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Guidance for the Development of Food Photographs for Portion Size Estimation in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries

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Contents

List of Abbreviations.....	iii
Definitions and Usage of Terms	iv
1 Introduction.....	1
2 Types of Food Photographs	2
2.1 Description of Graduated Portion-Size Food Photographs	2
2.2 Description of Full-Size Food Photographs	3
3 Food Items Appropriate to Depict with Each Type of Food Photograph	7
3.1 Food Items for Which Graduated Portion-Size Food Photographs Are Well Suited	7
3.2 Food Items for Which Full-Size Food Photographs Are Well Suited	8
4 Guidelines for the Development of Food Photographs	10
4.1 Guidelines for Establishing the Portion or Unit Sizes to Depict	10
4.1.1 Establishing Portion Sizes for Graduated Portion-Size Food Photographs.....	10
4.1.2 Establishing Unit Sizes for Full-Size Food Photographs	12
4.2 Guidelines for Preparing the Food Items to Be Photographed	13
4.2.1 Preparing the Food Items to Be Depicted in Graduated Portion-Size Food Photographs	13
4.2.2 Preparing the Foods to Be Depicted in Full-Size Food Photographs	13
4.3 Guidelines for Presentation of the Food Items to Be Photographed	13
4.3.1 Presentation of Food Items in Graduated Portion-Size Food Photographs	13
4.3.2 Presentation of Foods in Full-Size Food Photographs	14
4.3.3 Presentation of Food Items When Both Graduated Portion-Size and Full-Size Food Photographs Are Used in a Survey.....	15
4.4 Guidelines for Photographing the Food Items to Be Depicted.....	15
4.4.1 Taking Graduated Portion-Size Food Photographs	15
4.4.2 Taking Full-Size Food Photographs	15
4.5 Guidelines for Designing the Layout of a Photographic Series for a Given Food Item	16
4.5.1 Layout of Graduated Portion-Size Food Photographs.....	16
4.5.2 Layout of Full-Size Food Photographs	17
4.6 Guidelines for Documenting the Weight of Each Portion or Unit Size Depicted	17
5 Pre-Testing and Validating Food Photographs	20
References	21

TABLES

Table 1. Comparison of Graduated Portion-Size and Full-Size Food Photographs: How Food Items Are Typically Depicted and How the Food Photographs Can Be Operationalized	6
Table 2. Comparison of Graduated Portion-Size and Full-Size Food Photographs: Types of Food Items and Example Foods for Which Each Type of Photograph Is Well Suited.....	9
Table 3. Example of How the Weight for Each Portion or Unit Size Depicted Can Be Documented	17
Table 4. Comparison of Graduated Portion-Size and Full-Size Food Photographs: Steps Required for the Development of a Photographic Series	18

BOXES

Box 1. Steps for Identifying the Portion Sizes to Depict in a Photographic Series for a Graduated Portion-Size Food Photograph.....	11
Box 2. Steps for Identifying the Unit Sizes to Depict in a Photographic Series for a Full-Size Food Photograph..	12

FIGURES

Figure 1. Examples of Graduated Portion-Size Food Photographs for Portion Size Estimation: A Photographic Series for Potato Chips and Roasted Duck.....	2
Figure 2. Example of a Full-Size Photograph for Portion Size Estimation: A Photographic Series for Avocados	4

List of Abbreviations

cm	centimeter(s)
FRIL	food, recipe, and ingredient listing
g	gram(s)
kg	kilogram(s)
LMICs	low- and middle-income countries
NIN	National Institute of Nutrition
PSEM	portion size estimation method

Definitions and Usage of Terms

Edible portion: The parts of a food that are typically consumed after all inedible parts are removed, if the food has any. For example, the part of the avocado left after the peel and pit have been removed.

Edible portion factor (also called “edible coefficient”): A numeric value needed during data processing to account for any inedible parts of a given food (e.g., bones, seeds, pits, or peels). During data processing, the edible portion factor is used to convert the amount of food reported as consumed into its equivalent edible weight in grams (e.g., “grams consumed,” “grams of ingredient used,” or “grams of recipe prepared”). The edible portion factor is calculated as the ratio of the edible portion of a food to the entire food (i.e., the edible portion factor = edible portion ÷ [the edible portion + inedible portion]). The edible portion factor is a value >0 and ≤1 and is equal to 1 when the entire food is edible (i.e., there are no inedible parts). Every food in the food, recipe, and ingredient listing (FRIL) should have an associated edible portion factor listed in the portion size estimation method (PSEM) conversion factor database.

Food: A food that is not mixed with other foods (e.g., banana, groundnuts). For simplicity in language, in this document, we use the term “food” broadly to also refer to beverages. Composite foods, such as bread and cakes, which are prepared with multiple ingredients but often included in food composition tables as a single food item, may also be treated as a food in the FRIL for the purpose of dietary data collection.

Food form: Refers to the physical form of a food item listed in the FRIL (e.g., whole, sliced, diced, mashed, pureed).

Food item: A term used to refer collectively to foods, beverages, and mixed dishes consumed, as well as to ingredients used to prepare a mixed dish.

Food photograph: A photograph of a real food item developed to represent a known portion or unit size, to be used for portion size estimation during data collection for a quantitative 24-hour dietary recall survey.

Food presentation mode: Refers to how a food item listed in the FRIL is presented and served (e.g., served with or without inedible parts, served on a plate)

Food state: Refers to the preparation state of a food item listed in the FRIL (e.g., raw, boiled, steamed, roasted, grilled, baked, shallow-fried, deep-fried).

Food, recipe, and ingredient listing (FRIL): A comprehensive list of all foods, beverages, recipes, and ingredients - and their relevant descriptive details – that are likely to be encountered during the 24-hour dietary recall interviews carried out across all geographic areas where the survey will be implemented and for all demographic groups that will be included in the survey. The FRIL should list each food, recipe, and ingredient in the state (e.g., raw, boiled, steamed, grilled, fried), form (e.g., whole, sliced, diced, mashed, pureed), and presentation mode (e.g., served with or without inedible parts) in which it is consumed.

Full-size food photographs: Food photographs that depict a series of images of a single food in its natural, whole, unprocessed state at full size (i.e., 100% scale). The unit sizes depicted correspond to different size gradations in which the specified food exists naturally along a continuum from very small to very large (e.g., entire avocados of different sizes).

Graduated portion-size food photographs: Food photographs that depict a series of scaled-down images (i.e., the images are typically presented at <100% scale) of a food or mixed dish in a given state, form, and presentation mode. Food items are typically shown on a plate. An object of a known size (e.g., cutlery, such as a spoon, fork, knife, or chopsticks; and/or a ruler) is shown next to the plate to provide a reference for size. The portion sizes

depicted in the images for a photographic series correspond to different portion sizes along a continuum from very small to very large.

Homogenous mixed dish: A mixed dish in which all ingredients are more or less evenly distributed. Thus, any serving from the mixed dish would contain similar proportions of the constituent ingredients.

Inedible portion (also called “inedible part” or “non-edible part”): The parts of a food that are typically included in the food when served but not consumed. Examples of foods that are commonly served with inedible parts include chicken, fish, and other meat served with bone; groundnuts in the shell; maize on the cob; and fruits with inedible seeds, pits, or peels.

Ingredient: A food that is used in a mixed dish.

Mixed dish: A dish, usually with a specific culinary name, that is prepared using two or more ingredients.

Non-homogenous mixed dish: A mixed dish in which ingredients are not evenly distributed. Thus, any serving from the mixed dish would not necessarily contain similar proportions of the constituent ingredients. Typically, non-homogenous mixed dishes refer to dishes in which the ingredients that are not evenly distributed in the mixture are nutrient-dense (e.g., chunks of red meat, fish, or poultry in a stew).

Non-standard recipe (also called a “household recipe” or “unique recipe”): A recipe derived from data collected in the household during the 24-hour dietary recall interview. During the interview, the respondent, or the cook of the mixed dish, provides the details of the mixed dish consumed by the respondent; these include a detailed description of the ingredients and their amounts used, the total amount of mixed dish prepared, and the amount of mixed dish consumed.

