European Journal of Clinical Nutrition (2016) **70**, 352–357

www.nature.com/ejcn

ORIGINAL ARTICLE

Validating self-reported food expenditures against food store and eating-out receipts

W Tang[1], A Aggarwal[1], Z Liu[1], M Acheson[1], CD Rehm[1], AV Moudon[2] and A Drewnowski[1]

BACKGROUND/OBJECTIVES: To compare objective food store and eating-out receipts with self-reported household food expenditures.

SUBJECTS/METHODS: The Seattle Obesity Study II was based on a representative sample of King County adults, Washington, USA. Self-reported household food expenditures were modeled on the Flexible Consumer Behavior Survey (FCBS) Module from 2007 to 2009 National Health and Nutrition Examination Survey (NHANES). Objective food expenditure data were collected using receipts. Self-reported food expenditures for 447 participants were compared with receipts using paired *t*-tests, Bland–Altman plots and κ-statistics. Bias by sociodemographics was also examined.

RESULTS: Self-reported expenditures closely matched with objective receipt data. Paired *t*-tests showed no significant differences between receipts and self-reported data on total food expenditures, expenditures at food stores or eating out. However, the highest-income strata showed weaker agreement. Bland–Altman plots confirmed no significant bias across both methods–mean difference: 6.4; agreement limits: − 123.5 to 143.4 for total food expenditures, mean difference 5.7 for food stores and mean difference 1.7 for eating out. The κ-statistics showed good agreement for each (κ 0.51, 0.41 and 0.49 respectively. Households with higher education and income had significantly more number of receipts and higher food expenditures.

CONCLUSIONS: Self-reported food expenditures using NHANES questions, both for food stores and eating out, serve as a decent proxy for objective household food expenditures from receipts. This method should be used with caution among high-income populations, or with high food expenditures. This is the first validation of the FCBS food expenditures question using food store and eating-out receipts.

European Journal of Clinical Nutrition (2016) **70,** 352–357; doi:10.1038/ejcn.2015.166; published online 21 October 2015

INTRODUCTION

Since 2007–2008, the National Health and Nutrition Examination Survey (NHANES)[1] has included questions on estimated food expenditures at home and away from home. The questions were a part of the Flexible Consumer Behavior Survey (FCBS) Module that was developed by the Economic Research Service of the USDA in partnership with the National Center for Health Statistics.[2] Additional FCBS questions have addressed the perceived importance of price and convenience while shopping for groceries or eating out.

However, the questions in the FCBS Module have not yet been validated using objective food store and eating-out receipts. There is a growing literature on the usefulness of receipt data to dietary intake assessment.[3–11] Receipt data have been used to estimate the energy and fat content of food[7,8] and to capture household food purchases from a wide range of sources.[3,4] Some studies have examined household food purchases by family characteristics[9,10] and socioeconomic status (SES).[5,6] In such studies, receipts were considered the optimal and more reliable indices of food purchases than were self-reports[7] and other objective methods such as using barcode scanners or checking household food inventory.[12] The present goal was to validate FCBS food expenditure questions against 2-week household expenditures using receipts. We also examined sociodemographic trends in food expenditures across the two methods.

MATERIALS AND METHODS

The Seattle Obesity Study II is a prospective cohort study on food shopping, attitudes and food acquisition patterns. Address-based sampling stratified by residential property values was used to recruit a representative population-based sample.[13] Addresses were reverse-matched with telephone numbers by commercial vendors. Potential participants were sent pre-notification letters stating that their households were randomly selected by researchers from the University of Washington School of Public Health. Initial phone prescreening interviews and recruitment were conducted by Battelle Memorial Research Institute. Eligible criteria included: age 21–55 years, English speaking, primary food shoppers for the household, not incapacitated and without mobility issues. A total of 25 460 residential units with addresses were matched with phone numbers used for initial contact. Among those, 712 were eligible and provided verbal consent to participate in the study. Of these, 516 respondents were successfully enrolled for the baseline phase of the study. Each of these participants completed the 45 min health behavior survey and were asked to mail 2 weeks of food expenditure receipts for food stores and eating out for the entire household. Constant follow-ups were made by a trained staff member to minimize attrition. Of these, 449 subjects (87% of the sample) mailed back food receipts. After excluding participants with missing sociodemographic data, the analytical sample consisted of 447 adults (86% response rate). We compared respondents who provided receipt data with those who did not in order to examine any bias by sociodemographic variables. No significant differences were observed by age, gender, income and education ($P < 0.05$ for each), except for race such that non-whites were less likely to provide receipt data ($P = 0.013$). All the study protocols were approved by the institutional review board at the University of Washington.

