, including snacks, commencing with the food eaten first thing after they woke up and ending with the last food or beverage consumed of the day. These items were listed by the enumerator, recording the time and type of meal (breakfast, lunch, dinner, snack).

In the second pass, additional information on the ingredients and preparation methods of mixed dishes was also collected. Details necessary to select the most appropriate FCT entry were collected, such as degree of refinement of flours, whether foods were in fresh or dry form (e.g., legumes, nuts, fish), fruits were ripe or unripe, cooking method using (e.g., boiled, roasted or deep-fried in oil). For recipes, all ingredients were listed in detail. The enumerator then had to determine whether the recipe was included among the standard recipes or its imputed option. If not, these were considered as 'unique' recipes and it was necessary to collect the full recipe information in the third pass. Prompt lists

for food details and standard recipe lists were carried by the enumerators to facilitate these processes.

In the third pass, portion size and recipe ingredient amount information was probed. To aid in quantifying portion sizes consumed and ingredient amounts for household unique recipes, measurement tools included life-sized graduated photographs, graduated measuring spoons, weighing scales, and graduated measuring cylinders and play dough models; details are described elsewhere (Gibson and Ferguson, 1999). After questioning, and removing any leftovers, the final portions consumed were measured and recorded in the appropriate units. All of these proxy measures were later converted to gram weights of the food represented using a set of conversion factors.

Similar volume/weight estimation methods were used to obtain information on the composition of all mixed dishes prepared in the home, whereby the respondent was asked to demonstrate the amount of each ingredient added to the dish, and then to show the total volume of the final mixed dish prepared. The latter was done by adding dry rice to the cooking pot/pan used up to the level of the mixed dish after it was prepared. The rice was then weighed on a scale as a proxy weight. At the end of the interview, recalled food items were compared against those marked on the picture charts and any discrepancies discussed.

Finally, in the fourth pass, the information recorded was reviewed with the participant to verify the information and determine if any deletions or additions were needed. The information was also cross-checked against the picture chart for this purpose. Participants were also asked whether the intakes on that day were considered to be unusual in any way, such as more or less than what they usually eat, and what this was attributed to (e.g., illness, absence from the home, celebration). This information was used when assessing the plausibility of high or low dietary intakes and to identify any community-wide trends in food availability.

Data entry and data processing: The CSDietary program, built with the CSPro software platform, was used for dietary data entry and data processing. All data were entered in duplicate and discrepancies were identified using the validation function of this program. All discrepancies were rectified by a project coordinator and distributions of

intakes of the validated data were reviewed for plausibility by examining high and low intakes.

Four input databases are generally prepared for uploading to the CSDietary system to process the raw dietary intake data to quantitative intakes of food and nutrients: (i) the FCT; (ii) a food group name and code list; (iii) standard recipe data, and; (iv) portion size/gram weight conversion factors.

- The FCT, including foods and food groups, is described in further detail in **section 2.6**.
- The standard recipes, and the imputed versions, were compiled from the standard recipe data collection described in **section 2.4.3**.
- As the amounts of foods consumed are measured using different methods and units, a conversion factor table was created to enable the various types of conversions needed (**Table 3**). Many of the conversion factors needed were obtained from databases previously compiled for use in Uganda using this system. As nearly all cooked dish amounts consumed are estimated by volume, grams/mL was measured for all standard recipes collected in this project; for unique recipe data collected at the household, however, the program assumes a density of 1.0 grams/mL for these recipes to determine the grams of ingredients consumed. The same figures were applied to the recipes imputed from the primary versions.

Table 3. Conversions and conversion factor data needed to determine grams of intakes using the portion size estimation methods applied in the Standard 24HR survey method.

Portion size method	Examples using this method	Data recorded	Conversion required	Calculation
Standard unit size (with or without photo)	Bread slice, boiled egg	Number/fraction of units consumed	grams per unit	Grams/unit × units consumed = grams consumed
Photos depicting multiple sizes	Eggplant, onions, tomato (as ingredients)	Number/fraction and size of units consumed	grams per unit per size	Grams/unit size × units consumed = grams consumed
Playdough (PD)	Pieces of beef,	Weight of playdough	Density of food and playdough (grams/mL)	Weight PD × mL/gram PD = volume PD; Volume PD × grams/mL food item = grams food consumed
Volume (proxy weight using dry rice)	Porridge, soup, tea, total amount of cooked recipes	Weight of dry rice that represents the volume consumed	Density of food and dry rice (grams/mL)	Weight rice × mL/gram rice = volume rice; Volume rice × grams/mL food item = grams food consumed
Direct weight	Groundnuts	Weight of groundnuts in the amount consumed	None	None

2.5.2 Simplified 24HR survey method

Data collection: Selected women were first invited to an information session to prepare them for the interview and ensure they were aware of the day of food intake that would be recalled. However, these sessions were brief compared to the more extension information provided in the Standard 24HR process, and introduced only the food photo atlas for portion size estimation rather than the various other methods used in the Standard 24HR. No picture charts were provided or women to track their food intakes. This Simplified 24HR format also used a multiple pass approach, starting with the chronological listing of all foods and beverages consumed in the previous 24 hours, including any consumed outside the home, as per the standard protocol. The data collection form is given in **Appendix 3.5**.

During the first pass, the common name of the food item, or the dish plus its key ingredients, were recorded (without further detail). The time and meal type were also

recorded. After completing the listing, the interviewer did a second pass, going through the list in chronological order to probe for any additional details required and recorded these in a separate column. The necessary details were included in a probe list used by the enumerators for reference. These included details on the specific type of meat, fish, or green leaf, whether legumes or fish were fresh or dried, the color of sweet potato (white, yellow, orange), whether fruits were ripe or unripe, and the ingredients added to dishes. These options were somewhat more limited in number than for the Standard 24HR method. The addition of condiments or other additives to foods items after cooking was also to be probed, such as for sugar added to tea, margarine spread on bread, etc.

In the third pass, portion size estimation was obtained using the Food Photo Atlas. For each food item or mixed dish mentioned, the corresponding photo series was selected by the enumerator. The photos were shown to the participant, for each food going in chronological order, and she was asked to select the portion size that most closely represented the amount consumed, taking into account the amount served and any amount left over. If a photo of the same food or dish was not available in the atlas, the most similar photo series was chosen as a substitute. For example, if pears or apples were reported as consumed, for which no photos or portion size data were collected, enumerators were instructed to use the photo series for small mangos as a substitute; any cakes were to use the *mandazi* photo series, etc. A list of substitutes was carried by the enumerators for reference. As in all methods used in this study, the amount of meat or large fish consumed was estimated separately from other ingredients that it was prepared and served with (typically soups). For five food items (chicken pieces, sugarcane, plantain as fingers, packed juices, and commercial beer), only a single, standard portion size was depicted in a photo and the number/fraction of those items consumed was recorded. For this pass, the enumerator recorded the code for the photo series that was used, and the portion size code.

For all mixed dishes, only standard recipes were used - no unique household recipe data were collected for dishes having different main ingredients from the standard recipes. The selection of the closest substitute recipe was done at the stage of data entry. The standard recipes did make allowances for some key ingredient variations, such as inclusion of milk or sugar in porridges, and oil added to most main dishes or sauces.

Finally, in the fourth pass, the enumerator was to review the list of foods once again with the respondent to pick up any omissions or false inclusions. Respondents were also asked

whether the intakes on that day were considered to be unusual in any way, such as more or less than what they usually eat, and what this was attributed to (e.g., illness, absence from the home, celebration).

Data entry and data processing: The CSDietary software was also used to enter and process the survey data for the Simplified 24HR method. All data were entered in duplicate by different operators and discrepancies were identified using the validation function of the program. A supervisor determined the correct information used to produce a final clean version. The program functions utilized were reduced compared with those used in the Standard 24HR method:

- There were no household recipe data to enter, so the correct standard recipe only needed to be selected from the drop-down menu;
- Only two portion size estimation methods were used (photo series size and in a few cases, number/fraction of standard unit size), which simplified the data entry and processing for portion sizes.

These simplifications reduced the data requirements for the conversion factor database to primarily just the weights determined for the food photo atlas portion sizes, and standard unit size for a few food items. For several food items, including many vegetables, fruits and meats with bones, waste factor data were also obtained and applied to the food photo atlas portion size weights when waste was included in the photos.

The FCT for this method was built from the one used for the SQ-FFQ, and was only slightly expanded to cover the small number of additional details, such as specific green leaf, meat, and large fish types consumed (versus generic entries for green leafy vegetables, meat or large fish of any type as used in the SQ-FFQ). Additional details on the compilation of the FCT are given in **section 2.6**.

All data were reviewed and scrutinized by the project coordinators to identify any remaining missing data, incorrect selection of FCT entries, and to evaluate the plausibility of low and high intake data relative to the intake distribution.

2.5.3 SQ-FFQ survey method

Data collection: Respondents selected for this survey method were interviewed in their homes. This method used a closed list of food items and mixed dishes that were

determined to be likely to be consumed in the food listing exercise and the interview was conducted in two passes (**Appendix 3.6**). First, the enumerator began reviewing the list of foods in the questionnaire, organized by food group, and asked the respondent to indicate whether that item was consumed during the previous 7 days. Orientation was provided to the respondent to ensure it was clear to her which days of the week she was being asked to consider. The enumerator recorded "yes" or "no" accordingly for each item.

In the second pass, for each food with a 'yes' response, the respondent was then asked to recall: (i) the number of days during that 7-day period on which that particular food item was consumed; and (ii) the average number of times per day that item was consumed on those days. Finally, in the same pass, the respondent was asked to select, from the photo series (described above), the portion size that most closely represents the typical portion size when consumed in the last 7 days, after considering amounts served and left over. The correct photo series for each food item was pre-printed in the questionnaire, and the enumerator recorded the portion size code. This was repeated for all foods consumed. For several cooked food items, the addition of ingredients that contribute importantly to energy and/or nutrient intakes was also asked, such as the usual addition of milk and/or sugar to porridges and tea, or the inclusion of vegetable oil or fat in several main dish recipes and sauces. The main flesh color of any sweet potato consumed was also asked.

Data entry and data processing: All data were entered, in duplicate, using a CSPro-based data entry program designed specifically for this purpose. All discrepant data were identified and rectified. Primary data were exported to SPSS for data processing. The portion sizes were converted to grams using a table of weights per portion size code derived from the portion size estimation exercise, and this was multiplied by the number of days consumed, and average number of times consumed per day of consumption, to derive the total gram weight amount consumed per 7 days. This was divided by 7 to derive the average daily intake amount. For mixed dishes, these were linked to recipe data collected using the simplified method, where the proportion of ingredient per gram of mixed dish was used to determine the amount of each ingredient consumed. The ingredient amounts consumed were then merged back to daily amounts consumed of individual food items, and these were linked to the FCT derived for this survey method.

The FCT used for this method included values for all individual food items, and all ingredients in mixed dishes that were derived from the simplified recipe data collection

exercise (see **section 2.6** for additional details on the FCT compilation). Apart from the exceptions mentioned above, only one average recipe per dish type was used - no other ingredient variations were considered. The conversion factors used were the same as those described for the Simplified 24HR method above (i.e., gram weights associated with the portion sizes used in the food photo atlas, and in a few cases, number of standard units).

The processed database was scrutinized by the project coordinators to ensure completeness of all data entered and to ensure that the linking of intake data to portion size, recipe, and FCT data was done successfully.

For all three survey methods, the primary output data were in the form of 'short' databases, representing the total energy and nutrient intakes per person per day, and 'long' databases, representing the individual food intakes and their nutrient contribution for each person, per day. For the main analyses, these data bases were merged into a single database with survey method as the dependent variable.

2.6 Food Composition Table (FCT) Compilation

2.6.1 Food Composition Table: Primary survey data analysis

An FCT was compiled for this study and adapted for use with the different survey methods. An FCT previously compiled for use with the Optifood software, including foods from the African region, was used as the primary source for this. This FCT was compiled using similar methods to those previously described (Hotz et al., 2012), but used published food composition data for foods in African FCTs, with any missing values imputed from the same or similar foods found in the USDA nutrient databases after adjusting for difference in water content. For African foods for which no locally derived data were available, data for the same or similar foods were derived completely from the USDA nutrient databases.

FCT for the SQ-FFQ and the Simplified 24HR: For the SQ-FFQ, several foods listed were presented in generic form. These generic FCT entries were made by taking the average food composition of the composite items, which were chosen based on the those foods that were reported as being available for consumption in the food listing exercise. 'Meat' was used to cover the two common meat types (Beef, pork); 'organ meat' was used to

cover a variety of organs from beef and pork sources; 'large fish' covered the two main large fish types (Nile perch, tilapia); 'Beans, common, any type' was a composite of the three main types of common beans in the area (cranberry/roman beans, pinto beans, and kidney beans); 'other green leaves' covered the two common green leafy vegetable types (amaranth leaves, nakati/eggplant leaves); and 'other nuts, seeds' was used to cover the most common nuts and seeds for which food composition data were available (sunflower seeds, pumpkin seeds and palm nuts). Millet and sorghum flour were also combined as a composite FCT entry for recipes where this was a secondary ingredient, as these flours can be used in recipes interchangeably. For samosas, pea-filling was assumed as this is more common than beef filling in these areas. The only difference applied to the Simplified 24HR intake data was the distinction of amaranth and nakati leaves, rather than using the generic option for green leafy vegetables.

For the foods used as ingredients in recipes, we created separate entries in the FCT that used the raw weight form of the food but was adjusted for losses of nutrients during cooking (informally referred to as 'hybrid' food entries). This approach is used because the proportion of ingredients in final cooked recipes is determined based on the amount of raw ingredient added, but still allows for consideration of nutrient retention after cooking. It avoids having to make assumptions about the 'yield' amount of each individual ingredient after cooking, which largely takes into account its absorption or loss of water. Our method may underestimate the content of nutrients in the loss of solids or dissolved fats that may be drained off but few of the cooked foods included here are drained after cooking. When selecting retention factors for cooking losses, only the most common cooking method was applied, as determined from the Food Listing exercise.

FCT for the Standard 24HR: For this survey method, the food intake data recorded was open and not limited to the generic options used in the simplified methods. The FCT was expanded to include the individual items used in the generic ones and any additional foods arising during data entry were added (with the exception of common beans). Any foods not initially included in the FCT but appearing in the survey data were added during data processing.

2.6.2 Food Composition Table: Creation of a condensed food composition table

A process was defined to compile a condensed FCT, with entries that represent the average nutrient content of food sub-groups, for comparison to the full FCT (i.e.,

including entries for each individual food item) as would normally be used to estimate nutrient intakes from food intake data. A Food Sub-Group Composition Table (FSGCT) would intend to be ready-for-use by those conducting dietary assessment surveys but without detailed knowledge of how to compile a FCT, in populations where complete tables do not exist.

Data source: For this exercise, we used an FCT that was previously compiled for use with the Optifood software program in African and Latin American regions. The Optifood FCT uses a series of 15 food groups divided into 81 food subgroups, which were categorized based on consideration of the nutritional properties of those foods, and how those foods are incorporated into typical diets. The food groups and sub-groups are given in **Appendix Table 2.1**. Although it is not publicly available, this database was considered the most appropriate model to use for this exercise because it includes a wide range of foods available in Africa, whereas any single African FCT currently available contains limited food items, and many foods in more comprehensive FCTs (e.g., United States Department of Agriculture Food Composition Database) contain a large number of foods, including many processed and brand name foods, that are not available in the low-income regions of interest.

The list of foods in the Optifood FCT for the African region included those which were found in several FCTs compiled for Malawi, Mali, Mozambique, Tanzania, Uganda, West Africa, and Zambia, with additional foods considered from Ethiopia and South Africa. This process was used as it was considered to be feasible to apply in any future efforts (if deemed useful) to prepare aggregated regional FCTs containing only foods likely to be consumed in those regions, rather than a global aggregated FCT.

Process: The African food entries were reviewed to remove repeated items that had different local names but had the same nutrient content values. This was done to avoid overweighting the mean nutrient content of the food sub-group towards repeated foods.

Generally only one cooked form of a food item was included, although fried/deep-fried versions were also included, when available, to capture the additional oil content. For several food groups (e.g., beans, nuts, green leaves, meat, fish), entries for both dried and fresh versions of the same foods were retained. For meats, cuts with different fat content were included, as were different parts for chicken. For cereals, entries retained included all distinct forms of cooked cereals (i.e., boiled whole grains, stiff porridge, and lighter

porridges of thick, thin and average consistencies), and flours of different extraction rates, and different types (e.g., white and yellow maize flour).

The formation of the FSGCT was an iterative process and the results leading to the final version and its justification are detailed in **Section 3**.

2.7 Technical and resource requirements of the survey methods

For each of the input data collection steps, and the dietary assessment survey methods used, we will determine the both the technical and resource requirements for each method and compare those between the test methods and the reference method. For the resource requirements, we modeled the costing structure and categories from a previously developed costing template for dietary assessment studies (adapted from Fiedler et al., 2013). Three of the critical cost components that may result in differences between the test methods and the Standard 24HR method are the requirements for survey preparation and input data collection (person days + equipment/supplies + vehicle days + fuel), time required to complete the survey based on the number of interviews that can be completed per day per enumerator (person days), and the data processing time (person days).

The level of technical skill required and complexity of each step will also be considered. A draft framework was developed for assessing these qualities including defined survey components: (1) instrument development; (2) training; (3) survey data collection; (4) data entry; (5) data analysis. A qualitative description for each category and its subcomponents was prepared jointly by the two lead project consultants for all three methods. A ranking of low, medium, or high with regard to the relative complexity, level of effort, or skill level required, was done separately by each coordinator and a consensus reached on the final ranking after discussing disparate scores.

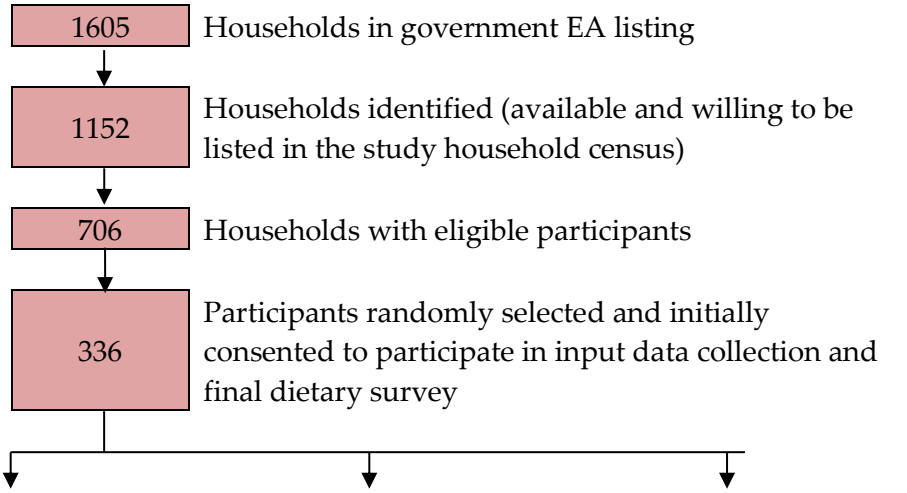
3. Results

3.1 Study population and sample

The sample selection by parish and EA is summarized in **Appendix Table 1.1**. Of the 1605 households listed in the government EA listings, 1152 households were identified, available, and were willing to participate in the household listing for the study. Of

those, 706 households with eligible women were identified. Of the initial sample of n=336 randomly selected women, informed, written consent was obtained. However, before the final dietary survey was conducted, more than one-third (n=128) dropped out or could not be reached during the final dietary survey, and alternate women were recruited and consented from the remaining eligible households to complete the sample. Therefore, some self-selection bias cannot be excluded. Nonetheless, the number of replacements was relatively evenly distributed across the three survey method groups. A summary of the sample by survey method, and reasons for dropping out, are given in **Figure 2**.

Figure 2. Summary of sampling process for participants (n) for the main dietary surveys



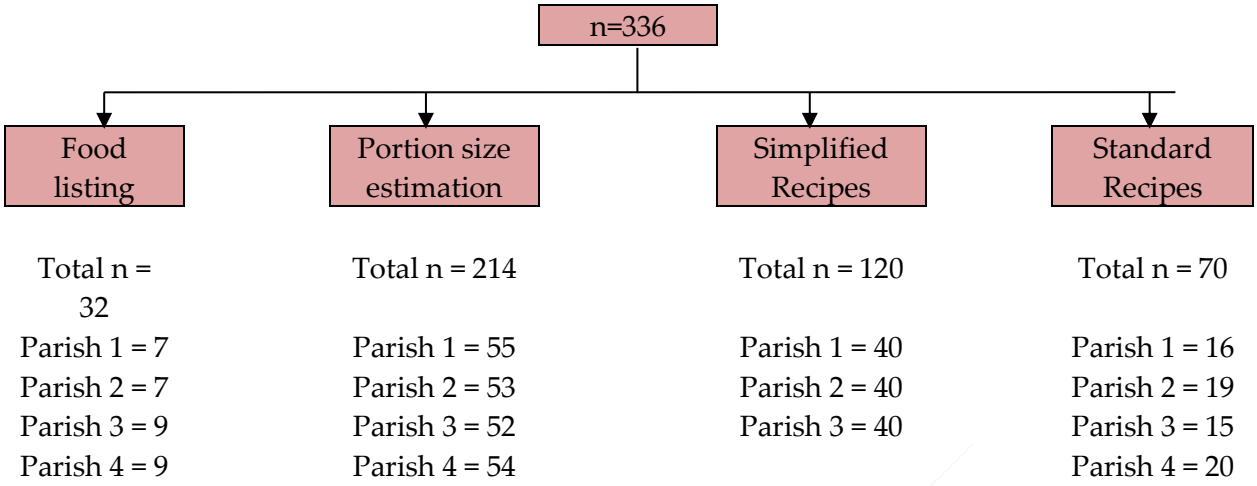
	Standard 24HR		Simplified 24HR		SQ-FFQ	
	Initial sample (replaced)	Final sample	Initial sample (replaced)	Final sample	Initial sample (replaced)	Final sample
Parish 1	28 (11)	30	28 (10)	28	28 (13)	28
Parish 2	28 (12)	29	28 (7)	24	28 (4)	27
Parish 3	28 (14)	30	28 (13)	29	28 (16)	28
Parish 4	28 (9)	26	28 (7)	30	28 (11)	27
Total	112 (36)	115	112 (37)	111	112 (44)	110

Reasons for dropping out:

- n=30 Selected household/respondent never identified by dietary survey team
- n=11 Consented but later refused participation in the study
- n=10 Provided written consent but were unable to participate due to work schedule
- n=30 Provided written consent but did not make themselves available to participate in study activities
- n=42 Participated in input data collection activities but not available to participate in the final dietary survey

For the four input data collection activities, sub-samples of participants were drawn from the main survey sample list. This was done to ensure that each participant was not called to more than two input data collection activities. A summary of the samples, by activity and parish, is given in **Figure 3**.

Figure 3. Summary of the sub-samples (n) participating in the input data collection activities



3.2 Food listing

The food listing exercise (key informant interviews and focus group discussions combined) identified a total of 162 foods that were expected to be available and consumed in the study area in the season of the survey (June-July, 2017). After excluding the foods considered to be only rarely consumed, and adding 11 foods that were not adequately probed or ranked during the focus group discussions (baked goods and commercial beverages), 120 items remained and included foods eaten as individual items, and recipe ingredients (**Appendix Table 4.1**). A total of 45 possible recipes, with obligatory and optional ingredients, were also identified during the focus group discussions. This information served as the basis for the preparation of the standard 24HR training materials, portion size estimation tools, standard recipe list, and initial FCT, as well as for the SQ-FFQ closed food list, the development of the food photo atlas, simplified recipes for data collection, and FCTs for the test methods. For the test methods, food items and recipes that were noted as being unlikely to be consumed were eliminated and a list of 54 distinct food items and 29 mixed/cooked dishes (not including noted ingredient variations) were identified for inclusion.

We compared the individual foods/ingredients identified by the focus group discussions to the food items recorded in the Standard 24HR survey. These data were used because all foods mentioned were recorded with appropriate detail, without use of any generic options (**Table 4**). From the food listing, 76 and 44 foods were considered to have a

medium to high, or low likelihood of being consumed, respectively; these foods were the focus for preparation of training materials, probe lists, portion size estimation methods and the FCT for the Standard 24HR. In the Standard 24HR survey, 76 unique food/ingredient items were mentioned; of those, 69 (91%) were among the 120 foods considered in tool development. There were no foods mentioned in the Standard 24HR survey that were not picked up in the food listing exercise.

Table 4. Comparison of foods identified during the food listing exercise and those occurring in the Standard 24HR survey

Food listing		Standard 24HR		
Ranking - likelihood of being consumed	Number	Number appearing	% appearing	
High or medium	76	59/76	78%	91%
Low	44	10/76	13%	
Unlikely	42	7/76	9%	
Total	162	76/76	100%	

3.3 Portion size estimation (dishing up)

The distribution of portion sizes derived for each food and mixed dish are summarized in **Appendix Table 4.2**. These data represent the weights used in the photos and therefore includes the weight of inedible portions for some foods. The number of participants reporting portion sizes for each item ranged from n=20 ('Millet bread', a stiff porridge of millet and cassava flours) to n=58 (sliced bread), with a mean of n=46, as data were collected only for those who have eaten or could recall portion sizes for that item.