Photographic series: A set of food images depicting different portion or unit sizes of a particular food item (e.g., representing six or eight different portion or unit sizes) used for portion size estimation during data collection for a quantitative 24-hour dietary recall survey.

Portion size estimation method (PSEM): A method used to estimate the amount of food, beverage, or mixed dish consumed by survey respondents; the amount of an ingredient used; or the total amount of a mixed dish prepared. As there is no single PSEM that can be used for all food items likely to be encountered in a survey, a set of different PSEMs must be selected for use in a survey. The use of PSEMs in dietary surveys in low- and middle-income countries often requires the use of equipment, tools, and aids, such as dietary scales, proxy materials (e.g., playdough, raw rice, Kinetic Sand®), household utensils, food photographs, two-dimensional shapes, and three-dimensional food models.

PSEM conversion factor: A numeric value needed during data processing to convert the amount of food reported as consumed using a pre-determined PSEM into its equivalent edible weight in grams (e.g., “grams consumed,” “grams of ingredient used,” or “grams of recipe prepared”) after accounting for any inedible parts of that food (e.g., bones, seeds, pits, or peels). The PSEM conversion factor for a given food item is calculated by multiplying the “PSEM-specific factor” by the “edible portion factor”. Every food item in the FRIL should have an associated PSEM conversion factor listed in the PSEM conversion factor database, for each PSEM assigned to that food item.

PSEM-specific factor: A numeric value needed to convert the amount of food reported as consumed, estimated using a pre-determined PSEM, into its equivalent weight in grams (e.g., “grams consumed,” “grams of ingredient used,” or “grams of recipe prepared”) before accounting for any inedible parts of that food (e.g., bones, seeds, pits, or peels). Every food item in the FRIL should have an associated PSEM-specific factor listed in the PSEM conversion factor database, for each PSEM assigned to that food item.

Recipe: A description of a mixed dish that provides the list of ingredients used to prepare the mixed dish, along with a detailed description of all ingredients used (including any processing and cooking methods applied to each ingredient before adding the ingredient to the mixed dish). The cooking methods applied to the mixed dish itself (if the dish is cooked) are also included as part of the recipe information. In dietary surveys, a recipe includes

information on the quantity (in grams) of each ingredient used to prepare the mixed dish (in the form added to the mixed dish, which is typically raw) and the final quantity of the mixed dish once it is fully prepared and/or cooked.

Standard recipe (also called a “pre-defined recipe”): An “average” recipe that aims to reflect the way that a mixed dish is usually prepared by respondents in a survey area. Standard recipes can be used for mixed dishes that are known to be prepared similarly across a defined survey area (in terms of the ingredients used, the preparation methods for those ingredients and the mixed dish itself, and the relative proportion of each ingredient used in the mixed dish). Standard recipes are also typically used when survey respondents report consuming mixed dishes prepared outside the home (e.g., by vendors or in restaurants or in “ready meals” purchased from stores).

Substitution factor: An additional conversion factor (i.e., numeric value) that is required during data processing to translate the portion size depicted in a graduated portion-size food photograph into the portion size of the substitution food item consumed.

Substitutions: Refers to using a PSEM developed for use with a specific food item to estimate the portion size consumed for a set of similar food items that are not depicted (e.g., use of graduated portion-size food photographs depicting cooked spinach to assess the amount of cooked kale consumed). Survey planners can consider the use of substitutions when using graduated portion-size food photographs but not when using full-size food photographs as a PSEM.

1 Introduction

Different portion size estimation methods (PSEMs) can be used in quantitative 24-hour dietary recall surveys to aid the respondent to visually represent and estimate the amount of each food item consumed.¹ Food photographs—visual images that represent a range of portion or unit sizes of real food items—are one PSEM that can be used to help respondents report the amounts of foods and mixed dishes consumed the previous day. Using food photographs during the 24-hour dietary recall interview is relatively easy. The respondent is shown a photographic series for a given food item with images that are arranged according to portion or unit sizes, usually arranged successively from smallest to largest, and asked to select the portion or unit size that most closely corresponds to the amount of the food item consumed.

The development of food photographs in the context of a dietary survey is resource-intensive and requires considerable technical expertise. To ensure that food photographs will provide an accurate method to estimate the amount consumed, there is a complex set of issues that need to be considered related to the development of the photographs.

The purpose of this guidance document is to outline the steps and to provide related technical guidance for the development of high-quality food photographs for portion size estimation in dietary surveys in low- and middle-income countries (LMICs).^{2,3} We first describe two different types of food photographs that can be used for portion size estimation (**Section 2**) and provide considerations for the selection of food items appropriate to depict with each type of food photograph (**Section 3**). Then, we provide guidance on how to carry out the steps required for the development of high-quality food photographs (**Section 4**). Finally, we describe the importance of pre-testing, and ideally validating, food photographs in the relevant survey context before using the photographs for portion size estimation when collecting data for a dietary survey (**Section 5**).

¹ For guidance on how to select PSEMs for use in a quantitative 24-hour dietary recall survey, while also taking account of contextual factors related to the survey, see Vossenaar M, Lubowa A, Hotz C, Deitchler M, Moursi M, Arimond M, Crispim SP, Arsenault J. 2020. *Considerations for the Selection of Portion Size Estimation Methods for Use in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available at: [Intake.org](https://intake.org).

² Several sections in this *Intake* publication provide content summarized or extracted directly from *Intake's* survey guidance document, *Considerations for the Selection of Portion Size Estimation Methods for Use in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries*. However, readers should note that because this document focuses on guidance for the development of food photographs, the document is not intended to address considerations related to the use of food photographs for portion size estimation in full detail. For this reason, we recommend that survey planners who are considering the use of food photographs as PSEMs in a dietary survey not only read this current document but also refer to the aforementioned document in footnote 1.

³ This guidance document does not describe the use of food photographs to help identify food items (e.g., to confirm that the respondent and the enumerator have a common understanding about the food item reported - as may be relevant when using “standard unit size” as a PSEM).

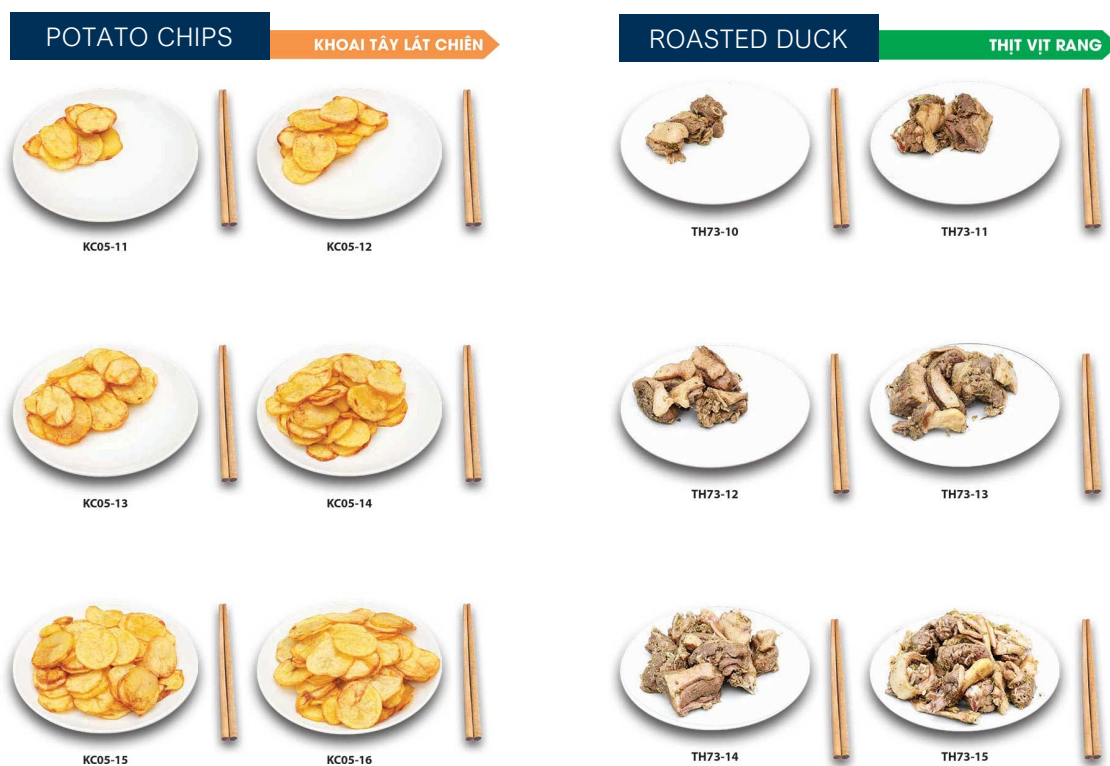
2 Types of Food Photographs

There are two types of food photographs that can be used for portion size estimation. For simplicity, we refer to these as “graduated portion-size food photographs” and “full-size food photographs”. These two types of food photographs differ in how they function as PSEMs. As described in **Section 2.1** and **Section 2.2** below, the two types of food photographs vary both in how the food items represented in the food photographs are typically depicted and in how the photographs can be operationalized for data collection.

