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Eight Self-Administered 24-hour Dietary Recalls Using the Internet are Feasible in African Americans and Caucasians: The Energetics Study

Lenore Arab, M.Sc. Ph.D.,

Professor, David Geffen School of Medicine at UCLA. 700 Tiverton, 1-940 Factor Building, Box 951736, Los Angeles, CA, 90095. Phone: 310-267-4474. Fax: 310-312-1615

Kate Wesseling-Perry, M.D.,

Assistant Professor of Pediatrics at UCLA. 10833 Le Conte Avenue Los Angeles, CA 90095. A2-383 MDCC. Phone: 310-266-6987

Patricia Jardack, M.S., R.D.,

Bionutrition Manager, General Clinical Research Center, David Geffen School of Medicine at UCLA. 10833 Le Conte Ave, 27-079 CHS, Los Angeles, CA 90095-1697. Phone: (310) 825-5768. Fax: (310) 206-9440

Judith Henry, M.S.Ed., and

Study Manager, Energetics Study. Director, The Phoenix Agency, Inc., 16105 N. Florida Avenue, Lutz, FL 33549. Phone 813-908-7701 Fax 813-908-7501

Ashley Winter, B.S.

Research Assistant, Energetics Study. 700 Tiverton, 1-940 Factor Building, Box 951736, Los Angeles, CA, 90095. Phone: 310-267-4266

Lenore Arab: larab@ucla.edu; Kate Wesseling-Perry: KWesseling@mednet.ucla.edu; Patricia Jardack: pjardack@mednet.ucla.edu; Judith Henry: jhenry@thephoenixagency.com; Ashley Winter: ashwinter@ucla.edu

Abstract

Background—To support research and to provide dietitians with a strong foundation for nutrient-based counseling, there is a need for affordable automated 24-hour dietary recalls. Multiple days of intake, along with repeated reports over time, are needed to achieve stable indicators of individual intakes and to support evaluation of success in meeting dietary goals due to intra-individual intake variability. Little information has been published on subject responses, participation rates, and the perceived subject burden of repeated 24-hour recalls.

Objective—To determine the willingness of subjects to conduct eight 24-hour recalls via the internet.

Design and Subjects/Setting—261 Caucasians and African Americans within 50 miles of UCLA participated in a study to validate a web-based, automated, self-administered 24-hour recall (DietDay). Subjects completed three DietDays at the study visits and another five on their own. The last two DietDays were completed one and two months after the final clinic visit. Subjects

Corresponding Author: Lenore Arab, M.Sc. Ph.D., Professor, David Geffen School of Medicine at UCLA. 700 Tiverton, 1-940 Factor Building, Box 951736, Los Angeles, CA, 90095. Phone: 310-267-4474. Fax: 310-312-1615. larab@ucla.edu.

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were notified by automatic email of the need for DietDay completion, and non-responders were pursued by personalized emails and phone calls.

Results—The perceived subject burden was minimal and, even after completing six recalls, 92% were willing to continue reporting their daily diets one and two months later. Caucasians had a slightly higher rate of return, with 94% completing all eight recalls, compared to 91% of African American subjects. Participants were able to access the internet in their homes, offices, library, or homes of friends or family. It is also of interest that 82% of subjects believed the 24-hour recall was superior to a diet history in reflecting their normal diet. This opens up new opportunities for dietitians to strengthen their nutritional counseling in an efficient and affordable manner without additional time investment.

Keywords

Web based dietary assessment; 24-hour recalls; feasibility

Introduction

Quantitative dietary assessment remains limited by the expense involved in telephone or in-person interviews, the time required to conduct quantitative nutrient analyses, and the need for multiple days to capture intra-individual intake variation and compare intakes with levels recommended by the National Academy of Science (1). The most widely-used assessment approach in large epidemiologic studies in the US has been the food frequency questionnaire (FFQ). FFQs are generally self-administered, can be scanned for entry, and pose little burden on the study staff, subjects, and investigators. However, they have failed to demonstrate energy intake validity (2). In light of this, the search for feasible, high quality and affordable methods has intensified (3,4).

