Agreement in Participant-Coded and Investigator-Coded Food-Record Analysis in Overweight Research Participants: An Examination of Interpretation Bias

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ABSTRACT

Validation studies support the use of self-administered computerized methods for reporting energy intake; however, the degree of interpretation bias with these methods is unknown. This research compared nutrient intake for food records that were both participant coded (using the National Cancer Institute's Automated Self-Administered 24-hour recall [ASA24] online program) and investigator-coded (a single investigator coded all food records using the ESHA Food Processor diet analysis program). Participants (n=28; mean age=41±11 years; mean body mass index=31±6) were participants in an 8-week trial (conducted between March 2011 and June 2011 in Phoenix, AZ) investigating the impact of meal preloads on satiety. Food records were collected on four occasions during the trial and, of the food records available for this investigation (n=161), 88% were completed on a weekday. Intra-class correlation coefficients were computed for selected nutrients and ranged from 0.65 to 0.81 for the macronutrients and from 0.50 to 0.66 for the micronutrients (overall mean=0.67). Overall mean coefficient improved to 0.77 when the data from three or more food records per participant were averaged, as is commonly done in nutrition research. All intra-class correlation coefficients were significant ($P<0.020$) and were not impacted by the day of week that food was recorded. For energy, macronutrients, and minerals, the percent median differences between coders were <±17%; however, percent median differences were large for vitamin C (+27%) and beta carotene (+294%). Findings from this study suggest that self-administered dietary assessment has merit as a research tool. Pretrial training for research participants is suggested to reduce interpretation bias.
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DIETARY ASSESSMENT IS A COMPLEX PROCESS AND extremely difficult to measure precisely. In a recent systematic review of 37 qualifying studies that utilized traditional methods for dietary assessment, 24-hour recalls or food records, Poslusna and colleagues concluded that about one third of female participants and 20% of male participants misreport energy and micronutrient intakes, mainly due to the under-reporting of energy.[1] The under-reporting of energy by 12% to 13% was similar for 24-hour recalls and food records, as indicated by doubly labeled water or the Goldberg cut-off technique. In addition to misreporting limitations, dietary assessment by traditional methods is costly and time consuming. A major advancement in diet assessment methodology was the development of software that computerized the 24-hour interview process, such as the validated Automated Multiple-Pass Method system (AMPM) of the US Department of Agriculture (USDA).[2] These systems permitted enhanced consistency of interviewing because of standardized probes (query details of food and portions) and supported computerized coding of the responses, a substantial time-saving feature. However, these computerized methods were also limited by energy-misreporting error to nearly the same degree as traditional methods.[3,4]

With advancing technology, self-administered computerized methods for diet recording and analyses are continually emerging, including smart phone apps, personal digital assistants, and web-based 24-hour recalls.[3,5-9] These tools permit researchers to secure large amounts of dietary data with relative ease. The National Cancer Institute's Automated Self-Administered 24-hour Recall (ASA24), patterned after the AMPM system for diet recall, is an easy-to-navigate, user-friendly program available at no cost to researchers.[10] This meal-based tool, which has yet to be validated for energy-reporting accuracy, includes audio assistance, specialized graphics, a helpful tutorial, and animated characters. However, self-coded diet analyses might be prone to interpretation bias, a consequence of cognitive processing variations among individuals. Diet entry by trained investigators utilizes food default listings and standard serving sizes to reduce bias

and inter-recorder variability and interpretation bias is managed in a standardized manner.[11]

The purpose of this research was to compare self-administered diet assessment (using the ASA24 online program) with investigator-administered diet record assessment (using the ESHA Food Processor software program) to determine the degree of agreement between methods.

METHODS

This research used dietary data collected during a randomized controlled trial that examined the impact of meal preloads on satiety in overweight individuals (body mass index [BMI] ≥25).[12] The trial was conducted March 2011 to June 2011 in Phoenix, AZ. Participants were nonsmokers who did not exercise vigorously more than twice a week. Exclusion criteria included a recent history of dieting and/or change in body weight (±5 kg); prescription drug use that impacted eating behavior and/or body weight, unresolved medical conditions and disease, and known food allergy. Written consent was obtained from all participants and the Institutional Review Board at Arizona State University approved the trial. Participants were stratified by sex, age, and BMI and randomly assigned to one of two preload treatments. All participants completed handwritten, 3-day food records before the start of the trial and at trial weeks 1, 4, and 8. Participants received brief standardized instruction for navigating the ASA24 website and were instructed to enter their recorded dietary data the following day on the ASA24 website. The online ASA24 interview covered a full day of food and drink intake from midnight to midnight and contained a database encompassing approximately 4,250 food codes and >8,000 food images for assisting users to quantify portion sizes (ASA24-2011, formerly known as version 1, utilizing version 4.1 of USDA's Food and Nutrient Database for Dietary Surveys).[10]

