J Acad Nutr Diet. Author manuscript; available in PMC 2019 September 01.

Published in final edited form as:
J Acad Nutr Diet. 2018 September ; 118(9): 1711–1718. doi:10.1016/j.jand.2018.02.014.

Portion sizes from 24-hour dietary recalls differed by sex among those who selected the same portion size category on a food frequency questionnaire

Minji Kang[1,2], **Song-Yi Park**[2], **Carol J. Boushey**[2], **Lynne R. Wilkens**[2], **Kristine R. Monroe**[3], **Loïc Le Marchand**[2], **Laurence N. Kolonel**[2], **Suzanne P. Murphy**[2], and **Hee-Young Paik**[1,4,*]

[1]Center for Gendered Innovations in Science and Technology Researches (GISTeR), Korea Federation of Women's Science & Technology Associations, Seoul, Republic of Korea;

[2]Cancer Epidemiology Program, University of Hawaii Cancer Center, Honolulu, Hawaii, USA;

[3]Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, California, USA

[4]Department of Food and Nutrition, College of Human Ecology, Seoul National University, Seoul, Republic of Korea

Abstract

Background—Accounting for sex differences in food portions may improve dietary measurement; however this has not been well examined.

Objective—The aim of this study was to examine sex differences in reported food portions from 24-hour dietary recalls (24HDR) among those who selected the same portion size category on a quantitative food frequency questionnaire (QFFQ).

Design—This study was conducted as a cross-sectional design.

Participants/setting—Participants (n = 319) were members of the Hawaii-Los Angeles Multiethnic Cohort who completed three 24HDRs and a QFFQ in a calibration study in 2010 – 2011.

Main outcome measures—Portions of individual foods reported from 24HDRs served as the outcome measures.

Statistical analyses performed—Mean food portions from 24HDRs were compared between men and women who reported the same portion size on the QFFQ, after adjustment for race/ethnicity using a linear regression model. Actual amount and the assigned amount of the selected portion size in the QFFQ were compared using one-sample t-test for men and women separately.

*Correspondence: Dr. Hee-Young Paik, Center for Gendered Innovations in Science and Technology Researches (GISTeR), Korea Federation of Women's Science & Technology Associations, Seoul, Republic of Korea; Department of Food and Nutrition, College of Human Ecology, Seoul National University, Seoul, Republic of Korea hypaik@kofwst.org, Telephone: +82-2-565-3701, Fax: +82-2-3452-2912.
Author contributions: MK and HYP contributed to the conception and design, analysis, interpretation of data, and manuscript drafting. SYP, CJB, and SPM contributed to analysis and interpretation of data. LRW, LLM, LNK, KRM and SPM collected the data. All authors reviewed and commented on subsequent drafts of the manuscript.

Conflict of interest: The authors declare no conflict of interest

Results—Of 163 food items listed with portion size options in the QFFQ, 32 items were reported in 24HDRs by ≥20 men and ≥20 women who selected the same portion size in the QFFQ. Although they chose the same portion size on the QFFQ, mean intake amounts from 24HDRs were significantly higher in men than in women for “beef/lamb/veal,” “white rice,” “brown/wild rice,” “lettuce/tossed salad,” “eggs cooked/raw,” “whole wheat/rye bread,” “buns/rolls,” and “mayonnaise in sandwiches.” In men, mean portions of 14 items from the 24HDRs were significantly different than the assigned amounts for QFFQ items (7 higher and 7 lower), while in women mean portions of 14 items were significantly lower than the assigned amounts (with 5 significantly higher).

Conclusions—These sex differences in reported 24HDRs food portions even among participants who selected the same portion size on the QFFQ suggests the use of methods that account for differences in the portions consumed by men and women when quantifying QFFQs may provide more accurate absolute dietary intakes.

Keywords

sex; 24-hour dietary recall; portion size; food frequency questionnaire; the Hawaii – Los Angeles Multiethnic Cohort Study

INTRODUCTION

In nutritional epidemiology, food frequency questionnaires (FFQs) and 24-hour dietary recalls (24HDRs) are the most frequently used tools to assess an individual’s dietary intake.[1, 2] A quantitative FFQ can provide estimates of long-term intake (typically 6 months to 1 year) but is less detailed concerning characteristics of individual foods than a 24HDR.[2–6] Intake estimates from FFQs invariably differ from the true intake values, largely due to inaccurate long-term recall and difficulty in estimating average frequency of consumption and portion size.[7] A single 24HDR obtained by a well-trained interviewer can provide accurate, quantitative dietary intake information covering a 24-hour time period.[3, 8] While 24HDRs are generally more accurate than FFQs, there is still measurement error, usually underreporting of foods eaten, which can result in lower energy intake estimates.[9]

To obtain quantitative data from FFQs, portion size information is required.[4, 10] Methods of quantifying portion sizes for a FFQ have varied and include: a single standard portion size such as a commonly used household unit where the respondent chooses the frequency for that portion; multiple categories such as small, medium or large; and a description by individuals of their own portion sizes.[4, 10] In reviews on 227 validation studies from thirty different countries with most (102) originating in the USA, reported correlation coefficients between FFQs and other dietary measures, such as 24HDRs or dietary records, were higher when individuals were able to describe their own portion size.[10,11] Efforts to estimate portion sizes more accurately for target populations have included color photographs of food items,[12, 13] age-sex portion size-specific for portion size categoires,[5] and adaptation of locally available portion sizes.[14]