3.4 Standard recipes collected using the reference and simplified methods

A total of 26 standard recipes were collected using the reference method, with two or more additional ingredient combinations imputed for 22 of those recipes. These were applied to the Standard 24HR dietary intake data. For the simplified approach, data were collected for 29 recipes, and additional recipe combinations were imputed to represent those with optional ingredients for dishes in the Simplified 24HR and SQ-FFQ surveys (i.e., sugar and milk for porridges, and vegetable oil/fat for most main mixed dishes and

sauces). To facilitate a direct comparison of recipes collected by the two methods, the proportion of ingredients and nutrient content of the recipe data collected by the reference method were first converted from the content per 100 grams to content per 100 ml; this was done using the density (grams/ml) data determined during recipe data collection.

The recipe ingredient proportions per 100 ml for 21 recipes that were collected by both methods are compared in **Table 5**. For the vast majority of ingredients, the difference in proportions of ingredients per 100 ml between methods was small. Most differences were less than 3 percentage points and 70% were 0-1 percentage point off. Differences were somewhat larger for bulky/chunky ingredients such as plantain and cassava pieces. Larger differences were noted for amaranth leaves and beef broth, which were both 14 percentage points different between methods. There was no systematic trend for over- or under-estimation by the simplified method compared to the reference method; of the 64 proportions calculated, 19 were negative differences, 20 were positive, and 24 were neutral (zero). These data suggest a high level of conformity between the two methods.

We also compared recipes calculated by the two methods on the basis of their nutrient content per 100 ml (**Appendix Table 4.3**). Differences were calculated relative to the reference method. For many recipes, the nutrient content of those collected using the simplified method compared well to those collected using the reference method. To use a somewhat arbitrary standard of comparison, recipes for which the percent difference in nutrient content exceeded 20% for no more than 4 of 11 nutrients were considered to conform well. These included porridges, most sauces of smoother texture, and main mixed dishes (*'Katogos'*). However, several types of recipes showed large differences in the percent nutrient content, including recipes made using green leafy vegetables and soups. In the majority of cases, the simplified method resulted in an underestimation of nutrient content compared to the reference method.

To have a somewhat more practical view of potential error, we also calculated the magnitude of differences in nutrient content of recipes collected by the two methods in relation to nutrient requirements. To be somewhat more representative of a portion size, the nutrient content was scaled up from that of 100 ml to 250 ml of recipe, and the difference expressed as a percent of the EAR[5]. This analysis demonstrated that for most

[5] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from:

recipes, the difference in nutrient content between methods was relatively small - in most cases being <5%. Notable exceptions were for vitamin A in recipes containing vegetable oil, and those containing green leafy vegetables. When expressed this way, the larger percent differences in content observed for some other main dishes (*katogos*), sauces and soup were reduced.

http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx. For iron, the EAR used for comparison was rescaled to represent a bioavailability of 10%, rather than 18% assumed by (FNB, IOM, 2001).

Table 5. Comparison of the proportion of ingredients (grams/100 ml) of selected standard recipes collected using a simplified method and a reference method

Recipe / Ingredient	Proportion of ingredient (weight/volume)		
	Simplified	Reference	Difference
Porridge, maize flour - w/milk and sugar			
Maize flour,white variety,refined,raw - boiled	0.08	0.08	0.00
Milk,cow,fresh,whole,fluid,producer - boiled	0.13	0.13	0.00
Sugar,refined	0.03	0.04	-0.01
Eggplant or Entula Sauce			
Carrots,fresh,raw - boiled/stir-fried	-	0.00	-
Eggplant/entula,fresh,raw - boiled/stir-fried	0.50	0.53	-0.03
Green pepper,fresh,raw - boiled/stir-fried	0.01	0.00	0.00
Onion,fresh,raw - boiled/stir-fried	0.03	0.04	-0.02
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.17	0.18	-0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.04	0.05	-0.01
Amaranth leaf Sauce			
Amaranth leaf,fresh,raw - boiled	0.65	0.51	0.14
Green pepper,fresh,raw - boiled/stir-fried	0.03	0.02	0.01
Onion,fresh,raw - boiled/stir-fried	0.06	0.03	0.02
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.14	0.15	-0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.04	0.03	0.01
Rice dish			
Carrots,fresh,raw - boiled/stir-fried	0.00	-	-
Green pepper,fresh,raw - boiled/stir-fried	0.00	-	-
Onion,fresh,raw - boiled/stir-fried	0.01	0.02	0.00
Rice,white,medium-grain,raw - boiled	0.33	0.31	0.02
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.02	0.05	-0.03
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.01	0.02	0.00
Katogo - Matooke, w/beans			
Banana,green/unripe,fresh,raw (Matooke,Kivuvu,Gonja,Bogoya,Ndiizi) - boiled	0.48	0.46	0.02
Beans,common,mature/dried,raw or boiled*	0.11	0.11	0.00
Carrots,fresh,raw - boiled/stir-fried	0.01	0.00	0.00
Eggplant/entula,fresh,raw - boiled/stir-fried	0.00	-	-

Recipe / Ingredient	Proportion of ingredient (weight/volume)		
	Simplified	Reference	Difference
Green pepper,fresh,raw - boiled/stir-fried	0.00	0.00	0.00
Onion,fresh,raw - boiled/stir-fried	0.01	0.01	0.00
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.04	0.04	-0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.01	0.01	0.00
Katogo - Matooke, w/gnuts			
Banana,green/unripe,fresh,raw (Matooke,Kivuvu,Gonja,Bogoya,Ndiizi) - boiled	0.61	0.54	0.07
Carrots,fresh,raw - boiled/stir-fried	0.00	-	-
Green pepper,fresh,raw - boiled/stir-fried	0.00	0.00	0.00
Groundnuts flour,dried,raw - boiled	0.07	0.07	0.00
Onion,fresh,raw - boiled/stir-fried	0.01	0.01	0.00
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.03	0.02	0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.00	0.00	0.00
Katogo - Cassava, plain			
Carrots,fresh,raw - boiled/stir-fried	0.00	0.01	0.00
Cassava,fresh,raw - boiled	0.52	0.60	-0.08
Green pepper,fresh,raw - boiled/stir-fried	0.00	0.01	-0.01
Onion,fresh,raw - boiled/stir-fried	0.02	0.01	0.01
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.07	0.05	0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.01	0.02	0.00
Katogo - Cassava, w/beans			
Beans,common,mature/dried,raw - boiled,drained,recooked	0.13	0.26	-0.03
Carrots,fresh,raw - boiled/stir-fried	-	0.00	-
Cassava,fresh,raw - boiled	0.37	0.42	-0.05
Green pepper,fresh,raw - boiled/stir-fried	0.00	0.00	0.00
Onion,fresh,raw - boiled/stir-fried	0.01	0.01	0.00
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.04	0.03	0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.01	0.01	0.00
Bean Sauce			
Beans,common,mature/dried,raw - boiled,drained,recooked	0.25	0.21	-0.04

Recipe / Ingredient	Proportion of ingredient (weight/volume)		
	Simplified	Reference	Difference
Carrots,fresh,raw - boiled/stir-fried	0.02	0.02	0.00
Eggplant/entula,fresh,raw - boiled/stir-fried	0.06	-	-
Green pepper,fresh,raw - boiled/stir-fried	0.01	0.01	-0.01
Onion,fresh,raw - boiled/stir-fried	0.02	0.02	0.00
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.07	0.08	0.00
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.02	0.02	-0.01
Mukene Sauce			
Carrots,fresh,raw - boiled/stir-fried	-	0.01	-
Fish,Mukene (silver fish),whole,dried,raw - boiled	0.09	0.12	-0.04
Green pepper,fresh,raw - boiled/stir-fried	-	0.02	-
Onion,fresh,raw - boiled/stir-fried	0.04	0.03	0.01
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.26	0.20	0.06
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.06	0.05	0.01
Groundnut Sauce (basic)			
Carrots,fresh,raw - boiled/stir-fried	0.00	-	-
Green pepper,fresh,raw - boiled/stir-fried	0.02	0.01	0.01
Groundnuts flour,dried,raw - boiled	0.18	0.22	-0.04
Onion,fresh,raw - boiled/stir-fried	0.03	0.02	0.00
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.09	0.06	0.03
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.00	0.00	0.00
Soup for meat, w/entula or eggplant			
Broth,beef,prepared	0.34	0.48	-0.14
Carrots,fresh,raw - boiled/stir-fried	0.09	0.03	0.06
Eggplant/entula,fresh,raw - boiled/stir-fried	0.24	0.17	0.07
Green pepper,fresh,raw - boiled/stir-fried	0.04	0.05	-0.01
Onion,fresh,raw - boiled/stir-fried	0.06	0.05	0.01
Tomato,red,ripe,fresh,raw - boiled/stir-fried	0.20	0.18	0.01
Vegetable oil or fat,repackaged,Vit-A fortified - cooked	0.03	0.04	-0.01

*For simplified recipes, beans were estimated using raw amounts, while in the reference recipe data collection, precooked beans were used. For comparison here, the latter were adjusted to the raw weight equivalent using a factor of 0.396, derived from the proportion difference in dry matter content of raw and cooked beans.

3.5 Food Sub-Group Composition Table (FSGCT)

The Optifood FCT for African foods used as the source for the FSGCT contained 997 entries. Following the protocol to remove duplicate or similar entries resulted in an abbreviated FCT with 512 foods covering 14 food groups and 66 food subgroups. The Fortified nutritional products food groups were removed.

After initial examination of the FCT values by sub-group, it was considered necessary to further subdivide many of the sub-groups into two sets: a primary set including foods that are either in cooked or 'as-eaten' form (e.g., porridges, cooked meats and vegetables, baked goods, fruits, beverages), and a secondary set including only raw forms of foods; many food types that are typically cooked before eating absorb or lose significant amounts of water so the difference in nutrient content per 100 g between raw and cooked forms can be significant (e.g., cereal grains/flours, raw meats, raw vegetables). The latter distinction was necessary to link to raw recipe ingredients which, in our process, are used as the basis for calculating intakes from mixed dishes[6]. It is noteworthy that these two categories were not mutually exclusive for some food sub-groups. In the sub-groups for fruits and nuts/seeds, for example, the 'as-eaten' category contained all entries including raw and cooked forms, while the 'raw' category contained only the raw forms of these foods.

For several food sub-groups, a separate 'raw' category was not relevant as all or nearly all foods were in ready-to-eat form (e.g., beverages, dairy, sugars, vegetable fats/oils, savory snacks, sweetened bakery products). Food sub-groups for which separate raw and 'as-eaten' FSGCT data were considered necessary included those that are typically included in recipes. The importance of this separation is demonstrated in **Table 6**, where the content of select nutrients per 100 grams is compared between the 'as-eaten' and 'raw' categories. Differences that are <-20% or >20% are highlighted. All food sub-groups in the groups for Primary Staple Grains & Products, Starchy Roots & other Starchy Plant Foods, plus sub-groups for Beans, Lentils & Peas, Soybeans & Products, Fish without Bones, Small Whole Fish with Bones, Vitamin A-rich Vegetables and Other Vegetables, all had differences exceeding 20% for 8 or more of the nutrients shown. For Nuts, seeds and unsweetened products and the Fruits groups, differences were negligible as the

[6] As noted in section 2.6, to calculate nutrient content of recipes, we used FCT data for the raw form of ingredients to conform to estimated weights of raw ingredients added to recipes, but adjusted for nutrient losses due to cooking.

majority of FCT entries were for raw versions of these foods. However, for the Meat, Fish & Eggs groups, the differences were less marked. Nutrients differed by more than 20% for ≤5 nutrients for Red Meat, Pork, Poultry/Rabbit, Other Animal Parts, and Eggs while for both Fish sub-groups, differences more than 20% occurred for ≥9 nutrients.

For application in this project, we thus retained two categories for all food sub-groups with differences >20% for at least 4 nutrients. The mean energy and nutrient content was calculated for each food sub-group category. For sake of brevity, data are only presented for the 13 food groups and 35 food sub-groups that appeared in the dietary surveys of this project, and for energy, protein, fat, 3 minerals, and 5 vitamins.

Table 6. Comparison of the nutrient content between raw only and 'as-eaten' foods in a food composition table aggregated by food sub-group

Food group	Food subgroup		Energy (kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Riboflavin (mg)	Folate DFE (ug)	Vit B12 (ug)	Vit A (ug RAE)	n
Primary staple grains & products	Whole grains and products	Raw only	345	9.5	3.1	31.1	5.09	2.3	0.1	0.15	35	0	2	20
		As-eaten	137	3.5	1.2	10.0	1.84	0.7	0.2	0.04	10	0	2	20
		% diff.	60%	63%	61%	68%	64%	68%	-50%	73%	71%	-	18%	
	Refined grains and products	Raw only	366	7.8	1.3	8.8	1.20	1.1	0	0.09	25	0	2	9
		As-eaten	125	2.7	0.6	2.6	0.44	0.4	0	0.03	6	0	1	8
		% diff.	66%	65%	54%	71%	63%	65%	-	67%	76%	-	66%	
Starchy roots & other starchy plant foods	Vitamin A-rich starchy plant foods	Raw only	271	4.9	0.2	94.5	1.92	0.9	6.3	0.18	32	0	765	3
		As-eaten	188	2.9	3.3	55.2	1.12	0.6	3.4	0.11	16	0	477	4
		% diff.	30%	41%	-1988%	42%	42%	41%	46%	39%	49%	-	38%	
	Other starchy plant foods	Raw only	152	2.4	0.2	34.8	1.20	0.7	10.9	0.07	24	0	20	9
		As-eaten	144	1.9	1.4	24.8	0.84	0.5	7.6	0.05	17	0	17	15
		% diff.	5%	19%	-656%	29%	30%	31%	30%	29%	27%	-	18%	
Legumes,nuts & seeds	Cooked beans,lentils,peas	Raw only	257	17.0	1.8	117.7	5.10	2.6	7.5	0.19	294	0	13	26
		As-eaten	118	7.5	0.7	49.2	2.06	1.0	3.2	0.07	80	0	7	41
		% diff.	54%	56%	59%	58%	60%	61%	57%	63%	73%	-	45%	
	Soybeans and products	Raw only	407	50.6	14.7	220.3	12.19	4.3	2.0	0.71	299	0	2	3
		As-eaten	273	36.1	10.1	119.2	6.40	2.7	1.9	0.34	103	0	0	4
		% diff.	33%	29%	31%	46%	47%	37%	4%	52%	66%	-	97%	
	Nuts,seeds,and unsweetened products	Raw only	447	18.4	30.1	218.3	8.98	3.4	8.3	0.26	124	0	3	26
		As-eaten	441	18.7	30.5	211.1	8.37	3.5	8.1	0.23	120	0	3	33
		% diff.	1%	-2%	-1%	3%	7%	-3%	2%	12%	3%	-	-3%	

Food group	Food subgroup		Energy (kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Riboflavin (mg)	Folate DFE (ug)	Vit B12 (ug)	Vit A (ug RAE)	n
Dairy products	Fluid or powdered milk (non-fortified)	Raw only	190	13	7.6	447.1	0.15	2.1	3.3	0.56	17	1.43	85	6
		As-eaten	190	13	7.6	447.1	0.15	2.1	3.3	0.56	17	1.43	85	6
		% diff.	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Meat, fish & eggs	Red meat	Raw only	247	29.4	13.6	21.5	2.85	4.1	1.0	0.41	13	2.92	1	14
		As-eaten	221	26.9	11.7	17.8	2.43	3.8	0.8	0.34	9	1.94	1	16
		% diff.	10%	8%	14%	17%	15%	8%	16%	17%	27%	34%	-20%	
	Pork	Raw only	214	26.3	11.4	26.7	1.06	2.5	0.3	0.26	3	0.79	1	7
		As-eaten	238	24.4	14.9	15.6	1.00	2.3	0.2	0.23	4	0.58	1	10
		% diff.	-11%	7%	-31%	41%	6%	8%	46%	12%	-11%	27%	-12%	
	Poultry,rabbit	Raw only	232	24.2	14.2	15.7	2.34	2.0	1.8	0.18	11	2.11	56	11
		As-eaten	221	25.5	12.4	18.5	1.98	2.1	0.7	0.19	7	0.72	37	14
		% diff.	5%	-5%	13%	-18%	16%	-5%	61%	-6%	39%	66%	33%	
	Eggs	Raw only	164	12.7	11.6	60.0	2.80	1.4	0	0.43	64	3.15	177	2
		As-eaten	157	11.8	11.3	58.1	1.97	1.2	0	0.52	43	1.02	162	4
		% diff.	4%	7%	3%	3%	30%	12%	-	-21%	32%	68%	8%	
	Fish without bones	Raw only	179	33.8	4.2	44.6	1.35	1.2	1.2	0.12	20	3.10	24	14
		As-eaten	136	23.5	4.2	39.7	0.97	0.7	0.7	0.09	10	2.20	15	24
		% diff.	24%	30%	1%	11%	28%	37%	37%	25%	48%	29%	37%	
	Small,whole fish,with bones	Raw only	264	40.3	10.3	137.3	3.35	2.8	0.9	0.40	12	13.38	53	10
		As-eaten	175	24.6	7.8	87.1	1.60	1.6	0.4	0.23	6	7.10	28	19
		% diff.	34%	39%	24%	37%	52%	43%	55%	43%	46%	47%	46%	
	Other animal parts	Raw only	188	17.9	12.4	37.7	3.61	1.6	12.1	0.20	8	2.14	9	6
		As-eaten	170	17.3	10.6	35.6	2.32	1.4	10.3	0.11	18	1.26	12	6

Food group	Food subgroup		Energy (kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Riboflavin (mg)	Folate DFE (ug)	Vit B12 (ug)	Vit A (ug RAE)	n
		% diff.	10%	3%	14%	6%	36%	13%	15%	45%	-121%	41%	-45%	
Fruits	Vitamin C-rich fruit	Raw only	100	2.0	0.3	117.8	2.69	0.5	80.2	0.05	20	0	27	12
		As-eaten	93	1.8	0.3	103.3	2.41	0.4	89.3	0.06	19	0	30	14
		% diff.	7%	9%	-10%	12%	10%	10%	-11%	-20%	6%	-	-11%	
	Other fruit	Raw only	130	1.7	3.7	33.4	1.30	0.3	11.8	0.07	15	0	11	37
		As-eaten	123	1.6	3.4	32.1	1.22	0.3	12.3	0.07	15	0	10	41
		% diff.	5%	5%	9%	4%	6%	7%	-5%	0%	2%	-	6%	
Vegetables	Vitamin A-rich vegetables	Raw only	104	9.0	1.2	470.9	12.17	1.7	106.1	0.61	223	0	536	29
		As-eaten	46	2.9	0.9	144.2	3.10	0.7	48.8	0.23	62	0	386	28
		% diff.	55%	68%	22%	69%	75%	61%	54%	62%	72%	-	28%	
	Vitamin C-rich vegetables	Raw only	46.1	2.8	0.29	43.9	1.01	0.49	74.97	0.08	36.3	0	28.5	10
		As-eaten	45.77	2.51	0.28	41.93	0.9	0.41	92.99	0.08	45.69	0	24.17	8
		% diff.	1%	10%	3%	4%	11%	16%	-24%	0%	-26%	-	15%	
	Other vegetables	Raw only	69	3.3	1.2	252.0	1.80	0.8	10.6	0.15	43	0	23	26
		As-eaten	54	2.4	1.8	97.1	1.46	0.4	10.1	0.09	27	0	32	37
		% diff.	22%	28%	-51%	61%	19%	51%	4%	40%	35%	-	-39%	
Added fats	Vegetable oil (fortified)	Raw only	884	0	100	0	0	0	0	0	0	0	1925	1
		As-eaten	884	0	100	0	0	0	0	0	0	0	1733	1
		% diff.	0%	-	0%	-	-	-	-	-	-	-	10%	

3.6 Dietary survey results

Socio-demographic characteristics: The dietary surveys were conducted over 6 days (July 3-7 and July 12[7]). Details of the survey implementation are given in the following section on technical requirements. The socio-demographic and PPI survey results for the sample participating in the dietary surveys is summarized in **Table 7**. For most characteristics included in the PPI score calculation, there were no group differences between the Simplified 24HR and the Standard 24HR or between the SQ-FFQ and the Standard 24HR, with the exception of whether all children 6-12 years of age in the household were in school in the latter comparison. However, the total PPI score was statistically significantly different ($P<0.05$) between the SQ-FFQ and the Standard 24HR. While this may indicate a slight bias in results, this is considered to be of little practical significance as all three groups fell within the same category for likelihood of being below the National Poverty Line (i.e., 1.6%), and the same category to estimate the percent living below $1.25 per day (i.e., 4.9%) or below $2.00 per day (i.e., 29.3%). Overall these groups would be considered relatively well off compared to the rest of Uganda.

Energy and nutrient intakes: The mean, median and 25th and 75th percentiles for energy and nutrients derived from each of the three dietary assessment methods are summarized and compared in **Tables 8** and **9**. As the energy and nutrient intake data were not normally distributed (Kolmogorov-Smirnoff $P<0.05$, not shown), non-parametric tests were used to compare outcomes. The energy and nutrient intakes estimated by the Simplified 24HR method were generally one-half to two-thirds lower than those derived from the Standard 24HR method, and the difference in mean intakes was significant for energy and all nutrients tested, with the exception of vitamin B12 (Table 8). In contrast, the SQ-FFQ resulted in mean intakes of energy and some nutrients being lower and some higher, compared to the Standard 24HR method (Table 9). However, these differences were only significant for energy and fat (lower), and vitamin C and vitamin B12 (higher).

[7] The gap in data collection was due to a previously unscheduled political event in the study area.

Table 7. Household socio-demographic results, as used to calculate the Progress out of Poverty Index Score, by survey method.

Characteristic	Response	Standard 24HR Mean or %	Simplified 24HR Mean or %	P†	SQFFQ Mean or %	P†
Age (years)		33.4 ± 9.0	34.3 ± 8.3	ns	34.3 ± 8.6	ns
Number of household members (n)		5.7 ±2.5	6.0 ±2.6	ns	6.2 ±2.7	ns
All household members own at least one pair of shoes (%)	Yes	76.5	73.0	ns	76.4	ns
All children 6-12 years in school (%)	Yes	64.3	70.3	ns	67.3	*
	No children 6-12 years	34.8	27.9		24.5	
Lead female able to read/write (%)	Yes	79.1	76.6	ns	74.5	ns
Main wall material (%)‡	Brick, earth or clay	91.3	93.7	ns	90.0	ns
Main roof material (%)‡	Iron sheets	96.5	100.0	ns	98.2	ns
Toilet facility type (%)‡	Pit latrine with cement slab	54.8	71.2	ns	58.2	ns
	Pit latrine - no cement slab	23.5	18.0	ns	19.1	ns
Cooking fuel type (%)‡	Wood / dung / grass	55.7	58.6	ns	68.2	ns
	Coal	44.3	41.4	ns	31.8	ns
Number of cell phones (%)	0	2.6	8.1	ns	6.4	ns
	1	21.7	25.2	ns	25.5	ns
	2	47.8	42.3	ns	49.1	ns
	≥3	27.8	24.3	ns	19.1	ns
PPI score		54.7	51.9	ns	51.2	*

† Two group differences (Standard 24HR *vs* Simplified 24HR and Standard 24HR *vs* SQFFQ) were tested by T-test for independent samples where means are presented and by Chi-square test where data are categorical.

‡ Data only shown for the primary responses recorded; statistical tests included all possible responses.

*P<0.05; ns, non-significant (P≥0.05)

Table 8. Nutrient intakes among women of reproductive age in Mukono District, Uganda as estimated by a Simplified 24HRmethod and compared to the Standard 24HR method, and nutrients for which the mean/median is less than the EAR†

Nutrient	EAR	Standard 24HR			Simplified 24HR			P
n		115			111			
		mean	*median*	*25th, 75th percentiles*	*mean*	*median*	*25th, 75th percentiles*	
Energy (kcal)	-	2403	2249	1811, 2768	1477	1450	1061, 1870	**0.000**
Protein (g)	-	58.4	51.5	41.0, 66.6	38.5	35.8	24.2, 51.5	**0.000**
Fat (g)	-	47.6	37.3	27.7, 54.9	24.2	22.2	11.4, 33.4	**0.000**
Calcium (mg)	800	**444***	**358***	199, 543	**293***	**220***	132, 367	**0.000**
Iron (mg)	14.6‡	**12.22***	**10.8***	8.40, 14.70	**7.73***	**7.3***	4.70, 10.10	**0.000**
Zinc (mg)	6.8	8.6	7.7	5.5, 10.7	**5.7***	**5.1***	3.6, 7.7	**0.000**
Vitamin C (mg)	60	131.6	100.7	64.6, 193.8	78.6	**56.0***	27.4, 95.6	**0.000**
Thiamin (mg)	0.9	1.160	1.071	0.765, 1.448	**0.741***	**0.633***	0.484, 0.975	**0.000**
Riboflavin (mg)	0.9	1.275	1.149	0.837, 1.566	**0.825***	**0.799***	0.536, 1.058	**0.000**
Niacin (mg)	11	13.672	11.906	8.476, 16.741	**8.725***	**8.446***	5.149, 11.486	**0.000**
Vitamin B6 (mg)	1.1	2.614	2.240	1.457, 3.348	1.499	1.247	0.841, 2.212	**0.000**
Folate (µg DFE)	320	431	423	257, 565	**227 ***	**196***	134, 293	**0.000**
Vitamin B12 (µg)	2.0	**0.64***	**0.00***	0.00, 1.03	**0.75 ***	**0.51***	0.00, 1.28	**0.019**
Vitamin A (µg RAE)	500	820	700	407, 1058	**389***	**276***	145, 470	**0.000**
Intake of nutrient <100% EAR (n)		3	3		9	10		

†Comparisons between the Standard 24HR and Simplified 24HR method, and the Standard 24HR and SQ-FFQ method, were done using one-way ANOVA; differences were considered statistically significant at P<0.05.