2.1 Description of Graduated Portion-Size Food Photographs

Graduated portion-size food photographs depict a series of portion sizes that increase along a continuum for a given food item. The food items represented in graduated portion-size food photographs should be depicted in a single state, form, and presentation mode, and are often shown on a plate. The food items represented are typically not depicted at full size; rather, an object of a known size (e.g., cutlery, such as a spoon, fork, knife, or chopsticks; and/or a ruler) is included in each image to provide a reference for size. An even number of portion sizes should be presented in a photographic series for a given food item to prevent the tendency of the respondent to select the middle-sized image (Nelson and Haraldsdóttir 1998b). Ideally, at least six portion sizes are included in a photographic series for a given food item. Examples of graduated portion-size food photographs are shown in **Figure 1**.

Figure 1. Examples of Graduated Portion-Size Food Photographs for Portion Size Estimation: A Photographic Series for Potato Chips and Roasted Duck



These photographic series are reproduced with permission from Viet Nam National Institute of Nutrition (NIN). 2019. *Photo Book for Dietary Assessment*. Medical Publishing House. Hanoi: Medical Publishing House. The photographic series for potato chips (page 21) and roasted duck (page 133) are both printed at 32% scale when printed on a full-size page.

Graduated portion-size food photographs should only depict food items with inedible parts excluded. Likewise, during the 24-hour dietary recall interview, the photographs should only be used to estimate amounts of food items that were served, and therefore can be most accurately visualized, with inedible parts excluded. If the presentation mode of the food item reported by the respondent is not consistent with the depiction of the food item in the graduated portion-size food photographs, a different PSEM should be used to estimate the amount of the food item consumed.

When using graduated portion-size food photographs for portion size estimation, survey planners may decide to operationalize the use of the food photographs so that the respondent can report:

1. Multiples of a portion size depicted by a food image
2. Fractions of a portion size depicted by a food image
3. Portion sizes not depicted (e.g., the portion size consumed falls in between two different portion sizes depicted or is smaller than the smallest or larger than the largest portion size depicted)

Due to the complexity of operationalization, it is not feasible to allow all three of the above reporting options within a given survey. Allowing the use of both multiple and fractional reporting (Options 1 and 2) is appropriate. However, the use of multiple and/or fractional reporting should not be allowed in combination with the reporting of portion sizes not depicted (Option 3). Conceptually, the cognitive process for reporting multiples and fractions is different from the cognitive process for reporting portion sizes not depicted; and, mathematically, they may not result in the same portion size. How survey planners decide to operationalize graduated portion-size food photographs should be informed by the numeracy level of both the respondents targeted for the survey and the enumerators collecting the dietary data, as well as the quality of the food photographs themselves (i.e., how the portion sizes depicted were derived and the range of portion sizes depicted for a given food item).

Before allowing any of the above reporting options with graduated portion-size food photographs, survey planners should carefully consider the various trade-offs. Adoption of any of the above reporting options brings added complexity for both the respondent and the enumerator during 24-hour dietary recall data collection. When a rigorous method is used to determine the portion sizes to be depicted and an appropriate number of portion size options are depicted for each food item, the need to allow any of the three options listed above can usually be avoided.

In addition to the above reporting options, graduated portion-size food photographs can be operationalized in a way that allows the use of “substitutions.” Substitutions refer to the use of a photographic series developed for a specific food item to estimate the portion size consumed of similar food items that are not depicted (e.g., using a photographic series of cooked spinach to assess the amount of cooked kale consumed). The use of substitutions with graduated portion-size food photographs is described in more detail in **Section 3.1**.

2.2 Description of Full-Size Food Photographs

Full-size food photographs depict a series of different sizes of a single food, each at 100% scale, with the food typically shown in a whole, unprocessed state and in sizes in which the food naturally exists (e.g., entire avocados of different sizes). A photographic series of full-size food photographs for a given food consists of images of entire foods that vary in size from smallest to largest but that are similar in shape. The sizes depicted for the food do not correspond to a range of possible portion sizes, but rather to different size gradations in which the specified food exists naturally. Often six or eight sizes of the food are included in a photographic series, although the number is limited by how many full-size images fit on a single sheet of paper. When possible, an even number of unit sizes of the food should be presented in a photographic series, to prevent the tendency of the respondent to select the middle-sized image (Nelson and Haraldsdóttir 1998b). Examples of full-size food photographs are shown in **Figure 2**.

Figure 2. Example of a Full-Size Photograph for Portion Size Estimation: A Photographic Series for Avocados



FR01-01



FR01-02



FR01-03



FR01-04



FR01-05



FR01-06

These images are at 100% scale when printed on a full-size page.

Full-size food photographs can depict foods that may or may not have inedible parts. If the unprocessed, whole, natural state, form, and presentation of a given food includes inedible parts, then these inedible parts must be included in the photograph (e.g., a mango with pit and skin). At the time of the 24-hour dietary recall interview, full-size food photographs should be used only to estimate amounts consumed (or amounts used as ingredients in mixed dishes) of foods visualized in the same unprocessed, natural state, form, and mode of presentation as the food is depicted in the photographic series. If the unprocessed, whole, natural state, form, and presentation of a given food includes inedible parts, then the respondent should report the amount consumed of that food in that form and presentation mode with inedible parts included. Alternatively, if the unprocessed natural state, form, and presentation mode of a given food does not have any inedible parts, this is how the full-size food photographs should depict the food, and how the respondent should report the amount consumed of that food. When the state, form, and presentation mode depicted in the photographic series is not consistent with the state, form, and presentation mode in which the respondent consumed the food, a different PSEM must be used for that food.

The use of full-size food photographs as a PSEM requires allowing respondents to report multiples and fractions of the selected unit size to ensure accurate portion size estimation. This is because the images depicted in full-size food photographs do not correspond to a range of portion sizes of a given food, but rather depict naturally occurring whole unit sizes of that food. Because respondents do not consume portion sizes that are limited to whole unit sizes of a given food, the use of multiples and fractions is therefore required. However, the reporting of fractions can present cognitive difficulties for both respondents and enumerators; therefore, survey planners should always consider the survey context carefully to determine whether fractional unit reporting is feasible. When the use of fractional unit reporting is deemed unreliable, then full-size food photographs should not be used as a PSEM. When deemed feasible, the use of fractions for reporting should be limited to halves, thirds, or fourths, as smaller fractions may be challenging to visualize and report and are unlikely to meaningfully affect the estimated amounts consumed.

Full-size food photographs should not be operationalized in a way that allows a respondent to indicate that the amount consumed falls in between two different unit sizes depicted or to indicate that the portion size consumed was smaller than the smallest or larger than the largest food size depicted. This is because full-size food photographs require allowing respondents to report multiples and fractions of a given food size depicted in a food photograph, and the use of multiple and fractional reporting in combination with portion sizes not depicted should never be allowed, given the complexity of operationalization.

Likewise, the use of substitutions is not relevant to the use of full-size food photographs because full-size photographs are used to represent different unit sizes of a whole food in an unprocessed state, and it cannot be assumed that the size increments for the given food for which the photographs were developed would relate to the appropriate size increments for a different food, or that a different food would have a similar edible portion to the food depicted.

The similarities and differences in how food items are typically depicted in graduated portion-size and full-size food photographs, and how they can be operationalized for data collection, are summarized in **Table 1**.