Several studies have compared portion sizes between men and women.[15, 16] In a previous study with 151 university students in the UK, men reported significantly larger portions of six of the 12 test foods, such as “peas,” “rice,” “new potatoes,” “tikka masala and rice,” “pasta and sauce,” and “beef lasagna” compared to women.[15] A study from the National Diet and Nutrition Survey of British adults aged 19 – 64 years (n = 1,519), reported median intakes for 24 (such as “rice and pasta,” “breakfast cereals,” “egg and egg dishes,” “meat dishes,” “meat products,” “alcoholic beverages”) out of 30 food groups were higher in men than in women, and 6 food groups did not show significant differences, including “low-fat milks,” “yoghurts,” “vegetables,” “fruits, juices, and nuts,” “fish,” and “beverages.”[16] These results support efforts to better reflect the usual portion size in FFQs and to discuss how men and women may perceive usual portion sizes differently.

The objective of this study was to examine sex differences in food portions reported on 24HDRs among those who selected the same portion from several portion size categories in a quantitative food frequency questionnaire (QFFQ).

METHODS

Study design and participants

The MEC in Hawaii and Los Angeles was established between 1993 and 1996 to study the associations of lifestyle and genetic factors with cancer and other chronic diseases. Details of the study have been described previously.[17] Briefly, the cohort consisted of 215,251 men and women aged 45 – 75 years at recruitment mostly from five race/ethnicities: African American, Native Hawaiian, Japanese American, Latino, and non-Hispanic white. At baseline, the cohort participants completed a 26-page self-administered questionnaire including demographic factors, QFFQ, lifestyle behaviors, and a medical history, family history of cancer, and reproductive history in women. The primary sampling frame for the MEC was drivers’ license files for HI and CA, and participants were broadly representative of the target populations based on comparison of education and marital status with 1990 census information for these populations.[17] Between 2003 and 2007 which was approximately 10 years from the baseline, the 26-page questionnaire was repeated. For the purposes of this paper, the first QFFQ administered is abbreviated as QFFQ1 and the second QFFQ administered is abbreviated as QFFQ2.

Participants for the current study were from a calibration study of the MEC QFFQ2. Details of the calibration study of the MEC QFFQ2 have been described previously.[18] Briefly, the goal was to recruit at least 300 participants in total, with at least 30 participants from each of the 10 sex-ethnic categories in the MEC. From 2010 to 2011, MEC participants aged 56 – 80 years who indicated interest on a recruitment call were mailed either the randomly assigned QFFQ1 or QFFQ2 with a consent form. After return of the assigned QFFQ and the signed consent form, three unannounced telephone-administered 24HDRs over a one month period were conducted. Two weeks after the recalls, the other QFFQ was mailed to participants, i.e., QFFQ1 or QFFQ2. Only data from the QFFQ2 administration were used in these analyses. A total of 357 participants completed at least one 24HDR and a total of 326 participants also completed QFFQ2 randomly assigned to be administered either before or after the 24HDRs. The final sample for this analysis included 319 participants who completed at least one 24HDR (three days, n = 314; two days, n = 4; one day, n = 1) in addition to the QFFQ2. The calibration study protocol was approved by the Institutional Review Boards at the University of Hawaii and University of Southern California.

Dietary assessment: QFFQ and 24HDRs

The baseline QFFQ1 was developed based on three day food records collected from approximately 60 men and women, aged 45 – 75 years, from each of the five main race/ethnic groups.[17] The food items in the QFFQ1 represent the minimum set that accounts for at least 85% of macronutrients and important micronutrients in each race/ethnic group.[17] In addition, specific food items uniquely associated with the traditional diets of a particular group were included, regardless of their contribution to nutrients (e.g., ham hocks for African Americans; tofu and salted fish for Japanese Americans; tamales for Latinos).[17] More than 180 items were listed in the QFFQ1 with eight frequency categories for foods (ranging from "never or hardly ever" to " ≥2 times a day") and nine frequency categories for beverages (ranging from "never or hardly ever" to "≥4 times a day"). Most items had three choices of portion size (in some instances two or four).[17] In a sub-study, the energy adjusted correlations between the QFFQ1 and three non-consecutive unscheduled 24-hour recalls were 0.55 – 0.74.[19] The QFFQ2 was updated with modest changes, generally in the design, the addition of newer foods (e.g., fortified beverages), and additional examples given for each food item. In the current study, portion size responses for each food item were based on the QFFQ2 completed in the calibration study. Participants were able to select the portion size for 163 food items on the QFFQ2: two choices for 5 items, three choices for 151 items, and four choices for 7 items. Pictures showing different portion sizes (A – the Smallest, B, and C or D – the Largest) of representative foods are displayed on several pages of the QFFQ2. Each portion size in the pictures was also described in terms of concrete units, such as 1/2 cup or 5 ounces. The vast majority of food items had 3 portion sizes. The foods with 2 portion sizes were spreads, such as jam or butter, with portions of "thin" or "thick", and those with 4 portion sizes were beverages. The respondents had to choose which response was closest to their consumption pattern. A single gram amount was assigned to A, B, C, and D. For countable items, such as eggs, the USDA gram weight equivalents were assigned. For other items, a single gram amount was assigned to each portion size (A, B, C, and D) based on the specific amounts provided in the QFFQ, such as 1/2 cup, 1 cup, etc. These gram weight amounts were selected based on the most commonly eaten amounts in grams in the QFFQ1 calibration 24HDRs within ranges defined specifically for this purpose; for example, the gram weights for portion sizes of A: 1/2 cup, B: 1 cup and C: 2 cups would be the most common amounts consumed in the corresponding ranges of < 3/4 cup, ≥ 3/4 and < 1.5 cups, and ≥ 1.5 cups. Copies of both questionnaires are available.[20]

