Photo-assisted recall increases estimates of energy and macronutrient intake in adults with intellectual and developmental disabilities

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Abstract

Diet assessment of adults with intellectual and developmental disabilities (IDD) is challenging due to their limited cognitive abilities. The objective of this study was to examine the feasibility and outcomes of combining photos with 24-hour dietary recalls for the assessment of energy and macronutrient intake in adults with IDD. Participants used an iPad 2 tablet computer to take

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photos of all food and beverages consumed before a standard, multiple-pass, 24-hour dietary recall. Following the standard 24-hour diet recall, the photos were reviewed with the participant for clarification details (e.g., portion size, etc.) and differences were recorded. The standard 24-hour recall and the photo-assisted recall were entered separately into Nutrition Data System for Research for computerized dietary analysis. Sixty-four eating occasions were entered from 23 participants (48% female; mean age 26.4 ±9.7 years). Participants captured photos for 66.5% ± 30.4% of all recorded eating occasions. Greater energy intake per eating occasion was reported with the photo-assisted recalls than the standard recalls (625.6 ± 85.7 kcals vs. 497.2 ± 86.6 kcals, p=0.002) and a greater intake of grams of fat (p=0.006) protein (p=0.029) and carbohydrates (p=0.003). Photo-assisted 24-hour recalls provided a significant increase in total calories and macronutrient content compared to a standard 24-hour recall and may be a feasible method to enhance dietary assessment in adults with IDD.

Keywords

24-hour dietary recall; intellectual and developmental disabilities; photo-assisted dietary recall

INTRODUCTION

Adults with intellectual and developmental disabilities (IDD) are a population that may benefit from dietary monitoring. Individuals with IDD have an increased risk of heart disease, obesity, osteoporosis, seizures; as well as lower levels of fitness. [1–4] Prevalence of obesity in adults with IDD is approximately two to three times greater than the general population. [5–9]

While the need for dietary assessment and monitoring is high in adults with IDD, there are inherent challenges in collecting dietary intakes data due to compromised cognitive functioning, poor memory, and a shortened attention span. [10,11] Due to the significant barriers in collecting valid data, researchers have not yet validated a method for dietary assessment in adults with IDD. [11]

Twenty-four hour recalls are a commonly used method of dietary assessment. [12–14] It balances reliability of responses with a fairly low respondent burden and avoids dietary intake changes in response to recording foods at the time they are eaten. [12] However, there are no published validation studies in adults with IDD using 24-hour recalls, or any other dietary assessment method. Thus, while 24-hour recalls are a valid dietary assessment in the general population, they may not be suitable for use in adults with IDD. Dietary assessment methods previously used in adults with IDD include a Block Screening Questionnaire for Fat Intake and the Behavioral Risk Factor Surveillance System's Fruit and Vegetable Module, [15] a food frequency questionnaire, [10,16] and proxy-assisted 3-day food record. [17,18]. However, the accuracy of the data is a commonly reported limitation as these assessment methods have not been validated for this population. [10,15,17,18]

A photo-assisted food recall is a new technique in which digital images are taken of all food and beverages consumed during the recall period. This method has been validated by comparing the images with a direct observation using the weighed and measured technique. Photo-assisted food recalls have been validated for assessing portion sizes, [19] and assessing energy and macronutrient intake in subjects eating prepared meals, [20–23] home meals, [24–26] and in confined settings. [27] The results indicate that photo-assisted recalls are useful in assessing dietary intake in the general population.

Elinder et al. [28] conducted a feasibility study in a population of adults with IDD (n=18; ages 23–60 years) to investigate participants' ability to use cameras to take accurate images of

food. It was found that with reminders from staff, participants with IDD photographed 85% of all observed eating or drinking occasions. The correlations between items assessed in images and direct observations were strong. The researchers concluded that personal digital photography appears to be a feasible and reliable method for assessing dietary intake in individuals with IDD. Humphries, Traci, and Seekins [29] conducted photo-assisted 24-hour recalls in nine adults with IDD to determine if photo-assisted recalls would result in more food items being collected. The researchers determined that the photo-assisted food recall may allow more food items to be identified; however, the extent to how much more was eaten in terms of total energy and macronutrient intake was not reported and remains unknown.

While previous studies suggest that using photos to enhance recall methods may improve the quantification of food and beverage intake in adults with IDD, no information is available regarding the utility of photo-assisted recalls to improve the measurement of total energy and macronutrient intake for individuals with IDD. As individuals with IDD are at an increased risk of obesity and related health complications, [30–32] improving the methods to obtain accurate dietary assessment methods, especially estimates of energy and macronutrient intake, may help to design the necessary diets for weight loss and health promotion. Therefore, the aim of this study was to determine if the use of photo-assisted recalls significantly improves the estimated amount of energy and macronutrient intake reported in 24-hour dietary recalls, in adults with IDD.

