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Estimating dietary costs of low-income women in California: a comparison of 2 approaches[1–3]

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ABSTRACT

Background: Currently, no simplified approach to estimating food costs exists for a large, nationally representative sample.

Objective: The objective was to compare 2 approaches for estimating individual daily diet costs in a population of low-income women in California.

Design: Cost estimates based on time-intensive method 1 (three 24-h recalls and associated food prices on receipts) were compared with estimates made by using less intensive method 2 [a food-frequency questionnaire (FFQ) and store prices]. Low-income participants (n = 121) of USDA nutrition programs were recruited. Mean daily diet costs, both unadjusted and adjusted for energy, were compared by using Pearson correlation coefficients and the Bland-Altman 95% limits of agreement between methods.

Results: Energy and nutrient intakes derived by the 2 methods were comparable; where differences occurred, the FFQ (method 2) provided higher nutrient values than did the 24-h recall (method 1). The crude daily diet cost was $6.32 by the 24-h recall method and $5.93 by the FFQ method ($P$ = 0.221). The energy-adjusted diet cost was $6.65 by the 24-h recall method and $5.98 by the FFQ method ($P < 0.001$).

Conclusions: Although the agreement between methods was weaker than expected, both approaches may be useful. Additional research is needed to further refine a large national survey approach (method 2) to estimate daily dietary costs with the use of this minimal time-intensive method for the participant and moderate time-intensive method for the researcher. *Am J Clin Nutr* 2013;97:835–41.

INTRODUCTION

The relation between dietary quality and cost has major policy and political implications. Few studies have been conducted on the relation between diet quality and diet cost across different strata of the American population. Several observational studies have reported that higher-quality diets are associated with higher diet costs (1, 2) and are more likely to be consumed by higher-income groups. Whether food costs pose a barrier to dietary change, especially for low-income consumers, remains an open question (3, 4). Whereas some reports suggest that all Americans, even those receiving food assistance, can afford a healthy diet (5, 6), other reports suggest that healthy diets are unaffordable for lower-income consumers (7). Policy measures would be aided by reliable data on the relation between diet quality and diet cost. However, obtaining accurate records of food consumption, food purchases, and food expenditures poses many challenges, particularly among low-income populations. Whereas a few published studies have described this process in some detail (8, 9), there are no suitable tools to assess diet costs and food expenditures among low-income or minority populations in the United States (10, 11).

The current focus on the development of instruments opens the door for further research on the effect of socioeconomic variables on dietary behavior, especially among low-income and minority respondents. Whereas many studies on food purchases have been done at the household level, establishing links to nutrition and health requires that daily diet costs be estimated for the individual. The specific objective of the current study was to compare 2 approaches for estimating daily dietary costs among a group of low-income women in California: *1*) the time-intensive food expenditure 24-h recall approach (method 1) and *2*) the relatively easy food-frequency questionnaire (FFQ)[4] approach (method 2). Our overall goal was to use the existing time-intensive method to validate a new simplified approach to collecting food expenditure information for a large sample, such as that used for a nationally representative study such as NHANES.

SUBJECTS AND METHODS

Participants

The study was conducted in 4 California counties representing a range of rural, suburban, and urban environments (Amador, San Joaquin, Solano, and Tulare) during 2006 and 2007. The counties were selected on the basis of their participation in the University

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[4] Abbreviations used: EFNEP, Expanded Food and Nutrition Education Program; FFQ, food-frequency questionnaire; FHCRC, Fred Hutchinson Cancer Research Center; NEERS5, Nutrition Education Evaluation and Reporting System 5; SNAP, Supplemental Nutrition Assistance Program.

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of California Cooperative Extension program. Study participants were lower-income women between 20 and 55 y of age who met the following inclusion criteria: household met low-income specifications (ie, ≤185% poverty or $37,000 for a 4-member family in 2006), primary purchaser and preparer of food in the household, at least one child at home, English speaking and accessible by phone, and willingness to collect food receipts for 2 wk and to be reminded by research staff daily. Pregnant or breastfeeding women and men were excluded. A description of the study population was published elsewhere (12).