The 24HDRs were conducted on randomly selected weekdays (two) and weekend days (one), and were collected by Registered Dietitians specifically trained in the USDA five-step multiple-pass method.[21] Intakes from 24HDRs were calculated using the RapidCalc program[22] which uses a food composition database of 1,530 single-item foods, as well as 1,113 recipes for commonly consumed food mixtures representing the various ethnic populations of Hawaii, California, and the Pacific Region.[22, 23]

Comparison of portion size between men and women

The portion sizes reported in the 24HDRs were compared between men and women who reported the same portion size in the QFFQ2. As a first step, individual foods reported from 24HDRs were matched with component foods that comprised each food item in the QFFQ2. For example, the "whole wheat or rye bread" item of the QFFQ2 consisted of five component foods such as "whole wheat bread," "light rye bread," "dark rye bread," "pita whole wheat bread," and "wheat bran bread." When any of these five component foods was reported in a 24HDR, it was linked to the "whole wheat or rye bread" item of the QFFQ2. For this analysis, food items reported in both the 24HDRs and the QFFQ2 (consumed at least once a month) by ≥20 men and ≥20 women who chose a specific portion size option (A – the Smallest, B, C, and D – the Largest) were selected. For each individual, the portion sizes in gram weight were averaged across the foods reported in the 24HDRs that were assigned to a specific QFFQ2 item. For instance, mean intake per eating occasion of "whole wheat or rye bread" from the 24HDRs was compared between men and women who selected their usual portion size as "1 slice or less," which was the smallest category of the 3 portion size options for that item in the QFFQ2. The same comparison was conducted for the B and C portion sizes, if the sample sizes allowed.

Statistical analysis

Participant characteristics were compared between men and women using the t-test for continuous variables and the chi-square test for categorical variables. The average portion sizes of the foods per meal from the 24HDRs assigned to a specific QFFQ2 item were compared between men and women who reported the same portion size for that item on the QFFQ2, after adjustment for race/ethnicity, using a linear regression model. The adjustment was to account for the possibility that the race/ethnic groups ate different foods with somewhat varying portion sizes within a portion size for a specific food item (e.g., one chicken breast compared to two thighs for serving B for fried chicken). Comparisons between the (average) portion sizes of the foods from 24HDRs assigned to a specific QFFQ2 item and the constant assigned amount in grams of the selected portion size for that QFFQ2 item were conducted for the selected item-portion comparisons using a one-sample t-test for men and women separately. The sample sizes were insufficient to make similar comparisons within sex-race/ethnic groups. However, the percentages of times the average portion size from the 24HRs of men was greater than that of the women (among those choosing the same portion size on the QFFQ2) was compared across the 5 ethnic groups, using the chi-square test of association. Differences were considered statistically significant at $p < 0.05$. Data were analyzed using SAS version 9.4.[24]

RESULTS

Among 319 participants included in this analysis, there were approximately equal numbers of men and women, and the race/ethnic distribution was approximately balanced by design (Table 1). The mean age was 69 years in men and 68 years in women. Among participants, 62% were from Hawaii and 38% were from California (primarily Los Angeles County), reflecting the fact that 3 racial/ethnic groups come predominantly from HI and 2 racial/

ethnic groups from CA. There were no significant differences in age and education between men and women.

Of the 158 food items reported in both the 3 days of 24HDRs and the QFFQ2, 32 items were consumed by ≥20 men and ≥20 women who selected the same usual portion size on the QFFQ2. For seven of these 32 items, the criteria were met for two different portion sizes, thus yielding 39 item-portion comparisons: A for 7 items, B for 29 items, and C for 3 items (Table 2). There was no item satisfying the above criteria in the portion size D. Mean portions from the 24HDRs among those who selected the same portion size option in the QFFQ2 adjusted for race/ethnicity were significantly higher in men than in women for 8 items: “beef, lamb, or veal,” “white rice,” “brown or wild rice,” “lettuce or tossed salad,” “eggs cooked or raw,” “whole wheat or rye bread,” “buns and rolls,” and “mayonnaise in sandwiches.” For many other items, although the sex differences were not significant, men tended to eat larger portion sizes than women. There was no item which was consumed significantly more by women than men. It is possible that race/ethnicity may interact with sex regarding differences in food consumption. However, the sample size is insufficient for detailed comparison of portion sizes between race/ethnic groups within sexes. When the 5 race/ethnic groups were compared, the percentages of the 39 food items where the average portion size from the 24HDRs for men was greater than that for women for the same QFFQ2 item varied: Native Hawaiian men had larger averages than Hawaiian women for 85% of the items, non-Hispanic white men for 67%, Japanese Americans for 64%, African Americans for 59%, and Latinos for 56% ($p = 0.07$ for chi-square test (4 df)).