METHODS

This was a cross-sectional design study in 23 adults with IDD (Age = 26.4 ± 9.7 years; BMI= 35.5 ± 5.7 kg/m^2). Table 1 presents total demographic data. All participants were community dwelling adults (18 years of age) with mild to moderate IDD enrolled in an ongoing healthy lifestyle intervention trial. Participant's level of IDD impairment (mild vs. moderate) had been previously assessed by The Community Developmental Disability Organization of Kansas. For this study, mild IDD was defined as having few activities of daily living that required direct assistance and moderate IDD was defined as typically needing direct assistance for most activities as determined by participants' caretakers. To be included, participants needed to be able to communicate preferences (e.g., foods liked and disliked), wants (e.g., more to eat, drink), and needs (e.g., assistance with food preparation) through spoken language, sign language, or augmentative and alternative communication systems, such as voice output communication aides. Participants were recruited through local community programs and agencies. Each participant and their legal guardian (if applicable) signed a consent form approved by the University of Kansas institutional review board.

The iPad 2 (Apple, Cupertino, CA, USA), Wi-Fi only model (241.2 × 185.7 × 8.8 mm; 601 g) with a 246-mm screen (diagonal dimension), 16 GB storage and iOS5 operating system was used for this study. [33] The iPad 2 uses a LED backlight screen with a 1024 × 768 screen resolution at 132 pixels per inch and battery life of up to 10 hours. The iPad 2's rear-facing camera (1280 × 720 pixels or 0.92 megapixel camera with autofocus) was used for the photo-assisted recalls. Study personnel delivered the tablet to participants approximately two days before the scheduled 24-hour hour recall (visit one). During this 30-minute visit, the participant was instructed on basic tablet computer functions. Specifically, the study personnel demonstrated how to operate the camera application and observed the participant independently take satisfactory photos. Participants were instructed to take before and after photos with the tablet computer of all food and beverages consumed 24-hours prior to the dietary assessment. Each participant was given a fiduciary marker (a 5 cm × 5cm checked square) to be included in all photos to serve as a reference measure to aid study staff in

determining portion sizes. Calendar prompts were programmed into the tablet computer to remind participants to comply with the photo/recall protocol.

During the home visit (visit two) a registered dietitian, who had passed internal reliability checks against multiple registered dietitians to conduct 24-hour recalls in this population, conducted a 24-hour multiple pass dietary recall. The recall followed the USDA multiple pass method consisting of 5 steps: (a) the quick list, which is an uninterrupted listing by the subject of foods and beverages consumed; (b) the forgotten foods list, which queries the subject on categories of foods that have been documented as frequently forgotten; (c) a time and occasion at which foods were consumed; (d) the detail cycle, which elicits descriptions of foods and amounts eaten aided by the interactive use of measuring guides; and finally (e) the final probe review. [13,34,35] The portion guides used in the interviews were 3-dimensional models consisting of a variety of items intended to provide a reference and improve recall accuracy (i.e., glasses, mugs, bowls, circles, thickness sticks, chip bags, drink bottles, a 12-inch ruler, measuring cups and spoons, a grid, wedges, geometric shapes, and diagrams of chicken pieces). [36] After completing the multiple pass 24-hour recall, the date and time stamped photos were evaluated. Each photographed meal or food item was discussed with the participant to identify if the photos provided additional detail regarding the food type, portion size, and other characteristics (e.g., drinks, side dishes, ingredients, condiments, etc.). The registered dietitian made a note by each meal recorded to identify if a photo had been taken of that meal. Food items, portion size, and specific details about any food items that were different from the standard recall, were recorded in a designated column on the 24-hour recall form to distinguish the photo-assisted recall from the standard recall. Additional details, including the reasons for the differences (e.g., forgot food, inaccurate portion size), number of meals captured by photo, and total number of meals consumed were also recorded.

The registered dietitian, who initially collected the recalls, entered all dietary records into Nutrition Data System for Research (NDSR) software version 2011. [37,38] The standard and the photo-assisted recalls were entered as two separate records. All photos were uploaded to a secure server and available to the registered dietitian while entering the photo assisted recall into NDSR. Dietary analysis of the recalls was exported from NDSR to determine intake of total calories, grams of fat, carbohydrate, and protein.