*Indicates nutrients for which the mean or median intake is less than the Estimated Average Requirement[8].

‡ For iron, the published EAR (8.1 mg/day assuming 18% bioavailability) was adjusted to a bioavailability of 10% by taking the physiological requirement for absorbed iron and dividing it by 0.10 (FNB, IOM, 2001).

[8] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from: http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx

Table 9. Nutrient intakes among women of reproductive age in Mukono District, Uganda as estimated by a SQ-FFQ method and compared to the Standard 24HR method, and nutrients for which the mean/median is less than the EAR†

Nutrient	EAR	Standard 24HR			SQ-FFQ			P
n		115			110			
		mean	*median*	*25th, 75th percentiles*	*mean*	*median*	*25th, 75th percentiles*	
Energy (kcal)	-	2403	2249	1811, 2768	2063	1961	1461, 2494	**0.001**
Protein (g)	-	58.4	51.5	41.0, 66.6	54.6	48.5	38.3, 66.7	0.260
Fat (g)	-	47.6	37.3	27.7, 54.9	40.0	36.5	25.6, 49.0	0.198
Calcium (mg)	800	**444***	**358***	199, 543	**479***	**452***	276, 598	0.062
Iron (mg)	14.6‡	**12.22***	**10.8***	8.40, 14.70	**11.79***	**10.47***	7.80, 14.48	0.462
Zinc (mg)	6.8	8.6	7.7	5.5, 10.7	8.4	7.8	5.6, 9.8	0.643
Vitamin C (mg)	60	131.6	100.7	64.6, 193.8	208	150.6	94.5, 260.0	**0.000**
Thiamin (mg)	0.9	1.160	1.071	0.765, 1.448	1.131	0.987	0.770, 1.427	0.690
Riboflavin (mg)	0.9	1.275	1.149	0.837, 1.566	1.380	1.316	0.954, 1.637	0.149
Niacin (mg)	11	13.672	11.906	8.476, 16.741	14.394	12.579	9.463, 17.926	0.297
Vitamin B6 (mg)	1.1	2.614	2.240	1.457, 3.348	2.394	2.148	1.500, 3.005	0.456
Folate (µg DFE)	320	431	423	257, 565	395	329	259, 503	0.090
Vitamin B12 (µg)	2.0	**0.64***	**0.00***	0.00, 1.03	**1.77 ***	**1.074***	1.43, 2.06	**0.000**
Vitamin A (µg RAE)	500	820	700	407, 1058	789	634	410, 992	0.408
Intake of nutrient <100% EAR (n)		3	3		3	3		

†Comparisons between the Standard 24HR and Simplified 24HR method, and the Standard 24HR and SQ-FFQ method, were done using one-way ANOVA; differences were considered statistically significant at P<0.05.

*Indicates nutrients for which the mean intake is less than the Estimated Average Requirement[9].

‡ For iron, the published EAR (8.1 mg/day assuming 18% bioavailability) was adjusted to a bioavailability of 10% by taking the physiological requirement for absorbed iron and dividing it by 0.10 (FNB, IOM, 2001).

[9] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from: http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx

The Standard 24HR method resulted in 3 of 11 nutrients with means (or medians) <100% of the EAR (calcium, zinc, and vitamin B12). The Simplified 24HR method resulted in means (or medians) for nearly all (9 of 11) nutrients being <100% of the EAR, with the mean intakes of vitamins C and B12 being the only ones above the EAR. The SQ-FFQ method estimated the mean intakes of 3 of 11 nutrients being <100% of the EAR, which were the same nutrients identified by the Standard 24HR method (i.e., calcium, iron and vitamin B12). We also examined the percentage of individuals with intakes <100% of the EAR for each method (**Table 10**) and similar results presented. For the Simplified 24HR method, the percentage was significantly higher for all but vitamin B12, while for the SQ-FFQ method, the difference in percentages was only significant for vitamin B12.

The specific food items that provided a mean nutrient amount of >5% of the EAR were identified and compared across methods (**Table 11 a-h**). The results of this comparison did not result in any clear systematic trend across nutrients when comparing methods. The SQ-FFQ generally identified a larger number of foods meeting this criteria for the vitamins examined (e.g., vitamin C, riboflavin, folate, vitamin B12, and vitamin A), while for the minerals, it identified fewer food types, compared to the Standard 24HR. The Simplified 24HR also identified a smaller number of foods for the minerals, compared to the Standard 24HR method, while for the vitamins results were mixed. Of the foods identified by the Simplified 24HR method, the concordance of those foods was high relative to those identified by the Standard 24HR (100% for 7 of 9 nutrients). However, the concordance of foods identified by the SQ-FFQ method and those of the Standard 24HR method was lower (less than 75% for all but one nutrient). In sum, the Simplified 24HR identified fewer foods providing >5% of the EAR but the ones it did identify were the same as those identified by the Standard 24HR method. The SQ-FFQ, on the other hand, identified more foods providing >5% of the EAR, and these were not always the same foods as identified by the Standard 24HR method.

Portion size and frequency of food intakes: To better inform some of the possible methodological differences in the energy and nutrient intake results between methods, we calculated the mean portion size (**Table 12**) and frequency (**Table 13**) for foods that provided >5% of the EAR for at least one nutrient. Results for the Standard and Simplified 24HR survey methods are directly comparable, with the exception of some foods that were captured differently in the two methods. It was, however, not possible to perform direct statistical comparisons at this stage. A comparison of results between the SQ-FFQ

and the Standard 24HR method was limited to the portion sizes of foods consumed as single items as substantial additional data processing and analysis would be required to generate more directly comparable estimates from the raw SQ-FFQ data for portion sizes of foods consumed as ingredients and frequency.

The results for mean portion size (mean grams per serving consumed) indicate that the Simplified 24HR tended to underestimate portion sizes of foods consumed relative to the Standard 24HR method (Table 12), with the exception of fruits, which were overestimated in comparison. The percent grams per portion for the Simplified over the Standard 24HR method was lower for 19 of the 26 foods compared, and the median percent across foods was 81%. It is difficult to make generalizations for the limited number of foods compared with the SQ-FFQ. However, similar to the Simplified 24HR, portion sizes for fruits were also over-estimated relative to the Standard 24HR method.

With regard to frequency, the Simplified 24HR method underestimated frequency compared to the Standard 24HR method (Table 13). When calculated as a percentage (total frequency divided by the number of respondents) to account for different sample sizes, the Simplified 24HR method resulted in a lower percentage for 22 of 29 foods compared and the median ratio of percentages for the Simplified over the Standard 24HR method was 0.72. These results suggest a systematic relative underestimation for the Simplified 24HR method.

Comparison of the SFGCT and the standard FCT: The mean and median (25th, 75th percentiles) of energy and nutrient intakes from the Standard 24HR data before and after substituting the condensed SFGCT for the standard FCT are shown in **Table 14**. Calculated intakes were significantly different for most nutrients, except for folate and vitamin A, and indicate a systematic overestimation of nutrient intakes. While the analysis with the Standard FCT resulted in the mean intake being <100% of the EAR for three nutrients, as noted above, the SFGCT did not result in means <100% of the EAR for any of the 9 nutrients presented.

Table 10. Prevalence of nutrient intakes below the EAR[10] among women of reproductive age in Mukono District, Uganda as estimated by two simplified dietary assessment methods and compared to the Standard 24HR method†

Nutrient	Standard 24HR	Simplified 24HR	P	SQ-FFQ	P
	115	111		110	
		% < EAR			
Calcium (mg)	84.3	95.5	**0.007**	90.0	0.236
Iron (mg)	74.8	93.7	**0.000**	77.3	0.755
Zinc (mg)	34.8	66.7	**0.000**	37.3	0.781
Vitamin C (mg)	20.9	53.2	**0.000**	11.8	0.074
Thiamin (mg)	33.9	71.2	**0.000**	40.0	0.407
Riboflavin (mg)	28.7	58.6	**0.000**	20.9	0.217
Niacin (mg)	44.3	71.2	**0.000**	35.5	0.220
Vitamin B6 (mg)	13.0	41.4	**0.000**	8.2	0.283
Folate (µg DFE)	38.3	79.3	**0.000**	49.1	0.108
Vitamin B12 (µg)	87.0	91.0	0.399	74.5	**0.027**
Vitamin A (µg RAE)	34.8	80.2	**0.000**	40.0	0.491

†Comparisons of prevalence of intakes <100% of the EAR were tested using a Chi Square Test (2-sided Exact test); significant differences are for P<0.05.

[10] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from: http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx

Table 11 (a-h). Food sources provide >5% of the EAR for selected nutrients

Table 11 a	Calcium		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Sweet potato, yellow	X		
Beans, common	X		
Milk, cow, fluid	X	X	X
Number of foods	3	1	1

Table 11 b	Iron		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Maize flour, white, refined	X	X	X
Banana, unripe	X		X
Sweet potato, yellow	X		
Beans, common	X	X	X
Number of foods	4	2	3

Table 11 c	Zinc		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Bread, wheat, white	X		
Rice, white	X		
Maize flour, white, refined	X	X	X
Sweet potato, yellow	X		
Cassava	X		
Beans, common	X	X	X
Milk, cow, fluid	X		X
Beef / Meat, any type*	X	X	X
Maize on cob, fresh, cooked	X		X
Number of foods	8	3	5

*For the Standard 24HR method, intake of meat was recorded by type of meat, while in the Simplified 24HR and SQ-FFQ methods, all meats were categorized together.

Table 11 d	Vitamin C		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Cassava, cooked	X	X	X
Banana, unripe	X	X	X
Potato, cooked	X		
Guava			X
Mango, ripe	X	X	X
Orange			X
Papaya, ripe	X	X	X
Jackfruit	X	X	X
Jambula			X
Cabbage, cooked	X		X
Pumpkin, cooked			X
Green leaf, any type			X
Avocado			X
Maize on cob, fresh, cooked			X
Tomato, cooked	X	X	X
Fruit juice, fresh, any type			X
Number of foods	8	6	15

Table 11 e	Riboflavin		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Maize flour, white, refined	X	X	X
Banana, unripe	X	X	X
Cassava, fresh	X		X
Sweet potato, white	X		
Sweet potato, yellow	X	X	X
Beans, common, cooked	X	X	X
Milk, cow, fluid	X	X	X
Egg, chicken	X		
Organ meat/offals, cooked			X
Pumpkin, cooked			X
Avocado			X
Maize on cob, fresh, cooked			X
Black tea, brewed	X	X	X
Number of foods	9	6	11

Table 11 f	Folate		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Cassava, fresh, cooked	X	X	X
Banana, unripe, cooked	X	X	X
Beans, common, cooked	X	X	X
Mango, ripe			X
Avocado	X		X
Black tea, brewed	X	X	X
Number of foods	5	4	6

Table 11 g	Vitamin B12		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Beef, cooked / Meat any type*	X	X	X
Small whole fish (mukene), dried, cooked	X		
Milk, cow, fluid		X	X
Fish, large, fresh		X	X
Organ meat/offals, cooked			X
Number of foods	2	3	4

*For the Standard 24HR method, intake of meat was recorded by type of meat, while in the Simplified 24HR and SQ-FFQ methods, all meats were categorized together.

Table 11 h	Vitamin A		
Food items	Standard 24HR	Simplified 24HR	SQ-FFQ
Sweet potato, orange	X	X	X
Sweet potato, yellow	X	X	X
Banana, unripe, cooked	X	X	X
Milk, cow, fluid	X	X	X
Organ meat/offals, cooked			X
Mango, ripe, fresh			X
Pumpkin, cooked	X	X	X
Carrots, cooked			X
Vegetable oil/fat, repackaged, vitamin A fortified	X	X	X
Number of foods	6	6	9

Table 12. Summary of mean portion sizes (grams) per occurrence of consumption, by dietary survey method for selected foods*

Food item	Standard 24HR	Simplified 24HR		SQ-FFQ	
	grams	grams	%†	grams	%†
Maize flour, white, refined	96	83	0.86		
Bread, wheat, white	154	63	0.41	83	0.54
Rice, white	94	71	0.76		
Banana, unripe	412	244	0.59		
Cassava, cooked	195	174	0.89		
Potato, cooked	252	287	1.14	223	0.88
Sweet potato, white	291	240	0.82	341	1.17
Sweet potato, yellow	343	276	0.80	323	0.94
Sweet potato, orange	199	309	1.55	309	1.55
Beans, common	293	49	0.17		
Milk, cow, fluid	580	169	0.29		
Beef / Meat, any type*	96	38	0.40	49	0.51
Organ meat/offals, cooked	-	-	-		
Small whole fish (mukene), dried, cooked	13	5	0.38		
Fish, large, fresh	43 / 87	91	-		
Egg, chicken	84	47	0.56		
Guava	-	-		17	-
Jackfruit	316	352	1.11	341	1.08
Jambula	45	-		159	3.53
Mango, ripe	97	162	1.67	193	1.99
Orange	31	117	3.77	128	4.13
Papaya, ripe	308	455	1.48	321	1.04
Avocado	77	82	1.06	93	1.21
Cabbage, cooked	89	82	0.92		
Carrots, cooked	5	2	0.40		
Green leaf, any type	-	30			
Maize on cob, fresh, cooked	156	132	0.85	165	1.06
Pumpkin, cooked	197	135	0.69	195	0.99
Tomato, cooked	25	15	0.60		
Fruit juice, fresh, any type (orange/passion as ingredient in juice recipe)	13 / 21	7 / 10			
Black tea, brewed	397	344	0.87	410	1.03
Vegetable oil/fat, repackaged, vitamin A fortified	7	3	0.43		
Median percentage for the foods presented			0.81		

* Data are shown only for those foods that provided >5% of the EAR for at least one nutrient examined (Table 11).Data for the 24HR methods represents average portion size for each eating occasion among individuals reporting to have consumed that food type. For the SQ-FFQ method, comparable data are presented only for foods that are consumed as individual food items and represent the usual portion size

for those foods amongst those reporting to have eaten those foods; these data may not be directly comparable to the 24HR methods.

†Percentage of the mean portion size of the test method over the mean portion size of the Standard 24HR method.

Table 13. Summary and comparison of the frequency of consumption by dietary survey method for selected foods*

Food item	Standard 24HR		Simplified 24HR		
	115		111		
	Freq†	%‡	Freq†	%	Ratio§
Maize flour, white, refined	64	0.56	62	0.56	1.00
Bread, wheat, white	29	0.25	13	0.12	0.46
Rice, white	48	0.42	34	0.31	0.73
Banana, unripe	68	0.59	53	0.48	0.81
Cassava, cooked	73	0.63	57	0.51	0.81
Potato, cooked	15	0.13	7	0.06	0.48
Sweet potato, white	23	0.20	13	0.12	0.59
Sweet potato, yellow	33	0.29	23	0.21	0.72
Sweet potato, orange	4	0.03	2	0.02	0.52
Beans, common	98	0.85	66	0.59	0.70
Milk, cow, fluid	59	0.51	53	0.48	0.93
Beef / Meat, any type*	16	0.14	27	0.24	1.75
Organ meat/offals, cooked	-		-	95	-
Small whole fish (mukene), dried, cooked	27	0.23	29	0.26	1.11
Fish, large, fresh	20	0.17	13	0.12	0.67
Egg, chicken	15	0.13	8	0.07	0.55
Guava	-		-		
Jackfruit	13	0.11	10	0.09	0.80
Jambula	1	0.01	-		
Mango, ripe	33	0.29	15	0.14	0.47
Orange	6	0.05	3	0.03	0.52
Papaya, ripe	10	0.09	5	0.05	0.52
Avocado	42	0.37	16	0.14	0.39
Cabbage, cooked	15	0.13	5	0.05	0.35
Carrots, cooked	31	0.27	140	1.26	4.68
Green leaf, any type	21	0.18	13	0.12	0.64
Maize on cob, fresh, cooked	45	0.39	47	0.42	1.08
Pumpkin, cooked	13	0.11	9	0.08	0.72
Tomato, cooked	241	2.10	229	2.06	0.98
Fruit juice, fresh, any type (orange/passion as ingredient in juice recipe)	15	0.13	46	0.41	3.18
Black tea, brewed	98	0.85	106	0.95	1.12
Vegetable oil/fat, repackaged, vitamin A fortified	208	1.81	158	1.42	0.79
Median % occurrence across all foods presented				0.72	

*Data are shown only for those foods that provided >5% of the EAR for at least one nutrient examined (Table 11).

† Freq: Data for the 24HR methods represent the total number of occurrences of the food item across all dietary records (not number of individuals reporting consumption of the food).

‡The percentage shown is the frequency of occurrence divided by the number of respondents (n). Percentages for the test methods that are lower than in the Standard 24HR method are shown in red font.

§ The ratio of percentage occurrence of the test method over the Standard 24HR method.

Table 14. Comparison of energy and nutrient intakes from Standard 24HR data using an FCT with entries for each food item and a condensed FCT with average nutrient content values for food sub-groups†

Nutrient		Standard FCT			Condensed FCT			P
	EAR	Mean	Median	25th, 75th percentiles	Mean	Median	25th, 75th percentiles	
Energy (kcal)	-	2403	2249	(1811, 2768)	2742	2541	(1999, 3223)	
Protein (g)	-	58.4	51.5	(41.0, 66.6)	76.1	65.4	(48.8, 91.4)	
Fat (g)	-	47.6	37.3	(27.7, 54.9)	54.9	46.8	(32.6, 66.7)	
Calcium (mg)	800	**444***	**358***	(199, 543)	1616	1356	(833, 2030)	**0.000**
Iron (mg)	14.6‡	**12.2***	**10.8***	(8.4, 14.7)	23.2	19.1	(13.5, 29.3)	**0.000**
Zinc (mg)	6.8	8.6	7.7	(5.5, 10.7)	12.5	11.2	(7.9, 15.1)	**0.000**
Vitamin C (mg)	60	131.6	100.7	(64.6, 193.8)	190.9	143.3	(78.8, 230.2)	**0.000**
Thiamin (mg)	0.9	1.160	1.071	(0.765, 1.448)	1.615	1.393	(1.026, 2.075)	**0.000**
Riboflavin (mg)	0.9	1.275	1.149	(0.837, 1.566)	2.167	1.830	(1.220, 2.719)	**0.000**
Niacin (mg)	11	13.672	11.906	(8.476, 16.741)	16.932	14.201	(10.431, 21.058)	**0.000**
Vitamin B6 (mg)	1.1	2.614	2.240	(1.457, 3.348)	3.380	2.934	(2.128, 4.571)	**0.000**
Folate (µg DFE)	320	431	423	(257, 565)	449	390	(264, 559)	0.600
Vitamin B12 (µg)	2.0	**0.64***	**0.00***	(0.00, 1.03)	2.97	2.12	(0.53, 4.67)	**0.000**
Vitamin A (µg RAE)	500	820	700	(407, 1058)	824	678	(396, 1105)	0.721

†Comparisons of the median (25th, 75th percentiles) were tested using a Sign Ranks Wilcoxan Test (2-sided) for two dependent samples; significant differences (P<0.05) are shown in bolded text.

*Mean or median intakes are less than the EAR[11].

‡ For iron, the published EAR (8.1 mg/day assuming 18% bioavailability) was adjusted to a bioavailability of 10% by taking the physiological requirement for absorbed iron and dividing it by 0.10 (FNB, IOM, 2001).

[11] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from: http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx

4. Technical requirements of the survey methods

A description of the technical requirements for the input data collection tools (**Table 15a and b**) and the test and reference dietary survey methods (**Table 16**) were summarized, together with rankings of the relative degree of complexity or level of requirement.

4.1 Technical requirements for input data collection

The food listing exercise, was not a hugely complex task, but the large amount of information and detail obtained was relatively high. As new tools were developed for this activity, extra time was needed to formulate them and clarify internally what information was needed to serve the purpose of all survey tools. For these reasons, the technical requirements were largely ranked as being moderate or low-moderate. Approximately 8 days were required for a full implementation of this exercise, from preparation through to translation of the data into the next stage of input data collection and tool development (i.e., portion size estimation for the food photo atlas, and foods included in the SQ-FFQ listing). Only a small number of staff members and participants are required to carry it out. The most notable technical requirements are for good data collection tools and interview guides to collect responses systematically, skilled interviewers who pay attention to detail, and the ability to summarize the data collected (albeit the information itself is simple in nature - lists of foods, rankings on likelihood of being eating, preparation methods, common recipes and ingredients, etc.).

Portion size estimation: The portion size estimation activity was fairly extensive and involved (Table 15a). This activity was variably ranked for level of complexity, ranging from low to moderate-high depending on the component. For example, the data collection itself was relatively simplistic, with low technical requirements of the enumerators, low burden to respondents, and rapid collection of the data required. However, the requirements for coordination, logistics, organization were more moderate to high, given the fairly large number of different foods to procure and prepare, and the number of enumerators and participants involved. The data collected were very simple (a single gram weight reading for each food item surveyed, plus limited details for some foods on size and inclusion of waste). The management of data was not complex in nature but some processing was required to convert gram weights of foods with/without waste to a standard presentation. The need to collect and apply waste factor data also required some coordination and care in data processing.

Recipe data collection: The technical requirements of the simplified standard recipe data collection were generally ranked as low or low-moderate (Table 15b). It was considered very helpful for supervisors to have a good understanding of recipe data collection and the details it entails to ensure quality of data collected. However, the data collection itself was very simple and straight forward, with a limited burden to enumerators and to respondents. The interviews were very rapid and the amount of data obtained from one person could in fact be easily increased to improve efficiency. The notable technical requirements include a degree of organizational, logistical and planning capacity to determine all the ingredients, their amounts, sizes represented etc, needed to be procured, and how best to prepare them for presentation to the participants. In comparison to the portion size estimation exercise, however, this was simpler due to the much smaller number of different food items involved.

4.2 Technical requirements for the test and reference dietary survey methods

Overall, we ranked the Standard 24HR method as needing a moderate to high degree of technical requirements, with the SQ-FFQ as having moderate requirements, and the Simplified 24HR as having low-moderate requirements (Table 16). It is important to note that these methods were assessed independently of the input data collection activities reported in Tables 17a and b, and thus refer only to the remaining processes. The main distinguishing factors among methods included the longer time needed to prepare for and implement the survey for the Standard 24HR method, the smaller staff needs for the Simplified 24HR method, which partly reflected the shorter time to complete a single interview and the relative ease of data entry compared to the Standard 24HR method, the lower burden to the respondent for the Simplified 24HR method, and the higher data management requirements for the Standard 24HR.

The requirements for the SQ-FFQ tended to be intermediate to the two 24HR methods, but had the advantage of generating data that is very rapid to enter and with a relatively lower requirement for data management, and using a method that is conceptually somewhat less demanding than the 24HR methods, reducing somewhat the overall needs for planning, coordination and management. Notably, the time required to complete a single interview, and hence the number of interviews that can be completed per day, were the same for the SQ-FFQ and the Standard 24HR method.

Table 15a. Summary of technical requirements for input data collection (food listing and portion size estimation)*

Technical category	Food listing		Portion size estimation	
	Rating	Description	Rating	Description
Overall planning, coordination& management	Moderate	Previous knowledge of local foods/diets is helpful; much time was spent in establishing the interview structure and data collection approach; if no previous experience, 2 days of training/orientation are suggested for coordinators to fully grasp the intended use and approach.	Moderate	Good working knowledge of local foods and how they are prepared & consumed is recommended. Logistics, supplies, field coordination and budget for data collection are complex due to the large number of foods, enumerators, and participants to organize.
Specific skills/tasks	Moderate	• A Master's degree in Nutrition is preferred for coordination. • Good organizational and data management skills are needed to compile, summarize and interpret the data.	Moderate	• A Master's degree in Nutrition is preferred for coordination. • Includes the need to address and manage other data in detail to ensure accuracy (i.e., dealing with waste factors). • Good organizational and data management skills are needed to compile, process, and summarize the data.
Time to prepare, implement & process data	Low	Approximately 8 days in total if previously defined tools are used: train for KIs (1 day), review KI data and prepare for FGDs (1 day); entry and summarization of data (2 days); translation of data for other input data collection tools (2 days).	Moderate - High	Approximately 17 days: Tool preparation & supervisor training (3 days); preparation for enumerator training and field logistics (3 days); enumerator training (1 day); data collection, including waste factor data (5 days); data entry, cleaning, summarizing, linking to FCT and recipe data (5 days) .
Staffing*	Low	2 Project Coordinators; 4 enumerators.	Moderate	2 Project Coordinators; 4 Supervisors; 18 enumerators; 8 local assistants; 1 community mobilizer.