Food amounts from the 24HDRs were compared with the assigned portion size in the QFFQ2 for the 39 item-portion comparisons. In men, mean intakes were significantly higher than the assigned amounts for seven items: “beef, lamb, or veal,” “carrots (A),” “onions,” “buns and rolls,” “butter added to bread items,” “jam or jelly added to bread items,” and “mayonnaise in sandwiches,” and significantly lower for seven items: “roasted, baked grilled, or stewed chicken,” “lettuce or tossed salad,” “tomatoes,” “carrots (B),” “oranges,” “other fruits,” and “whole wheat or rye bread.” In women, mean intakes of 19 items were significantly different from the assigned amounts, among which 14 items were lower (Table 2).

DISCUSSION

This study examined sex differences in average portion sizes reported in 24HDRs among men and women reporting the same portion size on the QFFQ2 using data from a calibration study of the QFFQ2 in the MEC. Due to the limited sample size, only 39 item-portion comparisons were available in both the 24HDRs and the QFFQ2 by ≥20 men and ≥20 women who chose the same portion size on the QFFQ2. Although they selected the same portion size in the QFFQ2, intakes reported for the 24HDRs were significantly lower in women than in men for eight food items. No item was consumed at a significantly higher amount by the women compared to the men. Although intakes of the other items were not significantly different between men and women, the means in men were higher than those in women for most items. Results of this study indicate men and women who chose the same portion size likely eat different amounts. This may lead to serious discrepancies in dietary assessment depending on sex, as nutrient intakes from the QFFQs are calculated by multiplying nutrient amount per gram of the item by daily amount consumed, computed as the frequency times the amount assigned to the selected portion size. Interestingly, the differences were most pronounced for QFFQ items with fewer types of items included, for which estimation may be easier, such as eggs as compared to an item like roasted chicken that can be eaten as an entrée or in sandwiches. This implies the sex differences in portion size are not likely due to men and women eating different foods assigned to a single QFFQ item.

Intakes from 24HDRs also showed sex differences in comparison with the assigned amounts of selected portion sizes, depending on the food items. For instance, among the participants who reported their usual portion size of “white rice” as B on the QFFQ2, the mean intake at an eating occasion among men from the 24HDRs (199.7 g) was close to the assigned amount of the B portion (1 rice bowl or 1 cup = 200 g), while women’s intake (145.0 g) was only 72% of the assigned amount. Thus, the QFFQ2 may be assumed to estimate “white rice” consumption accurately in men but may overestimate it for women. On the contrary, for “beef, lamb, or veal,” the mean intake at an eating occasion (97.5 g) was close to the assigned amount of the B portion (85 g) in women, but was much higher (147.4 g) in men. This suggests that the QFFQ2 may estimate “beef, lamb, or veal” consumption accurately in women but may underestimate it for men. For “lettuce or tossed salad,” mean intakes of both men (68.9 g) and women (51.7 g) were lower than the assigned amount of the C portion (92 g) that they selected on the QFFQ2. For those who reported thin spread of “mayonnaise in sandwiches” (5 g) on the QFFQ2, intake at each eating occasion from the 24HDRs was much higher both in men (19.2 g) and women (12.4 g).

The eight items with significant sex differences from the 24HDR were: “beef, lamb, or veal,” “white rice,” “brown or wild rice,” “lettuce or tossed salad,” “eggs cooked or raw,” “whole wheat or rye bread,” “buns and rolls,” and “mayonnaise in sandwiches.” Some of these items represent common, staple foods that contribute substantially to energy and macronutrient intakes. Indeed, of these eight food items, “lettuce or tossed salad,” “mayonnaise,” “whole wheat or rye bread,” “buns and rolls,” and “eggs cooked or raw” were identified in the top 25 most frequently consumed foods or beverages among adults in the 2007 – 2012 National Health and Nutrition Examination Survey (NHANES).[25] Results from the 1989–91 Continuing Survey of Food Intakes by Individuals (CSFII) indicated men’s portion sizes were larger compared to women for several foods including meats and grain products.[26] In addition, 1994–96 CSFII results on estimated amounts of 111 foods and food groups consumed per eating occasion showed that portion sizes of men were larger than that of women by 94% or more foods and food groups (20–39 years: 96.4%, 40–59 years: 98.2%, and 60 and older: 94.6%) including grain-based products, vegetables and vegetable juices, fruits and fruit juices, milk and milk products, meat, fish, poultry, eggs, and peanut butter, and chips and popcorn.[27]

Two studies have reported sex-specific portion sizes for assessing dietary intake.[11, 28] For instance, Cade et al.[11] reported that it may be appropriate to use sex-specific ‘typical’ portions instead of ‘standard’ portions to estimate nutrient intake from a FFQ because the variation in most foods in portion size within individuals exceeded that between individuals.