[1]Center for Public Health Nutrition, University of Washington, Seattle WA, USA and [2]Urban Form Lab, University of Washington, Seattle WA, USA. Correspondence: A Drewnowski, Center for Public Health Nutrition, University of Washington, Box 353410, Seattle, WA 98915, USA.
E-mail: adamdrew@uw.edu
Received 5 August 2014; revised 24 August 2015; accepted 31 August 2015; published online 21 October 2015

Self-reported food expenditures

Self-reported data on household food expenditures were collected using a computer-assisted health behavior survey, administered during the first in-person meeting. The following questions, modeled on the FCBS module of NHANES,[1] were used: (1) 'During the past 30 days, how much money (did your family/did you) spend at supermarkets or grocery stores?' and (2) 'During the past 30 days, how much money (did your family/did you) spend on eating out? Please include money spent in cafeterias at work or at school or on vending machines, for all family members'.

Data from these two questions were added together to compute the total monthly household expenditure on food. All three dependent variables of interest (total expenditures, expenditures at food stores and eating out) were converted to 2-week expenditure to match with the receipt data collected.

Sociodemographic variables of interest

Sociodemographic data were also collected during the computer-assisted health behavior survey. Annual household income and education were used as indicators of SES. Educational attainment was measured in seven categories from 'never attended school' to 'Master's, professional, or doctoral degree'. Education was collapsed into three categories for analytic purposes: 'high school or less', 'some college' and 'college degree or higher'. Household annual income was measured in six categories from '$<$ \$25 000' to '$\geqslant$ \$100 000'. Income was also collapsed into three categories: '$\leqslant$ \$50 000', '\$50 000 to $<$ \$100 000' and '$\geqslant$ \$100 000'. Demographic variables of interest were age, race/ethnicity and gender. Household composition was collected by asking the total number of children $<$ 12 years old, children 12–18 years old and adults living in the household. For the present analyses, income, education and the number of children in the household were the primary sociodemographic variables of interest.

Objective food expenditures based on receipts

All participants were instructed to collect receipts from all food stores and eating out for a 2-week period for the entire household. They were also asked to keep a record of any additional food purchases made without receipts (for example, farmers' markets, vending machines or food trucks). Past studies have shown that 2-week receipts adequately reflect household food purchasing behaviors.[3] A trained research staff member maintained constant contact with respondents to maximize response rate and completeness of the receipt data at the household level. Data from receipts for each participant were manually entered into a database. The data included purchase date, category of place (store or restaurant), grocery department (that is, bakery, frozen, meat) if available, food item name, amount purchased (g or oz), unit price (that is, \$1,99/lb, \$2.99/lb), cost of each food item (\$) and receipt total cost (\$). The 2-week food expenditure per person per household was further categorized into receipts from food stores or from eating out. Receipts from food stores included those from supermarkets, supercenters, grocery stores, wholesale stores, convenience stores/gas stations, meat shops, farmers' markets and community-supported agriculture deliveries. Eating-out receipts included restaurants, food courts, cafeterias at work or school, vending machines, carry-outs, bakeries and movie theaters.

Food source data were missing for $<$ 1% of food items purchased (~261 food). Those food were assigned to store or eating-out categories based on available indicators including gratuity, sales taxes and key words on the receipts (for example, dining, takeout, window number). Nonfood items, alcohol and tobacco products, nutrition supplements, tax and tips were excluded. The 2-week total food expenditure, food expenditures at food stores and eating out were computed separately.

Statistical analysis

The primary variables of interest were: total household food expenditure for 2 weeks, household food expenditure at food stores for 2 weeks and household food expenditure for eating out for 2 weeks, with each variable computed using objective receipt data and self-reported. Each of these measures were divided by household size to account for differences in household composition.