Table 1. Comparison of Graduated Portion-Size and Full-Size Food Photographs: How Food Items Are Typically Depicted and How the Food Photographs Can Be Operationalized

Graduated Portion-Size Food Photographs	Full-Size Food Photographs
How food items are typically depicted	
In the state, form, and presentation mode normally served (i.e., typically processed)	In a natural, whole, unprocessed state
Food items should be depicted without inedible parts	Foods that include inedible parts must be depicted with the inedible parts
On a plate with a serving utensil and/or ruler for scale	Without a plate, but a serving utensil and/or ruler can be included for scale
At <100% scale (with % scale shown on the photographic series)	At full scale ^A
A commonly consumed range of portion sizes are shown across the set of images in a photographic series	Naturally occurring unit sizes are shown across the set of images in a photographic series
Ideally, 6 or 8 different portion sizes are depicted in a photographic series	Ideally, 6 or 8 different unit sizes are depicted in a photographic series
An even number of portion sizes should be presented in a photographic series to prevent the tendency of the respondent to select the middle-sized image	An even number of unit sizes should be presented in a photographic series to prevent the tendency of the respondent to select the middle-sized image
How the food photographs can be operationalized for data collection	
Reporting multiples of a portion size depicted in a food image may be allowed ^B	Allowing the reporting of multiples of a unit size depicted in a food image is required for accurate portion size estimation ^C
Reporting fractions of a portion size depicted in a food image may be allowed ^D	Allowing the reporting of fractions of a unit size depicted in a food image is required for accurate portion size estimation ^C
Reporting portion sizes not depicted in a food image may be allowed ^E	Reporting unit sizes not depicted in a food image is not allowed
Substitutions for the food item depicted in a food image may be allowed	Substitutions for the food depicted in a food image depicted is not allowed

A With % scale depicted on each photographic series if used in combination in a survey with graduated portion size-food photographs.

B Can be allowed in combination with fractional reporting, but not with the reporting of portion sizes not depicted.

C Allowing for both multiple and fractional reporting is required.

D Can be allowed in combination with multiple reporting, but not with the reporting of portion sizes not depicted.

E Not allowed in combination with fractional or multiple reporting.

3 Food Items Appropriate to Depict with Each Type of Food Photograph

Although food photographs can be developed for a wide array of food items, in practice a limited selection of food photographs are typically newly developed for any given survey. The number of food photographs that can be developed largely depends on the resources and time available for their development and pre-testing, and possibly validating, in the field.

Given that practical considerations may limit the number of food photographs that can be developed for use in a given survey, food items for which food photographs are newly developed should be prioritized carefully. Food items to be considered should be widely consumed (e.g., staple foods) and/or have nutritional relevance for the population of interest (e.g., nutrient-dense foods such as meat and dark green leafy vegetables). The number of food items to be represented in food photographs will depend on whether substitutions are allowed (relevant only for graduated portion-size food photographs).

Considerations of whether a food item is well suited to be depicted by graduated portion-size or full-size food photographs include the specific characteristics of that food item, such as whether it is a single food or a mixed dish; how it is typically consumed (e.g., processed or unprocessed); how it is typically presented (e.g., with or without inedible parts); and how it is typically served and visualized (e.g., on a plate or without a plate). Details on the type of food items suitable for graduated portion-size and full-size food photographs are provided below.

Within a quantitative 24-hour dietary recall survey, either graduated portion-size food photographs or full-size food photographs, or a combination of both, can be used to estimate amounts consumed, but only one type of food photograph should be used for any food item in a given state, form, and presentation mode. However, it is feasible to develop graduated portion-size food photographs for a given food item in one state, form, and presentation mode (e.g., mashed avocado) and full-size food photographs for that food item in its natural, whole, unprocessed form (e.g., whole, unprocessed avocado).

3.1 Food Items for Which Graduated Portion-Size Food Photographs Are Well Suited

Graduated portion-size food photographs can be used for a wide selection of food items, including both single foods and mixed dishes. High-quality food photographs in which food items are depicted at an angle can show both the spread and the depth of the food item. As such, graduated portion-size food photographs are well suited to estimate portion sizes of solid or semi-solid foods that are typically served in mounds, heaps, lumps, or chunks. Graduated portion-size food photographs are especially well suited for food items that vary in the portion size commonly consumed along a continuum from very small to very large. They are also suited for items that are irregular in shape or size and that are not available in commercially standardized amounts. The food items depicted must be able to be served in the pre-established portion sizes to be depicted (as derived from existing dietary data, described in **Section 4.1.1**) such that the gram increment difference between each portion size depicted within a photographic series is equal (or very close to equal). For example, cooked rice can be served in any portion size and cooked potatoes can be cut into the intended portion sizes.

Examples of food items well suited for the development of graduated portion-size food photographs include solid or semi-solid staples, vegetables, legumes, meats, fish, and desserts presented with inedible parts excluded.

Graduated portion-size food photographs are not well-suited for depicting foods with inedible parts. This is because presenting the pre-established portion size of foods that include inedible parts is challenging. For example, it may not be possible to present different portion sizes of steak or fish with the same proportion of bone.

When graduated portion-size food photographs are used to depict a mixed dish, they should only be used to depict a mixed dish for which a standard recipe has been developed. The photographs can depict either homogenous or non-homogenous mixed dishes. In a non-homogenous mixed dish, the ingredients are not evenly distributed, such that any serving from the mixed dish would not contain similar proportions of the ingredients (e.g., varying chunks of red meat, poultry, or fish). Survey planners may decide that the amount consumed of nutrient-dense ingredients should be estimated separately from the amount consumed of the homogenous part of the mixed dish. When this is the case, it is not possible to use graduated portion-size food photographs for portion size estimation for that standard recipe. This is because a food photograph of the remaining homogenous portion of the mixed dish is not typically developed. In this case, an alternative PSEM⁴ should be used.

Given that practical constraints limit the number of graduated portion-size food photographs that can be developed, survey planners may wish to consider allowing the use of substitutions. The use of substitutions requires following a set of careful criteria for the selection of food items that will be allowed to be used as substitutions with the PSEM assigned to a given food item. The substitution and actual food item reported should look very similar in terms of shape, color, and consistency; be classified in the same food group (e.g., vegetables, dairy); be served similarly (e.g., served whole on a plate, served in squares); not include inedible parts; and be consumed in similar portion sizes. For mixed dishes, substitutions should be considered only for dishes that have the same “mandatory ingredients”⁵ (e.g., maize flour in maize porridge), but for which one or more “major ingredient” (e.g., sugar in maize porridge)⁶ or “minor ingredient”⁷ (e.g., cinnamon in maize porridge) may vary. In addition, substitutions should be considered only when both the actual mixed dish and the substitution mixed dish are homogenous and for which a standard recipe has been developed.

The use of substitutions can have complex downstream implications for data processing. An additional conversion factor (referred to as the “substitution factor”)⁸ is required to translate the portion size depicted in the food photograph into the portion size of the substitution food item consumed. Because the incorrect use of substitutions can lead to large errors in portion size estimation, *Intake* recommends avoiding the use of substitutions when possible. For this same reason, we advise against using substitutions for foods that are very prominent in the local diet (i.e., widely consumed and nutritionally relevant).

3.2 Food Items for Which Full-Size Food Photographs Are Well Suited

The use of full-size food photographs is limited to use with foods depicted in a whole, unprocessed state. Foods for which full-size food photographs are developed should be very similar in shape even as they vary in size and can, therefore, be grouped into average standard sizes ranging, for example, from very small through small, medium, large, and very large to extra-large. Furthermore, the food should typically be consumed or used in a few units, or fractions of units, that can be easily counted. The images of the different sizes depicted within a photographic series should fit on a single page at 100% scale. For some foods, shapes and color vary between varieties and a given photographic series will only be suitable for a given variety.

⁴ Suitable PSEMs may include: proxy weight using a material that can be shaped into different sizes and shapes, such as playdough; or proxy weight using a free-flowing material that is pourable, such as raw rice.

⁵ “Mandatory ingredients” are the primary constituents of a mixed dish and often give the dish its name.