Dietitians rely on 24-hour recalls to elicit information from specific memories of recent eating events. Twenty-four-hour recalls have the advantages of being based on short-term memory and are less likely to be biased by social desirability and are less likely to alter dietary behavior(5,6). Additionally, 24-hour recalls involve a relatively low respondent burden (7). However, a major drawback of the method is that a single or a few days of collection may not be adequate to characterize an individual's habitual diet. Infrequently consumed nutrients may require up to hundreds of days of assessment for estimation of an individual's true consumption (8).

Repeated contact with subjects can be costly. This limitation can be overcome through computer-assisted self-interview (CASI) and the use of web-based methods that can be accessed from any geographic location at low cost and with little effort. Although the internet is well-suited for this purpose, it has not yet been assessed for feasibility and validity (9). Other studies have explored the appropriateness of using the web for population-based studies (10,11). However, attempts to get repeated log-ins to interventions with web supplements to promote healthy eating behavior in a study of African-American families were disappointing (12). The question remains as to whether and how much repeat usage is possible without compromising participation and quality.

The Energetics Study, an NIH-supported validation study, designed to compare three different approaches to dietary assessment in the same biracial population, tested the feasibility of using online and multimedia approaches to support self-administered questionnaires. The study applied a total of eight independent 24-hour recalls. This report addresses the technical feasibility of, compliance with, and burden of subjects being asked to conduct eight independent web-based 24-hour recalls in a mixed population from the Los Angeles area.

Methods

Between August 16, 2006 and April 3, 2009, the Energetics Study recruited Caucasian and African-American adults via Craigslist, a website of classified ads, community notices, and posters distributed throughout the greater Los Angeles area. Interested subjects were referred to the Study website, (<http://brs.ucla.edu/energetics/>), where an automated self-screener determined their eligibility. Eligibility was driven by the need for dietary stability over the prior year to uphold the integrity of the biomarkers applied in the study, and involved being metabolically and weight stable, healthy, and a non-smoker. For the purpose of maintaining power for sub-group analyses, eligibility was restricted by age and race to include only self-identified Caucasians and African-Americans between 21 and 69 years of age. Subjects with known allergic responses to suntan lotion or para-amino benzoic acid (PABA), as this was used as a compliance marker in the study.

Eligible subjects were invited for a consent visit to the study office in West Los Angeles with the principal investigator. The subjects received a detailed explanation of the biomarker administration and collection procedures, along with information on how to access the web-based recall. The first self-administered recall was conducted at the study headquarters during the consent visit. The subjects were logged to the site and assigned user IDs that would allow merging of their recalls into individual files, but they did not receive any additional training or help conducting the interview by study personnel.

The UCLA Institutional Review Board approved the study protocol and all participants provided written informed consent. In total, 333 subjects consented to participate in the study, 268 were scheduled into the study, and 261 completed all clinic visits.

Over the course of a two-week period, subjects visited the UCLA General Clinical Research Center (GCRC) twice and completed additional computer-based questionnaires. The questionnaires included a General Questionnaire, the CASI-Diet History (CASI-DH), a web-based 24-hour recall (DietDay), an International Physical Activity Questionnaire (IPAQ) (13) and an Exit Questionnaire. A paper-pencil version of the National Cancer Institute (NCI) Diet History Questionnaire (DHQ) was also administered. The CASI-DH was administered twice (once at each clinical visit), and the DietDays were self-administered eight times throughout the study. Subjects were compensated for their time and effort with \$150 at the end of the clinical visits and a \$50 completion bonus if they finished all eight DietDays. The sequence of administration is outlined in Figure 1.

In total, subjects were asked to complete eight DietDays – three at the study visits and five on their own. The DietDays were scheduled by the coordinator on different days of the week. The final two DietDays were scheduled for 30 and 60 days after the last clinic visit. An automated system triggered subjects by email to conduct the last two recalls without prior notice so that eating behavior would not be influenced. Subjects were emailed at 3 a.m. and allowed until midnight of the same day to respond. The study website linked each participant's DietDay information with their online file. If DietDays were not completed in a timely manner, the coordinator followed up with a personalized email or phone call.

Starting with the 106th subject, every contact attempt was recorded in the participant's online file. This information was used to estimate the effectiveness of each additional contact for a subset of 124 subjects. This includes phone calls and personal email reminders above and beyond those that were part of the automated system.