Technical category	Food listing		Portion size estimation	
	Rating	Description	Rating	Description
Qualification of enumerators	Low-Moderate	Good interview skills and experience required to ensure all details are covered and to get through the information in a reasonable time.	Low	Some interview and recording skills required. Recorders must be proficient in use of electronic scales. Bachelors level training recommended / secondary school training acceptable.
Average duration of an interview	Moderate	2-3 hours each for KIs and FGDs.	Low	20 minutes per respondent for 5 foods.
Recommended number of interviews per day	Moderate	Two interviews completed per day - interviewers working in pairs.	Low	28 interviews completed per interviewer/recorder pair; more could be completed in one day, but must consider the additional logistics (preparation / coordination) of adding more foods in a single day.
Burden to participant	Moderate	Interviews are lengthy but require few participants.	Low	Interviews are rapid and easy for participants to respond.
Data management (entry, processing, summarizing)	Low-Moderate	Data can be entered and managed using basic spreadsheets; several spreadsheets are required with lots of details.	Low-Moderate	Data can be managed in a spreadsheet or with basic statistical software; the data to be entered are very basic; basic math skills needed to summarize results.

*The staffing will be proportionate to the size of the survey, particularly whether it covers geographies with different food availability, and the number of unique foods or recipes that are likely to be consumed. The present survey was done in a relatively homogenous population with regard to food availability so only one set of data collection for each activity was needed.

Table 15b. Summary of technical requirements for input data collection (simplified and reference standard recipe data).

Technical category	Simplified standard recipes		Reference standard recipes	
	Rating	Description	Rating	Description
Overall planning, coordination& management	Moderate	Previous knowledge of food preparation and recipe data collection is helpful - a good conceptual understanding is helpful to address potential errors and assist data processing. Logistics, supplies, field coordination and budget are moderately complex given the foods required but less than for portion size estimation.	Moderate	Previous knowledge of food preparation and recipe data collection is helpful to carry out the data collection effectively and thoroughly. Logistics, supplies, and coordination of data collection is moderately complex. It is a smaller, but more intense exercise than the simplified standard recipe data collection
Specific skills/tasks	Moderate	• A Master's degree in Nutrition is preferred for coordination. • Includes the need to address and manage other data in detail to ensure accuracy (i.e., dealing with waste factors). • Good organizational and data management skills are needed to compile, process, and summarize the data.	Moderate	• A Master's degree in Nutrition is preferred for coordination and execution. • Ability to provide clear instructions to respondents and monitor activities closely. • Ability to manage a database and perform careful calculations using a spreadsheet.
Time to prepare, implement & process data	Moderate	Approximately 14 days: Tool preparation & supervisor training (2 days); preparation for enumerator training and field logistics (3 days); enumerator training (1 day); data collection, including waste factor	Moderate	Approximately 13 days: Protocol and tool preparation, training preparation, budgeting (3 days); training of supervisors/enumerators (1 day); procurement of foods, supplies and community mobilization/coordination (2 days); data collection (3.5 days);

Technical category	Simplified standard recipes		Reference standard recipes	
	Rating	Description	Rating	Description
		data and on-site data entry (4 days); data processing, cleaning and linking to FCT (4 days) .		data entry and cleaning (2 days); data processing (2 days).
Staffing*	Low-Moderate	2 Project Coordinators; 4 Supervisors; 9 enumerators.	Low	1 Project Coordinator, 2 Supervisors; 4 enumerators.
Qualification of enumerators	Low	Some knowledge of food preparation methods ideal. Must have good interview skills and proficient in use of a scale. Bachelors level training recommended / secondary school training acceptable.	Moderate	Some knowledge of food preparation methods ideal. Must be proficient in use of a scale and pay attention to details. Secondary education acceptable but additional training may be required.
Average duration of an interview	Low	15 minutes per respondent for 3 recipes.	Moderate-high	Approximately 4 hours per respondent for 3-4 recipes (varies by complexity and cooking time of the recipe).
Recommended number of interviews per day	Low	8 interviews per enumerator per day. Could be comfortably increased to 12 interviews (3 recipes each) or increase the number of recipes per participant to 5-6.	Moderate	Recipe data collected from 2 groups of 5 participants each per day.
Burden to participant	Low	Interviews are rapid and easy for participants to respond.	Low	While participation time can be lengthy, 3-4 recipes per respondent was manageable; as a practical exercise and being able to take cooked food home, participation was not perceived as burdensome.
Data management (entry, processing, summarizing)	Low-Moderate	Data can be entered with basic survey software; data processing and cleaning requires attention to detail and care in dealing with gram weight conversion factors, waste factors, and linking to FCT values.	Low-Moderate	Data entry is very simple and rapid, with only basic skills and orientation required; data processing needs more careful attention and requires a good understanding of recipe calculations and how they are to be used.

Table 16. Summary of technical requirements for the Standard 24HR, Simplified 24HR and SQ-FFQ surveys*

Technical category	Simplified 24HR		SQ-FFQ		Standard 24HR	
	Rating	Description	Rating	Description	Rating	Description
Overall planning, coordination& management	Moderate -High	Previous experience with 24HR methods would be ideal; the protocol is more straight forward/limited in scope than for the Standard 24HR; Previous knowledge of local foods/diets is helpful; if no previous 24HR experience, 2 days of training/orientation are suggested for coordinators to fully grasp the method.	Moderate	If starting with an established protocol and reliable food listing/recipe data, this method is relatively straight forward to manage; Good working knowledge of local foods and how they are prepared & consumed is still recommended.	Moderate -High	The general protocol development is relatively straight forward if using existing tools/methods; the complexity arises in managing the locally adapted details of data collection, ensuring good interview skills, data capture, and logistics for equipment procurement and training for their use. Considerable experience is required to oversee all aspects of a Standard 24HR
Specific skills/tasks	Moderate	A Master's degree in Nutrition or Bachelor's degree with previous dietary survey management experience is preferred for coordination; In particular, the importance of training for thorough probing and good interview skills are needed; Good organizational and data management skills are needed to compile, summarize and interpret the data.	Moderate	A Bachelor's degree or higher is preferred, with nutrition survey experience for coordination. Good interview skills must be imparted and working with supervisors / enumerators to word questions carefully Data management skills or external support will be needed as tailored software is not available for data entry or processing.	Low-Moderate	A Master's degree in Nutrition is preferred for coordination.; Either previous experience or intermittent training/back up is needed for a good outcome. In addition to good organizational and management skills, and training skills for interview techniques, also need to be able to manage a high degree of detailed data and calculations

Technical category	Simplified 24HR		SQ-FFQ		Standard 24HR	
	Rating	Description	Rating	Description	Rating	Description
Time to prepare, implement & process data†	Moderate	Approximately 20 days if supervisors have some dietary survey experience: tool preparation and training of supervisors (3 days); field logistics (1 day); enumerator training / piloting, review (5 days); data collection (3 days); duplicate data entry, cleaning (4 days); data summary and basic analysis (1 day).	Moderate	A minimum of 20 days: tool preparation & supervisor training (3 days); field logistics (1 day); enumerator training / piloting (3 days); data collection (6 days); duplicate data entry, initial cleaning (3 days); data processing, summarizing, linking to FCT and recipe data (3 days); data summary and basic analysis (1 day) .	Moderate - High	Approximately 27 days: Adapt data collection tools & supervisor training (5 days); enumerator training / piloting (10 days); field logistics (1 day); data collection (4 days); duplicate data entry, processing, initial cleaning (4 days); data processing, summary and basic analysis (3 days).
Staffing	Low-Moderate	2 Project Coordinators; 1 supervisor; 3 enumerators; 1 community mobilizer / participant trainer.	Moderate	2 Project Coordinators; 1 supervisor; 4 enumerators; 1 community mobilizer.	Moderate	2 Project Coordinators; 2 supervisors; 6 enumerators; 1 community mobilizer / participant trainer.
Qualification of enumerators	Moderate	Some survey experience and good interview skills are required; Post-secondary / post-graduate education with field experience preferred; Lower qualifications are acceptable but additional practical training may be required.	Moderate	In-depth nutrition knowledge not required but post-secondary / post-graduate training with previous survey experience preferred.	Moderate	Post-secondary training is preferred, with at least some survey experience; nutrition training preferred but not required, but good knowledge of food preparation methods ideal; need good interview skills, and attention to detail.
Average duration of an interview	Low	24 ± 8 minutes	Moderate -High	59 ± 22 minutes	Moderate -High	56 ± 16 minutes
Number of interviews per day	Low	Maximum 10-12 interviews per enumerator per day	Moderate	4-5 interviews per enumerator per day	Moderate	4-5 interviews per enumerator per day

Technical category	Simplified 24HR		SQ-FFQ		Standard 24HR	
	Rating	Description	Rating	Description	Rating	Description
Burden to participant	Low	Interviews are relatively brief and easy for the participant to respond to. The use of the food photo atlas for portion size estimation and lack of need for recipe data contribute.	Moderate	Interviews are moderately long. The questions are not challenging but all foods on the list must be covered in the first pass, and some recall is required for the consumed foods.	Moderate -High	Interviews are moderately long. The questions are fairly detailed, and measurement methods require active participant engagement. Recipe data collection can add to the burden, if there are several.
Data management (entry, processing, summarizing)	Moderate	Data entered using existing specialized software; management of input databases, output files, and validation function requires experience and training to use properly; data entry and input databases more simplistic than for Standard 24HR due to single portion size estimation method and use of standard recipe data only; once the output data files are available, it is easy to complete the basic analysis.	Low-Moderate	The data entry software created for this survey was fairly straight forward and, given that this uses a closed list of foods, the data actually entered were extremely basic; however, skill is needed to process the data, and link it to input databases given the lack of specialized software; once the main output file is available, it is easy to complete the basic analysis.	High	Data entered using existing specialized software; data entry requires special care and ideally is done by enumerators; familiarity with the foods, necessary details, and portion size estimation methods is helpful to ensure correct data entry; updating of input databases is required as new foods can emerge and need to be added; once output files are available, it is easy to complete the basic analysis.
Time required to enter data for one participant	Moderate	10-15 minutes	Low	5 minutes	Moderate -High	15-30 minutes

*Descriptions and rankings for this section are independent of the input data collection requirements (Table 15).

†The time to complete tasks is co-dependent on the number of staff, at least to some extent; we used team sizes that were considered manageable and fit logically with the structure and logistics of study area. Some days were adjusted from the actual to account for imbalance in staff members

assigned to each survey method. For all surveys, the sample size was the same (n = 111-115). Does not include time required to prepare input databases from the input data collection activities or the FCT.

4.3. Resource requirements of the input data collection and survey methods

The costs of each survey component are summarized for the input data collection and survey activities, along with the cost of implementing complete stand-alone surveys with each method **Table 17**. A more detailed breakdown of the cost data, by expense category, is given in **Appendix Table 5.2.** Costs of lead consultants (two local and one international) and related travel were considered separately and are not included here as some of the activities were related to research of the comparison study that would not be necessary if a single dietary survey plus basic analysis were to be conducted. Income taxes for field staff were also not included as these amounts are calculated externally and were not available at the time of reporting. The costs presented here should, nonetheless, present a valid relative comparison across activities.

With regard to input data collection for the test methods, the cost of the food listing exercise was low (Table 17), while the cost of the portion size estimation including production of the food photo atlas was relatively high. The cost of the simplified standard recipe data collection was similar to that for the recipe data collected by the reference method, albeit the simplified tool was used to collect just a few more recipes. We could not provide a real cost for the full input data collection needed to support the Standard 24HR method as much of the data related to gram weight conversion factors was already available from previous surveys in the area and it was not practical to collect the same information again for the purposes of costing. We therefore estimated the additional cost of collecting and compiling input data, such as the average weight of food items used in photos (standard or multiple unit sizes) and calibrated volumes, associated edible portion factors, and gram:weight conversion factors for all foods measured using volume, or play dough weights, at US$2,200. This is shown in the 'portion size estimation' category.

With regard to the survey methods (survey activities only), the field expenses for the Standard 24HR method were substantially more costly than for either of the test methods, being more than 2.5 times greater than the SQ-FFQ and nearly 4 times greater than the Simplified 24HR. This was largely accounted for by the higher cost of training enumerators and the cost of data collection (both affected by the larger team size and the greater number of days needed for training and data collection; Table 16). However, after distributing the common costs across surveys and considering the input data activities

associated with each method, the estimated field activity costs of implementing a stand-alone survey for each method was similar. These were all roughly in the range of US$24,000 - 25,000. Although the field survey expenses were lower for the test methods compared to the Standard 24HR method, the main equalizing factor was the cost of the portion size data collection and production of the food photo atlas; other input data collection methods were similar across methods.

Table 17. Summary of costs (US Dollars) for the input data and survey data collection activities by main activity*

Main activity	Cost (US Dollars)†				
	Actual costs by activity	Cost per survey, for shared expenses‡	Cost required to conduct each survey as a stand-alone survey‡		
			Simplified 24HR	SQ-FFQ	Standard 24HR
Survey preparation & cross-cutting costs	7,520	2,507	2,507	2,507	2,507
Household census, listing and sample selection	3,903	2,001	2,001	2,001	2,001
Sensitization/informed consent	1,776	908	908	908	908
Food listing	1,438	1,438	1,438	1,438	1,438
Portion size data collection	8,693				
Food photo atlas production	1,701				
Subtotal for portion size estimation	10,394	10,394	10,394	10,394	(2,200) §
Simplified recipes	4,015	4,015	4,015	4,015	-
Reference recipes	3,883	3,883	-	-	3,883
Simplified 24HR survey	2,912	2,912	2,912	-	-
SQ-FFQ survey	4,280	4,280	-	4,280	-
Standard 24HR survey	11,446	11,446	-	-	11,446
Total			24,174	25,543	24,381

*Does not include the following costs: Cost of 2 local and 1 international coordinator; income taxes applied to all field and office staff; travel expenses for international coordinator.

†Actual expenses were made in Ugandan Shillings; a conversion rate of 3,560 Shillings:1 US Dollar was used.

‡To calculate actual costs to each survey method if these were to be conducted as stand-alone surveys, fixed costs for shared expenses were retained for all surveys while variable costs were evenly divided across the 3 survey methods.

§ The additional cost of collecting and compiling input data for the Standard 24HR method, such as the average weight of food items used in photos (standard or multiple unit sizes) and calibrated volumes, associated edible portion factors, and gram:weight conversion factors for all foods measured using volume, or play dough weights, as existing information previously collected in Uganda for this purpose was largely used to support the Standard 24HR survey.

5. Discussion and summary of results

This study included the practical development and field-testing of alternative methods to the Standard 24HR survey method, that was intended to identify potential simplified approaches to dietary assessment. Two different methodological approaches were tested: one based on a Simplification of the 24HR approach, and another based on a SQ-FFQ method. Much of the focus of the study was on the input data collection methods that could be used to support simplified and complete survey tools and data collection procedures. This study was also somewhat unique in assessing both the technical and resource requirements of each data collection method and their major subcomponents. Each of these aspects of the study were analyzed and assessed together.

5.1 Input data collection

5.1.1 Food listing exercise

The food listing exercise proved to be very useful in establishing the tools used in the test surveys. In the absence of pre-existing dietary survey data, the ranking of the likelihood of foods being consumed was a particularly useful and objective method to determine what foods to include in the data collection tools (i.e., portion size estimation for the food photo atlas, and foods included in the SQ-FFQ listing). The listing of recipes and the ranking of mandatory and optional ingredients was also particularly useful to establish the standard recipe list and data collection. Based on a comparison with the Standard 24HR survey, 91% of all foods recorded in the survey were among those listed and ranked with a low, moderate, or high likelihood of being consumed, with the remaining 9% being among those mentioned but ranked as unlikely to be consumed. The food listing process thus also will have served well to develop a complete food listing for inclusion in the SQ-FFQ and the food photo atlas.

With the exception of a simpler template used by one of the researchers in a previous project, we did not have existing tools or well-described processes available to guide data collection. In future surveys, the preparation time used for this activity may be reduced if the tools used here were made available, as these would then only need to be locally adapted. Ideally, establishing listings of foods consumed by the study population for inclusion in dietary assessment tools is derived from pre-existing dietary intake surveys of the same population, or from a preparatory survey designed for this purpose (Nelson

& Haraldsdóttir, 1998. In the former case, the foods contributing to the majority of energy and nutrient intakes of interest can be determined quantitatively, and minor contributors omitted if desired. However, we designed a more qualitative tool to serve this purpose, as in many settings, such pre-existing, representative information is not available.

In the absence of pre-existing data, various means have been used to derive the foods included in general dietary assessment tools. In the development of national food atlases, cited sources include consultation with households, and/or chefs and food service professionals, use of common and comprehensive local cook books, and other pre-existing compilations from government health services. For example, in Italy, a total of 434 foods and beverages were identified as being typical in the diet through consultation with recipe books and menus in cafeterias and restaurants (Turconi et al., 2005), while in Lebanon, local knowledge of dishes prepared in households and restaurants, and two main recipe books were used (Tueni et al., 2012). In Cameroon, this process included interviews with women in households who were in charge of preparing meals, with chefs in restaurants, and with food vendors (Amougou et al., 2016). In Abu Dhabi, the UK Food Atlas was used as the primary source for their national food atlas, with adjustments made as locally appropriate (Abu Dhabi Food Control Authority, 2014), but the process for the selection of additional local or regional foods was not described. None of these sources provided any details or about the information collected, or the tools used.

While these are relatively low-cost methods, it is not clear how complete and representative they are, and standardized guidelines and defined data collection methods and tools may be useful. The approach used in this study may have been somewhat more systematic than others. If a larger survey were to be done, the food listing would need to be replicated in different geographical areas where food patterns and preparation practices are likely to be different. On a technical level, formal validation of the completeness of this process may not be required but the more thoroughly and carefully it is done, the more like it is to be complete. At a cost of less than US$1500, we consider this a worthwhile investment.

5.1.2 Portion size estimation

We conducted a relatively extensive exercise in determining the distribution of usual portion sizes for inclusion in a food photo atlas. It proved to be one of the more costly activities, totaling over $10,000 when the production of the food photo atlas is included.

The extensive design of the survey was partly due to the lack of a well-defined quantitative process in the published literature, and a full quantitative approach was undertaken. From a technical point of view, a comparison of the portion size estimates derived from the use of the food photo atlas in the Simplified 24HR survey with those derived from the Standard 24HR suggests that this approach likely resulted in the relative underestimation of portion sizes consumed for many foods. This could be related to the quality of the photo atlas and its ability to clearly depict portion sizes and/or to the difficulty among the participants to relate amounts depicted in photographic images of a smaller scale to actual amounts consumed, or in some aspect of the way the enumerators presented the photos or prompted the participants. Further data processing and analysis could be done to compare portion size data using the food photo atlas in the SQ-FFQ to see if a similar trend towards underestimation was also present, but this was beyond the scope of the present project. This stresses the importance of conducting validation studies of food photo atlases to estimate actual portion sizes in these populations.

We chose this simplified method of estimating portion sizes based on a review of the literature and the promising results that were presented with regard to validity, taking note of evidence from some studies that photographs depicting portion sizes produce less error in estimation than other traditional food models (Foster et al., 2009; Thoradeniya et al., 2012; Bernal-Orozco et al., 2013; Kirkpatrick et al,. 2016). Nonetheless, validity does not appear to have been tested in African populations, including of design elements that may affect their validity (e.g., size or scale and number of photos, print *vs.* digital presentation). It is also noteworthy that the validation studies have been conducted in isolated conditions where only portion size estimation was assessed - they were not validated in the 'real-life' context of a dietary assessment survey and this should also be considered.

The work of Foster et al., (2009) with children suggested the importance of the food photo series being inclusive and representative of the range of portion sizes likely to be consumed. We turned to a quantitative survey approach to determine this range in our study, as recommended by others (Nelson and Haraldsdottir, 1998; Foster et al., 2009). However, in the absence of pre-existing survey data, a variety of methods appear to have been used to define portion size ranges. In Abu Dhabi, portion sizes for local or regional foods were deduced by various means, including by direct weighing in households, consulting a local food manual and experts in the catering industry (Abu Dhabi Food

Control Authority, 2014). In Italy, average portion sizes were determined for a food photo atlas using available government dietary reference data (Turconi et al., 2005), although not necessarily representing actual usual amounts consumed. The average was used to represent a 'medium' portion and fixed ratios were estimated by researchers for each food group and applied to the medium portion to derive 'small' and 'large' portion sizes. These initial portion sizes were then field tested with respondents who expressed their opinions on their appropriateness, and adjustments were made as required. In Bolivia, a somewhat more qualitative method was used that included interviews with local families (Lazarte et al., 2012).

In a study to develop a food photo atlas for intake of maize-containing foods in rural Eastern Cape, South Africa, a combination of data and methods was used to derive portion size series (Lombard et al., 2013). These included a previously conducted 24HR survey in the area, previously compiled dietary intake data from other South African surveys, and collection of new data of weighed amounts of usual portion sizes by women in what was termed 'dishing up' sessions. However, no attempt was made to statistically compare the portion sizes derived from the different sources for the same foods or decide which estimates were used preferentially. In Cameroon, portion sizes to depict in a food photo atlas for dietary assessment were derived using a similar 'dishing up' method, whereby women who prepared meals in households and chefs in restaurants were asked to demonstrate typical amounts of various foods served to adults and children (Amougou et al., 2016). These usual serving sizes were weighed and used to develop portion size distributions. The amounts depicted in photos used the mean (medium), mean +1 SD (large) and mean -1 SD (small), and allowed virtual portion size options as well. However, the cost and validity for these portion size data collection approaches has not been determined and standardized protocols are lacking.

It is possible that less formal approaches such as those described above could yield similar information on portion size ranges to depict in a food photo atlas. The primary parameters used to establish the portion sizes depicted were the 5^{th} and 95^{th} percentile of grams consumed, with the intermediate photo sizes determined as equal intervals between those values. It may be feasible to estimate these high and low percentiles through more qualitative means, asking a smaller group of respondents about the smallest and largest portion sizes they are likely to consume. However, this would also need to be validated.

5.1.3 Recipe data collection

In this project, we compared two different methods of collecting standard recipe data - one using a reference method that collects actual weights of ingredients and cooked amounts during cooking trials, and a simplified method that collects similar information using raw ingredient amounts and estimations of cooked amounts, but without doing the actual cooking. While food portion size estimates are often noted as an important source of error in dietary assessment methods, surprisingly little attention has been paid to the error introduced in estimating the proportion of ingredients in mixed dishes. This is perplexing as many of the foods reported in dietary surveys are likely represented by mixed dishes. In contrast to the large number of studies of food portion size estimation, we did not identify any studies attempting to compare or validate different methods of estimating recipe composition.

With regard to technical validity, a comparison of the proportion of ingredients for recipes collected by both methods indicated a high degree of conformity between them for nearly all recipe types. This conformity was confirmed by a similar comparison made on nutrient content (per 100 ml and per 250 ml portion in relation to the EAR). The latter comparison was helpful as percent differences in content can be large, but this may be nutritionally unimportant if the nutrient content is very low or negligible, especially in relation to requirements. This high level of conformity was somewhat surprising considering that: (1) the simplified method includes sources of estimation error, especially for ingredients for which average weights by size were used rather than direct weighing; (2) the total cooked amount was estimated by visual recall, and; (3) both methods include a natural variation in the way individuals prepare a particular recipe. This may be a reflection of the traditional nature of these recipes, and the ability of these experienced cooks to accurately recall and replicate recipes that they prepare on a regular basis, which may be further enhanced by using the same sized cooking pots during these demonstrations as they use at home.

The main food type that proved not to conform well between methods was green leafy vegetables. The proportion of amaranth leaves in a sauce differed by 14 percentage points between methods, and the nutrient content per 250 ml expressed as a percent of the EAR differed by up to 17% for amaranth leaf sauce and up to 138% for nakati/eggplant leaf relish, representing some of the largest differences observed across recipes. It is not clear why this was the case, especially since the amount of fresh leaves used in the simplified

recipe process were weighed directly. However, it may be difficult to gauge amounts of fresh leaves due to their irregular shape and differences in their bulk and the volume they take up depending on how tightly or loosely they are packed. Further, the amount of waste (stems and fibers) removed from leaves may also be variable, and weights can be affected by water content (e.g., if the surface of leaves are wet from washing when weighed, or if they are wilted through dehydration). Recipe data collection by either method may do better to control for these variables to improve estimates.

Some of the other notable differences in proportion of ingredients determined by these two methods were for other bulky, irregularly shaped items such as cassava and plantain. In the simplified method these were available in the raw, peeled form and were weighed directly on a scale, just as they were in the reference method. Some of the difficulty may lie in the ability to judge the total cooked amount for dishes that contain bulky food items and that may not be level across the surface.