Recruiting efforts were concentrated at sites traditionally frequented by low-income clients participating in 2 federal nutrition-education programs: the Expanded Food and Nutrition Education Program (EFNEP) (13) and the Supplemental Nutrition Assistance Program (SNAP)–Education (formally Food Stamp Nutrition Education Program) (14). These sites included community centers, health clinics, social service agencies, and offices for SNAP and the Supplemental Program for Women, Infants, and Children (15). Participants were not recruited at other traditional EFNEP sites, such as soup kitchens and homeless shelters, where clients tend to be more transitory. The focus was on recruiting noninstitutionalized low-income women who were likely to purchase food in supermarkets, local grocery stores, convenience stores, and fast-food restaurants.

All participants provided their written informed consent to participate in the study. Data were collected during 5 in-person interviews at places convenient to participants (ie, their homes, local clinics, or community centers) over a 2- to 3-wk period, and the participants were compensated for their participation in the study. The Institutional Review Board at the University of California, Davis, approved the study protocol.

The collection of 24-h dietary recalls

Participants were asked on 3 nonconsecutive days, including at least one weekend day, to provide information on their intake from the previous day. Intake of water was excluded from the recalls. Recalls were conducted following the USDA 5-pass method (16, 17) through a one-on-one interview with research staff. Protocols were developed to allow participants to report on meals eaten away from home, recipes used to prepare meals, foods obtained at food banks and soup kitchens, and gift foods received from family and friends. Data from the 24-h recalls were analyzed by using the Nutrition Education Evaluation and Reporting System 5 (NEERS5), which is also used by EFNEP in 50 states and 6 US territories to evaluate county, state, and national outputs, outcomes, and effects of the program (18). The nutrient composition database used by NEERS5 contains a list of ∼7000 foods and is derived from the USDA Nutrient Data Laboratory in Beltsville, MD.

Estimation of diet cost by using 24-h recalls and food expenditures

For the duration of the study period, participants were asked to save all food expenditure receipts. To facilitate data collection, participants were given a small wearable pouch in which to collect all receipts. For expenditures without receipts, participants were instructed to record the total expenditure, date, and store name on a sticky notepad, which was also in the pouch. For each item listed on the diet recalls, price as consumed was calculated, taking into account the edible portion or yield.

Food cost estimates were based on receipts, whenever possible, for *1*) all food prepared and eaten at home, *2*) food from carryout places and brought home to eat, *3*) foods prepared at home but eaten outside the home, *4*) foods eaten at a restaurant, *5*) foods donated to the household by other family members and friends, and *6*) food acquired at a food bank or soup kitchen.

A 6-step protocol was developed for this study for determining a food price:

1) With the use of methods comparable with those of Bowman (19), a price database was developed by aggregating the individual food items from participant food expenditure receipts with the list of foods in the NEERS5 nutrient composition database.

2) For cases in which foods and beverages from receipts were not listed in the NEERS5 database, the research team selected the closest match from the NEERS5 database by majority consensus; the NEERS5 nutrient composition codes were then used to link the participants' food expenditures to their 24-h recalls.

3) For cases in which the food consumed was free or gifted, the price was listed as zero dollars.

4) For cases in which a food was consumed by a participant but purchased before the study, the receipt database was scanned to determine whether there was a matching nonsale price from another participant in the same county, with the closest purchase date to the recall date; the rationale for this was to account for geographic and seasonal differences in prices.

5) If the matching price was available only from another county, the price with the closest date to the recall date was selected.

6) If no price existed in the receipt database, the lowest nonsale price available on the Safeway online grocery store (www.safeway.com) was used; all prices were matched to the extent possible by package size or weight.

To merge food expenditure data with food-consumption data from the 24-h dietary recalls, a Microsoft Access database application was developed specifically for this study to facilitate food receipt expenditure data entry. For each participant's food receipt, the following data were entered into this database application: store name, date of purchase, total food stamp expenditure (if applicable), and "flag for review box" with written comment if there was a problem with the given receipt. For each food item on the receipt, the Access database application searched through the list of ∼7000 USDA food items to retrieve all items that matched the query. In addition, this application searched the food-consumption database containing all participants' 24-h dietary recalls to determine whether the food item listed on the receipt was consumed by any participant in the study. The food item was identified with a "1" if the given item was purchased and consumed by the same individual, with a "2" if the given item was consumed by an individual in the same county, with a "3" if the given item was consumed by an individual in a different county, or with a "4" if the given purchased item was not consumed by an individual in the study. Sale prices were noted as such.