Recently, Almiron-Roig et al.[28] noted that reference portion sizes in a FFQ need to be representative of the ethnic group studied and to account for sex and age differences, especially for amorphous foods such as rice and noodle dishes. In the present study, using data from a multiethnic population, intakes of “white rice” and “brown or wild rice” differed between men and women even when they selected the same usual portion size; there was also a sex difference in comparison with the standard amount of the selected portion size, even though the QFFQ2 portion sizes were given in specific units, such as 1 cup, rather than as generic labels, such as “small”.

Sex differences in true portion sizes for a given QFFQ portion size could bias some analysis results, particularly those that rely on absolute amounts, such as nutrient distributions and indices for meeting recommendations. Test statistics for sex-specific analyses would be unaffected, but the percentage meeting or not exceeding a recommended consumption level would be biased in different directions for men and women, due to the differential portion size misclassification.

Alternative methods of obtaining portion size information should be considered in future FFQs for their ability to provide accurate portion sizes for men and women. Provision of a wide range of portion sizes, as in NCI’s Automated Self-Administered 24-Hour Recall that uses an array of portion size pictures specific to each food, allows for substantial variability in response.[29] It could be that provision of sex-specific or a wide range of portion sizes is required of specific foods. Also, incorporation of camera and mobile telephone technology[30] can provide objective measures of the amount of food consumed for comparison based on images obtained before and after foods are eaten.[31, 32]

The present study had several limitations that need to be considered. First, due to the small sample size, only 39 food item-portion combinations were reported in both the 24HDRs and the QFFQ2 by ≥20 men and ≥20 women. This number of food items is only a small fraction of the 163 items each with several portion sizes which comprise the QFFQ2. Second, the 24HDR portion sizes were used as the reference value for usual amount; however, the 24HDR is also subject to measurement error, as suggested by previous studies.[1, 9, 19, 33] Third, the intakes were from three days of 24HDRs, and averages over a small number of days may not adequately represent individual usual intake.[34] Fourth, men tended to consume larger amounts given the same reported portion size on the QFFQ2 across all ethnic groups, and an interaction may exist between race/ethnicity and sex. However, our sample size was insufficient for a thorough study of the suggested differences between men and women across race/ethnicity. Lastly, the respondents were only from Hawaii and California, so some limitations may exist in the generalizability of the findings.

CONCLUSIONS

In summary, even though participants selected the same portion size option in the QFFQ, the actual reported consumption from 24HDRs for men was higher than for women for many items. The amount reported for the 24HDRs also differed from the assigned amount of the reference portion for some food items in the QFFQ, and women’s portion sizes in the 24HDRs were smaller for more items than men. Since portion size is an important factor for calculating nutrient intakes for the QFFQ, the use of methods that account for differences in the portions consumed by men and women when quantifying QFFQs may contribute to more accurate absolute dietary intake estimates in epidemiological studies.

Acknowledgments

Grant support:

Supported by the National Cancer institute at the National Institutes of Health (R37CA054281, U01CA164973, P30CA071789)

Supported by Support Program for Women in Science, Engineering and Technology through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning (Grant no. 2016H1C3A1903202)

REFERENCES

1. Beaton GH. Approaches to analysis of dietary data: relationship between planned analyses and choice of methodology. Am J Clin Nutr. 1994;59:253S–261S. [PubMed: 8279436]
2. Johnson RK. Dietary intake—how do we measure what people are really eating? Obes Res. 2002;10:63S–68S. [PubMed: 12446861]
3. Barrett-Connor E Nutrition epidemiology: how do we know what they ate? Am J Clin Nutr. 1991;54:182S–187S. [PubMed: 2053559]
4. Thompson FE, Subar AF. Dietary assessment methodology In: Am Coulston, Boushey CJ Ferruzzi MG, Delahanty LM. Nutrition in the Prevention and Treatment of Disease. 4th edition 2017, Elsevier Academic Press: San Diego, CA 5–48
5. Block G, Hartman AM, Dresser CM, Carroll MD, Gannon J, Gardner L. A data-based approach to diet questionnaire design and testing. Am J Epidemiol. 1986;124:453–469. [PubMed: 3740045]
6. Subar AF, Midthune D, Kulldorff M, et al. Evaluation of alternative approaches to assign nutrient values to food groups in food frequency questionnaires. Am J Epidemiol. 2000;152:279–286. [PubMed: 10933275]
7. Freedman LS, Schatzkin A, Midthune D, Kipnis V. Dealing with dietary measurement error in nutritional cohort studies. J Natl Cancer Inst. 2011;103:1086–1092. [PubMed: 21653922]
8. Moshfegh AJ, Rhodes DG, Baer DJ, et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr. 2008;88:324–332. [PubMed: 18689367]
9. Freedman LS, Commins JM, Moler JE, et al. Pooled results from 5 validation studies of dietary self-report instruments using recovery biomarkers for energy and protein intake. Am J Epidemiol. 2014;180:172–188. [PubMed: 24918187]
10. Cade J, Thompson R, Burley V, Warm D. Development, validation and utilisation of food-frequency questionnaires–a review. Public Health Nutr. 2002;5:567–587. [PubMed: 12186666]
11. Cade J, Burley V, Warm D, Thompson R, Margetts B. Food-frequency questionnaires: a review of their design, validation and utilisation. Nutr Res Rev. 2004;17:5–22. [PubMed: 19079912]
12. Forster H, Fallaize R, Gallagher C, et al. Online dietary intake estimation: the Food4Me food frequency questionnaire. J Med Internet Res. 2014;16:e150.
13. Labonté M-È, Cyr A, Baril-Gravel L, Royer M, Lamarche B. Validity and reproducibility of a web-based, self-administered food frequency questionnaire. Eur J Clin Nutr. 2012;66:166–173. [PubMed: 21934698]
14. Gupta N, Verma S, Singh A, Tandon N, Puri S, Arora NK. Adaptation of Locally Available Portion Sizes for Food Frequency Questionnaires in Nutritional Epidemiological Studies: How Much Difference does it Make? Indian J Community Med. 2016;41:228–234. [PubMed: 27385878]
15. Brunstrom JM, Rogers PJ, Pothos EM, et al. Estimating everyday portion size using a ‘method of constant stimuli’: In a student sample, portion size is predicted by gender, dietary behaviour, and hunger, but not BMI. Appetite 2008;51:296–301. [PubMed: 18467005]