First, mean food expenditures along with s.d. were computed for total food expenditures, and by food source type (food stores vs eating out) by key sociodemographic variables. Second, paired *t*-tests were conducted to examine mean differences in receipt-based food expenditures vs self-reported, by income, education and the number of children in the household. Third, Bland–Altman analyses were used to assess the overall level of agreement and by each strata of income and education. This approach estimates whether the receipts measure is systematically different from the self-reported measure. The Bland–Altman method also estimates the 95% limits of agreement, defined as the difference in expenditure between the two methods $\pm$ 1.96 s.d. of the bias. Bland–Altman plots were used to report this information visually to show the degree of agreement between receipt and self-reported food expenditures.[14] Fourth, receipt-based and self-reported food expenditures were stratified into quintiles and weighted κ-coefficient analyses were performed to evaluate the agreement between the two methods. Weights were defined as 1.0 for perfect match, 0.8 for discordant by one category, 0.5 for discordant by two categories and 0 for discordant by more than two categories. Additional analyses were conducted to examine completeness of the receipt data and whether there were any sociodemographic biases by the number of household receipts. Sensitivity analyses were conducted by excluding outliers (identified as those respondents with number of receipts 3 s.d. above the mean). All analyses were conducted using Stata statistical software, version 11 (College Station, TX, USA).[15]

RESULTS

Sociodemographic characteristics of the sample are presented in Table 1. The mean age of the sample was 46 years. Majority of the sample were females (69%), with 31% males. Most respondents were Whites (80%). The sample was more likely to be college educated (62%), higher income (34% $\geqslant$ \$100K) and with ~50% of the sample with one or more children in the household. The 2-week food expenditures by sociodemographic variables are presented in Table 2. On average, 16 receipts (s.d. = 10) were

Table 1. Subject characteristics

	N *(%)*
Total	447
Age, years	
21–39	82 (18)
40–49	187 (42)
50–64	178 (40)
Gender	
Men	140 (31)
Women	307 (69)
Race/ethnicity	
White	358 (80)
Non-White	89 (20)
Highest education	
High school graduate or less	48 (11)
Some college	121 (27)
College graduates	278 (62)
Annual household income	
$<$ \$50 000	130 (29)
\$50 000 to $<$ \$100 000	164 (37)
$\geqslant$ \$100 000	153 (34)
Household size (person)	
1	104 (23)
2	123 (28)
3–4	171 (38)
$\geqslant$5	49 (11)
No. of children in household	
0	243 (54)
1	72 (16)
2	97 (22)
$\geqslant$3	35 (8)

Table 2. Agreement between 2-week food expenditures per person per household from receipts vs self-report, by income, education and the number of children in the household