Not all receipts contained information about the purchased quantity. In those instances, 2 methods were used to determine an appropriate estimate of quantity:

1) Online databases were searched: www.safeway.com, www.amazon.com, or the website of the receipt being entered if applicable. These websites contain an extensive database of foods with detailed quantity descriptions.

2) The list of matching items already entered into the Access receipt database application was searched. During the interviews, data collectors asked the participants to estimate the "as purchased" cost and "as purchased" quantity of items on their recalls for which there were no corresponding receipts.

The sum of prices for the given foods included on a recall determined the total price of foods consumed for that recall, with the edible portion or yield taken into account. The edible portion or yield reflects the gain or loss of food weight that occurs during preparation, because of the discarding of nonedible portions (eg, peel or bone) and/or hydration during cooking. Yield values were obtained from the USDA *Handbook 102* (20). This procedure was repeated for each of the participant's diet recalls (n = 3), and an average cost of the diet was determined by using the mean of the 3 recalls. This procedure was repeated for each of the participant's diet recalls (n = 3), and an average adjusted cost of the diet was determined for 2000 kcal.

Dietary intake assessment by using an FFQ

The FFQ, developed by the Fred Hutchinson Cancer Research Center (FHCRC) (21), listed 152 food items, each of which is based on one or more component foods (22). In total, there were 384 component food items in the FFQ database. The nutrient contribution of the component foods to each food item is weighted, based on food-consumption data (when available) or on expert judgment. For example, the white bread item is based on 3 component foods: white bread, bagel, and English muffin, weighted 70:20:10. On completion of data collection from all participants, the FFQs were shipped to the FHCRC in Seattle for analysis (23). Nutrient analysis software, developed at the FHCRC, links the FFQ spreadsheet to the nutrient database at the Nutrition Coordinating Center at Minnesota (24, 25). The Nutrition Coordinating Center database is one of the most accurate and comprehensive databases available and primarily uses data from the USDA Nutrient Data Laboratory in Beltsville, MD, supplemented with data from the scientific literature and manufacturers' analyses (26).

Estimation of diet cost by using an FFQ and retail prices

To add a cost vector to the FFQ, local retail prices ($/100 g edible portion) were collected for all FFQ component items in each of the 4 counties. Prices for most of the foods were collected at centrally located supermarkets within each county (27). For 3 of the composite foods (pizza, hamburgers, and French fries), prices were collected at fast-food chains. These prices and a 4-county average price were then added to the FHCRC nutrient database. To calculate individual nutrient intakes, the software multiplies frequency of use of each FFQ food item by portion size and by the vector of nutrient values. Analogous to the FFQ approach for estimating nutrient intakes, to calculate individual FFQ-diet costs, the software multiplies the frequency of use of each FFQ item by portion size and by the vector of retail food prices (28). The same component foods and the same adjustments for edible portion were used for both nutrient and cost procedures. These methods were described elsewhere (12, 29, 30).

Statistical methods

Descriptive statistics were used to examine the distribution of all variables. The distribution for most nutrients was right-skewed; therefore, all variables were natural log transformed before the analyses. Paired t tests were computed to assess differences in mean values between the FFQ and the 24-h recall (mean of 3 recalls). Means are presented as geometric means, calculated as the antilog of the mean natural log-transformed values, and 95% CIs. Pearson correlation coefficients for both unadjusted and energy-adjusted values were computed to determine the strength of the linear association between the recall and FFQ methods. The energy-adjusted coefficients were determined per 2000 kcal and by using Willett's method of residuals (31). Finally, the Bland-Altman procedures assessed the 95% limits of agreement between the daily dietary costs (unadjusted and energy adjusted per 2000 kcal) from the 2 methods (32, 33). No log transformations were performed for these sets of analyses. A sample size of 112 participants was needed to detect a correlation between the FFQ-based diet costs and food-based expenditure diet costs of ≥0.3 with 90% power and a 5% level of significance. To account for attrition, the recruitment goals were to enroll a total of 120 participants among the 4 counties. The level of significance for all tests was set at $P < 0.05$. Statistical analyses were performed by using SPSS software (version 18; SPSS Institute).