⁶ “Major ingredients” are optional ingredients that may or may not be added to a mixed dish depending on choice and availability. These ingredients alter the nutrient content of the dish but do not change the basic nature of the dish.

⁷ “Minor ingredients” or flavorings are optional ingredients added in small quantities that are judged inconsequential to the overall nutrient content of a mixed dish.

⁸ For guidance related to the compilation, collection, and use of PSEM conversion factors and the calculation and use of substitution factors, see Vossenaar M, Hotz C, Arsenaault J, Deitchler M, Arimond M, Lubowa A, Moursi M. Forthcoming. *How to Compile the Portion Size Estimation Method Conversion Factor Database for a Quantitative 24-Hour Dietary Recall Surveys in a Low- or Middle-Income Country*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available soon at: [Intake.org](https://www.intake.org).

Full-size food photographs should not be developed for single foods that are more easily visualized when processed (e.g., a slice of watermelon) or for any type of mixed dish. They can, however, be used to estimate amounts of ingredients that are most easily visualized before they are processed and added to a mixed dish.

Examples of foods well suited for the development of full-size food photographs include: fruits (e.g., mangoes, avocados, guava, bananas, apples), vegetables often used as ingredients (e.g., onions, tomatoes, carrots, eggplant, peppers), and roots and tubers used as ingredients (e.g., beets, turnips, potatoes).

Since the use of full-size food photographs is limited to foods in a whole, unprocessed state, images should depict the food including all inedible parts (if the food has any).

The types of food items for which graduated portion-size food and full-size food photographs can be used to estimate amounts consumed are summarized in **Table 2**.

Table 2. Comparison of Graduated Portion-Size and Full-Size Food Photographs: Types of Food Items and Example Foods for Which Each Type of Photograph Is Well Suited

Graduated Portion-Size Food Photographs	Full-Size Food Photographs
Types of food items for which the food photograph type is well suited	
Single foods (including ingredients) and mixed dishes that have a standard recipe ^A	Single foods (including ingredients used in mixed dishes before processing)
Solid or semi-solid foods and mixed dishes that are typically served in mounds, heaps, lumps, or chunks	Foods in a natural, whole, unprocessed state
Food items that are irregular in shape or size and that are not available in commercially standardized amounts	Foods that are very similar in shape even as they vary in size
Food items that vary in portion sizes commonly consumed along a continuum from very small to very large	Foods consumed or used in a few units or fractions of units that can be easily counted
Food items that can be served in the intended portion sizes (with an equal gram increment difference separating each successive portion size)	Foods items that exist in different, naturally occurring sizes
Food items typically presented without inedible parts	Foods that may or may not include inedible parts, but unprocessed foods usually include inedible parts
Examples of foods for which the food photograph type is well suited	
Solid or semi-solid staples, vegetables, legumes, meats, fish and desserts presented with inedible parts excluded	Fruits, vegetables, roots and tubers ^B

A A standard recipe is an “average” recipe that aims to reflect the way that mixed dishes are usually prepared by respondents in a survey area.

B Either consumed unprocessed, or when estimating the amount of ingredients used in a mixed dish (and the amount estimated is before any processing of the ingredient).

4 Guidelines for the Development of Food Photographs

The development of high-quality food photographs requires several steps. First, the number of different portion or unit sizes to depict and what portion or unit sizes to represent in each photographic series must be established. Careful work is then required to prepare and present the food items to be depicted as intended. During the development of food photographs, it is essential to determine the corresponding weight in grams of each portion or unit size depicted. Once the food photographs are taken, the images within a photographic series for a given food item must be appropriately edited and arranged.

Below, we provide guidance for each of the steps required for the development of graduated portion-size and full-size food photographs. Key differences between the development of the two types of photographs are highlighted. When using electronic data collection methods, if food photographs are used as a PSEM, the food photographs are typically printed on paper and not integrated into the data collection software. The guidance provided below, therefore, relates to printed food photographs—not to images that are integrated into an electronic data collection program.

4.1 Guidelines for Establishing the Portion or Unit Sizes to Depict

The selection of the number of different sizes and which portion or unit sizes to depict is an important consideration for high-quality food photograph development. The respondent's ability to accurately report the amount consumed is related to the number, interval, and range of portion or unit sizes depicted. Decisions around the portion or unit sizes to include in a photographic series requires considerable technical expertise.

Intake recommends ensuring that an a sufficiently large number of portion or unit size options are depicted for each food item; this number will depend on the food item to be depicted and, in the case of graduated portion-size food photographs, on the range of portion sizes typically consumed by the demographic group with whom the food photographs will be used for portion size estimation. At least six portion or unit sizes should be depicted in a photographic series; these can typically fit on a single page. The portion or unit size increments should not be so large as to lead to errors in the estimation of amounts consumed, but at the same time, the difference in the portion or unit sizes depicted should be visually discernible to the respondent (i.e., there should be a clear difference in portion or unit size between each successive portion or unit size depicted).

4.1.1 Establishing Portion Sizes for Graduated Portion-Size Food Photographs

When graduated portion-size food photographs are developed, the number of portion sizes and the portion sizes to depict within a photographic series should ideally be derived from existing quantitative 24-hour dietary recall data collected from the same (or very similar) geographic area during a similar season as planned for the survey. The available data should be of high quality and be somewhat representative of the demographic groups to be targeted for the planned survey (e.g., infants and young children, adolescents, adult males, adult females).

Quantitative 24-hour dietary recall data are needed to identify the minimum and maximum portion sizes typically consumed. When relevant, minimum and maximum portion sizes may need to be set differently by demographic group to be targeted for the survey (e.g., infants and young children consume a different range of portion sizes than adults). The minimum and maximum portion sizes depicted in a photographic series for a food item are often defined as the 5th–10th and 90th–95th percentile of reported portion sizes for a given demographic group, respectively, derived from the reported distribution in previous dietary surveys (Nelson and Haraldsdóttir 1998b). Intermediate portion sizes are then set between the minimum and maximum portion sizes depicted, with a consistent difference in grams between each portion size depicted.

Box 1 outlines the recommended steps to follow for identifying the portion sizes to depict in a photographic series for a food item to be represented in a graduated portion-size food photograph.

Box 1. Steps for Identifying the Portion Sizes to Depict in a Photographic Series for a Graduated Portion-Size Food Photograph

Step 1. Identify the minimum and maximum portion sizes to be depicted for the given food item using existing quantitative dietary data

- Identify a high-quality dataset from which reported portion sizes can be derived.
- Plot the distribution of reported portion sizes for the demographic group of interest for the survey and choose which percentiles to use to derive the minimum and maximum portion size to depict. In general, the minimum and maximum can be defined as the 5th–10th and 90th–95th percentile of consumption, respectively.
- Review the minimum and maximum portion size for the food item and consider if they are realistic in the given context.

Step 2. Identify a set of intermediate portion sizes to depict for the given food item, which are in-between the minimum and maximum portion sizes identified

- For most food items, it is appropriate to identify six or eight portion sizes to depict in a photographic series. An even number of portion sizes should be depicted.
- Calculate the difference between the minimum and maximum portion size for the food item in grams, then divide this amount by one less than the number of portion sizes to be depicted. This represents the portion size increment (in grams) to depict between each image of the food item. Using this method to calculate the intermediate portion sizes to depict for a given food item ensures that the portion sizes depicted vary along a continuum and that the increment in portion size is always the same in grams.

Step 3. Visually confirm the usability of the selected portion sizes for the given food item, and adjust the portion sizes, if needed

- Visually confirm that the differences in portion sizes for the food item are discernible; oftentimes, this can only be checked during the photo session.
- Visually confirm that it is not difficult to sort the portion sizes from smallest to largest.
- If, after visual inspection, any of the two criteria above for usability of the selected portion sizes cannot be confirmed, adjust the portion sizes to depict in the photographic series, either by increasing the overall range of portion sizes to depict or by reducing the number of portion sizes to depict. Follow the guidance above in Steps 1 and 2, as much as possible, when doing so; and, once this is done, visually confirm the usability of the adjusted portion sizes.

NOTE If multiple demographic groups will be targeted by the survey, it may be necessary to carry out Steps 1-3 by demographic group to determine the appropriate portion sizes to depict separately for each demographic group (e.g., infants and young children consume a different range of portion sizes than adults).