	N *(%)*	*Number of receipts, mean (s.d.)*	*Receipt expenditure ($), mean (s.d.)*	*Self-reported expenditure ($), mean (s.d.)*	*Bias*[a]	P-*value*[b]	*95% Limits of agreement*
(A) The 2-week total food expenditure per person per household							
Overall	447	16 (10)	138 (84)	132 (75)	6.4	**0.04**	(−123.5 to 143.4)
Highest education							
High school graduate or less	48 (11)	13 (7)	111 (75)	101 (56)	9.9	0.32	(−123.5 to 143.4)
Some college	121 (27)	14 (9)	118 (79)	120 (68)	−2.1	0.69	(−116.7 to 112.5)
College graduates	278 (62)	17 (10)	152 (85)	142 (78)	9.4	**0.02**	(−126.3 to 145.1)
Annual household income							
< $50 000	130 (29)	13 (8)	116 (79)	115 (71)	0.5	0.92	(−118.0 to 119.0)
$50 000 to < $100 000	164 (37)	16 (8)	143 (84)	144 (79)	−0.7	0.88	(−103.9 to 102.5)
≥ $100 000	153 (34)	18 (12)	152 (86)	133 (70)	19.0	< **0.01**	(−100.3 to 128.4)
Children in household							
None	243 (54)	15 (9)	165 (93)	160 (84)	4.8	0.33	(−144.8 to 154.3)
1	72 (16)	17 (11)	117 (70)	107 (48)	9.7	0.19	(−113.6 to 133.0)
2	97 (22)	17 (10)	108 (50)	100 (38)	8.5	0.08	(−83.5 to 100.5)
≥ 3	35 (8)	15 (11)	81 (47)	77 (38)	4.3	0.56	(−80.9 to 89.5)
(B) The 2-week food store expenditure per person per household							
Overall	444	8 (5)	96 (59)	90 (53)	5.7	**0.03**	(−99.6 to 110.9)
Highest education							
High school graduate or less	48 (10)	7 (5)	85 (51)	76 (41)	9.2	0.24	(−95.5 to 113.8)
Some college	118 (27)	8 (6)	89 (63)	84 (51)	4.3	0.30	(−84.8 to 93.4)
College graduates	278 (63)	8 (5)	101 (58)	96 (55)	5.6	0.10	(−106.1 to 117.3)
Annual household income							
< $50 000	129 (29)	7 (5)	87 (63)	83 (49)	3.9	0.36	(−90.4 to 98.3)
$50 000 to < $100 000	164 (36)	8 (5)	97 (57)	98 (57)	−0.7	0.86	(−103.9 to 102.5)
≥ $100 000	151 (34)	9 (6)	103 (59)	89 (50)	14.1	< **0.01**	(−100.3to128.4)
Children in household							
None	243 (54)	8 (5)	102 (63)	96 (57)	5.3	0.09	(−117.3 to 124.2)
1	72 (16)	8 (4)	80 (49)	74 (34)	6.7	0.20	(−87.9 to 112.2)
2	97 (22)	10 (5)	81 (38)	75 (34)	5.9	0.42	(−62.9 to 78.7)
≥ 3	35 (8)	13 (13)	66 (18)	54 (15)	11.2	0.15	(−74.5 to 77.4)
(C) The 2-week eating-out expenditure per person per household							
Overall	407	8 (7)	45 (47)	43 (40)	1.7	0.38	(−74.0 to 77.4)
Highest education							
High school graduate or less	40 (19)	6 (5)	32 (36)	29 (31)	2.2	0.70	(−95.5 to 113.9)
Some college	109 (27)	6 (5)	33 (40)	37 (38)	−3.8	0.32	(−84.8 to 93.4)
College graduates	258 (63)	9 (7)	52 (50)	48 (42)	3.9	0.10	(−106.1 to 117.3)
Annual household income							
< $50 000	109 (27)	6 (5)	34 (41)	36 (37)	−2.4	0.50	(−90.4 to 98.3)
$50 000 to < $100 000	154 (37)	8 (6)	46 (48)	47 (45)	−1.0	0.76	(−103.9 to 102.5)
≥ $100 000	144 (35)	10 (8)	53 (48)	45 (36)	7.7	**0.02**	(−100.3 to 128.4)
Children in household							
None	243 (54)	7 (7)	51 (51)	48 (43)	3.3	0.18	(−91.6 to 95.5)
1	72 (16)	6 (6)	25 (22)	29 (26)	−4.3	0.16	(−52.6 to 52.3)
2	97 (22)	9 (6)	28 (21)	31 (17)	−2.8	0.54	(−45.9 to 48.4)
≥ 3	35 (8)	7 (6)	23 (17)	13 (12)	10.0	0.10	(−31.3 to 41.3)

[a]Bias = mean difference from paired *t*-test (receipts – self-reported). [b]*P*-value from paired *t*-test of mean difference (receipts – self-reported). The values $P < 0.05$ are in bold.

provided by respondents to reflect their 2-week household food expenditures. The range for the number of receipts was 1–66 with median (interquartile range) of 14 (9–20). Almost half of these receipts were for food stores (mean ± s.d. = 8 ± 5), with median (interquartile range) of 7 (5–10). For eating-out receipts, the mean (s.d.) number of receipts were 8 (7), with a median (interquartile range) of 5 (2–11).

The average 2-week food expenditure per person per household, based on receipts, was $138, with $96 for food stores and $45 for eating out. The corresponding numbers based on self-reported food expenditure questions from NHANES were very similar ($132, $90 and $43, respectively).