Mixed modeling for repeated measures [39–41] was used to examine the differences between the standard recall and the photo-assisted recall. Models were adjusted for the participants' age, gender, race, education level, and level of IDD impairment (mild vs. moderate). [42] A priori power calculation [43] with pilot data indicated that a minimal sample size of 18 participants would provide adequate power to detect differences in energy and macronutrient data between the standard and photo-assisted 24-hour recalls (power = 0.80 with n = 18 and d = 0.64). Statistical significance was determined at 0.05 alpha level and all analyses were conducted using Statistical Analysis Software (version 9.2, 2012, SAS Institute Inc). [44]

RESULTS

Sixty-four eating occasions were entered from 23 participants. Participants captured photos for $66.5 \pm 30.4\%$ of all eating occasions. There was an average of 2.7 ± 1.1 dietary differences, such as incorrect portion size, between the standard and photo-assisted recall per meal captured by the tablet computer. The most common difference was forgetting a food eaten (45.9%) followed by having incorrect or missing details about a food item (29.6%), reporting an incorrect portion size (21.4%), and reporting a food not actually consumed (3.1%).

Table 2 provides data describing the intake differences between standard and photo-assisted recalls for total energy and grams of fat, carbohydrate, protein. The photo-assisted 24-hour recalls reported significantly greater intakes of total calories (a 25.8% increase) grams of fat (a 41.4% increase) carbohydrates (a 19.1% increase) and protein (a 23.0% increase) per eating occasion (all $p < 0.05$).

The macronutrient composition (percent of total energy from grams of fat, protein, and carbohydrates) was evaluated for both the standard and photo-assisted recall to examine whether certain types of foods were captured differently between methods (e.g., high fat foods were concealed, etc.). Figure 1 illustrates the macronutrient composition for both recall methods. There was no statistical difference for the percent distribution of grams of fat, protein, or carbohydrates.

DISCUSSION

This study was designed to determine if photo-assisted recalls provide added value when assessing 24-hour dietary recall in adults with IDD. The results of this study indicate that the use of photo-assisted 24-hour food recalls provided significantly greater intake of total calories and macronutrients compared to standard 24-hour food recalls. These significant differences in caloric and macronutrient intake may have important clinical implications when evaluating dietary intake in this population as these results suggest that standard 24-hour food recalls alone may underestimate dietary intake in adults with IDD.

Similar to Elinder et al [28] all participants in this study were able to take photos of their meals without assistance. In this study, with the calendar prompts from the tablet computer, participants were able to capture photos of two-thirds of all eating occasions. The most common reason for not taking a photo of a meal reported in the standard recall was due to consuming a meal while at work or at a public event where the participant felt uncomfortable bringing the tablet computer. The participants in this study ranged in age from 18–60 years, suggesting that both younger individuals who may have been more familiar with technology, such as a camera, computer, or tablet computer, and older individuals who may be less familiar with this technology were able to use the tablet computer to take photos of food.

This study identified a 25.8% greater energy intake when photos were used to assist the recall than without. The primary reason for the higher reported intake in photo-assisted recalls was that the photos captured a food or an entire meal that was forgotten in the standard recall, for example forgetting breadsticks with pasta or forgetting an entire afternoon snack. Another area where the photos provided an additional benefit was in improving the accuracy of portion size estimation, for example reporting 2 slices of pizza when a photo showed 4 slices of pizza, or a reporting a small beverage when the photo showed a large. Significantly, more grams of fat, carbohydrate, and protein intake were reported in the photo-assisted 24-hour recall compared to the standard 24-hour recall ($p < 0.05$); however, the macronutrient composition (percent calories from fat, protein, and carbohydrate) was not different. This shows that the participants were probably not intentionally misreporting certain types of foods (e.g., high fat foods) on the standard 24-hour recall. However, it may indicate that the participants were unable to accurately recall all of the food/beverages consumed or the portion sizes.

While this study highlights the value of using photo-assisted 24-hour recalls in adults with IDD, several limitations do exist. Participants in this study were not randomly selected and were volunteers in a healthy lifestyle intervention, which may limit the generalizability of this study. It can also be suggested that the act of taking photos may help the participants

have a better memory of what was eaten; however, Humphries et al (2008) found that the act of solely taking a photo did not improve dietary recalls in adults with IDD. [29] Finally, not all meals were captured throughout the day, as participants did not bring the tablet computer to work. In turn, it was not possible to evaluate the difference in energy and macronutrient intake between recall methods for all eating occasions in the 24-hour period.