4.1.2 Establishing Unit Sizes for Full-Size Food Photographs

Full-size food photographs represent single foods at 100% scale, meaning that foods that are depicted in full-size photographs appear in the printed photographs in the same size that they would appear in real life. Full-size food photographs do not depict portion sizes from smallest to largest portion along a continuum; instead, the food is typically depicted in its natural, whole, unprocessed state form (e.g., entire avocado, entire mango), with the size of the food presented in different, naturally occurring sizes (e.g., a very small, small, medium, large, very large and extra-large avocado).

Box 2 outlines the recommended steps to follow for identifying the unit sizes to depict in a photographic series for a food to be represented in a full-size food photograph.

Box 2. Steps for Identifying the Unit Sizes to Depict in a Photographic Series for a Full-Size Food Photograph

1. Collect a sample of 20-30 units of the food (e.g., avocado) to be depicted in the food photograph. The sample of different units of the food should be collected by purchasing the food from different vendors in the survey area. Across the sample collected, the units of the food purchased should vary in size.
2. Take a single weight measurement for each food sample, including all inedible parts,^A and document the respective weight (to the nearest gram) (i.e., weigh each avocado purchased and record its weight, including the peel and pit).^B All weight measurements should be made with a dietary scale that meets *Intake* specifications^C and has been tested for accuracy and precision.^D
3. Organize the food samples, along with the corresponding weight measurement for each unit of the food, in a continuum from smallest to largest (i.e., physically arrange the avocados in size from smallest to largest, using the recorded weight measurement as the reference for size).
4. Identify six or more weights along the continuum that are spaced in such a way that, to the extent possible, the difference in size between each of the weights is visually perceivable and fairly equally spaced (in terms of the gram difference in weight). For this step, an even number of weights should be identified. The smallest (or next smallest) and the largest (or next largest) food in the sample (in terms of gram weight) should typically be included among the weights identified, with the goal of representing the likely range of sizes. If the weights for a sample of 25 avocados were: 100 g, 105 g, 120 g, 123 g, 140 g, 142 g, 146 g, 148 g, 150 g, 170 g, 175 g, 180 g, 188 g, 192 g, 196 g, 200 g, 202 g, 203 g, 205 g, 210 g, 220 g, 222 g, 225 g, 225 g, and 228 g, it might be reasonable to select the following six weights from this sample of avocados to represent the series of avocado sizes to depict in the photographic series: 105 g, 123 g, 150 g, 175 g, 200 g, and 225 g.^B

A As such, during data processing, an “edible portion factor” is needed to derive the edible portion of the food item.

B The weight of each food sample selected for depiction in the photographic series must be recorded systematically and documented as described in **Section 4.6**.

C Essential features include electronic with digital readout, a maximum weight capacity ranging from 5 kg to 15 kg, 1 g display increments, and a precision of 1% across the load range. For guidance on dietary scale specifications, see Vossenaar M, Hotz C, Lubowa A, Ferguson E, Deitchler M. 2020. *Recommended Specifications for Dietary Scales for Use in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available at [Intake.org](https://intake.org).

D For guidance on dietary scale testing, see Vossenaar M, Deitchler M, Hotz C, Lubowa A, Ferguson E. 2020. *Routines and Procedures to Test the Accuracy and Precision of Digital Dietary Scales Used in Quantitative 24 - Hour Dietary Recall Surveys*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available at [Intake.org](https://intake.org).

4.2 Guidelines for Preparing the Food Items to Be Photographed

4.2.1 Preparing the Food Items to Be Depicted in Graduated Portion-Size Food Photographs

Food items for which graduated portion-size food photographs are developed should be depicted in the state (e.g., raw, boiled, steamed, grilled, fried), form (e.g., whole, sliced, diced, mashed), and presentation mode (e.g., served on a plate, presented with inedible parts excluded) in which they are usually consumed or most easily visualized. Food items likely to be encountered in the survey should be indicated in the food, recipe, and ingredient listing (FRIL) developed during pre-survey activities.⁹ This listing includes descriptive details¹⁰ of all items listed, including the particular state, form, and presentation mode of the food item.

All food items should be prepared using common, usual preparation methods relevant to the survey context. During a photo session, carefully consider how many food items need to be prepared and the number of people who will be able to help in the preparation. Depending on the number of food items and photographs to be developed, it may be necessary to prepare some food items in advance or even plan multiple sessions on separate days.

Some food items will be ready for placement at any time and can be prepared in advance, while others will have to be prepared just a few moments before the photo shoot to preserve the aspects of a good presentation (e.g., peeled banana, sliced apple). This is true for food items that change their appearance with time. For some food items, a solution with citric acid may be helpful to prevent discoloring. Vegetable blanching may be helpful in certain cases (e.g., spinach). Some of the food items will require heating before plate placement for a better presentation because they tend to dry out (e.g., porridges). For food items that need to be warmed, be careful to not have steam visible during the photo shoot.

4.2.2 Preparing the Foods to Be Depicted in Full-Size Food Photographs

Foods for which full-size food photographs are developed should be depicted in a whole, unprocessed state. Therefore, no processing or preparation is needed. If the food has an inedible portion, these should be included in the photographic series (e.g., mango with peel and pit).

4.3 Guidelines for Presentation of the Food Items to Be Photographed

Once the food items to be depicted have been prepared, they should be presented for the photo shoot according to the state, form, and presentation mode that corresponds to how the food item is described in the FRIL for use with either graduated portion-size food photographs or full-size food photographs as the PSEM. Within a given survey, the presentation of the food items to be photographed should be as consistent as possible.

4.3.1 Presentation of Food Items in Graduated Portion-Size Food Photographs

Items depicted in graduated portion-size food photographs should be presented on plates that are commonly used in the survey area in terms of diameter, shape, and other characteristics. Only one type of plate (e.g., the same white plate) should be used for a photographic series, and, ideally, that same type and size of plate should be used for all the graduated portion-size food photographs developed for a given survey.

⁹ For further guidance on the pre-survey activities required for a quantitative 24-hour dietary recall survey, refer to Vossenaar M, Arimond M, Deitchler M, Lubowa A, Hotz C, Moursi M. 2020. *An Overview of the Main Pre-Survey Tasks Required for Large-Scale Quantitative 24-Hour Recall Dietary Surveys in Low- and Middle-Income Countries*. Washington, DC: Intake – Center for Dietary Assessment/FHI Solutions. Available at: intake.org.

¹⁰ Relevant descriptive details vary by food group. Examples include variety/type/color; state (e.g., fresh, dried); maturity (ripe, unripe); part (e.g., seed, flesh, with or without bones); mechanical processing (e.g., grated, chopped, sliced, pounded); other processing (e.g., fermented, brined, smoked, frozen, canned); cooking methods (boiled, roasted, shallow-fried, deep-fried); additions (e.g., salted, added sugar); brand, fortification, and enrichment (for commercial products); and the presentation mode or the way in which a food or ingredient is served and consumed (e.g., chicken leg eaten on the bone; chicken leg cut off the bone before eating).

All graduated portion-size food photographs should include a reference object (e.g., cutlery and/or a ruler) to allow the respondent to relate the scale of food images in the photograph to the reference object. The reference object should always be placed on the same side of the plate and at the same distance from the plate. In addition, *Intake* recommends printing an image of the empty plate at 100% scale. During the 24-hour dietary recall, the photograph of the empty plate can be held beside the scaled-down food photographs to help the respondent visualize the scale of the image. In a bounded photobook, the photograph of the empty plate can be developed as a foldout page.

The amount of food depicted in each food image should be as close as possible to the portion size that was pre-established for each image (as described in **Box 1**). When preparing the portion sizes to depict for each food image, a dietary scale that meets *Intake* specifications¹¹ and has been tested for accuracy and precision¹² should be used to ensure the correct portion size is depicted on the plate. The weight of the plate should be discounted each time separately because the weight of plates may also vary (even for the same size and type of plate). The weight of each portion size depicted in the food image must be recorded systematically and documented as described in **Section 4.6**. If the weight does not equal exactly the intended, pre-established portion size, the actual weight of the portion size depicted in the food image is the weight that should be documented and used for all later steps of data processing and analysis.