Differences in food expenditures by key sociodemographic variables are presented in Table 2. First, higher education and higher-income respondents had higher per capita total food expenditures based on both receipts and self-reported data; however, the observed gradient was less with self-reported data (Table 2A). For example, the 2-week per capita food expenditure based on receipts was $152 among college graduates vs $111 among high school graduates or less. The corresponding numbers based on self-reported data were $142 and $101, respectively. Similar associations were observed with income, where 2-week total per capita expenditure was $152 among ⩾100K income category vs $116 among < 50K. The corresponding figures from self-reported data were $133 and $115, respectively. Table 2A further examined differences in food expenditures across the two methods using paired *t*-tests. The mean bias between overall total food expenditure by receipts vs self-reported was 6.4 ($P < 0.04$). Once stratified by income and education, the bias remained significant only among highest income and education

categories ($152 from receipts vs $133 based on self-reports among those with income ⩾100K, *P*-value <0.01). No significant difference was observed between receipts vs self-reported based expenditures at other levels of education and income. These analyses were replicated to examine whether there were any significant trends by the number of children in the household. Overall, an inverse trend was observed between 2-week per capita food expenditures and the number of children, based on both receipts ($165 for households with no children to $81 among households with ⩾3 children) and self-reported data ($160 and $77, respectively). Paired *t*-tests showed no significant difference between receipts vs self-reported food expenditures by the number of children (Table 2A).

After stratifying expenditures by food stores vs eating out, consistent results were obtained (Tables 2B and C, respectively). Higher education and higher income were each associated with higher per capita expenditures at food stores as well as eating out. For example, on average, 2-week per capita expenditure at food stores based on receipts was $87 among lower household income to $103 among highest-income category (Table 2B). The corresponding numbers for expenditures on eating out were $34 and $53, respectively (Table 2C). However, the gradient in expenditures by income was less steep based on self-reported expenditures ($83 among lowest income to $89 among highest income for food store expenditure, and $36 among lowest income to $45 among highest income for eating-out expenditure). The mean bias between overall total food store expenditure by receipts vs self-reported was 5.7 ($P<0.03$), whereas the mean bias between overall eating-out expenditure was 1.7 ($P=0.38$). Once stratified by income and education, the bias remained significant only among highest-income categories ($103 from receipts vs $89 from self-report in food store expenditure among those with income ⩾100K, *P*-value <0.01; $45 from receipts vs $43 from self-report in eating-out expenditure among those with income ⩾100K, *P*-value = 0.02). There was no difference in per capita food expenditures based on receipts vs self-reports for lower- and middle-income groups (mean difference of <$1 for income <50K and <$1 for 50 to <100K with *P*-values >0.05 for each).

No significant differences were observed in food stores or eating-out expenditures across two methods by the number of children in the household (Tables 2B and C). None of the other demographic variables such as age, gender and race/ethnicity showed any associations with food expenditure data across the two methods (results not shown). As a result, all further analyses were restricted to two key sociodemographic variables: income and education.

Table 2 also examined whether the total numbers of receipts received varied by key sociodemographic variables. Higher-income or higher educated households provided significantly higher total number of food receipts for a 2-week period (18 receipts among income ⩾100K vs 13 receipts among income <50K, and 13 receipts among high school or less vs 17 receipts among college graduates). No associations were observed between number of receipts and age, gender and race/ethnicity of the respondent (data not shown). All the analyses were replicated before and after excluding outliers for sensitivity analyses. Respondents whose number of receipts were 3 s.d. above the mean were treated as outliers. The results remained entirely unchanged, and therefore the results for the entire sample have been shown.

Validating self-reported food expenditures against objective receipt data

Bland–Altman analyses were conducted to visually examine the degree of agreement across two methods. Overall, good agreement was observed between receipt-based and self-reported food expenditures (Figures 1a–c). For total 2-week expenditures (Figure 1a), the limits of agreement in difference in receipt vs self-reported food expenditures ranged from −$123.5 to $143.4. The corresponding limits of agreement in difference in receipt vs self-reported food store expenditure ranged from −$99.6 to $110.9 (Figure 1b). The corresponding limits of agreement in difference in receipt vs self-reported eating-out expenditure ranged from −$74.0 to $77.4 (Figure 1c). In all three figures, greater deviation from the mean was observed as total food expenditure, food store expenditure and eating-out expenditure increased.