Beef soup also did not conform well between recipe methods and this can be attributed to two methodological issues. First, in the simplified recipe data collection, because beef soup is made with beef, but we require the recipe of just the liquid fraction, it is difficult to estimate the total cooked amount of broth while mentally subtracting the volume contributed by the beef. In the standard recipe data collection, the beef was physically removed from the pot before weighing. Second, in both methods, the proportion of broth shown as an ingredient was calculated as the difference between 1.0 and the proportion of all other ingredients, which may also introduce some degree of error. Despite the dilute nature of the soup, when expressed on a nutrient content basis the differences between methods were still substantial for two nutrients (vitamin C and vitamin A).

The comparison between methods was informative and the generally high degree of conformity for most ingredient/recipe types is encouraging for the likely validity of the simplified method as an alternative approach to standard recipe data collection. Direct validation studies, such as by having participants prepare a standard recipe one day with weighed ingredients and total cooked amounts, and then testing their ability to accurately recall these amounts using the simplified method on the following day, could also be considered, especially if methods to improve estimation of challenging ingredients/recipes by the simplified method were developed. However, the technical and resource requirements for this approach need also be considered.

The simplified method of recipe data collection was less burdensome for the respondents as approximately only 15-20 minutes of their time was needed to cover 3 recipes each, whereas for the reference method, participants were engaged for a half day to prepare 4 recipes and the requirements for their participation were more involved. The simplified method did, however, require a larger number of respondents and enumerators to carry it out (i.e., 120 participants vs 70 for the reference method; Table 5), but this could be greatly reduced by increasing the number of recipes recalled by each respondent to 6. Both methods required significant preparation to determine the ingredients required and the procurement amounts. However, the simplified approach had the additional requirement of collecting average weights and edible portion data for several ingredients, adding another half to one day of work of data collection. The total budget for each method was virtually the same - nearly $US4000 (Table 19).

Overall, while the simplified recipe data collection may be a technically viable alternative for most recipes and be less burdensome for participants and enumerators, when considering all of the requirements to implement data collection, there may be little advantage of using this approach in practice compared to the reference method. A decision may thus be determined based on the preference of survey coordinators and the skills of available enumerators.

5.2 Dietary survey results

Of the two modified methods developed and field tested here, the SQ-FFQ produced similar results with respect to mean energy and nutrient intakes, the identification of nutrients with a mean <100% of the EAR, and the percentage of individuals with intakes <100% of the EAR, as the Standard 24HR method. In contrast, the Simplified 24HR method did not perform well against the Standard 24HR as it systematically underestimated energy and nutrient intakes, and identified a much larger number of nutrients with a mean less than the EAR. With regard to the identification of food sources of nutrients providing >5% of the EAR the Simplified 24HR identified fewer foods than the Standard 24HR method but there was a high concordance in the ones that it did identify. The SQ-FFQ method tended to identify a larger number of foods meeting this criteria for several nutrients, and did not always identify the same foods as the Standard 24HR method.

It is not clear why the Simplified 24HR method performed so poorly in estimating energy and nutrient intakes. The method was intended to use the same degree of prompting and interview techniques as the Standard 24HR method, but just recording fewer details about foods and recipes and using only the food photo atlas for estimating portion sizes. The difference is unlikely attributed to the difference in source of recipe data as these were quite comparable for most recipes with regard to proportion of ingredients (Table 7), as noted above. An examination of the estimated portion sizes for specific food items, and the frequency with which they were reported, suggests that the Simplified 24HR method underestimated intakes in both of these areas. Therefore, to some extent, the food photo atlas may have influenced participants to choose smaller portion sizes compared to the more dynamic portion size estimation methods used in the Standard 24HR method. And to some extent, the survey format did not support the drawing out of complete detailed information on all foods consumed. It may be that the simplification of process gave the enumerators a sense that this was a rapid survey method and stimulated less discussion and rapport with the respondents.

Also of consideration is that although participants received some preparation on the day before the survey, it was less extensive and did not include use of a picture chart for participants to track foods consumed on the day of recall. While the effect of these training sessions and use of the picture chart on outcomes of 24HR dietary surveys does not appear to have been formally tested, it may be that participants are more aware of what they are eating, particularly when using the picture chart, and thus may be less likely to omit foods consumed.

SQ-FFQ methods can sometimes result in overestimation of dietary intakes compared to reference methods (Coates et al., 1997; Ortiz-Andrellucchi et al., 2009; Burrows et al., 2010) but this will depend greatly on the population of study, the design of the questionnaire, and the nutrient of interest. However, this trend was not apparent in this study, with generally similar intake estimates produced. Generally, SQ-FFQ methods that allow participants to select portion sizes tend to compare better against reference methods than those that assume a single portion size (Cade et al., 2002).

An examination of the foods noted in the SQ-FFQ method suggests that there was a greater variety of fruits and vegetables in particular reported in this method, which is expected given that it covers intakes over 7 days, and this may be one reason why the

identification of food sources of nutrients differed to some extent from those identified by the Standard 24HR method.

In practice, the SQ-FFQ method tested here could be a useful adjunct to the current FACT surveys where the objectives of the survey include assessment of energy and a broader range of nutrient intakes from all foods. The additional resource and technical requirements to do so would need to be taken into account. The results observed in this study suggest it may be a viable approach. However, validation in different settings with different dietary patterns would be useful.

5.2.1 Use of an SFGCT to estimate nutrient intakes and relative adequacy

The condensed SFGCT did not perform well compared to the Standard FCT used and resulted in a large and systematic over-estimation of energy and nutrient intakes. The concept of testing a condensed FCT was intended to provide a simple, readily available tool that users with limited or no experience in dietary assessment or FCT compilation could apply. FCT data can be a major limitation for dietary surveys given that few national or regional tables are available, and even these often contain gaps or data for a limited number of nutrients.

Several considerations were made in developing this SFGCT to make it simple but minimizing variation in nutrient content represented by the average values. We chose to use the Optifood FCT for African foods, as this is a recent compilation and the use of regionally appropriate data would limit the number of foods included that are never consumed in this population. However, the foods that are included may still be somewhat limited and do not necessarily include all relevant food items. Also, to improve applicability of the condensed FCT data, we saw the need to produce two categories for some food sub-groups as the nutrient content for raw, uncooked versions of foods (such as flour) is very different from cooked forms of that food (such as porridge). One of the main limitations of this approach, however, was that some of the food sub-groups had a limited number of foods contributing to the average nutrient content for the sub-group, particularly after separating out the 'raw only' foods from the 'as-eaten' foods. Despite these efforts to make a condensed FCT that is useful, the results suggest that this is not a good alternative for unfamiliar users. Having access to a comprehensive, public database with regionally relevant foods, such as the one produced for Optifood, may be a better option.

5.3 Technical and resource requirements for the test and reference survey methods

Our assessment of the technical requirements graded the three survey methods somewhat differently, with the least complex being the Simplified 24HR method, and the most complex being the Standard 24HR, with the SQ-FFQ being intermediate to the two. These categorizations are somewhat subjective, but took into account the level of technical skill, complexity of tasks, time required, and staffing required to complete the survey data collection. When considering only the field survey data collection activities, the actual costs indicated the same trend, lending some support to our rankings of technical requirements.

However, when considering the addition of the input data collection activities, the overall costs were virtually equalized across the three methods, all being within the range of US$24,000 - 25,000 for field costs. As the costs of the food listing exercise were considered as the same for all three methods, and the cost of the simplified recipe data collection was nearly the same as the reference recipe data collection, the major difference was in the cost of the portion size estimation activity, including production of the food photo atlas. This activity used a thorough, quantitative survey approach to determining the distribution of portion sizes likely to be encountered in the study population. As noted in the discussion above, if a somewhat less quantitative method were shown to result in a similar range of portion sizes (marking only the lowest and highest portion sizes likely to be observed), the technical and resource requirements of data collection could be significantly reduced.

5.4 Limitations

There are several limitations of this study that require consideration. First, the consultants leading this project have fairly extensive experience in conducting dietary assessment surveys, including the selected study population, and the field supervisors were also experienced individuals with Master degrees in nutrition. While we tried to assess the technical requirements as objectively as possible, it is recognized that in many settings, this level of experience will not be available. Second, the input data collection methods designed and tested here represent more quantitative options. It was beyond the scope of this study to test a wider range of methods, including more qualitative approaches, that may have had lower resource and technical requirements. These could be explored

in future studies. Third, the rankings of technical requirements should thus be viewed as 'relative' across the activities evaluated. The costing presented here represents only the field implementation costs, converted from local currency to US Dollars; we did not attempt to factor in local income taxes or contract value of the project coordinators; some of the latter costs were related to other components of the study besides the data collection activities themselves, including the design process of the tools, comparison of resource and technical requirements, and comparison analyses across methods. However, the expenses summarized here provide a good direct relative costing for the three survey methods.

5.5 Summary

In summary, this study resulted in the identification and design of two possible alternative approaches to dietary data collection to inform the design of food-based nutrition programs and generate key outcome variables including the mean/median energy and nutrient intakes, mean nutrient intake as a percent of the EAR, the percentage of individuals with intakes below the EAR, and the foods that provide >5% of the EAR, for selected nutrients.

The results of the dietary surveys indicate a relatively high level of conformity between the Standard 24HR method and the SQ-FFQ method, particularly with respect to the mean energy and nutrient intakes, and identification of nutrients with a mean/median <100% of the EAR, and the percentage of individuals with intakes below the EAR. Less conformity was found in identifying specific foods contributing >5% of the EAR, although this is likely attributed at least in part to the longer recall period inherent in the SQ-FFQ method.

In contrast the Simplified 24HR method resulted in a substantial, systematic underestimation of energy and nutrient intakes, with low conformity for the key outcome indicators. It is not entirely clear why this occurred but appears to be a combination of lower portion size estimations and less frequent mention of foods consumed; both may be related to interview skills and degree of probing employed by the enumerators suggesting that more in-depth training on these aspects would be required to improve the method. It is not clear whether the food photo atlas functioned well in this population; additional studies would be useful to validate this approach in these types of populations as it has been in other settings, and to improve the design of the atlas.

Our attempt to develop a food composition table representing average nutrient contents for food subgroups resulted in relatively large, significant differences in nutrient intake estimates when substituted for a standard FCT. This approach does not appear likely to be a viable option to simplify the resource burden of dietary data collection. Rather, it may be advisable to produce regionally relevant and complete FCTs, following FAO guidelines, that are freely accessible to users.

While the cost of survey field data collection was substantially lower for the two test methods, particularly for the Simplified 24HR method, the total cost of implementing these methods was equalized by the cost of the portion size estimation input data activity. If a less quantitative approach to portion size estimation were validated, the total cost, and technical burden, of implementing these alternative dietary assessment approaches would be much lower in comparison to the Standard 24HR method, as conducted in this setting.

Based on the present findings and methodological approaches adopted in this study, the selection of either the SQ-FFQ method or the Standard 24HR may result in similar key outcomes; given the relatively similar costs, the main decision factors may include the technical expertise available in-country, preference and perhaps previous experience of the survey coordinators, and other survey co-objectives that might make one method more appropriate than the other. Any future reduction of the cost of valid, portion size estimation methods would make the SQ-FFFQ a more favorable option.

6. Recommendations

- The food listing exercise implemented here for all three survey methods proved to be useful, and efforts to share the methodology, data collection tools and process may be helpful for others planning dietary assessment surveys where pre-existing dietary intake data is not available. For the SQ-FFQ method that uses a closed list of foods, this is a critical process to ensure that only limited foods are missed, while for the 24HR methods, the process is likely to help in the preparation of tools and methods without needing to go back to the field to collect additional recipe data or conversion factors after the survey is completed.

- While some studies have suggested that food photo atlases provide a valid tool for estimating food intake portion sizes in some settings, the validity of these tools merits testing in populations that may be less 'photo-literate'.
- The method used here for quantitatively determining the distribution of portion sizes to depict in the food photo atlas was relatively extensive and costly, other methods described in the literature were more subjective in nature, or not well defined. Testing the validity of more qualitative approaches to determining an appropriate range of portion sizes to depict would be useful, including through interactive focus group interviews, to simplify this process, and reduce the technical and resource burden.
- The simplified standard recipe data collection could be recommended as an option to support future surveys as it performed very well against the reference method. While there was no strong advantage in terms of time or cost, compared to the reference method, it may be technically less challenging for some.
- Some further consideration of the Simplified 24HR method may be warranted to clarify why it underperformed in this study. The method was technically much more simple to implement in the field, and could be significantly less costly and time consuming than the Standard 24HR approach if the portion size estimation exercise is simplified.
- The SQ-FFQ method could be considered as an adjunct to the current FACT surveys if objectives extend beyond assessment of fortified or fortifiable foods alone. The additional time burden of extending the tools and the interview time would require consideration for each survey. However, the results observed in the study suggest it may be a viable approach. Further validation in different settings is warranted.
- While the SGFCT tested here did not perform well, it would be helpful to compile more comprehensive, regionally representative FCTs for users to access. The approach used in compiling the Optifood FCT for African foods is a good example, but this would need to be updated to conform to the Food and Agricultural Organization standards.

7. Literature Cited

Aaron GJ, Friesen VM, Jungjohann S, Garrett GS, Neufeld LM, Myatt M. Coverage of large-scale food fortification of edible oil, wheat flour, and maize flour varies greatly by vehicle and country but is consistently lower among the most vulnerable: results from coverage surveys in 8 countries. J Nutr 147: 984S-994S; 2017.

Abu Dhabi Food Control Authority. A photographic atlas of food portions for the Emirate of Abu Dhabi. User's guide. Abu Dhabi: ADFCA; 2014.

Amougou N, Cohen E, Mbala ML, Grosdidier B, Bernard JY, Said-Mohamed R, Pasquet P. Development and validation of two food portion photograph books to assess dietary intake among adults and children in Central Africa. Br J Nutr 115:895-902; 2016.

Bernal-Orozco M, Vizmanos-Lamotte B, Rodriguez-Rocha NP, Macedo-Ojeda G, Orozco-Valerio M, Roville-Sausse F, Leon-Estrada S, Marquez-Sandoval F, Fernandez-Ballart JD. Validation of a Mexican food photgraph album as a tool to visually estimate food amounts in adolescents. Br J Nutr 109:944-952; 2013.

Block G, Hartman AM, Naughton D. A reduced dietary questionnaire: Development and validation. Epidemio 1: 58-64; 1990.

Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. J Am Diet Assoc 110:1501-1510; 2010.

Cade J, Thompson R, Burley V, Warm D. Development, validation and utilisation of food-frequency questionnaires - a review. Pub Health Nutr 5: 567-587; 2002.

Coates J, Colaiezzi B, Fiedler JL, Wirth J, Lividini K, Rogers B. A program needs-driven approach to selecting dietary assessment methods for decision-making in food fortification programs. Food Nutr Bull 33 (Suppl 3): S146-S156; 2012.

Coates J, Colaiezzi B, Bell W, Gibson RS. INDDEX priority technical criteria and review of technology-assisted 24-hour recall software programs. Boston: INDDEX project; 2016.

Coates RJ, Noteilh CP. Assessments of food frequency questionnaires in minority populations. Am J Clin Nutr 65 (4 Suppl): 1108S-1115S; 1997.

De Pee S, Halati S, Bloem MW, and the 24-VASQ development team. 24 VASQ method for estimating vitamin A intake. Jakarta, HKI Asia Pacific; Draft report, January 2006.

Fiedler JL, Martin-Prevel Y, Moursi M. Relative costs of 24-hour recall and Household Consumption and Expenditures Surveys for nutrition analysis. Food Nutr Bull 34:318-330; 2013.

Food and Nutrition Board [FNB], Institute of Medicine [IOM]. Dietary Reference Intakes: Applications in dietary assessment. Washington DC: Institute of Medicine; 2000.

Food and Nutrition Board [FNB], Institute of Medicine [IOM]. Dietary Reference Intakes for Vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington DC: Institute of Medicine; 2001.

Foster E, Adamson AJ, Anderson AS, Barton KL, Wrieden WL. Estimation of portion size in children's dietary assessment: lessons learnt. Eur J Clin Nutr 63:S45-S49; 2009.

Gibson RS. Principles of nutritional assessment. Second edition. New York: Oxford University Press; 2005.

Gibson RS, Ferguson EL, An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries. Washington DC: ILSI Press; 1999.

Hotz C, Lubowa A, Sison C, Moursi M, Loechl C. A food composition table for central and eastern Uganda. HarvestPlus Technical Monograph Series, No. 9. Washington DC & Cali: IFPRI and CIAT; 2012.

Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. Rome: FAO; 2010.

Kirkpatrick SI, Potischman N, Dodd KW, Douglass D, Zimmerman TP, Kahle LL, Thompson FE, George SM, Subar AF. The use of digital images in 24-hour recalls may lead to less misestimation of portion size compared with traditional interviewer-administered recalls. J Nutr 146:2567-2573; 2016.

Kristal AR, Peters U, Potter JD. Is it time to abandon the food frequency questionnaire? Cancer Epidemio Biomarkers Prev 14:2826-2828; 2005.

Lazarte CE, Encinas ME, Alegre C, Granfeldt Y. Validation of digital photographs, as a tool in 24-h recall, for the improvement of dietary assessment among rural populations in developing countries. Nutr J 11:61; 2012. http://www.nutritionj.com/content/11/1/61

Lombard M, Steyn N, Burger H-M, Charlton K, Senekal M. A Food Photograph Series for Identifying Portion Sizes of Culturally Specific Dishes in Rural Areas with High Incidence of Oesophageal Cancer. Nutrients *5*:3118-3130; 2013.

Nelson M, Haraldsdóttir J. Food photographs: practical guidelines II. Development and use of photographic atlases for assessing food portion size. Publ Health Nutr 4:231-237;1998.

Ortiz-Andrellucchi A, Doreste-Alonso J, Sanchez-Henriquez P, Cetin I, Serra-Majem L. Dietary assessment methods for micronutrient intake in pregnant women: a systematic review. Br J Nutr 102 (Suppl 1): S64-S86; 2009.

Slimani N, FerrariP, Ocke M, Welch A, Boeing H, van Liere M, Pala V, Amiano P, Lagiou A, Mattisson I, Stripp C, Engeset D, Charrondiere R, Buzzard M, van Staveren W, Riboli E. Standardization of the 24-hour diet recall calibration method used in the European Prospective Investigation into Cancer and Nutrition (EPIC): general concepts and preliminary results. Eur J Clin Nutr 54:900-917; 2000.

Thoradeniya T, de Silva A, Arambepola C, Atukorala S, Lanerolle P. Portion size estimation aids for Asian foods. J Hum Nutr Diet 25:497-504; 2012.

Tueni M, Mounayar A, Birlouez-Aragon I. Development and evaluation of a photographic atlas as a tool for dietary assessment studies in Middle East cultures. Pub Health Nutr 15:1023-1028; 2012.

Turconi G, Guarcello M, Gigli Berzolari F, Carolei A, Bazzano R, Roggi C. An evaluation of a colour food photography atlas as a tool for quantifying food portion sizes in epidemiological dietary surveys. Eur J Clin Nutr 59:923-931; 2005.

Wrieden W, Peace H, Armstrong J, Barton J. A short review of dietary assessment methods used in national and Scottish research studies. Briefing paper prepared for: Working Group on Monitoring Scottish Dietary Targets Workshop; September, 2003.

8. Appendices

Appendix 1: Survey Sample

Appendix Table 1.1. Summary of sample selection, by parish, from Mukono District, Nakasunga Sub-County, Uganda.

Parish name	Parish code	EA name	EA code	Eligible women per EA	Selected women per EA
Kyetume	1	Bukasa 'A'	11	84	38
		Kazinga 'B' + 'A'	12	67	31
		Lufunve 'A'	13	45	15
Namayiba	2	Katuba Mawa 'C'	21	59	40
		Namaiba 'D'	22	36	25
		Kakuba	23	29	19
Namuyenje	3	Nangwa 'C'	31	80	34
		Namuyenje 'B'	32	61	24
		Nangwa 'B'	33	65	26
Seeta Nazigo	4	Kavule 'A' + 'B'	41	66	28
		Kitebe Namaliga 'A' + "B'	42	58	30
		Makata 'A' + 'B'	43	56	26
	4		***12***	***706***	***336***

Appendix 2: Configuration of the FSGCT

Appendix Table 2.1. Food groups and food subgroups used for the condensed FSGCT

Food group code	Food group short name	Food group full name	Food sub-group code	Food sub-group
1	Primary grains	Primary staple grains & products[1]	101	Whole grains and products
			102	Refined grains and products
			103	Enriched/fortified grains and products
			104	Grain/grain product porridges - unenriched/unfortified
			105	Grain/grain product porridges - enriched/fortified
			106	Whole-grain bread - enriched or unenriched
			107	Refined grain bread - enriched or unenriched
2	Secondary grains	Secondary grain products[2]	201	Ready-to-eat (RTE) cereals
			202	Pancakes, waffles, scones, crackers
3	Roots	Starchy roots & other starchy plant foods[3]	301	Vitamin A-rich starchy plant foods
			302	Vitamin C-rich starchy plant foods
			303	Other starchy plant foods
			304	Starchy root/plant food porridges
4	Legumes	Legumes, nuts & seeds	401	Cooked beans, lentils, peas
			402	Soybeans and products[4]
			403	Nuts, seeds, and unsweetened products[5]
5	Dairy	Dairy products[5]	501	Fluid or powdered milk - non-fortified
			502	Flavored milk - non-fortified
			503	Fluid or powdered milk – fortified
			504	Infant formula – fortified
			505	Yoghurt, solid and drinkable
			506	Cheese
			507	Cream/sour cream
			508	Other dairy excluding butter
6	Meats	Meat, fish & eggs	601	Red meat (beef, game meat, goat, lamb, rodents)
			602	Pork
			603	Poultry/rabbit
			604	Eggs
			605	Processed meat (sausages, ham, bacon, balls)
			606	Fish without bones

			607	Small, whole, fish with bones
			608	Seafood (shrimp, clam, oyster, lobster)
			609	Organ meats (kidney, liver, heart, gizzard)
			610	Insects, grubs
			611	Blood, blood sausage
			612	Other animal parts (feet, intestines, lungs, skin, tripe)
			613	Reptiles (snakes, frogs, turtles)
7	Fruits	Fruits	701	Vitamin A-rich fruits[7]
			702	Vitamin C-rich fruits[8]
			703	Other fruits[9]
8	Vegetables	Vegetables	801	Vitamin A-rich vegetables[7]
			802	Vitamin C-rich vegetables[8]
			803	Other vegetables[10]
9	Fats	Added fats	901	Vegetable oil – non-fortified
			902	Red palm oil
			903	Vegetable oil – fortified
			904	Butter/ghee/ margarine – non-fortified
			905	Margarine – fortified
			906	Other added fats (animal fats)
10	Sugars	Added sugars	1001	Sugar - non-fortified
			1002	Sugar – fortified
			1003	Honey, syrup, nectars
11	Sweets	Sweetened snacks & desserts	1101	Sweet snack foods (candy, chocolate)
			1102	Sweetened bakery products (cookies, fritters, cakes, doughnuts, sweet breads)
			1103	Sweetened dairy products/desserts (flan, custard, sweetened yogurt)
			1104	Sweetened legume/nut/seed products (sweet press cakes, halawa, sugar-coated nuts)
			1105	Other sweetened desserts (gelatin, non-dairy ice)
12	Beverages	Beverages (non-dairy or blended dairy)	1201	Brewed tea, herbal infusions (with or without sugar or milk)
			1202	Brewed coffee (with or without added milk or sugar)
			1203	Chocolate beverage or powdered mix – non-dairy
			1204	Alcoholic beverages

			1205	Juices - pure [11]
			1206	Soda/sweetened beverages (includes diluted, sweetened, or artificial juices)
			1207	Beverage or powder mix – fortified
			1208	Other unsweetened beverages (includes diet beverages, soy milk, coconut water)
			1209	Cereal-based beverages – non-alcoholic (atoles with or without added milk, fermented or unfermented cereal-based drinks)
			1210	Fruit/dairy-containing blended beverages (smoothies, licuados)
13	Miscellaneous	Miscellaneous	1301	Condiments, herbs, spices[12]
			1302	Savory snacks – salted, spiced, fried (potato and tortilla chips, popcorn)
			1303	Savory spreads, sauces, pastes, salad dressings, pickles[13]
			1304	Sweet sauces, jams, pastes and spreads
			1306	Other miscellaneous[14]
14	Composites	Composites (mixed food groups)[15]	1401	Main meal recipes
			1402	Grain products with filling (burgers, empanadas, enchiladas, sandwiches)
			1403	Salads with mixed food groups
			1404	Soups
			1405	Broths
			1406	Other composites
15	Fortified	Fortified foods (targeted)	1501	Sprinkles
			1502	Lipid-based Nutrient Supplement
			1503	Fortified biscuits

Appendix 3: Guides and Questionnaires used for Input Data Collection

Appendix 3.1. Data collection forms for food listing interviews - focus group discussions (foods and recipes)

Appendix 3.2. Data collection form used for portion size estimation (example from Day 1)

Appendix 3.3. Data collection form used for simplified standard recipes (example from Day 1)

Appendix 3.4. Standard 24HR data collection forms

Appendix 3.5. Simplified 24HR data collection forms

Appendix 3.6. SQFFQ data collection form

Appendix 3.1. Data collection forms for food listing interviews - focus group discussions (foods and recipes)

(These forms have been slightly modified from their original format)

DATE: _____ **FGD NUMBER /PARISH:** _____

FOOD GROUP: _____

FOOD NAME: _____

Food variety, form or type		**Is it consumed in FRESH, DRIED, or FLOUR form?**		**CHANCE** food item will be consumed in July 2017	When consumed as a single food, please list all **COOKING METHODS** used	Please list all **MIXED DISHES** and **PRODUCTS** made with this food item	**ADD ANY COMMENTS/CONTEXT**
Pre-fill based on KI data sheet, use extra sheets, confirm/probe for extra foods		Insert "Y" if consumed in that form AND "N' if NOT consumed in that form		1=High; 2=Moderate; 3=Low; 4=Not at all	Raw, boiled, steamed, roasted, deep fried in oil, fermented For flours, indicate **GRADES** of flour	Write the name of the dish or product prepared with this food form	
1		Eaten fresh?					
		Eaten dried?					
		Milled into flour?					
2		Eaten fresh?					
		Eaten dried?					
		Milled into flour?					
4		Eaten fresh?					
		Eaten dried?					

