Self-Monitoring of Dietary Intake by Young Women: Online Food Records Completed on Computer or Smartphone Are as Accurate as Paper-Based Food Records but More Acceptable

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ABSTRACT

Adherence and accuracy of self-monitoring of dietary intake influences success in weight management interventions. Information technologies such as computers and smartphones have the potential to improve adherence and accuracy by reducing the burden associated with monitoring dietary intake using traditional paper-based food records. We evaluated the acceptability and accuracy of three different 7-day food record methods (online accessed via computer, online accessed via smartphone, and paper-based). Young women (N=18; aged 23.4±2.9 years; body mass index 24.0±2.2) completed the three 7-day food records in random order with 7-day washout periods between each method. Total energy expenditure (TEE) was derived from resting energy expenditure (REE) measured by indirect calorimetry and physical activity level (PAL) derived from accelerometers (TEE=REE×PAL). Accuracy of the three methods was assessed by calculating absolute (energy intake [EI]−TEE) and percentage difference (EI/TEE×100) between self-reported EI and TEE. Acceptability was assessed via questionnaire. Mean±standard deviation TEE was 2,185±302 kcal/day and EI was 1,729±249 kcal/day, 1,675±287kcal/day, and 1,682±352 kcal/day for computer, smartphone, and paper records, respectively. There were no significant differences between absolute and percentage differences between EI and TEE for the three methods: computer, −510±389 kcal/day (78%); smartphone, −456±372 kcal/day (80%); and paper, −503±513 kcal/day (79%). Half of participants (n=9) preferred computer recording, 44.4% preferred smartphone, and 5.6% preferred paper-based records. Most participants (89%) least preferred the paper-based record. Because online food records completed on either computer or smartphone were as accurate as paper-based records but more acceptable to young women, they should be considered when self-monitoring of intake is recommended to young women.
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SELF-MONITORING OF DIETARY INTAKE IS consistently associated with weight loss in behavior-based programs.[1] However, adherence is a recognized challenge, and completion of self-monitoring records usually declines over time.[1] Traditionally, self-monitoring has involved paper-based food records where individuals record the type and amount of food or drink consumed in a written diary. These are labor intensive and require a high degree of motivation, with the participant burden potentially reducing the accuracy of the record.[1] Comparisons of paper-based food records with objective measures of total energy expenditure (TEE) indicate that energy intake (EI) is underestimated by 4% to 37%.[2] Misreporting may also diminish the value of self-monitoring as a strategy to motivate behavior change; for example, if individuals grossly underreport, they may be unaware they are exceeding their energy requirements.

The use of information technologies such as computers and smartphones to complete food records may reduce participant burden by simplifying recording and reducing diary completion time.[3] In addition, these technologies can increase the speed with which feedback can be provided about self-monitoring entries, including in real-time, which may improve participant motivation.[4] Few studies have evaluated the accuracy or acceptability of food records completed using current information technologies. We previously compared the accuracy of EI reported using a web-based food record to TEE assessed by doubly-labeled water (DLW) in women and found EI was misreported by −550 kcal/day.[5] Carter and colleagues[6] compared the accuracy of a smartphone application food record to two 24-hour recalls among 41 adults and found EI was misreported by −49 kcal/day. Burke and colleagues[7] demonstrated, using DLW, that personal digital

assistants' food records were as accurate as paper-based food records and preferred by participants. As technologies have evolved, personal digital assistants have largely been replaced by smartphones, with more than 60% of mobile subscribers owning one in the United States.[8] To date, no studies have compared the use of current technologies to traditional paper-based food records in terms of accuracy or acceptability for self-monitoring. Therefore, the aims of the current study were to assess and compare the accuracy and acceptability of completing three different food records (online accessed via a computer, online accessed via a smartphone, and paper-based).