When placing an amount of food item on the plate which does not cover the entire plate, a consistent method for placement of the food item on the plate should be used. For example, smaller portions should consistently be placed on one side of the plate (e.g., always on the left side). As the portion size on the plate increases, the depth and the spread of the food item on the plate should be kept consistent. For food items for which it is important to visualize depth, the food item should be turned at an angle so that the depth of the food item is visible (e.g., showing the side of a slice of cake). The exact presentation angle will vary according to the size of the food but is likely to be around 45 degrees. The same presentation angle should be used for all portion sizes of a given food item included in a photographic series.

When food items can be presented in different forms (e.g., cooked or mashed potatoes), the development of two separate photographic series is required, as depicting different states, forms, or presentation modes for a food item in the same photographic series can cause confusion during the 24-hour dietary recall interview and data processing.

4.3.2 Presentation of Foods in Full-Size Food Photographs

Because foods depicted in full-size food photographs are presented in the form in which they naturally exist without any processing, the foods depicted are not typically presented on plates. The unit sizes that are presented in a photographic series should correspond to the unit sizes for a sub-set of the food samples that were earlier collected for that food (as described in **Box 2**). Since the weight of each unit size in the sample was already taken (Step 2 in **Box 2**), the weight of the selected unit sizes to depict does not have to be taken again during the photo shoot.

When full-size food photographs are taken, often a single photograph of all selected sizes to be depicted for a specific food is taken in a single shot. The different unit sizes of a given food should be arranged from smallest to largest from left to right. Because it is important to visualize depth, the food should be turned at an angle so that the depth of the food is visible (e.g., showing a mango at an angle to show all dimensions). The exact presentation angle will vary according to the size of the food and number of units to be depicted but is likely to be around 45

¹¹ Essential features include electronic with digital readout, a maximum weight capacity ranging from 5 kg to 15 kg, 1 g display increments, and a precision of 1% across the load range. For guidance on dietary scale specifications, see Vossenaar M, Hotz C, Lubowa A, Ferguson E, Deitchler M. 2020. *Recommended Specifications for Dietary Scales for Use in Quantitative 24-Hour Dietary Recall Surveys in Low- and Middle-Income Countries*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available at [Intake.org](https://intake.org).

¹² For guidance on dietary scale testing, see Vossenaar M, Deitchler M, Hotz C, Lubowa A, Ferguson E. 2020. *Routines and Procedures to Test the Accuracy and Precision of Digital Dietary Scales Used in Quantitative 24 - Hour Dietary Recall Surveys*. Washington, DC: *Intake* – Center for Dietary Assessment/FHI Solutions. Available at [Intake.org](https://intake.org).

degrees. The same presentation angle should be used for all unit sizes of a given food included in a photographic series.

Although not essential, because full-size food photographs are printed at 100% scale, full-size food photographs can include a reference object (e.g., cutlery and/or a ruler). If a reference object is added to any full-size food photograph, then this should be done consistently for all foods to avoid confusion among respondents.

4.3.3 Presentation of Food Items When Both Graduated Portion-Size and Full-Size Food Photographs Are Used in a Survey

When a combination of graduated portion-size and full-size food photographs is used within a survey, the respondent may need to transition between the two types of photographs for portion size estimation of different food items consumed. To avoid confusion as to which food photographs are printed at scale and which are scaled down, all photographs should include a reference object (e.g., cutlery and/or a ruler). In addition, the scaling of each food item depicted should be printed on the page (e.g., 100%, 75%, or 60% scale). Graduated portion-size and full-size food photographs should never be presented on the same page or be developed for the same food item in the same state, form, and presentation mode.

4.4 Guidelines for Photographing the Food Items to Be Depicted

The development of high-quality food photographs requires a professional photographer.

Photographs should be taken following these guidelines:

- a. Photographs should be taken with good lighting.
- b. Photographs should be taken at high resolution to allow large, high-quality prints.
- c. The background should be unobtrusive, neutral, and light (e.g., white or light gray).
- d. All photographs should be taken in color.

4.4.1 Taking Graduated Portion-Size Food Photographs

When taking graduated portion-size food photographs, a separate photograph is often shot for each portion size, and these are later depicted as a photographic series on a single page. It is therefore essential that all photographs for a given food item are taken using the same specifications so that the only difference is the portion size depicted. Ideally, the same specifications are used for all graduated portion-size food photographs developed for a survey.

All reference items (e.g., cutlery and/or a ruler) should be included when the photographs are taken. Although these can theoretically be added during the photograph editing process (e.g., using Adobe Photoshop), it is often challenging to present the reference items at the same angle and scale across all images when they are only added after the photographs have already been taken.

The following camera angle and distance specifications should be followed for graduated portion-size food photographs:

- a. All photographs should be taken at a consistent 45-degree camera angle.
- b. The distance between the camera and the food item should be consistent for all photographs (i.e., somewhere between 150 cm and 180 cm).

4.4.2 Taking Full-Size Food Photographs

When taking full-size food photographs, the photographer often takes a single shot of all sizes of the food to be depicted.

If reference items are added, they should be included when the photographs are taken. Although these can theoretically be added during the photograph editing process (e.g., using Adobe Photoshop), it is often challenging to present the reference items at the same angle and scale across all images when they are only added after the photographs have already been taken.

The following camera angle and distance specifications should be followed for full-size food photographs:

- a. The angle at which the photograph is taken may vary according to the height of the food but should be approximately 45 degrees.
- b. The distance between the camera and the food may vary according to the size and number of items to be fit in a single shot but should be approximately 150 cm to 180 cm.

4.5 Guidelines for Designing the Layout of a Photographic Series for a Given Food Item

Once the food photographs have been taken, experienced designers and/or photographers should design the layout of each photographic series. This should ideally be done with design software, such as Adobe InDesign, to allow for a higher-quality page presentation. The software is also used to help adjust a photograph to the correct size and to place all photographs on a page after the photo is taken. If needed, software such as Adobe Photoshop can also be used to improve the visual depth of the food images. The formatting of a photographic series for a given food item is described below.

4.5.1 Layout of Graduated Portion-Size Food Photographs

When graduated portion-size food photographs are taken, the following presentation guidelines should be followed:

- a. Present all food images included in a specific photographic series on a single page.
- b. At the top of the page, include a header with the name of the food item depicted. The name of the food item should be sufficiently descriptive to avoid confusion. When relevant, the name of the food item should also include the preparation mode.
- c. Ensure that all individual food images are the same size (e.g., 9 cm x 5.7 cm).
- d. Crop the food images to ensure that the food item is depicted at the intended scale when printed and that the plates remain centered in the image. The scale of all graduated portion-size food photographs used for a survey should be the same (i.e., the same scale is used for each food item). When this is done and the same sized plates are used to present all food items, the plates on which the food is served will all be printed in the same size.
- e. At the top or bottom of the page, indicate the scale at which the images are depicted.
- f. Within each photographic series, order the food images from smallest to largest portion size. Place the image representing the smallest portion on the upper left and the one representing the largest portion on the lower right. The order should first be horizontal (i.e., second smallest portion in the upper right) and then vertical.
- g. For each portion size of the food item depicted, include the image number (e.g., 1 to 6), as well as a code that is used for data entry and that is linked to a specific weight in grams.
- h. Do not add the corresponding weight in grams for each portion size depicted. Arguments for not including weights include:
 - Showing the weight of the portion sizes depicted could influence respondents in their choice.
 - Too much information would be displayed on one page, which can be confusing.
 - Data entry of a code is simpler and less prone to error than the exact weight in grams (e.g., “C” vs. “248 g”).