		Milled into flour?					
5		Eaten fresh?					
		Eaten dried?					
		Milled into flour?					
6		Eaten fresh?					
		Eaten dried?					
		Milled into flour?					

MIXED DISHES PREPARED WITH FOOD ITEM (Complete Recipe Sheet for each Recipe mentioned*: Example, Mugoyo w/wo beans: Sweet potato (any variety, common beans, tomato, onion, oil*)

Name of Dish	Description of ingredients

DATE: _____ **FGD NUMBER /PARISH:** _____

FOOD GROUP: _____

RECIPE NAME (MAIN INGREDIENT): _____

NAME OF MIXED DISH	**NAME OF INGREDIENT**	**Is this a MAJOR or MINOR ingredient ?**	**FREQUENCY IN DISH**	Probe for states and form of the ingredient before addition to dish		
				Cooking state as added	Added fresh or dried	Processing state
Write the local name or basic description of dish	Ingredient name Please list all possible ingredients in the dish	Major, minor	1=Always; 2=Often; 3=Rare	Raw, boiled, steamed, roasted, fried, fermented	Fresh, dried	Pounded, sliced/diced, dehulled

List the most popular ingredient combinations (*Example: Gnuts flour+beans+tomatoes+onions*)

1	
2	
3	
4	

Appendix 3.2. Data collection form used for portion size estimation (example from Day 1)

DATE OF DATA COLLECTION:		**MAY**	**2017**	**SESSION TIME**	
	DAY	MONTH	YEAR		AM/PM
NAME OF PARISH :					
PARTICIPANT #				**DISHING DAY**	
					(1, 2, 3)
PARTICIPANT'S NAME				**VILLAGE:**	

FOOD #	NAME OF FOOD ITEM, OR MIXED DISH	CONTAINER DESCRIPTION		Weight of food serving (Grams)	Weight record includes Non-Edibe Parts/Waste ?	ADDITIONAL INFORMATION
		Bowl				Examples
		Plate	Small, Large		Y/N	Small, medium large,
		Cup	Pink, clay			Slices, chunks or whole
		Tumbler	Small, large			Waste included seeds, peels or bone
	RECORDER'S NAME:					
	TABLE 1					
1	Fresh Fish Sauce (SOUP ONLY)					
1b	Fresh fish (FLESH ONLY)					
2	Cabbage, fried w/oil					
3	Pawpaw					
4	Sweet potato, yellow, boiled					
5	Chapatti					
6	Biscuits					
	RECORDER'S NAME:					
	TABLE 2					
7	Porridge, millet					
8	Mukene, fried w/oil					
9	Citrus (Oranges/tangerines/lemons)					
10	Groundnuts, roasted					
11	Fiya 23, raw, ripe					
	RECORDER'S NAME:					
	TABLE 3					
12	Nakati leaf, stir-fried					
13	Tomato sauce					
14	Mango - (w/skin, wo/skin)					
15	Katogo Cassava, w/Beans					
16	Millet bread (Millet/Cassava blend)					

Appendix 3.3. Data collection form used for simplified standard recipes (example from Day 1)

DATE OF COLLECTION	JUNE 2017
PARISH CODE/NAME	
ENUMERATOR CODE/NAME	
SESSION (AM/PM)	
RECIPE NO. / NAME	
WOMAN NO./NAME	

ING. NO.	INGREDIENT NAME	Measurement Method used	Weight of Ingredient (Grams)	NUMBER	SIZE DESCRIPTION	NEP included?	NEP Description
	Write name and state of ingredient	Direct Weight (DW) OR Standard size (Size)	Tare and record ONLY weight of Ingredient	Count and record number used	Small, Medium, Large, Uniform	Y/N	Cabbage- Core, Cassava-Strings, Meat-Bones
1							
2							
3							
4							
5							
6							
7							
8							
9							

FINAL VOLUME OF COOKED DISH		
Ask participant to use the saucepan used to prepare the dish, the expected volume of the cooked dish. Use dry rice to determine and record final volume in mililitres	|___|___|___|___|___|	mL

NEP, Non-edible portion

Appendix 3.4. Standard 24HR data collection forms

UGANDA DIETARY METHODS STUDY 2017

MAKERERE UNIVERSITY, GAIN AND USAID

STANDARD 24-HOUR RECALL QUESTIONNAIRE WOMAN 18-49 YEARS

Enumerators

1. Start by introducing the purpose and procedures of the 24 hour recall interview to the respondent as follows

- In this section of the interview, we would like to get information about all **FOODS AND BEVERAGES** that you (the reference woman) consumed during the previous day, YESTERDAY from the time you woke up until the time you finally went to bed at night
- Emphasize that we will be talking about food consumed **ONLY** by you (respondent) but not what was cooked for or consumed by the family
- **Explain and emphasize the importance of reporting both MAIN MEALS and SNACKS.**
  - **Let me stress** that I need you to tell me about **main meals** such as lunch and dinner which are planned as well as ***snacks that may be*** consumed incidentally, in small quantities, between meals or other time**.**
- Briefly outline the 4 steps in which interview will be conducted
  - Step 1: We will list all foods and beverages consumed
  - Step 2: Then we will obtain more detailed description and preparation methods on foods and beverages consumed
  - Step 3: We will use different methods to estimate quantities of foods and beverages consumed
  - Step 4: Finally, we will review information recorded to ensure that nothing has been forgotten
- Explain that the interview might take about 1 to 1.5 hrs and request for patience. Allow respondent to finish urgent chores

D. RESPONDENT'S CHARACTERISATION OF HER APPETITE AND FOOD CONSUMPTION YESTERDAY			
D1	How would you describe your overall food consumption yesterday? **READ OPTIONS TO RESPONDENT** *Senga ogerageranya, wandigambye otya ku ngeri gyewalidde emere olunakku lwajjo?*	☐	1 = Usual, *(kyabulijjo)* 2= Less than usual, (*kitono kubulijjo)* 3= More than usual *(kyasinze kubulijjo)*
D2	If LESS THAN USUAL, what do you think were the reasons for it? *Bwekiba kya badede kitono ku kyabullijjo, olowooza lwa nsogaki?*	☐	1= I was sick, 2= food was not enough, 3= I did not like the type of food served, 4= I was not at home for a lengthy period, 5= Don't know
D3	If MORE THAN USUAL, what do you think were the reasons for it? *Ate bwekiba kyasinze ku bulijjo, kyabadde lwa nsonga ki?*	☐	1= Yesterday was a feast day (party, celebration etc.) 2= Household had more food yesterday, 3= other reason, 4=Don't know
D4	What time did you wake up yesterday? *Olunnaku lwajjo, wazukusse saawa mmekka?*	☐☐:☐☐	Indicate time using 24hour system
D5	What time did you finally go to bed/sleep at night? *Ate webasse ku ssawa mmekka?*	☐☐:☐☐	Indicate time using 24hour system

NAME OF WOMAN _____

PAGE 1

EA CODE/NAME : _____

	FIRST PASS						*SECOND PASS*		*THIRD PASS*	
	FOOD TYPE FILL AFTER PASS 2 **A**	**TIME OF DAY** HOUR/MIN **B**	AM/PM **C**	**MEAL TYPE** 1= B/FAST, 2= LUNCH, 3= DINNER, 4= SNACK **D**	**EPISODE #** **E**	**NAME OF FOOD/MIXED DISH** **F**	**DESCRIPTION OF THE FOOD OR DISH** USE PROBELIST **G**	**Unique RECIPE #** **H**	**Measure method** REFER TO MEASUREMENT LIST **I**	**Amount & Unit consumed** **J**
1										
2										
3										
4										
5										
6										
7										

FOOD TYPE

1=Single Food Item

2= Standardised recipe

3= Unique Household Recipe

MEASUREMENT METHOD

1= Direct weighing - DW

2= Volume - VOL

3= Length - LENGTH

4 = Standard Volume

5 = Size photo – PHOTO

7= Playdough – PD

NAME OF WOMAN _____ **PAGE 2** EA CODE/NAME : _____

	FIRST PASS						*SECOND PASS*		*THIRD PASS*	
	FOOD TYPE FILL AFTER PASS 2 **A**	**TIME OF DAY** HOUR/MIN **B**	AM/PM **C**	**MEAL TYPE** 1= B/FAST, 2= LUNCH, 3= DINNER, 4= SNACK **D**	**EPISODE #** **E**	**NAME OF FOOD/MIXED DISH** **F**	**DESCRIPTION OF THE FOOD OR DISH** USE PROBELIST **G**	**Unique RECIPE #** **H**	**Measure method** REFER TO MEASUREMENT LIST **I**	**Amount & Unit consumed** **J**
8										
9										
10										
11										
12										
13										
14										

FOOD TYPE

1=Single Food Item
2= Standardised recipe
3= Unique Household Recipe

MEASUREMENT METHOD

1= Direct weighing - DW
2= Volume - VOL
3= Length - LENGTH
4 = Standard Volume
5 = Size photo – PHOTO
7= Playdough – PD

NAME OF WOMAN _____ **PAGE 3** EA CODE/NAME : _____

	FIRST PASS						*SECOND PASS*		*THIRD PASS*	
	FOOD TYPE FILL AFTER PASS 2 **A**	**TIME OF DAY** HOUR/MIN **B**	AM/PM **C**	**MEAL TYPE** 1= B/FAST, 2= LUNCH, 3= DINNER, 4= SNACK **D**	**EPISODE #** **E**	**NAME OF FOOD/MIXED DISH** **F**	**DESCRIPTION OF THE FOOD OR DISH** USE PROBELIST **G**	**Unique RECIPE #** **H**	**Measure method** REFER TO MEASUREMENT LIST **I**	**Amount & Unit consumed** **J**
15										
16										
17										
18										
19										
20										
21										

FOOD TYPE

1=Single Food Item
2= Standardised recipe
3= Unique Household Recipe

MEASUREMENT METHOD

1= Direct weighing - DW
2= Volume - VOL
3= Length - LENGTH
4 = Standard Volume
5 = Size photo – PHOTO
7= Playdough – PD

RECIPE NUMBER	1

RECIPE FORM FOR UNIQUE RECIPE CONSUMED BY REFERENCE WOMAN

Name of unique recipe _____

Name of person who cooked the dish _____ (Must be the one interviewed for this dish)

Final volume of cooked dish | | | | | (ask for saucepan used to cook dish/ estimate final volume using dry rice)

Volume of dish in words _____

LIST OF INGREDIENTS		***INGREDIENT DESCRIPTION***	***QUANTITY OF INGRDIENT ADDED***	
	Name of the ingredient	Use probe list to describe ingredients including the cooking state it was measured	Measure method	Amount & Unit of ingredient decribed
1				
2				
3				
5				
6				
7				

MEASUREMENT METHOD

1= Direct weighing - DW
2= Volume - VOL
3= Length - LENGTH
4 = Standard Volume
5 = Size photo – PHOTO
7= Playdough – PD

Appendix 3.5. Simplified 24HR data collection forms

UGANDA DIETARY METHODS STUDY 2017

MAKERERE UNIVERSITY, GAIN AND USAID

SIMPLIFIED 24-HOUR RECALL QUESTIONNAIRE WOMAN 18-49 YEARS

Enumerators

2. Introduce the 24 hour recall interview to the respondent as follows

- In this section of the interview, we would like to get information about all **FOODS AND BEVERAGES** that you (the reference woman) consumed during the previous day, YESTERDAY from the time you woke up until the time you finally went to bed at night
- Emphasize that we will be talking about food consumed ONLY by you (respondent) but not what was cooked for or consumed by the family
- **Explain and emphasize the importance of reporting both MAIN MEALS and SNACKS.**
  - **Let me stress** that I need you to tell me about **main meals** such as lunch and dinner which are planned as well as ***snacks that may be*** consumed incidentally, in small quantities, between meals or other time**. This includes leftover foods, foods not bought or not necessarily prepared in the household.**

- Briefly outline the 4 steps in which interview will be conducted
  - Step 1: We will list all foods and beverages consumed
  - Step 2: Then we will obtain more detailed description and preparation methods on foods and beverages consumed
  - Step 3: We will estimate quantities of foods and beverages consumed using the food Atlas
  - Step 4: Finally, we will review information recorded to ensure that nothing has been forgotten
- Explain that the interview might take about 30 minutes and request for patience. Allow respondent to finish urgent chores
- Tell the respondent that you would like to start by asking about her appetite yesterday)

D. RESPONDENT'S CHARACTERISATION OF HER APPETITE AND FOOD CONSUMPTION YESTERDAY			
D1	How would you describe your overall food consumption yesterday? **READ OPTIONS TO RESPONDENT** *Senga ogerageranya, wandigambye otya ku ngeri gyewalidde emere olunakku lwajjo?*	☐	1 = Usual, *(kyabulijjo)* 2= Less than usual, (*kitono kubulijjo)* 3= More than usual *(kyasinze kubulijjo)*
D2	If LESS THAN USUAL, what do you think were the reasons for it? *Bwekiba kya badede kitono ku kyabullijjo, olowooza lwa nsogaki?*	☐	1= I was sick, 2= food was not enough, 3= I did not like the type of food served, 4= I was not at home for a lengthy period, 5= Don't know
D3	If MORE THAN USUAL, what do you think were the reasons for it? *Ate bwekiba kyasinze ku bulijjo, kyabadde lwa nsonga ki?*	☐	1= Yesterday was a feast day (party, celebration etc.) 2= Household had more food yesterday, 3= other reason, 4=Don't know
D4	What time did you wake up yesterday? *Olunnaku lwajjo, wazukusse saawa mmekka?*	☐☐.☐☐	Indicate approximate time
D5	What time did you finally go to bed/sleep at night? *Ate webasse ku ssawa mmekka?*	☐☐.☐☐	Indicate approximate time

NAME OF WOMAN _____ PAGE 1

	FIRST PASS						SECOND PASS	THIRD PASS	
	FOOD TYP FILL AFTER PASS 2 A	TIME OF DAY HOUR/MIN B	AM/PM C	MEAL TYPE 1= B/FAST, 2= LUNCH, 3= DINNER, 4= SNACK D	EPISODE # E	NAME OF FOOD/MIXED DISH F	DESCRIPTION OF THE FOOD OR DISH USE PROBELIST G	FOOD PHOTO NUMBER CHECK FOOD ATLAS (RANGE: 1-72) H	PORTION SIZE CODE INSERT CODE 1 - 5 I
1									
2									
3									
4									
5									
6									
7									

FOOD TYPE

1=Single Food Item

2= Standardised recipe

Interviewer's comments

Please provide any comments relevant to interpretation of data collected e.g., plausibility of frequency, eestimation of average number of times per day, and average portion sizes. Also indicate the respondent's cooperation and your overall confidence in the quality of information given by the respondent. You may also comment on reported intakes for specific foods in the survey.

Appendix 3.6. SQFFQ data collection form

UGANDA DIETARY METHODS STUDY 2017

MAKERERE UNIVERSITY, GAIN AND USAID

SEMI-QUANTITAVE FOOD FREQUENCY QUESTIONNAIRE FOR WOMAN 18-49 YEARS

In this section, we going to talk about how you consumed different types of food and drinks during the past 7 days. I am going to read to you a list of foods and drinks and I would like you to recall and tell me if or not you consumed that food during the past 7 days. Let me start by explaining to you the period of 7 days we are talking about

ENUMERATOR INSTRUCTIONS:

1. Explain and help the respondent to under the reference period. If the interview day is a Tuesday, they are asked to remember what foods were consumed since Tuesday of the previous week until yesterday which is the day before the interview (Monday of this week). Please note: we are talking about past 7 days, NOT the past week.
2. Explain that we be will talking about the consumption of the respondent alone but not what the family/household consumed or what she cooked.
3. Also explain that food and beverages consumed in small quantities or consumed as snacks or leftover food are as important as main meals.
4. At this point, DO NOT explain about number of days or number of times food item was consumed – you will do that when you reach the second pass
5. Indicate to the respondent that interview will take about 45 minutes, and request for patience.

First pass

6. Let the respondent know that you have a list of different foods that you will be reading to her. Explain that you want her to listen attentively as you read and try to recall if or not that food item was consumed
7. Now start reading list of foods food group by food group. When one food group is finished, alert the respondent that now you will talk about "INSERT NAME OF FOOD GROUP"
8. As you read the food list, constantly check and repeat to/Remind respondent that you are asking about the 7 day period already explained.
9. Complete reading the entire list of foods (First pass) before you start the second pass). i.e from 'the porridges" to the last item "sugarcane"

Translated statement

Kakati tugenda kwogera ku ngeri gyobadde olyamu emere n' ebyokunywa ebyenjawulo mu banga lya nnaku musanvu eziyise. Enaku ezo omusanvu ze zino…leero lwa(say day), okuva ku Monday ya wiki ewedde okutusa jjo (list all seven days). Ngenda okusomera olukalala lwebyokulya, njagala owulilize bulungi

ombulire oba kyensomye wakiryaako oba nedda. Bwoba wakiryaako munnaku ezo omusavu, ogya kumbulira ennaku ziwakiliramu ate oluvanyuma ombulire emirundi gyewakiryamu. Bwetunamala,tujja kukozessa ebifinanyi ondage obunji bwewalya.

Second Pass

1. In the second pass, you will ask questions about ONLY those indicated as consumed in the previous 7 days – I,e with X in the 'YES' box of the first pass
2. For each food, ask and record answers for all questions in the row i.e. frequency of consumption (# days and # times) up to amount (portion size) consumed.
3. Explain properly the difference between Number of days and number of times food item was consumed during past 7 days
4. Remember to ask for specific ingredients if indicated

Explain properly how respondent can use Food Atlas photos to show you average amount consumed

FIRST PASS			SECOND PASS					
Food item	**Consumption**		**Frequency**			**Key Ingredients**	**Portion size:**	
In the last 7 days, did you consume any....{state food type from the list below}? ***Munaku omusanvu eziyise, walyako ku mere eno?***			**If yes: In the last 7 days, on how many days did Wajiryamu ennaku meeka** **Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?**	**If yes: On those days, how many times did you eat {food item}?** **Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?**	***Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?*** ***Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?***		***Usually, how much of {Food item} did you eat at one sitting?*** ***Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?***	
Food Group / Food, Beverage, or Recipe type	**No (X)**	**Yes (X)**	**If yes, number of days in last 7 days (1-7)**	**Number of times per day in last 7 days (average)**	***Circle YES/NO if ingredient if added in the recipeor not***		***Photo Number to use***	***Choose photo size and insert Code 1-5) ****
PORRIDGES & POSHO								
Porridge, maize flour - ***obuji bwakasoli***					Milk /Sugar		1	
Porridge, millet flour - ***obuji bwobuseera/obulo***					Milk /Sugar		2	
Porridge, cassava & sorghum/millet flour					Milk /Sugar		3	
Posho, maize flour							4	
Posho, cassava & millet flour (Millet bread) - ***akalo***							5	
MAIZE & RICE DISHES / SNACKS								
Maize on cob - ***kasooli owo kikongoliro***							6	
Maize and beans (Nyoyo) - ***kasoli agatidwamu ebijanjalo***							7	
Maize grain, deep-fried ***(Embelenge oba empogola)***							8	
Popcorn							9	
Rice dish - ***(emere y'omucere)***					Oil/Fat	No Yes	10	
WHEAT FLOUR: BREADS, BUNS & SNACKS								
Bread, sliced - small loaf							11	
Bread, sliced - large loaf							12	
Buns - long							13	

FIRST PASS			SECOND PASS					
Food item	**Consumption**		**Frequency**			**Key Ingredients**	**Portion size:**	
In the last 7 days, did you consume any....{state food type from the list below}? ***Munaku omusanvu eziyise, walyako ku mere eno?***			**If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka** **Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?**	**If yes: On those days, how many times did you eat {food item}?** **Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?**	***Did this dish contain any {state the listed ingredient}?*** ***or*** ***Was this food fried in oil or fat?*** ***Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?***		***Usually, how much of {Food item} did you eat at one sitting?*** ***Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?***	
Food Group / Food, Beverage, or Recipe type	**No (X)**	**Yes (X)**	**If yes, number of days in last 7 days (1-7)**	**Number of times per day in last 7 days (average)**	***Circle YES/NO if ingredient if added in the recipeor not***		***Photo Number to use***	***Choose photo size and insert Code 1-5) ****
Buns - round	☐	☐	☐	☐			14	☐
Chapatti (including as Rolex, or w/other fillings)	☐	☐	☐	☐			15	☐
Donuts	☐	☐	☐	☐			16	☐
Mandazi - long	☐	☐	☐	☐			17	☐
Mandazi - square	☐	☐	☐	☐			18	☐
Biscuits - round	☐	☐	☐	☐			19	☐
Biscuits - square	☐	☐	☐	☐			20	☐
Samosa	☐	☐	☐	☐			21	☐
ROOTS & TUBERS: BOILED, STEAMED, ROASTED OR FRIED								
Cassava (raw or cooked)	☐	☐	☐	☐	fried in oil/fat	No Yes	22	☐
Matooke mashed	☐	☐	☐	☐			23	☐
Matooke, Kivuvu, Gonja, whole fingers	☐	☐	☐	☐			-	Number fingers ____
Sweet potato	☐	☐	☐	☐	Flesh colour	WF YF OF	24	☐
Cocoyam or other yams	☐	☐	☐	☐			25	☐
Irish potato	☐	☐	☐	☐			26	☐
Chips, Irish potato, fried	☐	☐	☐	☐			27	☐

Food item	Consumption		Frequency			Key Ingredients	Portion size:	
In the last 7 days, did you consume any....{state food type from the list below}? *Munaku omusanvu eziyise, walyako ku mere eno?*			If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka	If yes: On those days, how many times did you eat {food item}?	*Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?*		*Usually, how much of {Food item} did you eat at one sitting?*	
			Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?	Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?	*Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?*		*Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?*	
Food Group / Food, Beverage, or Recipe type	No (X)	Yes (X)	If yes, number of days in last 7 days (1-7)	Number of times per day in last 7 days (average)	*Circle YES/NO if ingredient if added in the recipeor not*		*Photo Number to use*	*Choose photo size and insert Code 1-5) **
KATOGOS & MUGOYO								
Katogo - Matooke, w/beans					Oil/Fat	No Yes	28	
Katogo - Matooke, w/gnuts							28	
Katogo - Cassava, plain					Oil/Fat	No Yes	29	
Katogo - Cassava, w/beans					Oil/Fat	No Yes	30	
Katogo - Irish potato w/beans					Oil/Fat	No Yes	28	
Mugoyo - Sweet Potato					Oil/Fat	No Yes	31	
VEGETABLES & DISHES								
Cabbage, fried							32	
Cabbage Relish					Oil/Fat	No Yes	33	
Entula							34	
Eggplant or Entula Sauce					Oil/Fat	No Yes	35	
Katunkuma							36	
Pumpkin							37	
Tomato Sauce					Oil/Fat	No Yes	38	

Food item	Consumption		Frequency			Key Ingredients	Portion size:	
In the last 7 days, did you consume any....{state food type from the list below}? *Munaku omusanvu eziyise, walyako ku mere eno?*			If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka	If yes: On those days, how many times did you eat {food item}?	*Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?*		*Usually, how much of {Food item} did you eat at one sitting?*	
			Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?	Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?	*Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?*		*Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?*	
Food Group / Food, Beverage, or Recipe type	No (X)	Yes (X)	If yes, number of days in last 7 days (1-7)	Number of times per day in last 7 days (average)	*Circle YES/NO if ingredient if added in the recipeor not*		*Photo Number to use*	*Choose photo size and insert Code 1-5) **
GREEN LEAFY VEGETABLES & DISHES								
Green leaf (any type) Sauce					Oil/Fat	No Yes	39	
Green leaf (any type), Relish					Oil/Fat	No Yes	40	
Green leaf (any type), plain					Oil/Fat	No Yes	40	
LEGUME & NUT SAUCES & SNACKS								
Bean Sauce					Oil/Fat	No Yes	41	
Pea Sauce					Oil/Fat	No Yes	44	
Groundnut Sauce (basic) (Includes gnut sauce taken with dried fish)							42	
Groundnut Sauce w/ Vegetables (eg, entula)							42	
Groundnut Sauce w/mukene							42	
Groundnuts, roasted							43	
Other nuts, seeds (palm nut, Kulekula nut, sunflower seeds, pumpkin seeds)							43	