DietDay

DietDay is a fully automated, self-administered, web-based, CASI, 24-hour dietary recall, viewable at www.24hrrecall.com. DietDay applies multi-passes similar to the USDA-designed multi-pass approach (14): a first overview report of all types of food consumed by meal, a comprehensive reporting of details on those foods down to seven levels of information, a reminder about possibly forgotten snack foods, and a last review of the reported foods to allow additions and changes. It also assesses supplement use, and provides feedback in the form of extensive individual dietary evaluations based on the National Academy of Science recommendations (1).

DietDay contains 9,349 foods and over 7,000 food images in 61 modules. Portion sizes are quantified by household measures using images of different amounts of food on a standard plate, glass, or bowl, as seen in Figure 2. Food preparation methods are also assessed, as well as condiments and additions. DietDay asks about usual consumption by time of day (midnight to 11 a.m., 11 a.m. to 5 p.m., and 5 p.m. to midnight). DietDay applies automatic branching, complex skip routines, range checks, edit checks, and prompts during the questionnaire (15). Nutrient values in the program were based on USDA values and expanded to include mixed dishes and product labeling information.

Feasibility of DietDay was assessed using subjective responses to a wide range of questions at an exit interview, a log of all technical issues maintained by study personnel, and the actual participation and completion rates of all study components.

Results

Study Participation and Demographics

A total of 261 subjects completed all clinic visits in the Energetics Study. Sixty-five subjects consented but were not scheduled for clinic visits or had career changes, illness or weight fluctuation. The demographic profile of the subjects participating in the Energetics Study did not differ from those consented into the study, and is summarized in Table 1. The subjects were a convenience sample of approximately half African-Americans and half Caucasians that lived within 50 miles of UCLA. They were all healthy, weight stable and non-smokers at the time of the study. 35% of subjects were male, 65% were female. Subjects were all between the ages of 21 and 69, the majority under 50-years-old. 38% of the subjects had some college education, an additional 44% were college graduates, and 15% held post-graduate degrees. Less than half of the subjects had a Body Mass Index (BMI) under 25, and 36% of the African American subjects had a BMI of greater than 30, qualifying them as “obese.”

DietDay Completion Rate

Of the 261 subjects, 99% conducted at least five DietDays. 97% completed six, 94% finished seven, and 92% completed all eight (Table 2). Caucasians had a slightly higher response rate, with 100% completing five recalls, versus 97% of African Americans, and 94% completing all eight recalls compared to 91% of African Americans.

Although there was concern that increasing the number of dietary assessments from three to eight would be a burden, the vast majority reported it easy to complete multiple recalls. Subjects accessed the internet at home, school, their office, local library, or the homes of friends or family. 83% of the African American participants reported that completing the 24-hour recall eight times was ‘easy’ to complete, versus 79% of the Caucasians. Although they needed to access the web on their own to accomplish this, 98% of Caucasians and 95% of African Americans completed six DietDays.

Responsiveness to Reminders by Email and Phone

In a subset of 124 people who completed all eight DietDays, one-quarter of the Caucasian and one-sixth of the African American participants completed all recalls without personalized calls or emails. Caucasian subjects were much more likely to complete the recalls without reminders (23.8% vs. 13.4%), and to respond to a single reminder (21.4% vs. 15.9%). Participation rates evened out after the 6th reminder, when 90% of Caucasian and 94% of African American participants had completed all required DietDays.

The responsiveness to reminders differed by gender, with women responding more intensely to the first few reminders, whereas men continued to respond through the tenth reminder. Additional reminders beyond the first two did little to motivate greater response among women. Among men, there was no saturation point: additional reminders continued to enhance participation.

Subjective Responses

Subjects were asked about their impressions of the dietary assessment methods and what they found cumbersome in the study on a web-based exit interview, completed by the subjects without study staff present (Table 3 and 4). As seen in Table 3, 86% of Caucasians as compared with 64 % of African Americans clearly preferred the web-based 24-hour recall approach to a diet history. The Caucasians were also slightly more likely to recommend this method to their friends and family (82% vs. 74%). Most subjects (82%) believed the DietDay (24-hour recall) more accurately captured their usual diet than the diet history (CASI-DH). 75% found the DietDay easier than the CASI-DH. 98% of African Americans and 85% of Caucasians did not find anything difficult to understand in DietDay. 88% of African Americans and 74% of Caucasians were able to find all their foods in DietDay (Table 4).