RESULTS

A total of 121 women enrolled and completed all study protocols. Nineteen women opted not to continue at the first interview. Participants in the study were racially and ethnically diverse. The mean age was 36 y, and their mean BMI (in kg/m^2) was 30. The prevalence of obesity in the sample was 45%. Household incomes for 75% of the participants were ≤$2000/mo without including estimated values for federal program benefits (**Table 1**).

TABLE 1
Demographic and socioeconomic characteristics of the study population

Characteristic	Study population (n = 121)
Age (y)[1]	35.7 ± 9.7[2]
BMI (kg/m^2)	30.3 ± 9.2
BMI (%)	
Low to normal, ≤24.9 kg/m^2	26.4
Overweight, 25.0–29.9 kg/m^2	28.9
Obese, ≥30 kg/m^2	44.6
Household incomes ≤$2000/mo (%)	75.2
High school graduate or higher (%)[3]	89.2
Race-ethnicity (%)	
Non-Hispanic white	36.4
Hispanic	33.9
Non-Hispanic black	10.7
Asian/Pacific Islander	9.9
American Indian	8.3
Other	0.8

[1] n = 117.
[2] Mean ± SD (all such values).
[3] n = 120.

TABLE 2
Mean nutrient intakes and daily diet costs determined from an FFQ or the mean of three 24-h recalls (n = 121)[1]

Variable	24-h Recall	FFQ	P^2
Energy (kcal/d)	1903 (1798, 2015)	1986 (1806, 2183)	0.330
Total fat (g/d)	79 (74, 85)	80 (73, 89)	0.778
Carbohydrate (g/d)	218 (203, 234)	244 (220, 269)	0.020
Protein (g/d)	75 (70, 79)	70 (64, 77)	0.165
Cholesterol (mg/d)	254.0 (232.7, 277.3)	261.4 (232.2, 294.3)	0.639
Vitamin A (RE/d)	722.7 (642.5, 812.8)	810.6 (730.8, 899.1)	0.102
Vitamin C (mg/d)	71.9 (63.1, 81.9)	98.8 (86.9, 112.3)	<0.001
Vitamin E (IU/d)	12.6 (11.5, 13.8)	13.3 (12.0, 14.7)	0.393
Niacin (mg/d)	20.1 (18.8, 21.4)	18.7 (17.0, 20.6)	0.146
Thiamine (mg/d)	1.3 (1.3, 1.4)	1.5 (1.4, 1.6)	0.028
Riboflavin (mg/d)	1.6 (1.5, 1.7)	2.1 (1.9, 2.3)	<0.001
Vitamin B-6 (mg/d)	1.6 (1.5, 1.7)	1.8 (1.6, 2.0)	0.009
Vitamin B-12 (μg/d)	3.4 (3.0, 3.8)	5.6 (5.0, 6.2)	<0.001
Folate (μg/d)	237.5 (217.2, 259.8)	255.7 (231.9, 281.9)	0.153
Calcium (mg/d)	693.4 (636.9, 754.9)	862.9 (778.2, 956.7)	<0.001
Magnesium (mg/d)	253.6 (237.6, 270.8)	281.3 (257.0, 308.0)	0.021
Iron (mg/d)	13.1 (12.2, 14.0)	13.0 (11.8, 14.3)	0.891
Potassium (mg/d)	2403 (2256, 2560)	2811 (2570, 3074)	<0.001
Sodium (mg/d)	3205 (2996, 3428)	3126 (2837, 3444)	0.613
Copper (mg/d)	1.2 (1.1, 1.2)	1.2 (1.1, 1.4)	0.262
Zinc (mg/d)	10.0 (9.3, 10.7)	10.8 (9.8, 11.8)	0.103
Diet cost ($/d)	6.32 (5.88, 6.81)	5.93 (5.42, 6.49)	0.221
Dietary energy cost ($/2000 kcal/d)	6.65 (6.27, 7.04)	5.98 (5.79, 6.17)	0.001

[1] All values are geometric means; 95% CIs in parentheses. FFQ, food-frequency questionnaire; RE, retinol equivalent.
[2] Means were compared by paired t tests; $P < 0.05$ indicates a significant difference.