In the last 7 days, did you consume any....{state food type from the list below}? *Munaku omusanvu eziyise, walyako ku mere eno?*			If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?	If yes: On those days, how many times did you eat {food item}? Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?	*Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?* *Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?*		*Usually, how much of {Food item} did you eat at one sitting?* *Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?*	
Food Group / Food, Beverage, or Recipe type	**No (X)**	**Yes (X)**	**If yes, number of days in last 7 days (1-7)**	**Number of times per day in last 7 days (average)**	***Circle YES/NO if ingredient if added in the recipeor not***		***Photo Number to use***	***Choose photo size and insert Code 1-5) ****
MEAT & FISH DISHES								
Meat, roasted (any type)	☐	☐	☐	☐			45	☐
Meat, boiled (any type) (if part of a dish, soup or other ingredients assessed separately)	☐	☐	☐	☐			46	☐
Soup for meat (basic)	☐	☐	☐	☐	Oil/Fat	No Yes	56	☐
Soup for meat, w/ entula or eggplant	☐	☐	☐	☐	Oil/Fat	No Yes	56	☐
Organ meat (kidney, liver, offals)	☐	☐	☐	☐			46	☐
Chicken pieces	☐	☐	☐	☐			-	Number pieces_____
Mukene Sauce	☐	☐	☐	☐	Oil/Fat	No Yes	47	☐
Mukene, fried w/oil	☐	☐	☐	☐			48	☐
Fish (large), deep-fried	☐	☐	☐	☐			49	☐
Fresh fish (large), boiled - mid-section (soup assessed separately)	☐	☐	☐	☐			50	☐
Fresh fish (large), boiled - head	☐	☐	☐	☐			51	☐
Fresh fish (large), boiled - tail	☐	☐	☐	☐			52	☐
Soup for fish (large)	☐	☐	☐	☐			57	☐
Dried fish (large), boiled	☐	☐	☐	☐			53	☐
Soup for fish (large)	☐	☐	☐	☐			57	☐
Dried fish (large), w/gnut sauce (sauce assessed separately)	☐	☐	☐	☐			53	☐

In the last 7 days, did you consume any....{state food type from the list below}? *Munaku omusanvu eziyise, walyako ku mere eno?*			If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?	If yes: On those days, how many times did you eat {food item}? Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?	*Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?* *Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?*		*Usually, how much of {Food item} did you eat at one sitting?* *Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?*	
Food Group / Food, Beverage, or Recipe type	**No (X)**	**Yes (X)**	**If yes, number of days in last 7 days (1-7)**	**Number of times per day in last 7 days (average)**	***Circle YES/NO if ingredient if added in the recipeor not***		***Photo Number to use***	***Choose photo size and insert Code 1-5) ****
EGGS								
Egg, hard-boiled							54	
Omelette (including as Rolex)					oil/fat	No Yes	55	
FRUITS								
Avocado							58	
Banana, ripe, medium/large types (eg, Bogoya, Fiya)							59	
Banana, ripe (eg, Ndizi)							60	
Berries (any type)							65	
Citrus (Orange, lemon, tangerine)							61	
Guava							62	
Jackfruit							63	
Jambula							64	
Mango, medium/large types							65	
Mango, small types							66	
Pawpaw							67	
Passion Fruit							68	
Pineapple							69	
Watermelon							70	
Other fruits (apples, pears, other)							62	

In the last 7 days, did you consume any….{state food type from the list below}? *Munaku omusanvu eziyise, walyako ku mere eno?*			If yes: In the last 7 days, on how many days did you eat Wajiryamu ennaku meeka Munaku ezo omusanvu, emere eno wagyiryamu enaku meka?	If yes: On those days, how many times did you eat {food item}? Okutwaliza awamu, wajjilya mirundi emeka mulunaku olumu?	*Did this dish contain any {state the listed ingredient}?* *or* *Was this food fried in oil or fat?* *Emere eno yali esikidwaako oba erimu buto oba omuzigo ogwekika kyona?*		*Usually, how much of {Food item} did you eat at one sitting?* *Munnaku ezzo zewalyamu emere eno, walyanga bunji ki mu lutuula olumu?*	
Food Group / Food, Beverage, or Recipe type	**No (X)**	**Yes (X)**	**If yes, number of days in last 7 days (1-7)**	**Number of times per day in last 7 days (average)**	***Circle YES/NO if ingredient if added in the recipeor not***		***Photo Number to use***	***Choose photo size and insert Code 1-5) ****
BEVERAGES								
Milk tea or coffee w/milk	☐	☐	☐	☐			71	☐
Black tea	☐	☐	☐	☐			71	☐
Milk, Fresh or Bongo or yoghurt	☐	☐	☐	☐			71	☐
Fruit juice, fresh (any type)	☐	☐	☐	☐			72	☐
Fruit juice, factory packed (any type)	☐	☐	☐	☐			72	☐
Soda (any type)	☐	☐	☐	☐			-	Number bottles_____
Local beer	☐	☐	☐	☐			72	☐
Commercial beer (bottled)	☐	☐	☐	☐			-	Number bottles_____
MISCELLANEOUS								
Sugarcane	☐	☐	☐	☐				Number of joints ___

Interviewer’s comments

Please provide any comments relevant to interpretation of data collected e.g., plausibility of frequency, eestimation of average number of times per day, and average portion sizes. Also indicate the respondent's cooperation and your overall confidence in the quality of information given by the respondent. You may also comment on reported intakes for specific foods in the survey.

Appendix 4: Input Data Results

Appendix Table 4.1. Food listing data

Food Group / Food Item	Food consumed in **fresh, dried or flour** forms?	**Food item consumed? ***	What is the likelihood food item will be consumed in July 2017? **	What are **cooking methods** if/when consumed as an individual food item?	What **recipes** are consumed with this food as the main ingredient?	Interviewer comments
List derived from foods first listed by team members plus key informant interviews	**Fresh / Dried / Flour**	**Y = yes; N = no**	**1= High, 2= Medium, 3= Low, 4= Not likely at all**	Cooking methods or raw	Recipe name	Example, products made with food item, unique processing methods
Cereals and Grains						
Maize grain, white	Dried	Y	**2** = 3,1	Roasted (Manyi gavu); Deep-fried; Oil-fried	Maize & Beans (sometimes beans are more)	Boiled and dried before deep drying
	Flour	Y	**1** = 1,1		No. 1 (most common): Posho (mostly No. 1); Porridge; Mandazi; Kabalagala No. 1.5 Posho, Mandazi, sometimes Porridge No. 2. If have, mostly only use for porridge (Posho rarely)	See other snacks/fried products
Maize on cob	Fresh	Y	**1** = 1,2	Boiled**; Steamed; Roasted; Baked in hot ash		
	Dried	N				Available in july

Sorghum	Flour	Y	**3** = 3,4		Ingredient (eg, Sorghum bread 'like posho' w/cassava; cassava porrridge)	See sub-form on flour blends (Cassava flour is more, but considered to be a sorghum recipe because of strong taste)
	Dried	N				
Millet	Flour	Y	**2** = 3,1		Porridge (cassava/millet flour blend); Kalo (millet bread 'like posho'); Malwa (alcoholic); ; Millet porridge (100% millet);	See flour blends sub-form
Rice	Dried	Y	**1** = 1,1	Boiled/steamed (rare); Fried (plain w/oil)	Boiled rice; Fried rice; Ingredient (maize porridge; bikyepele/omondi snacks)	Rice is grown by a few people and milled locally
	Flour		**3** = 3,4		(Ingredient as porridge for chldren)	Training to make this for infant food
Wheat	Flour	Y	**1** = 1,1		Chapati; Samosa; Mandazi; Bread; Daddies (cookies/small dried mandazi); Cakes; Ingredient (in soups, coating)	Always purchased in flour form
Popcorn maize	Dried	Y	**1**	Popped	Popcorn + Soy beans	
	Flour	Y	**3**		**As for maize, white**	
Legumes						
Beans, common	Fresh	Y	**4** = 4,4		Bean Sauce (Magela); Bean Sauce (Kango)	Soak and hull to make magera (mashed cooked beans)
	Dried	Y	**1** = 1,1		Bean Sauce (Magela); Ingredient in Katogo, Nyoyo	Varieties (K131, K132, Nabe 15, Nabe 19, Kanyebwa,

						Manyi Gamulimi, Nambale, Yellow/green)
Cow peas (Mpindi)	Fresh	Y/N	**3** = 3,4		Cowpea Sauce	
	Dried	Y/N	**3** = 3,4		Cowpea Sauce	
Pigeon peas	Fresh					
	Dried					
Soybeans	Dried	Y	**3** = 3,3	Roasted; Deep fried		Boiled and dried or soaked in hot water before deep frying
	Flour	Y	**2** = 2,2	Boiled (w/other flours)	Soybean Sauce (rare); Ingredient (porridge w/other flours)	
Bigaaga/Buyindindi						
Field peas, green	Fresh	Y	**4** = 4,4		Ingredient (Katogo, Samosa, Irish potato, Fish Sauce)	
	Dried	Y	**1** = 1,1		Pea Sauce; Ingredient (Katogo, Samosa, Irish potato, Fish Sauce)	
Field peas, yellow	Fresh	N				
	Dried	Y	**3**		Pea Sauce; Ingredient (Katogo, Samosa)	
Beans w/iron	Dried					
Empande	Fresh	Y/N	4		Empande Sauce	
	Dried	Y/N	4		Empande Sauce	
Empokya (likely mung beans)		N				
Ebigaga	Fresh	Y/N	**4**		Ebigaga Sauce	
	Dried	Y/N	**4**			
Lentils (Kyeroko)	Dried	Y/N	**4**		Lentil Sauce	

Roots, Tubers and Plantain						
Cassava	Fresh	Y	**1** = 1,1	Raw; Boiled; Steamed; Roasted; Deep fried	Katogo	Also eaten raw
	Dried	N				Boiled then dried, and make flour
	Flour	Y	**1** = 1,1		Cassava bread 'like posho'; Porridge (alone or mixed); Pancakes; Bagiya	
Sweet potato, white	Fresh	Y	**1** = 2,1	Boiled; Steamed; Roasted; Deep fried	Mugoyo; Katogo	
	Flour	Y/N	**4**		Porridge	
Sweet potato, orange	Fresh	Y	**1** = 2,1	Boiled; Steamed; Roasted; Deep fried	Mugoyo; Katogo	
	Flour	Y/N	**4**		Porridge	
Sweet potato, yellow	Fresh	Y	**1** = 1,1	Boiled; Steamed; Roasted; Deep fried	Mugoyo; Katogo	
	Flour					
Irish potato	Fresh	Y	**1** = 1,1	Deep fried (Chips); boiled	Katogo; Mashed potatoes	
Cocoyam (Bukupa)	Fresh	Y	**2** = 2,2	Boiled: Steamed	Katogo (Same as for Cassava Katogo w/beans)	Flour for pancakes, or crisps
Other yams (eg, Bwaise)	Fresh	Y	**2** = 2,3	Boiled: Steamed	Katogo (Same as for Cassava Katogo w/beans)	
Matooke (plantain), cooking type	Fresh	Y	**1** = 2,1	Steamed; Roasted	Katogo	When ripe can be used to make pancakes (kabalagala)
Gonja (plantain)	Fresh	Y	**3** = 3,3	Steamed; Roasted; Deep fried (crisps)		
Brewing type banana (Musa, Kisubi, Mbidde, Kayinja, Fiya)	Fresh		**3** = 3,4	Boiled	Katogo; Juice; Local brew	Make waragi, and sometimes juice (rare),

						when ripe can make pancakes (kabalagala)
Fiya 23 (plantain)	Fresh	Y	**1** = 2,1	Raw (ripe)	Katogo	
		N				
Kivuvu (plantain)	Fresh	Y	**2** = 3,2	Raw	Katogo	
Vegetables						
Tomatoes	Fresh	Y	**1** = 1,1	Raw	Tomato sauce; ingredient in other sauces	
Onions	Fresh	Y	**1** = 1,1	Raw	Raw onions with raw tomatoes 'salad' (Kachumbali - rare); (ingredient)	
Cabbage	Fresh	Y	**2** = 2,2	Raw; Fried w/oil; Sweated (boiled w/no water)	Cabbage dish; ingredient in other dishes	
Sweet peppers						
Okra						
Eggplant	Fresh		**1** = 2,1		Eggplant sauce; Eggplant dish; (ingredient)	
Entula	Fresh		**1** = 1,1	Raw; Boiled; Steamed	Entula sauce; Entula dish; ingredient	
Carrots	Fresh		**2** = 3,2	Raw	Ingredient only	
Mushrooms	Fresh		**4** = 4,4	Mushroom sauce; ingredient		
	Dried		**3** = 3,3	Mushroom sauce		
Bitter gourd						
Lettuce	Fresh		**4** = 4,4	Fried; Sweated	Lettuce Dish (like cabbage)	
Broccoli						
Cauliflower						
Garlic	Fresh		**2** = 3,2		Ingredient only	

Squash						
Cucumber			**4**			
Pumpkin	Fresh		**2** = 1,3	Steamed; Boiled	Katogo (pumpkin w/beans); Stuffed pumpkin (rare)	
	Flour		**4** = 4,4		Porridge	
Green pepper	Fresh		**2** = 2,2		Ingredient	
Beet root			**4**			
Katunkuma (small, bitter ntula)	Fresh		**2** = 2,2	Steamed; Boiled	Katunkuma Sauce; ingredient	
	Dried		**3** = 3,3	Raw	Ingredient (eg, Sauce)	
	Flour		**3** = 3,3		Ingredient (eg, Gnut sauce)	
French beans			**4**			
Green amaranth leaves (Doodo)	Fresh		**1** = 1,1	Stir Fried; Fried w/oil; Steamed	Doodo Sauce; Doodo dish; ingredient	
Red amaranth leaves (Bugga)	Fresh		**2** = 3,2	Stir Fried; Fried w/oil; Steamed	Bugga sauce; Bugga Dish; ingredient	
Spider plant leaves (Ejobyo)	Fresh		**2** = 3,1	Stir Fried; Fried w/oil; Steamed	Spider leaf Dish; Ingredient	
Nakati leaves	Fresh		**2** = 2,2	Stir Fried; Fried w/oil; Steamed	Green leaf Dish; ingredient	
Kales (Sukuma wiki)	Fresh		**3** = 4,3	Stir Fried; Fried w/oil; Steamed	Green leaf Sauce; Green leaf Dish; ingredient	
Spinach/Saaga leaves	Fresh		**3** = 3,4	Stir Fried; Fried w/oil; Steamed	Green leaf Dish; ingredient	
Ensuga leaves	Fresh		**3** = 3,3	Stir Fried; Fried w/oil; Steamed	Green leaf Dish; ingredient	
Saaga leaves						
Yam leaves	Fresh		**3** = 3,3	Stir fried; Steamed	Green leaf sauce; Green leaf Dish; ingredient	
	Flour		**3** = 3,3		Ingredient (eg, Gnut sauce)	
Leeks			**3** = 3,3		Ingredient	

Fruits						
Ripe banana (Bogoya)	Fresh	Y	**1** = 1,1	Raw; Deep fried (rare)	Juice (common); Local brew (uncommon)	One group says deep frying NO
Ripe banana (Ndizi)	Fresh	Y	**1** = 1,1	Raw; Deep fried (rare)	Juice (common); Local brew (uncommon)	One group says deep frying NO
Citrus (Oranges/tangerines/lemons)	Fresh	Y	**1** = 1,1	Raw	Juice	
Mango	Fresh	Y	**2** = 3,2	Raw	Juice	
Pineapple	Fresh	Y	**2** = 3,1	Raw	Juice; Munanasi (special juice recipe)	
Apple	Fresh	Y	**2** = 2,3	Raw	Juice	
Jackfruit	Fresh	Y	**1** = 1,1	Raw	Juice	
Watermelon	Fresh	Y	**2** = 2,1	Raw	Juice	
Pawpaw	Fresh	Y	**1** = 1,1	Raw	Juice	
Soursop	Fresh	Y	**4** = 4,4	Raw	Juice	
Avocado	Fresh	Y	**1** = 1,1	Raw		
Guava	Fresh	Y	1 = 1,2	Raw		
Berries	Fresh	Y	**3** = 3,4	Raw		
Passion fruit	Fresh	Y	**1** = 1,1	Raw	Juice	
Pears	Fresh	Y	**3** = 4,3	Raw		
Matungulu	Fresh	Y	**4** = 4,4	Raw		
Jambula	Fresh	Y	**2** = 4,1	Raw	Juice	
Meats, poultry and organ meat						
Beef	Fresh	Y	**2** = 3,2	Boiled; Roasted; Fried w/only;	Meat sauce; Meat dish; Luwombo	Ingredient in Samosas; Luwombo is fairly rare and fairly similar to Meat sauce

						(meat is steamed in banana leaf usually without oil
Goat/mutton	Fresh	Y	**4** = 4,4	Boiled; Roasted; Fried; Steamed	Meat sauce; Meat dish; Tuwomobo	
Chicken	Fresh	Y	**3** = 3,3	Boiled; Roasted; Fried	Meat sauce; Meat dish (rare); Luwombo	
Duck/turkey/pigeons	Fresh	Y	**4** = 4,4	Boiled; Roasted; Fried; Steamed	Meat sauce; Meat dish; Tuwomobo	
Rabbit	Fresh	Y	**4** = 4,4	Boiled; Roasted; Fried; Steamed	Meat sauce; Meat dish; Tuwomobo	
Pork	Fresh	Y	**1** = 1,1	Boiled; Roasted; Fried	Meat sauce; Meat dish; Luwombo	
Game meat (bush rat)	Fresh	Y	**4** = 4,4	Boiled; Roasted; Fried; Steamed	Meat sauce; Meat dish; Tuwomobo	
Kidney	Fresh	Y	**3** = 4,3	Boiled; Roasted; Fried	Meat sauce; Meat dish	
Liver	Fresh	Y	**3** = 3,3	Boiled; Roasted; Fried	Meat sauce; Meat dish	
Offals	Fresh	Y	**2** = 1,3	Roasted (rare); Deep fried	Meat sauce	Mainly as a sauce (rarely as food item)
Heart	Fresh	Y	**4** = 4,4	Boiled; Roasted; Fried; Steamed	Meat sauce	
Tongue	Fresh	Y	**3** = 3,3		Meat sauce	
Trotter (hooves)	Fresh	Y	**3** = 3,3		Meat sauce	
Fish						
Tilapia (ngege)	Fresh	Y	**2** = 3, 1	Boiled; Deep fried; Roasted (smoked)/Boiled	Fresh Fish sauce;	Most common
	Dried	Y	**2** = 3, 2	Boiled	Dried fish sauce; Dried fish/gnuts	
Nile perch (mputa)	Fresh	Y	**2** = 2, 2	Boiled; Deep fried; Roasted (smoked)/Boiled	Fresh Fish sauce;	

	Dried	Y	**2** = 2, 2	Boiled	Dried fish sauce; Dried fish/gnuts	
Catfish (male/mamba/semutundu)	Fresh	Y	**4** = 4,4	Boiled; Deep fried	Fish sauce; Fish & Gnuts;	Grown in ponds for commercial purposes
	Dried	Y	**4** = 4,4			
Mudfish (nsonzi)	Fresh	Y	**4** = 4,4	Boiled; Roasted	Fish sauce; Fish & Gnuts;	
	Dried	Y	**4** = 4,4	Boiled		
Mukene	Dried	Y	**1** = 1,1	Raw; Fried in oil (snack)	Fish sauce; Mukene dish	When pounded or whole, added to sauces; when pounded, is added to porridges
	Flour	Y	**3** = 4,3	(Ingredient only)		
Nkejje (small, bug bigger than Mukene)	Dried	Y	**3** = 3, 4	Roasted; Fried	Fish sauce	When pounded or whole, added to sauces; when pounded, is added to porridges
	Flour	Y	**4**	(Ingredient only)		
Ensuma	Fresh	Y	**4**			
Enkolongo	Fresh	Y	**3** = 3,3	Fried; Deep fried	Fish sauce	
	Dried	Y	**2** = 2,2		(Ingredient)	
Mukendi	Fresh	Y	**4** = 4,4			
	Dried	Y	**4** = 4,4			
Emamba	Fresh	Y	**4** = 4,4			
	Dried	Y	**4** = 4,4			
Insects						
Grasshoppers (Ensenene)			4	Roasting	-	

White ants (Ensewa)			4	Roasting	-	
Milk, Dairy Products, and Eggs						
Cow milk, farm fresh	Fresh	Y	**2** = 2,1	Boiled	Tea; Ingredient (eg, porridge)	
Cow milk, packed	Fresh	Y	**2** = 3,2	Raw: Boiled	Tea; Ingredient (eg, porridge)	
Bongo (fermented milk)	Fresh	Y	**3** = 4,3	Raw		
Cow milk, powdered	Dried	Y	**3** = 4,3	Boiled		
Yogurt (commercial)	Fresh	Y	**3** = 4,1			Commercial only
Eggs, chicken	Fresh	Y	**1** = 1,1	Hard boiled; Fried	Egg Sauce; Omelette	
Eggs, other poultry	Fresh	Y	**4** = 4,4		Egg Sauce; Omelette	
Fats and Oils						
Vegetable oil (commercial)		Y	**1** = 1,1		Ingredient	
Vegetable oil (locally produced)		Y	**4**		Ingredient	
Vegetable fat (commercial)		Y	**2** = 3, 1		Ingredient	
Cow ghee (commercial)		Y	**3** = 3,3		Ingredient	
Lard (commercial or local)		Y	**2** = 1,2		Ingredient	
Margarine (commercial)		Y	**2** = 3, 1		Ingredient	
Spices and Condiments						
Curry		Y	spices not ranked			
Ginger		Y				
Bay leaf		Y				
Royco		Y				
Nuts & Seeds						

Groundnuts	Fresh	Y	**3** = 4,3	Boiled (mpogola); Steamed; Roasted (Kuvumbika)		
	Dried	Y	**1** = 1,1	Roasted; Steamed		
	Flour	Y	**1** = 1,1		Gnut Sauce; Ingredient	
Sesame	Dried	Y	**4** = 4,4			
	Flour	N	**4** = 4,4			
Sunflower		N	**4** = 4,4			
Kulekula nuts	Fresh	N				
	Dried	Y	**3** = 4,3	Roasted (Kuvumbika)		
	Flour	Y	**3** = 4,3		Kulekula Sauce (same as groundnuts)	
Pumpkin seeds (Ebihyo)	Fresh	Y	**3**	(Boiled w/pumpkin)		
	Dried	Y	**3**	Roasted; Pan fried		
	Flour	Y	**4**		Pumpkin Seed Sauce	
Palm nut (Ekinazi)	Fresh	Y	**4**	Raw		
	Dried	N				
	Flour	N				
BEVERAGES (NON-DAIRY)	**(not included in key informant interviews)**					
Tea		Y	Beverages not ranked			
Coffee		Y				
Chocolate		N				
Homemade juices		Y				
Commercial juices			Not mentioned in FGDs but known to be available			
Soda						
Beers						

Spirits						
Sugars and Sweets						
Sugar (standard)		Y	**1** = 1,1		Ingredient	
Honey		Y	**3** = 3,3		Ingredient	
Sweets (candy)		Y	**1** = 1,1			
Baked or fried goods/snacks						
Chapatti		Y	**1**			
Mandazi		Y				
Bread (sliced)		Y				
Cakes		Y				
Samosas (type of filling)		Y				
Bagiya		Y	Not ranked			
Cassava chips		Y/N				
Buns			Not mentioned in FGDs but known to be available			
Donuts						
Biscuits						

*If blank, item was mentioned during the KIs but not mentioned during the FGDs; If Y / N, one Focus Group answered Yes and the other No.

**Rankings from both FGD interviews are shown; the final ranking is taken as the mean of the two, rounding down to the lower number (i.e., higher likelihood ranking).