While photo-assisted 24-hour recalls appear to be a feasible method of collecting dietary intake information from adults with IDD, it is still not a validated dietary assessment method in this population. Methodology still needs to be developed to assure the capture of all meals consumed throughout the day. Furthermore, validation studies need to be conducted to determine if photo-assisted recalls, can be used to provide a valid dietary assessment data in adults with IDD. Common validation practices are to compare the dietary assessment method against another similar method, [14] to compare the dietary assessment to direct observation of meal consumption, [12] and the use of doubly labeled water. [45–47] As no other validated dietary assessment exists in this population, comparing one dietary assessment method to another would not be feasible; thus, direct observation or the use of doubly labeled water would be the best techniques.

To our knowledge this is the first study to examine the difference in energy and macronutrient intake between standard and photo-assisted 24-hour hour recalls in adults with IDD. Although photos were not available for all meals, the photos provided substantial additional detail about dietary intake. This information may be valuable as individuals and clinicians working with adults with IDD may be able to use photo-assisted recalls to obtain more accurate dietary information that could allow for better assessments of nutritional intake and possibly help identify nutritional concerns and deficiencies in the individuals with whom they are working.

SUMMARY

Adults with IDD are a nutritionally vulnerable population but lack a valid dietary assessment technique. Photo-assisted 24-hour recalls provided a statistically significant improvement for estimation of total calories and macronutrient intake compared to a standard 24-hour recall in adults with IDD. The clinical implications of this study suggest that use of standard 24-hour food recalls alone may underestimate the dietary intake of adults with IDD. Nutrition professionals working with adults with IDD should be aware of the challenges in obtaining accurate dietary assessments, and be cognizant that underreporting may occur. This study provides evidence that photo-assisted 24-hour food recalls are a feasible dietary assessment method in adults with IDD that may improve estimates of dietary intake. However, validation studies are needed to determine if this method provides an accurate and reliable assessment of the dietary intake of adults with IDD.

Acknowledgments

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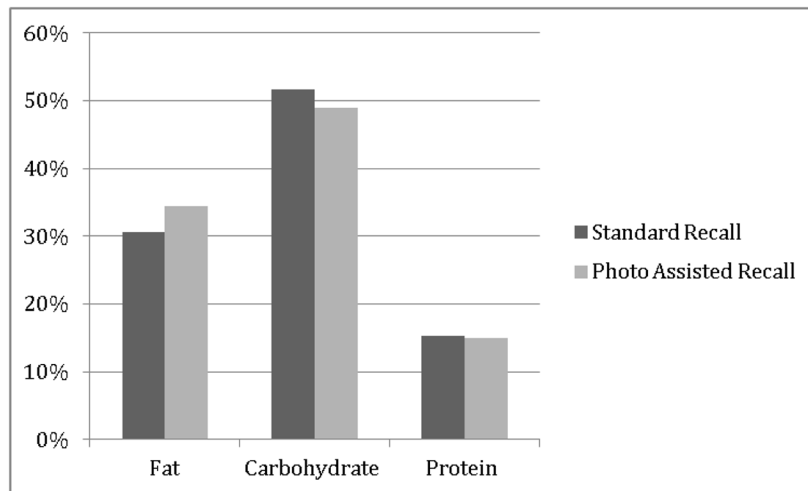
Figure 1.
Macronutrient composition as percentage of total energy for standard and photo-assisted dietary recalls per eating occasion
No statistical difference was observed; all p>0.05

Table 1

Study sample characteristics

Variable	n	M ± SD/%
Age (years)	23	26.4 ± 9.7
Gender		
Male	12	52.2%
Female	11	47.8%
Race		
White	18	78.3%
Other	5	21.7%
Ethnicity		
Not Hispanic/Latino	23	100.0%
Hispanic/Latino	0	0.0%
Education level		
Less than 9th grade	0	0.0%
9th–12th grade	11	47.8%
High school/GED	9	39.1%
More than high school	3	13.0%
Level of IDD impairment		
Mild	14	60.9%
Moderate	9	39.1%

Table 2

Energy and macronutrient intake per eating occasion assessed by a standard multiple pass 24-hour recall compared to photo-assisted 24-hour recalls in adults with IDD

Variable	24-hour multiple pass recall		Photo-assisted 24-hour recall		
	M	SD	M	SD	p
Energy (kcals)	497.2	86.6	625.6	85.7	0.002
Fat (g)	16.9	5.3	23.9	5.2	0.006
Carbohydrate (g)	64.3	9.0	76.6	8.9	0.003
Protein (g)	19.0	2.2	23.3	2.1	0.029

Note. Values are Mean +/− Standard Deviation.

IDD = Intellectual and Developmental Disabilities.

g = grams.