16. Kelly MT, Rennie KL, Wallace JM, et al. Associations between the portion sizes of food groups consumed and measures of adiposity in the british national diet and nutrition survey. Br J Nutr. 2009;101:1413–1420. [PubMed: 18845021]
17. Kolonel LN, Henderson BE, Hankin JH, et al. A multiethnic cohort in Hawaii and Los Angeles: baseline characteristics. Am J Epidemiol. 2000;151:346–357. [PubMed: 10695593]
18. Ettienne-Gittens R, Boushey CJ, Au D, Murphy SP, Lim U, Wilkens L. Evaluating the feasibility of utilizing the Automated Self-administered 24-hour (ASA24) dietary recall in a sample of multiethnic older adults. Procedia Food Sci. 2013;2:134–144. [PubMed: 28149712]
19. Stram DO, Hankin JH, Wilkens LR, et al. Calibration of the dietary questionnaire for a multiethnic cohort in Hawaii and Los Angeles. Am J Epidemiol. 2000;151:358–370. [PubMed: 10695594]
20. The Multiethnic Cohort Study. University of Hawaii Cancer Center website. http://www.uhcancercenter.org/research/the-multiethnic-cohort-study-mec. Accessed December 11, 2017.
21. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. Am J Clin Nutr. 2003;77:1171–1178. [PubMed: 12716668]
22. Murphy SP, Martin CL, Davison N, Cheung LW-K, Au DL, Novotny R. A comparison of two systems for entering and assessing dietary data for a research study. J Am Diet Assoc. 2009;109:905–908. [PubMed: 19394479]
23. Murphy SP. Unique nutrition support for research at the Cancer Research Center of Hawaii. Hawaii Med J. 2002;61:15, 17. [PubMed: 11868199]
24. SAS Statistical Software [computer program]. Version 9.4. Cary, NC: SAS Institute, Inc; 2013.
25. Eicher-Miller HA, Boushey CJ. How Often and How Much? Differences in Dietary Intake by Frequency and Energy Contribution Vary among US Adults in NHANES 2007–2012. Nutrients. 2017;9:86.
26. Hogbin M, Shaw A, Anand RS. Food portions and servings: How do they differ? Family Economics and Nutrition Review. 2001;13:92.
27. Smiciklas-Wright H, Mitchell DC, Mickle SJ, Cook AJ, Goldman JD. Foods commonly eaten in the United States: quantities consumed per eating occasion and in a day, 1994–96. US Department of Agriculture NFS report. 2002; 96–5: 252.
28. Almiron-Roig E, Aitken A, Galloway C, Ellahi B. Dietary assessment in minority ethnic groups: a systematic review of instruments for portion-size estimation in the United Kingdom. Nutr Rev. 2017;75:188–213. [PubMed: 28340101]
29. Subar AF, Crafts J, Zimmerman TP, et al. Assessment of the accuracy of portion size reports using computer-based food photographs aids in the development of an automated self-administered 24-hour recall. J Am Diet Assoc. 2010;110:55–64. [PubMed: 20102828]
30. Stumbo PJ. New technology in dietary assessment: a review of digital methods in improving food record accuracy. Proc Nutr Soc. 2013;72:70–76. [PubMed: 23336561]
31. Zhu F, Bosch M, Boushey CJ, Delp EJ. An image analysis system for dietary assessment and evaluation. Proc Int Conf Image Proc. 2010;1853–1856. [PubMed: 22025261]
32. Boushey CJ, Spoden M, Delp EJ, et al. Reported energy intake accuracy compared to doubly labeled water and usability of the mobile food record among community dwelling adults. Nutrients. 2017;9:312:1–17.
33. Dwyer J, Picciano MF, Raiten DJ, Committee S. Collection of food and dietary supplement intake data: what we eat in America–NHANES. J Nutr. 2003;133:590S–600S. [PubMed: 12566509]
34. Dodd KW, Guenther PM, Freedman LS, et al. Statistical Methods for Estimating Usual Intake of Nutrients and Foods: A Review of the Theory. J Am Diet Assoc. 2006;106:1640–1650. [PubMed: 17000197]

RESEARCH SNAPSHOT

Research Question

Are there sex differences in food portions on 24-hour dietary recalls (24HDRs) among those who selected the same portion size on a quantitative food frequency questionnaire (QFFQ)?