African Americans were less likely to report any technical difficulties with using the program on their own (6.9% of AA versus 14.8% of Caucasians). 94% of each group reported willingness to repeat the same study for equal compensation six months later.

Report Decay over Time

Although subjects were highly compliant – returning to the web to conduct multiple recalls – within reports, reporting decay was evident, as seen in Table 2. With each additional day over the first two weeks of the study, the mean and median caloric intake reports dropped, as did the reported intake of fat and carbohydrates. Interestingly, subjects had a 30-day break between the 6th and 7th report, and this break was associated with a rise in reported intakes, but not to a level equal to the initial two days of reporting.

The caloric intake median slid by 393 kcal/day (483 kcal/day for Caucasians, 310 for African Americans) between day one and day eight of the DietDays. This trend was not linear: the largest macronutrient reduction was in reported median carbohydrate intake, which was 43 g/day (27 g/day for Caucasians and 47 g/day for African Americans) lower at the end of the assessment period. Protein and fat intakes were less affected by repeat reporting. Alcohol median intakes were zero across groups and days.

Discussion

The potential benefits of web-based computerized dietary assessment are well known and include reduced costs, lower carbon footprint, improved quality assurance due to built-in skip routines and range checks (16) and through the use of audio and images, enhanced accessibility low literacy populations. This technology readily supports the use of food images which can improve portion size estimation and reduce misunderstandings (17).

However, skepticism remains about the ability to motivate individuals to repeatedly return to a website and report intake.

Although frequently and successfully used in studies involving surveys that solicit confidential answers to questions concerning substance abuse, HIV risk behaviors, and other sensitive behaviors(18,19,20), it is not commonly used in dietary assessment (21). Computer assisted self-interview (CASI) appears to improve reporting of sensitive behavior and intakes perceived to be undesirable by the subject (22,23,24,25,26). Computer-based communications are acceptable to and easily used by disadvantaged populations and those with low literacy (26). The acceptability of computer-based games involving memory skills has been demonstrated in normal and in cognitively impaired frail adults (27,28).

In this study, healthy volunteers were asked to complete a web-based dietary recall on eight different occasions. As with all convenience samples, there is always concern that subjects may not be representative of the broader population. Thus the feasibility demonstrated here may be a best-case scenario. The population was, however, diverse in their age. They ranged in age from 21 to 69 years of age, and represented both genders and two ethnic groups. They varied widely in education and economic means. And not all had access to the internet in their homes: some went to friends' homes, internet cafes or their public library.

The 92% completion rate of eight self-administered recalls exceeded our expectations. The study was designed to demonstrate a decay rate in participation, but this was not evidenced. However, reporting fatigue in the form of lower caloric reports per subject was noted with increasing number of days. Personal phone calls and email reminders were found to be quite effective in enhancing completion. In the subset of people for whom the medium of reminders were recorded, 17% of the subjects required no reminders. Two reminders added an additional 38%, and each of the next three reminders increased completion rates by 11-12% each, bringing the participation rate to 90% of those who did finally conduct all 8 recalls. Among this group, access to the Internet was at home, at a friend's house, or at the public library, consistent with the large and growing Internet penetration rate was in the US (29,30),

Population-based studies have attempted to use Internet-based questionnaires and assess response bias (31). Nevertheless, it remains to be proven whether a truly randomly selected or population-based study can depend upon this methodology, and if participation depends upon health, risk of disease, and diagnosis.

Subjective responses support the high participation rates and indicate that the perceived subject burden was not great with this method. In fact, this dietary assessment approach was generally favored over a more lengthy diet history. Taken together, these are very encouraging findings that suggest a powerful new approach for dietary assessment that can be administered via the Internet. The findings clearly need to be expanded to other ethnic groups and, more broadly, to population-based groups of healthy and less-healthy individuals.