METHODS

Design

We assigned participants in this crossover study to complete three different 7-day food records (Days 2 to 8, 16 to 22, and 30 to 36). To reduce the likelihood of differences in accuracy and acceptability due to order of record completion, participants were assigned to complete the records in a random order. A computer-generated sequence was created by one of the researchers before study commencement, and each participant was assigned the next sequence on enrollment. A washout period of 7 days occurred between each method (Days 9 to 15 and 23 to 29), with data collected in the laboratory on Days 1, 9, 15, 23, 29, and 37. Each method provided a means of participants obtaining the calorie content for each food item recorded, as well as their EI per day, which is consistent with self-monitoring.

Participants and Recruitment

Young (aged 18 to 30 years) healthy weight or overweight (body mass index [calculated as kg/m^2] 21 to 30) women were recruited at the University of Newcastle, Australia, from January to May 2012 via advertisements on university bulletin boards, website, and social networking. A homogenous sample of young women was selected because they are most representative of users of the online weight management program used in this study.[9] Eligibility criteria were access to a computer and smartphone with Internet, self-reported moderate levels of Internet and smartphone skills, weight stability over the previous 3 months and willing to remain weight-stable, not currently or planning to become pregnant, not currently breastfeeding, not taking medications that affect weight, no metabolic disorders, and nonsmokers. The study was approved by the University of Newcastle Human Ethics Committee and participants received A$30 reimbursement to cover travel and parking costs associated with study participation. Written consent was obtained from all participants before attendance at data collection on Day 1. To remain weight-stable, all participants agreed to make no changes to their usual eating and physical activity habits during the study.

Accuracy of Food Records: Test Measures

All food quantities were estimated using household measures, with measuring cups and spoons provided. Detailed instructions on how to complete each food record were provided on the day before commencing (ie, Days 1, 15, and 29). They were instructed to complete each food record for 7 days and record the type and amount of all food and drinks consumed as soon as possible after consumption.

Online Food Records. The online food record is a component of an online weight management program (SP Health Pty Ltd) and can be accessed by computer or smartphone. The participants received free access to this commercial program during the recording periods. The features of the online weight management program have been previously described[10] and include goal setting, weekly online weigh-ins with feedback, meal and exericise plans, online forums, and weekly tutorials. However, participants were instructed to only access the food record. Participants used the online food database to search for foods or drinks and selected the most appropriate item from a list of options generated automatically from the platform's database. Foods and drinks could be entered as individual items or as combinations that participants could create and save (eg, mixed dishes) to speed up future data entries. The EI of all food and drink items was sourced by the program developers from a commercial Australian food composition database (iFed Interactive Food & Exercise Database; www.ifed.com.au), which models nutrient values from the Australian Government Nutrient Data Tables for use in Australia 2010, as well as manufacturer data.

Participants were provided feedback on their dietary intake as the caloric value of each recorded item was automatically displayed, as well as cumulative EI for the day. Participants accessed the online record using computer access only or smartphone access only during the two randomly assigned 7-day monitoring periods. The same website was accessed for the computer and smartphone food record, but two separate interfaces were available (computer and mobile) that accounted for differences between the devices (eg, screen size). The website automatically detected the type of device and presented the relevant interface.

Paper-Based Food Record. Participants were provided with paper food record sheets to record the time, type, and amount of all foods and drinks consumed. They were asked to record the energy (calorie) content of each food or drink item recorded using a calorie counter book[11] and to calculate their overall EI at the end of each day. If an exact match for the food consumed was not available in the book, they were instructed to record the caloric value of the food item that was most similar.

Analysis of Energy Intake. Daily food records were classified as complete if two or more meals were recorded with average EI/day calculated using data from these records only. Participants were excluded from analysis if <85% of recording days (<6 days) were completed. Data from the online record entries were provided to the researchers by SP Health Co. Paper-based food records were reanalyzed using iFed by a dietitian to ensure a consistent food composition database was used for all three food records.

Accuracy of Food Records: Reference Measure

Resting Energy Expenditure. Resting energy expenditure (REE) was measured by indirect calorimetry using a ventilated hood system (Sensormedics Vmax Spectra 229D) on