Appendix 4.2. Portion size data, as used in the food photo atlas*

FOOD GROUP / FOOD NAME	N	MEAN	MEDIAN	MIN	1	2	3	4	5	MAX
PORRIDGES & POSHO										
Porridge, maize flour	55	540	547	122	293	503	713	924	1134	1176
Porridge, millet flour	44	488	443	60	133	376	620	863	1107	1198
Porridge, cassava & sorghum flour	38	429	407	266	270	347	424	502	579	580
Posho, maize flour	49	328	340	69	98	210	323	436	549	917
Posho, cassava & millet flour (Millet bread)	20	254	258	88	89	195	302	408	515	520
MAIZE & RICE DISHES / SNACKS										
Maize on cob	53	306	257	53	66 g (2 small)	219 g (1 med)	340 g (1 large)	522 g (2 med)	716 g (3 small)	817
Maize and beans (Nyoyo)	21	184	172	51	55	132	208	285	361	365
Maize grain, deep-fried	44	35	34	2	8	23	38	53	69	71
Popcorn	51	40	16	3	5	18	31	44	57	1026
Rice dish	49	285	301	60	88	182	275	369	463	508
WHEAT FLOUR: BREADS, BUNS & SNACKS										
Bread, sliced - small loaf	58	78	78	18	1/2 slice (17 g)	1 slice (28 g)	2 slices (61 g)	3 slices (90 g)	4 slices (122 g)	150
Bread, sliced - large loaf	58	78	78	18	1/2 slice (23 g)	1 slice (43 g)	2 slices (87 g)	3 slices (132 g)	4 slices (179 g)	150
Buns - long (small)	51	82	80	23	1/2 (24 g)	1 (45 g)	2 (94 g)	3 (135 g)	-	
Buns - round (large)	51	82	80	23	1/4 (36 g)	1/2 (54 g)	3/4 (88 g)	1 (120 g)	1 1/2 (159 g)	153
Chapatti	50	129	111	69	1/2 (47 g)	1 (92 g)	1 1/2 (156 g)	2 (214 g)	2 1/2 (254 g)	267

Donuts	37	79	89	22	23 g (1/4)	47 g (1/2)	76 (3/4)	95 g (1)	129 g (1 1/4)	172
Mandazi - long	47	98	91	39	1/3 (42 g)	1/2 (57 g)	3/4 (84 g)	1 (110 g)	1 1/4 (139 g)	717
Mandazi - square	47	98	91	39	1/4 (32 g)	1/2 (57 g)	3/4 (92 g)	1 (118 g)	1 1/4 (150 g)	717
Biscuits - round	37	29	28	4	1 (6 g)	4 (21 g)	6 (32 g)	7 (48 g)	12 (64 g)	68
Biscuits - square	37	29	28	4	1 (10 g)	2 (19 g)	4 (38 g)	6 (53 g)	7 (67 g)	68
Samosas	49	64	61	8	12	57	102	146	191	403
ROOTS & TUBERS: BOILED, ROASTED OR FRIED										
Cassava	50	179	179	27	63	133	202	272	341	451
Matooke	54	361	369	91	111	239	367	495	624	659
Sweet potato	49	327	327	68	102	240	378	517	655	793
Cocoyam	49	166	141	31	43	132	221	310	399	481
Irish potato	40	144	140	47	56	107	159	210	261	306
Chips, Irish potato, fried	48	92	86	7	19	76	132	188	245	324
KATOGOS & MUGOYO										
Katogo - Matooke, w/beans or gnuts	48	463	440	215	260	386	512	638	764	829
Katogo - Cassava, plain	48	319	279	107	131	270	409	549	688	824
Katogo - Cassava, w/beans	49	458	436	140	177	315	454	592	730	949
Mugoyo - Sweet Potato	42	322	294	117	126	259	393	527	660	710
VEGETABLE DISHES										
Cabbage, fried	44	107	99	32	40	83	126	169	212	225
Cabbage Relish	56	111	115	37	45	80	115	150	185	203
Eggplant or Entula	37	68	63	21	22	47	72	98	123	150
Eggplant or Entula Sauce	48	194	182	79	95	152	210	268	325	358
Katunkuma	37	46	41	5	7	43	79	115	151	192
Pumpkin	53	231	212	26	54	176	298	419	541	677

Tomato Sauce	38	107	97	29	44	84	124	165	205	228
GREEN LEAFY VEGETABLE DISHES										
Green leaf (any type) Sauce	45	174	123	58	71	142	214	285	356	1515
Green leaf (any type), stir-fried	50	76	70	24	28	60	93	125	157	192
LEGUME & NUT SAUCES & SNACKS										
Bean Sauce	51	236	220	88	122	184	247	310	372	379
Groundnut Sauce (any type)	48	92	83	10	42	75	108	140	173	277
Groundnuts, roasted	50	51	48	10	20	40	60	80	100	115
Pea Sauce	40	204	202	46	67	146	225	304	383	413
MEAT & FISH DISHES										
Meat, roasted (any type)	37	71	39	1	5	60	115	171	226	1093
Meat, boiled (any type)	53	88	75	34	36	71	106	142	177	330
Mukene Sauce	53	50	47	16	19	36	53	70	87	88
Mukene, fried w/oil	22	34	32	15	15	28	40	53	66	67
Fish (large), deep-fried	47	84	72	24	34	66	98	130	162	185
Fresh fish (large), boiled - mid-section	46	137	122	33	55	101	147	192	238	271
Fresh fish (large), boiled - head					140	190	240			
Fresh fish (large), boiled - tail					115	135	155			
Dried fish (large), boiled	49	124	111	47	51	97	142	188	233	261
EGGS										
Egg, hard-boiled	47	57	47	22	1/2 egg (26 g)	1 egg (51 g)	1 1/4 egg (64 g)	1 3/4 egg (89 g)	2 eggs (102 g)	167
Omelette	56	54	39	10	13	42	72	101	130	137
SOUPS FOR MEAT, FISH OR EGGS										
Soup for meat or eggs	53	73	70	9	12	44	77	109	141	194
Soup for fish (large)	46	72	64	25	29	62	96	129	163	183
FRUITS										
Avocado	40	115	102	29	34	89	143	198	252	254

Banana, ripe, medium/large types (Bogoya, Fiya)	53	177	188	47	70 g (1/2 med)	136 g (1 small)	203 g (1 1/2 med)	270 g (2 small	318 g (2 large)	754
Banana, ripe, small types (Ndizi)	41	148	142	54	92 g (2)	124 g (2 1/2)	156 g (3)	188 g (4)	220 g (4 1/2)	228
Citrus (Orange, lemon, tangerine)	46	107	77	17	20 g (1/4)	101 g (1/2)	183 g (1)	265 g (2 med)	347 g (2 large)	359
Guava	51	67	60	8	15 (1/2)	53 g (1)	91 g (1 1/2)	128 g (2)	166 g (1 1/2)	403
Jackfruit	56	435	422	22	178	395	612	829	1047	1508
Jambula	48	121	79	18	19	143	266	390	514	841
Mango, medium/large types	43	236	209	101	110 g (1/2 med)	194 g (1 med)	279 g (3/4 large)	364 g (1 large)	449 g (1 1/2 large)	472
Mango, small types	43	236	209	101	109 g (1)	194 g (2)	279 g (2)	364 g (3)	449 g (4)	472
Pawpaw	37	351	249	119	139 g (1 small)	400 g (2 small)	669 g (2 med)	939 g (3 med)	1208 g (3 large)	1437
Passion Fruit	47	68	66	16	26	57	88	118	149	207
Pineapple	48	188	174	74	88	174	260	347	433	617
Watermelon	50	463	373	107	112	309	507	705	902	3244
BEVERAGES										
Milk tea	55	430	398	206	250	332	415	497	579	886
Fruit Juice (any type)	51	315	296	108	160	241	321	402	482	485

*Portion sizes presented as: Amount g (number/size) were derived from the portion size estimation data; portion sizes presented as: Number/size (Amount g) were based on standard or common unit sizes, and the portion size data collected were used as a guide.

Appendix Table 4.3. Comparison of the nutrient content of standard recipes collected using a simplified method and a reference method*

Recipe Type	Recipe_name	Energy (kcal)	Protein (g)	Fat (g)	Ca (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Ribo (mg)	Folat (ug D
Simple	Porridge, maize flour - w/milk and sugar	48	1.0	0.5	15.9	0.17	0.3	0.2	0.043	
Ref		54	1.0	0.5	16.2	0.17	0.3	0.2	0.044	
	Difference	-6	0.0	0.0	-0.3	0.00	0.0	0.0	-0.001	-0
	% difference	-12%	-2%	-1%	-2%	-2%	-2%	-	-2%	
	Difference as % EAR @ 250 ml				**-0.1%**	**-0.1%**	**-0.2%**	**0.0%**	**-0.3%**	
Simple	Porridge, millet flour - w/milk and sugar	44	1.2	0.7	13.0	0.33	0.3	0.1	0.022	
Ref		57	1.2	0.8	15.8	0.31	0.2	0.2	0.026	
	Difference	-13	0.0	-0.1	-2.7	0.02	0.0	0.0	-0.004	
	% difference	-24%	-2%	-8%	-17%	6%	2%	-	-16%	
	Difference as % EAR @ 250 ml				**-0.9%**	**0.3%**	**0.2%**	**-0.1%**	**-1.1%**	
Simple	Posho, maize flour	144	2.8	0.2	3.7	0.81	1.0	0.0	0.110	
Ref		121	2.4	0.2	3.1	0.68	0.9	0.0	0.092	
	Difference	23	0.5	0.0	0.6	0.13	0.2	0.0	0.017	
	% difference	19%	19%	19%	19%	19%	19%	-	19%	
	Difference as % EAR @ 250 ml				**0.2%**	**2.2%**	**6.0%**	**0.0%**	**4.9%**	
Simple	Cabbage Relish	77	1.5	5.5	42.8	0.52	0.2	29.4	0.042	
Ref		80	1.3	6.0	37.5	0.47	0.2	26.5	0.038	
	Difference	-3	0.1	-0.4	5.2	0.05	0.0	2.9	0.003	
	% difference	-3%	9%	-7%	14%	11%	7%	-	9%	
	Difference as % EAR @ 250 ml				**1.6%**	**0.9%**	**0.5%**	**12.2%**	**1.0%**	
Simple	Eggplant/Entula Sauce	51	0.7	4.0	7.0	0.18	0.1	3.2	0.021	
Ref		60	0.8	4.8	8.0	0.20	0.2	3.4	0.024	
	Difference	-9	-0.1	-0.8	-1.1	-0.02	0.0	-0.2	-0.003	
	% difference	-16%	-11%	-17%	-14%	-10%	-11%	-	-11%	
	Difference as % EAR @ 250 ml				**-0.3%**	**-0.3%**	**-0.7%**	**-0.9%**	**-0.7%**	-
Simple	Amaranth leaf Sauce	59	1.8	4.6	143.1	1.57	0.6	23.2	0.102	
Ref		46	1.5	3.6	116.3	1.28	0.5	19.0	0.084	
	Difference	12	0.3	1.0	26.8	0.29	0.1	4.2	0.019	
	% difference	26%	21%	29%	23%	22%	22%	-	23%	
	Difference as % EAR @ 250 ml				**8.4%**	**4.9%**	**4.1%**	**17.4%**	**5.2%**	
Simple	Nakati leaf Relish	62	2.7	4.0	166.8	6.87	0.3	34.9	0.139	
Ref		165	5.1	12.7	307.4	12.60	0.5	66.1	0.258	

Recipe Type	Recipe_name	Energy (kcal)	Protein (g)	Fat (g)	Ca (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Ribo (mg)	Folat (ug D
	Difference	-103	-2.4	-8.7	-140.6	-5.73	-0.3	-31.1	-0.119	
	% difference	-62%	-47%	-69%	-46%	-45%	-48%	-	-46%	
	Difference as % EAR @ 250 ml				**-43.9%**	**-98.1%**	**-9.2%**	**-129.6%**	**-33.0%**	**-2**
Simple	Milk tea (no sugar)	34	1.7	1.9	63.3	0.03	0.2	0.7	0.086	
Ref		36	1.8	2.0	66.1	0.03	0.2	0.7	0.089	
	Difference	-2	-0.1	-0.1	-2.9	0.00	0.0	0.0	-0.004	
	% difference	-4%	-4%	-4%	-4%	-4%	-4%	-	-4%	
	Difference as % EAR @ 250 ml				**-0.9%**	**0.0%**	**-0.4%**	**-0.1%**	**-1.1%**	**-**
Simple	Rice dish	131	2.2	1.5	3.6	0.26	0.4	0.4	0.015	
Ref		126	2.1	1.9	3.6	0.25	0.4	0.6	0.014	
	Difference	5	0.1	-0.4	0.0	0.01	0.0	-0.3	0.001	
	% difference	4%	6%	-19%	-1%	4%	6%	-	4%	
	Difference as % EAR @ 250 ml				**0.0%**	**0.2%**	**0.8%**	**-1.1%**	**0.2%**	**-**
Simple	Katogo - Matooke, w/beans	108	3.1	1.6	14.2	0.80	0.3	8.0	0.042	
Ref		104	3.1	1.4	14.0	0.87	0.3	7.7	0.041	
	Difference	4	0.0	0.2	0.2	-0.07	0.0	0.3	0.01	
	% difference	4%	1%	12%	1%	-8%	11%	4%	3%	
	Difference as % EAR @ 250 ml				**0.1%**	**-1.2%**	**1.2%**	**1.2%**	**0.3%**	**-2**
Simple	Katogo - Matooke, w/groundnuts	115	2.6	3.6	8.8	0.69	0.3	9.6	0.041	
Ref		108	2.6	3.8	8.7	0.66	0.3	8.5	0.037	
	Difference	7	0.0	-0.2	0.2	0.03	0.0	1.0	0.004	
	% difference	6%	1%	-5%	2%	5%	0%	-	10%	
	Difference as % EAR @ 250 ml				**0.1%**	**0.6%**	**0.0%**	**4.3%**	**1.0%**	
Simple	Katogo - Cassava, plain	98	0.8	1.6	9.5	0.16	0.2	9.4	0.025	
Ref		111	0.9	1.8	10.6	0.18	0.2	10.8	0.029	
	Difference	-13	-0.1	-0.2	-1.1	-0.02	0.0	-1.4	-0.003	
	% difference	-12%	-11%	-10%	-10%	-10%	-10%	-	-12%	
	Difference as % EAR @ 250 ml				**-0.3%**	**-0.3%**	**-0.7%**	**-5.9%**	**-0.9%**	**-**
Simple	Katogo - Cassava, w/beans	115	3.5	1.5	20.6	0.70	0.4	6.8	0.037	
Ref		112	2.9	1.3	19.0	0.68	0.4	7.6	0.035	
	Difference	3	0.6	0.2	1.6	0.02	0.0	-0.8	0.002	
	% difference	2%	19%	15%	9%	3%	11%	-10%	6%	
	Difference as % EAR @ 250 ml				**0.5%**	**0.4%**	**1.6%**	**-3.2%**	**0.6%**	**-2**
Simple	Bean Sauce	103	5.9	1.9	29.9	1.19	0.7	2.1	0.043	

Recipe Type	Recipe_name	Energy (kcal)	Protein (g)	Fat (g)	Ca (mg)	Iron (mg)	Zinc (mg)	Vit C (mg)	Ribo (mg)	Folat (ug D
Ref		95	4.9	2.6	25.0	1.16	0.6	2.2	0.035	
	Difference	8	1.0	-0.7	4.9	0.03	0.1	-0.1	0.008	
	% difference	9%	19%	-26%	20%	3%	10%	-3%	23%	
	Difference as % EAR @ 250 ml				**1.5%**	**0.6%**	**2.3%**	**-0.3%**	**2.2%**	**-4**
Simple	Mukene Sauce	90	4.9	7.2	6.3	0.19	0.2	3.2	0.047	
Ref		98	6.9	7.2	7.1	0.22	0.2	3.7	0.064	
	Difference	-8	-2.0	0.0	-0.7	-0.04	0.0	-0.5	-0.018	
	% difference	-8%	-29%	0%	-10%	-16%	-19%	-	-28%	
	Difference as % EAR @ 250 ml				**-0.2%**	**-0.6%**	**-1.6%**	**-2.1%**	**-4.9%**	
Simple	Groundnut Sauce (basic)	107	4.7	9.2	18.0	0.84	0.6	2.0	0.024	
Ref		128	5.7	11.0	21.3	1.03	0.7	1.2	0.029	
	Difference	-20	-1.1	-1.8	-3.3	-0.18	-0.1	0.8	-0.004	
	% difference	-16%	-18%	-16%	-16%	-18%	-18%	-	-14%	
	Difference as % EAR @ 250 ml				**-1.0%**	**-3.1%**	**-4.9%**	**3.4%**	**-1.1%**	**-**
Simple	Groundnut Sauce w/Eggplant/entula	110	5.0	9.1	19.7	0.91	0.7	2.1	0.030	
Ref		155	6.4	13.4	24.4	1.15	0.8	1.2	0.036	
	Difference	-45	-1.4	-4.3	-4.6	-0.24	-0.2	0.9	-0.006	
	% difference	-29%	-22%	-32%	-19%	-21%	-21%	-	-16%	
	Difference as % EAR @ 250 ml				**-1.5%**	**-4.2%**	**-6.5%**	**3.7%**	**-1.6%**	**-**
Simple	Groundnut Sauce w/mukene	115	6.4	9.2	18.7	0.87	0.6	1.2	0.040	
Ref		143	8.3	11.5	22.3	1.07	0.8	1.2	0.051	
	Difference	-28	-1.8	-2.3	-3.6	-0.20	-0.2	0.1	-0.012	
	% difference	-20%	-22%	-20%	-16%	-19%	-19%	-	-23%	
	Difference as % EAR @ 250 ml				**-1.1%**	**-3.4%**	**-5.6%**	**0.2%**	**-3.2%**	**-**
Simple	Soup for meat (basic)	31	1.8	1.8	6.5	0.23	0.2	3.3	0.014	
Ref		56	0.4	5.4	5.3	0.11	0.1	6.1	0.009	
	Difference	-26	1.4	-3.5	1.2	0.12	0.1	-2.9	0.005	
	% difference	-46%	376%	-66%	22%	109%	113%	-47%--	59%	
	Difference as % EAR @ 250 ml				**0.4%**	**2.0%**	**3.2%**	**-11.9%**	**1.4%**	**-**

*The nutrient content is presented per 100 ml of recipe, from which the absolute difference and % difference were calculated. The content was rescaled to 250 mL and the difference expressed as a percent of the EAR; for iron, 10% bioavailability was assumed.

Appendix 5: Dietary Assessment Survey Results

Appendix Table 5.1. Nutrient intakes among women of reproductive age in Mukono District, Uganda as estimated by two dietary assessment test methods and compared to the Standard 24HR method, and nutrients for which the mean is less than the EAR†

Nutrient	**EAR**	**Standard 24HR**		**Simplified 24HR**		**P**	**SQ-FFQ**		**P**
n		115		111			110		
		mean	*(95% Confidence Interval)*	*mean*	*(95% Confidence Interval)*		*mean*	*(95% Confidence Interval)*	
Energy (kcal)	-	2403	(2254, 2551)	1477	(1367, 1587)	**0.000**	2063	(1885, 2242)	**0.004**
Protein (g)	-	58.4	(53.6, 63.1)	38.5	(35.0, 42.0)	**0.000**	54.6	(49.9, 59.3)	0.261
Fat (g)	-	47.6	(41.7, 53.5)	24.2	(21.0, 27.4)	**0.000**	40.0	(35.9, 44.0)	**0.038**
Calcium (mg)	800	**444***	(382, 505)	**293***	(249, 336)	**0.000**	**479***	(421, 537)	0.412
Iron (mg)	14.6‡	**12.22***	(11.14, 13.29)	**7.73***	(6.99, 8.47)	**0.000**	**11.79***	(10.50, 13.08)	0.614
Zinc (mg)	6.8	8.6	(7.8, 9.3)	**5.7***	(5.2, 6.2)	**0.000**	8.4	(7.59, 9.14)	0.701
Vitamin C (mg)	60	131.6	(113.8, 149.4)	78.6	(62.7, 94.5)	**0.000**	208	(164.5, 251.8)	**0.001**
Thiamin (mg)	0.9	1.160	(1.061, 1.260)	**0.741***	(0.668, 0.814)	**0.000**	1.131	(1.026, 1.237)	0.692
Riboflavin (mg)	0.9	1.275	(1.163, 1.387)	**0.825***	(0.747, 0.903)	**0.000**	1.380	(1.252, 1.508)	0.220
Niacin (mg)	11	13.672	(12.361, 14.984)	**8.725***	(7.845, 9.605)	**0.000**	14.394	(12.925, 15.862)	0.468
Vitamin B6 (mg)	1.1	2.614	(2.322, 2.906)	1.499	(1.317, 1.681)	**0.000**	2.394	(2.143, 2.645)	0.260
Folate (µg DFE)	320	431	(393, 468)	**227 ***	(204, 250)	**0.000**	395	(347, 444)	0.253
Vitamin B12 (µg)	2.0	**0.64***	(0.45, 0.83)	**0.75 ***	(0.59, 0.92)	0.376	**1.77 ***	(1.29, 2.25)	**0.000**
Vitamin A (µg RAE)	500	820	(718, 923)	**389***	(302, 475)	**0.000**	789	(653, 925)	0.714
Nutrients with intake <100% EAR (n)		3		9			3		

†Comparisons between the Standard 24HR and Simplified 24HR method, and the Standard 24HR and SQ-FFQ method, were done using one-way ANOVA; differences were considered statistically significant at P<0.05.

*Indicates nutrients for which the mean intake is less than the EAR[12].

[12] Food and Nutrition Board, Institute of Medicine, National Academies. Dietary Reference Intakes (DRIs): Estimated Average Requirements accessed online from: http://nationalacademies.org/HMD/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx

‡ For iron, the published EAR (8.1 mg/day assuming 18% bioavailability) was adjusted to a bioavailability of 10% by taking the physiological requirement for absorbed iron and dividing it by 0.10 (FNB, IOM, 2001)

Appendix Table 5.2. Summary of expenses (US Dollars) for field data collection of components of two test methods and a reference method of dietary intake assessment

Main Activity		Sub-Activity		US Dollars	
Code	Description	Code	Description	Amount	Sub-total
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	1	OFFICE SET UP & RUNNING EXPENSES	3821	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	2	PLANING & TEAM BUILDING MEETINGS	103	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	3	STUDY INTRODUCTION - DISTRICTS AND SUB-COUTY AUTHORITIES	204	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	4	TRANSPORT, CONVENYANCE & COURIER COSTS	524	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	5	AIRTIME AND INTERNET EXPENSES	379	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	6	IRB AND RESEARCH PERMITS APPLICATION	826	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	7	TRAINING (FIELD TEAMS)	65	
1	SURVEY PREPARATION & CROSS-CUTTING COSTS	14	REPORT -WRITING	1600	7520
2	HOUSEHOLD CENSUS/LISTING AND SAMPLE SELECTION	7	TRAINING (FIELD TEAMS)	1050	
2	HOUSEHOLD CENSUS/LISTING AND SAMPLE SELECTION	10	DATA COLLECTION	2160	
2	HOUSEHOLD CENSUS/LISTING AND SAMPLE SELECTION	13	DATA MANAGEMENT	693	3903
3	FGD/KI FOR FOOD AND RECIPE LISTING	7	TRAINING (FIELD TEAMS)	157	
3	FGD/KI FOR FOOD AND RECIPE LISTING	10	DATA COLLECTION	944	
3	FGD/KI FOR FOOD AND RECIPE LISTING	13	DATA MANAGEMENT	337	1438
4	DISHING UP EXERCISE	7	TRAINING (FIELD TEAMS)	1394	
4	DISHING UP EXERCISE	10	DATA COLLECTION	7018	
4	DISHING UP EXERCISE	13	DATA MANAGEMENT	281	8693
5	FOOD FOTO ATLAS PRODUCTION	11	PORTION SIZE PHOTOGRAPHY	1071	
5	FOOD FOTO ATLAS PRODUCTION	12	PHOTO ALBUM PRINTING	630	1701
6	SIMP RECIPE COLLECTION	7	TRAINING (FIELD TEAMS)	642	
6	SIMP RECIPE COLLECTION	10	DATA COLLECTION	3374	4015
7	RESPONDENT SENSITIZATION & INFORMED CONSENT MEE	7	TRAINING (FIELD TEAMS)	79	
7	RESPONDENT SENSITIZATION & INFORMED CONSENT MEE	8	FIELD MEETINGS (SENSITIZATION)	1658	1736
9	MAIN SURVEY - STD 24 HR RECALL ONLY	7	TRAINING (FIELD TEAMS)	4671	
9	MAIN SURVEY - STD 24 HR RECALL ONLY	9	MAIN SURVEY MOBILISATION & MOTHER TRAINING	607	
9	MAIN SURVEY - STD 24 HR RECALL ONLY	10	DATA COLLECTION	5945	
9	MAIN SURVEY - STD 24 HR RECALL ONLY	13	DATA MANAGEMENT	223	11446
10	MAIN SURVEY - SIMP 24 HR RECALL ONLY	7	TRAINING (FIELD TEAMS)	627	
10	MAIN SURVEY - SIMP 24 HR RECALL ONLY	9	MAIN SURVEY MOBILISATION & MOTHER TRAINING	559	
10	MAIN SURVEY - SIMP 24 HR RECALL ONLY	10	DATA COLLECTION	1523	
10	MAIN SURVEY - SIMP 24 HR RECALL ONLY	13	DATA MANAGEMENT	203	2912
11	MAIN SURVEY - SEMI-FFQ ONLY	7	TRAINING (FIELD TEAMS)	864	
11	MAIN SURVEY - SEMI-FFQ ONLY	9	MAIN SURVEY MOBILISATION & MOTHER TRAINING	260	
11	MAIN SURVEY - SEMI-FFQ ONLY	10	DATA COLLECTION	3006	
11	MAIN SURVEY - SEMI-FFQ ONLY	13	DATA MANAGEMENT	150	4280
12	STD RECIPE COLLECTION	7	TRAINING (FIELD TEAMS)	78	
12	STD RECIPE COLLECTION	10	DATA COLLECTION	3630	
12	STD RECIPE COLLECTION	13	DATA MANAGEMENT	176	3883