Mean energy and nutrient intakes and daily diet costs, as obtained from the 24-h recall and the FFQ methods for the 2006 and 2007 periods, are presented in **Table 2**. The estimates for energy, protein, fat, and most micronutrients that were obtained by the 2 methods were not significantly different. The FFQ produced higher estimates for carbohydrates, vitamin C, thiamine, riboflavin, vitamin B-6, vitamin B-12, calcium, magnesium, and potassium (Table 2). The mean unadjusted daily diet costs were $6.32 for the 24-h recall compared with $5.93 for the FFQ; this difference was not significant ($P = 0.221$). The energy-adjusted means were $6.65 for the 24-h recall compared with $5.98 for the FFQ ($P = 0.001$).

Pearson correlation coefficients for unadjusted nutrient intakes ranged from 0.23 (vitamin A) to 0.46 (energy), which indicated moderate linear associations between methods (**Table 3**). Overall, the energy-adjusted correlation coefficients for nutrient intake were similar for both energy-adjustment methods; however, compared with the unadjusted coefficients, some nutrients had higher coefficients and others had lower values (Table 3). Pearson correlation coefficients for dietary costs were 0.21 for the energy-unadjusted method, 0.21 for the energy-adjusted per 2000 kcal method, and 0.13 for the energy-adjusted residual method.

The mean of the difference in the unadjusted daily dietary cost of the FFQ minus the 24-h recall was –0.14 (95% CI: −7.76, 7.48) (**Figure 1**). Therefore, this can be interpreted to mean that, for 95% of individuals in the study, the FFQ estimate for the daily dietary cost was between $7.76 under and $7.48 over a dietary cost estimate from the 24-h recall. Likewise, the mean of the difference in the energy-adjusted daily dietary cost of the FFQ minus the 24-h recall was −0.94 (95% CI: −5.98, 4.10) (**Figure 2**). Therefore, for 95% of individuals, the FFQ estimate for the energy-adjusted daily dietary cost was between $5.98 under and $4.10 over a dietary cost estimate from the 24-h recall.

TABLE 3
Pearson correlation coefficients (r) derived by using 3 approaches (unadjusted, energy adjusted, energy-adjusted with residuals) between nutrient intakes and daily dietary costs determined from a food-frequency questionnaire or the mean of three 24-h recalls (n = 121)[1]

Variable	Unadjusted	Energy-adjusted per 2000 kcal	Energy-adjusted with residuals[2]
Energy	0.46*	—	—
Total fat	0.45*	0.34*	0.35*
Carbohydrates	0.45*	0.27*	0.28*
Protein	0.34*	0.39*	0.33*
Cholesterol	0.34*	0.31*	0.32*
Vitamin A	0.23*	0.45*	0.36*
Vitamin C	0.35*	0.48*	0.45*
Vitamin E	0.28*	0.23*	0.20*
Niacin	0.34*	0.22*	0.16
Thiamine	0.38*	0.45*	0.42*
Riboflavin	0.39*	0.47*	0.46*
Vitamin B-6	0.28*	0.41*	0.32*
Vitamin B-12	0.33*	0.22*	0.28*
Folate	0.42*	0.44*	0.46*
Calcium	0.38*	0.20*	0.49*
Magnesium	0.40*	0.61*	0.57*
Iron	0.33*	0.32*	0.30*
Potassium	0.40*	0.55*	0.51*
Sodium	0.34*	0.19*	0.16
Copper	0.29*	0.43*	0.36*
Zinc	0.34*	0.13	0.13
Dietary cost	0.21*	0.21*	0.13

[1] $*P < 0.05$.
[2] Energy adjusted by using Willett's method of residuals (31).