Key Findings

This cross-sectional calibration study included 319 men and women from the Hawaii-Los Angeles Multiethnic Cohort. Of the 163 food items listed with portion size options in the QFFQ, 32 items that were also reported in up to three 24HDRs by ≥20 men and ≥20 women were further examined. For those choosing the same portion size on the QFFQ, mean intake amounts from 24HDRs were significantly higher in men than in women for eight items ($p < 0.05$).

Table 1.

Characteristics of participants in the calibration study of the revised quantitative food frequency questionnaire in the Hawaii – Los Angeles Multiethnic Cohort[a]

	Men	Women
	←*mean ± standard deviation*→	
Age at calibration study (years)	69.3 ± 5.3	68.2 ± 5.3
	←*n (%)*→	
No. of participants	160 (50.2)	159 (49.8)
Area		
Hawaii	103 (64.4)	96 (60.4)
California (primarily Los Angeles County)	57 (35.6)	63 (39.6)
Race/ethnicity		
African American	38 (23.8)	40 (25.2)
Native Hawaiian	34 (21.3)	34 (21.4)
Japanese American	30 (18.8)	32 (20.1)
Latino	19 (11.9)	23 (14.5)
non-Hispanic White	39 (24.4)	30 (18.9)
Education		
≤ 12 years	34 (21.3)	32 (20.4)
college/vocational school	50 (31.3)	60 (38.2)
≥ College graduate	76 (47.5)	65 (41.4)

[a]There were no significant differences between men and women and they are balanced by design

Table 2.

Food portions from 24-hour dietary recalls (24HDRs) among those who reported the same portion size on the revised quantitative food frequency questionnaire (QFFQ2) in the Hawaii – Los Angeles Multiethnic Cohort

QFFQ2				24HDRs				
				Men (M)		Women (W)		M vs. W
Food items[a]		Portion size	Assigned amount[b]	n	mean ± sd (g)	n	mean ± sd (g)	p-value[c]
Beef, Lamb, or Veal (such as steak, roast, teriyaki beef, carne asada, machaca)””	B[d]	Photo B (3 ounces or 1 chop)	85 g	23	147.4 ± 57.6***[e]	31	97.5 ± 54.9	0.0016
Roasted, Baked, Grilled, or Stewed Chicken (such as ground, in sandwiches, teriyaki, cornish hen)	B	Photo B (1 breast, 2 thighs, 3 wings, or 1 sandwich)	120 g	28	92.7 ± 55.5*	31	96.7 ± 52.7**[f]	0.7685
Sausage (such as pork, beef, Portuguese, Vienna, Polish, hot links, chorizo)	B	2–3 pieces or links or 1 patty	75 g	20	93.3 ± 55.9	24	60.8 ± 55.4**	0.0510
White Rice (includes musubi, rice pilaf, jook, rice gruel)	B	1 rice bowl (1 cup) or 1 musubi	200 g	49	199.7 ± 85.8	31	145.0 ± 83.4***	0.0036
Brown or Wild Rice	B	1 cup or 2 scoops	194 g	20	180.9 ± 97.7	21	126.1 ± 87.7**	0.0397
Lettuce or Tossed Salad (all varieties)	B	1 cup	61 g	52	57.3 ± 31.9	56	49.8 ± 31.1*	0.2249
	C	1–1/2 cups or more	92 g	58	68.9 ± 43.4***	48	51.7 ± 44.4***	0.0475
Tomatoes (fresh or canned)	B	4 slices or 1/2 medium tomato	81 g	20	64.4 ± 64.8**	35	69.6 ± 62.4	0.7695
Regular Salad Dressings or Mayonnaise Added to Salads	B	1 Tablespoon	15 g	33	18.9 ± 13.2	40	18.5 ± 13.7	0.9148
	C	2 Tablespoons or more	30 g	33	27.0 ± 22.7	23	20.7 ± 23.3	0.2769
Eggs Cooked or Raw (includes egg salad)	B	1 egg or 1 sandwich	53 g	32	72.6 ± 33.0	61	56.1 ± 32.9	0.0215
	C	2 eggs or more	106 g	45	116.6 ± 65.8	25	89.1 ± 64.2	0.0951
Dark Leafy Greens (such as spinach, collard greens, watercress, mustard cabbage, choi sum, chard)	B	Photo B (1/2 cup)	71 g	23	72.3 ± 76.0	26	52.3 ± 76.3	0.3300
Other Green Vegetables (such as celery, zucchini, green peppers, asparagus)	B	Photo B (1/2 cup)	75 g	38	75.5 ± 72.0	37	58.4 ± 69.6	0.2943
Carrots (raw or cooked)	A	Photo A (4 to 5 sticks or less)	25 g	23	60.2 ± 47.8**	28	59.4 ± 49.1*	0.9533
	B	Photo B (1/2 cup or 1 medium)	72 g	22	51.6 ± 34.6**	31	42.7 ± 33.4***	0.3548
Onions (yellow, white, or red, raw or cooked) (such as in sandwiches, as garnish, in salads, fried onion rings)	A	1 Tablespoon chopped or 1 slice	7 g	29	35.9 ± 42.4***	36	33.8 ± 39.7***	0.8404
	B	1/4 cup	41 g	26	44.4 ± 40.8	35	30.1 ± 37.8	0.1641
Other Vegetables (such as cucumber, mixed vegetables, mushrooms, sprouts, eggplant)	B	Photo B (1/2 cup)	59 g	37	64.2 ± 62.5	50	47.4 ± 60.1*	0.2047
Oranges (excluding juices, includes tangerines, madarin oranges)	B	1 orange or 2 tangerines or 1 cup	160 g	23	124.4 ± 55.5*	26	110.1 ± 54.2***	0.3684
Apples (fresh or dried) and Applesauce	B	1 apple or 1 cup	132 g	27	121.8 ± 55.1	41	108.7 ± 54.6**	0.3376