4.5.2 Layout of Full-Size Food Photographs

When full-size food photographs are taken, the following presentation guidelines should be followed:

- a. Present all food images included in a specific photographic series on a single page.
- b. At the top of the page, include a header with the name of the food depicted. The food name should be sufficiently descriptive to avoid confusion. When relevant, the food name should include the specific variety of the food depicted.
- c. Within each photographic series, order the food images from smallest to largest unit size. Place the image representing the smallest unit size on the left and the one representing the largest unit size on the right; two rows may be needed. If a single shot of all food sizes was taken, then the foods were arranged during the photo shoot. If separate photographs were taken, then each food image should be arranged during the layout stage.
- d. Adjust the size of each food image so that the food depicted is shown at full scale when printed.
- e. When both graduated portion-size and full-size food photographs are used in a survey, at the top or the bottom of the page, indicate the scale at which the images are depicted.
- f. For each unit size of the food depicted, include the image number (e.g., 1 to 6), as well as a code that is used for data entry and that is linked to a specific weight in grams.
- g. Do not add the corresponding weight in grams for each unit size of the food depicted. Arguments for not including weights include:
 - Showing the weight of the unit sizes depicted could influence respondents in their choice.
 - Too much information would be displayed on one page, which can be confusing.
 - Data entry of a code is simpler and less prone to error than the exact weight in grams (e.g., “B” vs. “144 g”).

4.6 Guidelines for Documenting the Weight of Each Portion or Unit Size Depicted

When food photographs are developed, the following information should be documented and available to survey planners for each photographic series: the food item name in the relevant language(s), food item codes, number/code of each portion or unit size, and the exact weight per food image. All of this information, except for the weight of each portion or unit size depicted, should be visible to the respondent and the enumerator during the 24-hour dietary recall interview (i.e., the weights of the portion or unit sizes depicted should not be included on the same page as the food photograph). This information, in addition to the corresponding page number of the food photographic series, is typically included at the start or end of the photo book, for example, as shown in **Table 3**.

Table 3. Example of How the Weight for Each Portion or Unit Size Depicted Can Be Documented

Page	Food item name in local language(s)	Food item name in English	Food item code	Gram weight per portion or unit size <u>as depicted</u> (i.e., the weight includes any inedible parts shown)					
				1	2	3	4	5	6

The weight of each portion or unit size depicted constitutes the “PSEM-specific factor” needed during data processing to convert amounts of foods consumed estimated using a food photograph into their equivalent weight in grams (e.g., “grams consumed” or “grams of recipe prepared”).⁸ For graduated portion-size food photographs, the food item is weighed when it is being presented for the photo shoot (as described in **Section 4.3.1**). For full-size food photographs the unit sizes are weighed when the collected samples are weighed to determine the unit sizes to depict (as described in **Section 4.1.2**).

For full-size food photographs, *Intake* recommends that the entire food item to be depicted in the food image is weighed (i.e., including any inedible parts of the food item shown in the photograph). As such, during data processing, an “edible portion factor” is needed to derive the edible portion of the food item. *Intake* does not recommend removing all inedible parts before weighing the food to derive the corresponding weight of the edible portion only as doing so can confuse survey planners and possibly lead to double counting of the inedible portion.

When using previously developed food photographs, it is essential to confirm if the weight assigned to the food items depicted corresponds to the weight of the entire food item or only the edible portion. The documentation should clearly state that the gram weights that are shown correspond to the portion or unit sizes as depicted (i.e., the weight includes any inedible parts shown).

The steps required for the development of a photographic series for a food item to be depicted in a graduated portion-size food photograph and for a food to be depicted in a full-size food photograph are summarized in **Table 4**.

Table 4. Comparison of Graduated Portion-Size and Full-Size Food Photographs: Steps Required for the Development of a Photographic Series

Graduated portion-size food photographs	Full-size food photographs
Establishing how many and which portion or unit sizes to depict	
Quantitative dietary data are used to identify the minimum and maximum portion sizes typically consumed; then intermediate portion sizes are set	20–30 food samples that vary in size are weighed; a set of unit sizes of the food that are visually different and fairly equally spaced are selected
Preparation of the food item to be photographed	
The food item should be depicted in the state, form, and presentation mode in which the food item is usually consumed or most easily visualized by the respondent, but only if the typical presentation mode is with inedible parts excluded	Food should be depicted in a whole, unprocessed state; therefore, no processing or preparation of the food is needed
Presentation of the food item to be photographed	
The food item should typically be shown on a plate	The food is typically shown without a plate
Each image of the food item should include a reference object (e.g., cutlery and/or a ruler)	Each image of the food can include a reference object (e.g., cutlery and/or a ruler)
For food items for which it is important to visualize depth, the food items should be turned at an angle so that the depth is visible (e.g., 45 degrees)	The food should be turned at an angle so that the depth is visible (e.g., 45 degrees)
Photographing the food item to be depicted	
The development of high-quality food photographs requires a professional photographer	
Separate photographs are taken for each portion size of the food item to be depicted	A single shot of all unit sizes of the food to be depicted can be taken
All photographs should be taken at a consistent 45-degree camera angle	The angle at which the photograph is taken may vary according to the height of the food but should be approximately 45 degrees

Graduated portion-size food photographs	Full-size food photographs
Photographing the food item to be depicted (continued)	
The distance between the camera and the food item should be consistent for all photographs (i.e., between 150 cm and 180 cm)	The distance between the camera and the food may vary according to the size and number of items to be fit in a single shot (i.e., approximately 150–180 cm)
Designing the layout of a photographic series	
All food images included in a photographic series should be presented on a single page	
The name of the food item depicted should be indicated with sufficiently descriptive details at the top of the page	
Within each photographic series, the food images should be ordered from the smallest to the largest portion size	Within each photographic series, the food images should be ordered from the smallest to the largest unit size
The image number and code for each portion size of the food item depicted should be included	The image number and code for each unit size of the food depicted should be included
The scale at which the images are depicted should be included at the top or bottom of the page.	When used in combination with graduated portion-size and food photographs, the scale at which the images are depicted should be included, at the top or bottom of the page
The corresponding weight in grams for each portion size depicted should not be added on the same page as the food photograph	The corresponding weight in grams for each unit size depicted should not be added on the same page as the food photograph
Documenting the weight of each portion or unit size depicted	
The weight in grams of each portion size depicted must be documented, but should not be visible to the respondent or the enumerator	The weight in grams of each unit size depicted must be documented, but should not be visible to the respondent or the enumerator
The weight of each portion size is determined when the food item is being presented for the photo shoot	The weight of each unit size is determined when the unit sizes to depict are established
The weight recorded for the food item should correspond to the weight of the entire food item depicted, which should not include any inedible parts	The weight recorded for the food item should correspond to the weight of the entire food item depicted (i.e., including any inedible parts of the food item shown in the photograph)

5 Pre-Testing and Validating Food Photographs

When new food photographs are developed for use in a dietary survey, they should be pre-tested and, ideally, validated before use. Pre-testing of food photographs is needed to determine if they are feasible for respondents to use for portion size estimation in the specific survey context. The pre-testing of food photographs should always occur before enumerator training and data collection to allow sufficient time to revise the food photographs, or assign other PSEMs to a given food item, as needed.

When resources and time allow for validating the food photographs developed, it is typically done after an initial pre-test. A validation study can be designed to provide information about the performance of the food photographs in relation to weighed records and/or in relation to another PSEM. When designed and implemented properly, food photograph validation studies can provide survey planners with useful information about the use of food photographs for PSEM, such as whether the food photographs tested perform well across the range of portion sizes usually consumed, perform similarly across diverse geographic areas (e.g., rural and urban), and/or perform equally well across the set of demographic groups for which they were developed. The results from such a study can thus inform how the food photographs would be most appropriately used during data collection in a large-scale survey, or whether revisions to the food photographs are needed or a different PSEM should be assigned to a given food item.

Traditionally, validation studies of portion sizes include the evaluation of one or more cognitive skills, as proposed by Nelson and Haraldsdóttir (1998a). These are the “perception,” “conceptualization,” and/or “memory” of consumed quantities, from which errors are estimated based on known shown or consumed quantities. The “perception” of food refers to the ability of an individual to relate to an amount of food that is shown in reality, with the amount of food shown in a visual aid. “Conceptualization” refers to an individual’s ability to translate a mental construction of a food quantity into a value depicted in a visual aid. “Memory,” on the other hand, is especially important to remembering the quantities consumed and affecting the accuracy of conceptualization. In practical terms, the food to be recalled is shown in real-time during the perception assessment. On the other hand, foods to be recalled in the conceptualization and memory assessments are shown or eaten a few minutes or hours before the recall assessment, respectively.

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