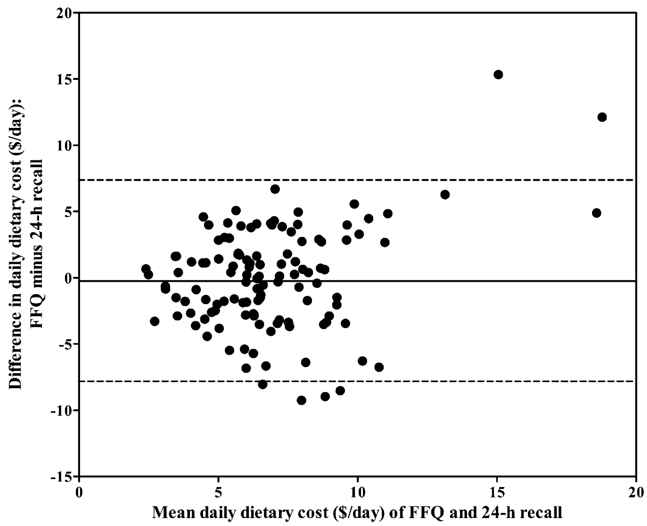

FIGURE 1. Difference in unadjusted daily dietary cost (FFQ − 24-h recall) by the mean daily dietary cost of both methods. The solid line on the *y* axis represents the mean of the difference in diet costs (−0.14). The dashed lines above and below show the 95% limits of agreement between the 2 methods (−7.76, 7.48) (*n* = 121). FFQ, food-frequency questionnaire.

DISCUSSION

Results from the current study show that estimates of energy and nutrient intakes were similar between methods. However, where differences in intakes did occur, the FFQ estimates were greater than the 24-h recall estimates. This was likely due to overreporting of food and beverage intakes for the FFQ instrument (34), and/or underreporting for the dietary recalls. Pearson correlation coefficients for most energy and nutrient intakes ranged from ∼0.1 to 0.6, which suggests that the strength of the linear association between methods was low to moderately high. For dietary costs, the unadjusted means were similar between methods; however, when adjusted for energy intake, the mean estimate from the 24-h recall was higher than that of the FFQ. Pearson correlation coefficients for dietary cost ranged from ∼0.1 to 0.2, which suggests a poor linear association between methods. Moreover, the Bland-Altman limits of agreement analyses indicated that, for dietary costs, the FFQ estimate was between $8 under to $7 over compared with the 24-h recall for 95% of individuals. The limits of agreement improved to between $6 under to $4 over when adjusted for energy intake.

Methodologic factors surrounding the collection of food prices and calculation of dietary costs may contribute in part to the differences between methods. For example, the food prices collected for the FFQ composite list of foods were the lowest available nonsale food prices collected at supermarkets, with only 3 prices from fast-food chains. However, the food expenditure receipts indicated that only 16% of all purchases were from supermarkets, whereas 24% of purchases were from fast-food chains and restaurants, and 32% of purchases were from large discount food chains. Therefore, the wider selection of stores likely contributed to the wider range in food prices and subsequent dietary cost estimates for the 24-h recalls. Further research using a wider range of prices for the composite list of FFQ foods may improve the strength of agreement between methods.

Most participants in the current study were classified as overweight or obese, and 32% of the participants had one or more self-reported health disorders. Having a health disorder might have an effect on the results; however, findings from a secondary analysis (data not shown) with the 82 apparently healthy participants showed only modest improvements for the Pearson correlation coefficients (0.31 for both unadjusted and energy-adjusted values) and no changes for the other results. Moreover, free foods might have a significant effect on the mean prices. However, in an analysis in which prices of free foods were estimated by using data from the receipt database, there were no differences to the results (data not shown). Nevertheless, this may still be an important issue to consider for further research, particularly among low-income populations in whom acquisition of "free" food from food banks/kitchens and family occurs to varying degrees and is more common compared with other socioeconomic status groups.

Consideration should be given to respondent burden. The respondent burden for the FFQ (method 2) is considerably less when compared with saving 2 wk of food receipts for the 24-h recalls (method 1). The researcher burden for costing the FFQs (method 2) is also less, but nonetheless substantial, compared with that for the 24-h recalls (method 1).