During the ASA24 interview process, participants completed the following steps: selected meals/food/drinks, added details, and approved a final review of items entered. First, after selecting a meal and entering some general information about the time and location of the meal, the participant chose the type of food and drink that were consumed during that particular meal. Once all of the meals, snacks, food, and drink were entered for the day, the system uses food probes to provide further specification of items consumed. The system also prompts users to insert any commonly omitted items, such as beverages, condiments, and desserts. Lastly, at the final review, the participant is given the opportunity to correct mistakes or modify food, drink, or supplement items within the record.

Participants returned the handwritten food records to the study investigators at the biweekly study visits. A trained nutrition professional skilled in standardized diet entry processed the food records using the Food Processor SQL Edition analysis software that includes >18,000 food codes and utilizes the USDA Nutrient Database sr24 (version 10.10, 2011, ESHA Research). To reduce interpretation bias, a comprehensive default food code list encompassing >450 foods and beverages was utilized when an item could not confidently be assigned a specific code. Standard USDA serving sizes were used when portion amounts were not clearly stated.

Statistical Analysis

Agreement between participant-coded food records and investigator-coded food records was examined for energy (kcal) and nine nutrients: carbohydrate (g), protein (g), total fat (g), fiber (g), sodium (mg), iron (mg), calcium (mg), vitamin C (mg), and beta carotene (ug). Data are reported as the mean±standard deviation and median. The Wilcoxon signed ranks test was used to assess differences between means, and median values were used as a reference for calculating the percent differences between groups (participant-coded value minus investigator-coded value divided by investigator-coded median value). Intra-class correlation coefficients were calculated to determine the strength of agreement between participant-coded and investigator-coded food records. Nutrient analysis data are reported for all available food records that were both participant-coded and investigator-coded (n=161). The number of matched food records per participant ranged from 1 to 12 days. Food record data were averaged for the 21 participants who had three or more matched diet records (averaged records represent 7.1±2.9 days), and the same analyses as described here were performed using the nutrient averages. Data plots for selected nutrients were prepared to permit graphic assessment of agreement between coders. Participant characteristics were compared using independent *t*-tests and the Pearson correlation was used to assess relationships between variables. All statistical analyses were performed using the statistical package for the social sciences (version 19.0, 2011; SPSS Inc, an IBM Company), and statistical significance was set at $P \leq 0.05$.

RESULTS AND DISCUSSION

A total of 161 diet records matched the days for completed self-administered recalls from 28 research participants (mean age=41±11 years; mean BMI=31±6; 25 women/3 men). There were no significant differences for sex, age, weight, or BMI between the 28 participants who completed the self-administered, online interviewees who are the focus of this investigation, and the remaining 16 participants of the parent study. Seventy-six percent of the matched food records represented food consumed on a Tuesday, Wednesday, or Thursday, and 12% of the food records represented food consumed on a weekend day.

Means±standard deviations, medians, percent median differences, and intra-class correlation coefficients for selected nutrients from the 161 matched dietary entries are presented in Table 1. Intra-class correlation coefficients ranged from 0.65 to 0.81 for the macronutrients and from 0.50 to 0.66 for the micronutrients (overall mean=0.67). For the averaged food record analyses, intra-class correlation coefficients improved to 0.70 to 0.88 for the macronutrients and to 0.61 to 0.86 for the micronutrients (overall mean=0.77) (Table 2). All intra-class correlation coefficients presented in Tables 1 and 2 were significant ($P<0.001$). Graphic representations reveal the close agreements between the participant-coded and investigator-coded food records, particularly when diet records are averaged for each participant (Figure). Correlation coefficients were not impacted by day of reporting (mean variation in *r* for the selected nutrients=0.002). The higher agreement noted for averaged nutrient intakes is important because it is common practice to average food record data for