Validity of the approach is crucial before definitive recommendations can be made. Indications of the reduction in reported caloric intake suggest that weariness may occur with additional days. A comprehensive evaluation of validity based upon doubly labeled water, 24-hour urine base biomarkers, and serum nutrient levels is forthcoming and surpasses the scope of this paper. However, indications are that, despite the reduction in reports, the validity of responses increases with increasing numbers of days, as was presented at the Experimental Biology Conference in New Orleans, April 2009 (32).

Conclusion

The internet has become so widely accessible in Western countries that it is an attractive alternative for large epidemiologic population studies, as well as in general practice. It simplifies the process of acquiring repeated diet measures and eliminates logistic issues of arranging appointments and personal interviews.

The Energetics Study found it is feasible to receive as many as eight self-conducted 24-hour recalls from volunteers, and that the majority did not find it this to be a burden. Even after completing six recalls, 92% of subjects were willing to continue reporting their daily diet months later. Although the study was a convenience sample, internet access for web-based programs was not a major problem in this group. In motivating subjects to complete their recalls, it was discovered that personalized emails or phone calls significantly enhanced participation, although the yield of three or more reminders decreased dramatically as compared to the first two reminders. Access to CASI and web-based dietary analysis opens up new opportunities for dietitians to strengthen their nutritional counseling in an efficient manner without additional time investment or reducing the time allotted to their counseling sessions.

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Timeline in Days

Figure 1.
Timeline of the Energetics Study

DietDay Current Time: 01 : 27 PM User Profile DietDay Diet Report

Lunch Time: Portion Selection - salads Monday 11/12/2007 (yesterday)

You said that you ate **green salad** yesterday.

During lunchtime, how many did you eat this type of salad?

How much of this did you eat?

MORE
+
-
LESS

How many servings of this did you eat?

One Serving
Two Servings
3 Servings
4 Servings
5 Servings
6 Servings
7 Servings
8 Servings
9 Servings
10 Servings

Your exact portion may not be available. If this is the case, just select the closest option.

Quit Click "More" or "Less" to change portion, then select servings. Click the Right Arrow to continue.

Figure 2.
DietDay Portion Size Screen Shot

Table 1

Descriptive statistics of the Energetics Study population

Race	Total (%)	Caucasian (%)	African-American (%)
N	261	130	131
Gender			
Females	65	59	70
Males	35	41	30
Age			
≤30	39	53	26
30-39	18	9	28
40-49	20	15	24
50-59	18	19	17
≥60	5	4	5
Education Level			
Less Than High School	0	0	1
High School Graduate	3	0	5
Some College	38	25	50
College Graduate	44	51	37
Post Graduate	15	24	7
BMI			
<18.5	3	4	2
[18.5, 25)	45	61	29
[25, 30)	28	23	33
> = 30	24	12	36

Table 2

DietDay report decay over time

Variable	N	Total*			N	Caucasian [†]			N	African American [‡]		
		Mean	SD	Median		Mean	SD	Median		Mean	SD	Median
Energy (Kcal)												
Day 1	261	2670	2149	2210	130	2589	1277	2307	131	2750	2758	2121
Day 2	261	2625	1616	2233	130	2680	1522	2229	131	2573	1709	2233
Day 3	261	2531	1726	2176	130	2711	1848	2360	131	2352	1583	2073
Day 4	259	2386	1519	2053	130	2199	1026	1906	129	2375	1876	2112
Day 5	257	2340	1551	1956	130	2350	1403	1941	127	2332	1695	2000
Day 6	253	2199	1207	1983	128	2177	974	2036	125	2221	1410	1906
Day 7	245	2389	1823	2027	125	2306	1396	2064	120	2184	2184	1940
Day 8	241	2135	1192	1817	122	2241	1275	1824	119	2025	1096	1811
Total difference		-535		-393		-348		-483		-725		-310
Protein (g)												
Day 1	261	104	79	86	130	105	63	95	131	103	92	78
Day 2	261	105	64	91	130	105	58	89	131	105	71	91
Day 3	261	99	68	87	130	105	72	89	131	93	63	80
Day 4	259	96	68	82	130	89	43	81	129	103	86	83
Day 5	257	92	61	80	130	91	55	82	127	94	66	79
Day 6	253	85	46	74	128	84	38	77	125	86	53	71
Day 7	245	92	92	82	125	89	58	82	120	95	73	81
Day 8	241	82	82	72	122	86	57	69	119	78	40	74
Total difference		-22		-14		-19		-26		-25		-4
Fat (g)												
Day 1	261	111	124	78	130	103	804	81	131	118	155	75
Day 2	261	105	85	81	130	102	74	76	131	108	95	86
Day 3	261	101	87	80	130	108	96	82	131	94	77	76
Day 4	259	91	70	71	130	81	56	68	129	101	81	76
Day 5	257	91	77	70	130	92	76	71	127	89	78	70