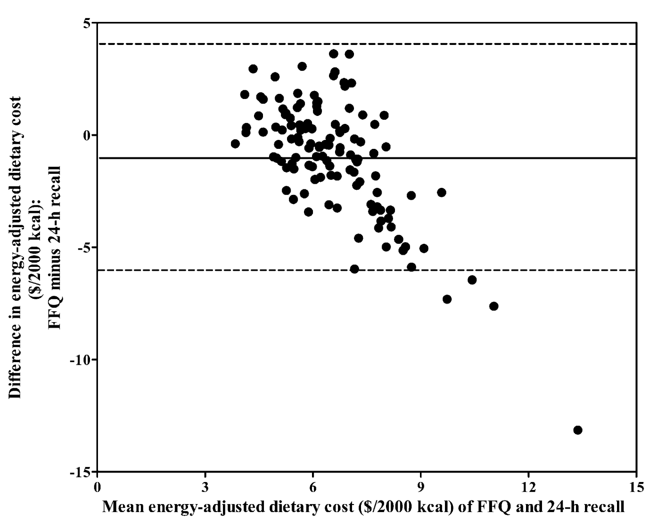

FIGURE 2. Difference in energy-adjusted daily dietary cost (FFQ – 24-h recall) by the mean daily dietary cost of both methods. The solid line on the *y* axis represents the mean of the difference in diet costs (−0.94). The dashed lines above and below show the 95% limits of agreement between the 2 methods (−5.98, 4.10) (*n* = 121). FFQ, food-frequency questionnaire.

Strengths and limitations

Whereas past studies have assessed dietary costs, to the best of our knowledge this is the first study that has attempted to compare different methods for estimating daily dietary costs. The strengths of the current study include the supervised data collection in low-income communities and rigorous interview and receipt collection protocols. One limitation of the study was that the FFQ-cost instrument (method 2) was designed to assess usual intake and dietary costs over a 3-mo period. Whereas we did collect multiple 24-h recalls on nonconsecutive days (method 1), this is still not representative of the usual diet for micronutrients

(35, 36). A second limitation was that the composite list of FFQ food prices for the 384 composite foods (method 2) used to generate dietary costs was largely collected from supermarkets. However, this approach does not take into consideration the wide variety of shopping options available to consumers and does not take into account the generally higher prices paid for foods purchased and eaten away from home. In our study population, 25% of participant expenditures were at fast-food chains or restaurants. A third limitation was that the study was conducted among a convenience sample of English-speaking low-income women in California. Thus, the external validity of the results needs to be tested in other settings. A fourth limitation is that food prices vary by date and location. However, participant food costs for the recalls and supermarket food prices for the FFQ were collected during the same time period: 2006 and 2007. Because this is a validation study, the results apply to other years given that food prices would be updated for the year of application. Also, the focus is on overall daily food costs, not costs for specific foods, so the outcomes for the validation study are applicable to subsequent years. Finally, in comparison studies such as the current study, generally one method is compared against a gold standard. Whereas we made the assumption that the expenditure-based approach was the gold standard for comparison, in actuality there is no true gold standard for determining dietary costs at the individual level. Both methods may have biases that make comparisons of the present nature difficult to interpret. Nonetheless, this type of research is essential for the study of diet cost methods among US population groups, with particular attention to low-income groups receiving SNAP.

Conclusions

The current study is unique in that it compared 2 methods for estimating daily dietary costs among low-income women. The methodology provided here for the 6-step protocol for matching food receipts to 24-h diet recalls is new (method 1). Whereas additional research is still needed to further refine the FFQ approach (method 2), the method may be practical for use in large-scale data collection efforts such as NHANES. Both approaches may be useful to researchers. In addition, the methodologies developed in the current study could be further advanced by researchers testing newer inexpensive cost-capturing software applied to grocery receipts; examples of such software include Neat Receipts (http://www.neat.com/) or Expensify (http://www.expensify.com).

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The authors' contributions were as follows—GJA: implemented the protocol, completed the data collection and statistical analyses, and drafted the manuscript; MST, NLK, and AD: provided training, supervised the data collection, and reviewed and edited the manuscript. All authors played a role in the design of the study. None of the authors had any personal or financial conflicts of interest.

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