QFFQ2				24HDRs				
Food items[a]		Portion size	Assigned amount[b]	Men (M)		Women (W)		M vs. W
				n	mean ± sd (g)	n	mean ± sd (g)	p-value[c]
Bananas	B	1 banana (8 inch)	118 g	58	108.3 ± 41.6	48	$97.3 \pm 43.0^{***}$	0.1826
Other Fruits (fresh, canned, or dried) (such as grapes, raisins, strawberries, nectarines, honeydew melon)	A	1/2 cup or less	81 g	33	58.3 ± 70.2	48	$56.9 \pm 67.0^{**}$	0.9311
	B	1 cup	162 g	29	$76.5 \pm 49.8^{***}$	35	$70.5 \pm 50.6^{***}$	0.6380
Other Fruit Juices or Fruit Drinks (such as cranberry juice cocktail, apple juice, passion-orange drink)	B	Large glass (8 ounces)	240 g	21	264.5 ± 147.8	22	260.6 ± 155.7	0.9319
White Bread (such as French, pan dulce, Portuguese sweet bread, pita, in sandwiches)	B	2 slices	66 g	30	87.2 ± 60.3	29	63.6 ± 54.3	0.1139
Whole Wheat or Rye Bread (such as pumpernickel, whole wheat pita, in sandwiches)	B	2 slices	56 g	59	52.3 ± 13.5*	49	$42.5 \pm 13.5^{***}$	0.0003
Buns and Rolls (includes bagels, English muffins)	B	1 item (3 inch)	45 g	28	$57.3 \pm 20.6^{**}$	26	46.1 ± 19.9	0.0464
Butter Added to Bread Items	A	spread thin	5 g	23	$12.5 \pm 10.6^{**}$	27	11.3 ± 10.6*	0.6982
Jam or Jelly Added to Bread Items	A	spread thin	7 g	22	$19.2 \pm 9.5^{***}$	25	$13.6 \pm 9.9^{***}$	0.0616
Mayonnaise in Sandwiches	A	spread thin	5 g	41	$19.2 \pm 15.6^{***}$	48	$12.4 \pm 15.7^{***}$	0.0363
Cooked Cereals (such as oatmeal, corn grits, cream of wheat)	B	1 cup or individual packet	206 g	30	188.1 ± 95.1	28	174.5 ± 98.4	0.5889
Regular Cheese (such as American, cheddar, Monterey, Queso Chihuahua)	B	1 slice (1 ounce)	28 g	43	34.8 ± 22.4	44	32.4 ± 22.1	0.6127
Crackers and Pretzels (such as soda, graham, Wheat Thins, Japanese rice crackers)	A	4 to 5 snack or 1 large cracker	15 g	20	19.7 ± 12.8	22	17.2 ± 12.9	0.5154
	B	6 to 10 snack or 2 large crackers	27 g	22	33.0 ± 23.3	21	23.7 ± 21.8	0.1749
Peanuts or Other Nuts (includes trail mix)	B	1/4 cup	32 g	33	51.5 ± 45.2	26	32.3 ± 43.1	0.0890
Chips (such as potato, tortilla, corn, chicharrones, pork rinds)	B	1 snack bag or 1 cup	28 g	20	29.1 ± 16.1	20	26.9 ± 16.6	0.6536
Regular Sodas	B	1 can or large glass	360 g	32	365.9 ± 98.7	23	356.8 ± 100.2	0.7318
Diet Sodas	B	1 can or large glass	360 g	27	367.4 ± 118.9	20	352.7 ± 115.9	0.6769

[a]Food items that were reported in both the 3-days 24HDRs and the QFFQ2 by ≥20 men and ≥20 women

[b]Assigned amount of usual portion size in QFFQ2

[c]Mean portions were adjusted for race/ethnicity and compared between men and women using a linear regression model

[d]The portion sizes are ordered so that A is the smallest, B, C, and D is the largest

[e]Comparison between the mean portions from 24HDRs and the assigned portion size of QFFQ2 among men ($^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$)

[f]Comparison between the mean portions from 24HDRs and the assigned portion size of QFFQ2 among women ($^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$)