Variable	Total*				Caucasian [†]				African American [‡]			
	N	Mean	SD	Median	N	Mean	SD	Median	N	Mean	SD	Median
Day 6	253	86	68	67	128	86	60	69	125	86	76	62
Day 7	245	95	107	70	125	90	82	66	120	100	127	71
Day 8	241	84	66	66	122	88	72	67	119	80	58	63
Total difference		-27		-12		-15		-14		-38		-12
Carbohydrate (g)												
Day 1	261	325	255	273	130	311	165	273	131	339	319	272
Day 2	261	326	215	279	130	349	239	289	131	304	187	269
Day 3	261	316	228	264	130	336	246	276	131	297	209	249
Day 4	259	300	223	250	130	278	146	246	129	324	279	256
Day 5	257	293	222	239	130	289	181	237	127	300	257	247
Day 6	253	279	159	250	128	273	146	249	125	285	171	250
Day 7	245	286	195	243	125	275	155	246	120	296	230	231
Day 8	241	271	158	230	122	283	160	246	119	259	156	225
Total difference		-54		-43		-28		-27		-80		-47
Alcohol (g)												
Day 1	261	7	19	0	130	9	21	0	131	4	15	0
Day 2	261	4	12	0	130	7	15	0	131	2	7	0
Day 3	261	10	25	0	130	15	31	0	131	4	15	0
Day 4	259	8	24	0	130	11	28	0	129	6	17	0
Day 5	257	8	24	0	130	11	30	0	127	6	16	0
Day 6	253	6	15	0	128	9	19	0	125	4	10	0
Day 7	245	9	24	0	125	13	28	0	120	6	18	0
Day 8	241	7	20	0	122	11	25	0	119	4	13	0
Total difference		1		0		2		0		0		0

* All trends for the total group of Caucasians and African Americans for all nutrients presented were statistically significant at $p < 0.001$

[†] Only the trend for protein intake was statistically significant at $p = 0.002$ among Caucasians

[‡] All trends for the African Americans for all nutrients presented were statistically significant at $p < 0.01$

Statistically significant test for trend within the group at $p \leq 0.001$

Table 3
Subjects' Response Comparing Two Dietary Assessment Methods, the DietDay 24-Hour Recall, and Diet History

Question	Total			Caucasian			African American		
	DietDay	Same	Diet History	DietDay	Same	Diet History	DietDay	Same	Diet History
Which dietary assessment method was easier?	75.4	21.9	2.7	86.7	12.5	0.8	64.4	31.1	4.5
Which did you believe more accurately reflected your diet?	82.3		17.7	86.7		13.3	78.0		22.0
Which method would you recommend to others for dietary assessment?	78.1		21.9	82.0		18.0	74.2		25.8
	Easy	Neutral	Difficult	Easy	Neutral	Difficult	Easy	Neutral	Difficult
How difficult was it to conduct 8 repeat DietDays on the web?	81.0	13.2	5.8	78.9	16.4	4.7	83.1	10.0	6.9

Table 4

Subject responses to DietDay difficulty

	Total (%)	Caucasian (%)	African American (%)
Question	Yes	Yes	Yes
Did you find anything difficult to understand in Diet Day?	8.5	14.8	2.3
Were you able to find all the foods you were looking for in DietDay?	81.0	74.2	87.7
Were you able to find reasonable portion sizes to match your own?	93.8	92.2	95.4
Did you find the portion size option awkward to use?	20.5	18.8	22.3
Did you have any technical problems using the program?	10.9	14.8	6.9
Would you recommend DietDay to your friends or family for dietary assessment?	94.9	93.0	96.9
Would you be willing to repeat the study in 6 months?	94.2	94.5	93.9