The κ-statistic was also used as another method to examine the degree of agreement across receipts and self-reported

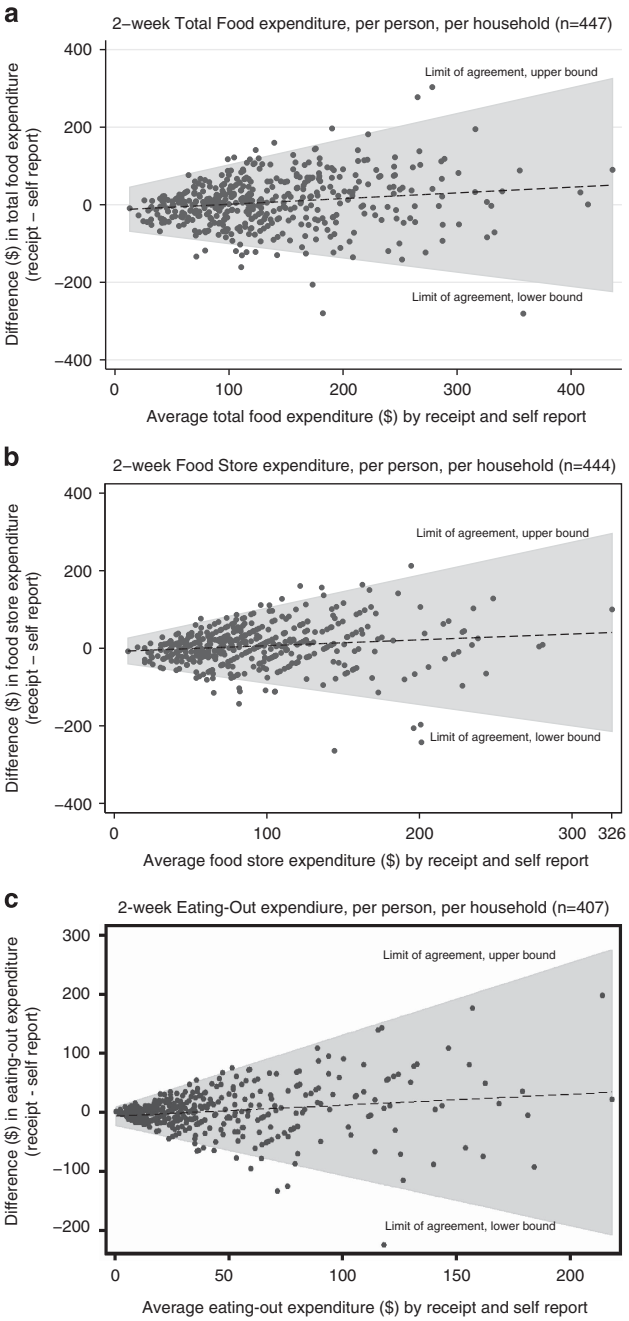

Figure 1. Bland–Altman plots to compare receipt expenditures vs self-reported expenditures. (**a**) The 2-week total food expenditure, per person, per household ($n=447$). (**b**) The 2-week food store expenditure, per person, per household ($n=444$). (**c**) The 2-week eating-out expenditure, per person, per household ($n=407$).

expenditure and is presented in Table 3. The observed agreement for total food expenditures over 2 weeks using the quintiles method was 79.2%, with κ-coefficient of 0.51. The observed agreement for food store expenditures using the quintiles method yielded a κ-coefficient of 0.41. For eating out the κ-coefficient was 0.49. These values of κ-coefficient indicate moderate to good agreement.

DISCUSSION

This study represents the first validation of the FCBS food expenditure questions relative to objective food store and eating-out receipts. We had several interesting findings.

First, higher income and education groups had higher household food expenditures and per capita expenditures, based on both objective receipts and self-reported questions from NHANES. They tend to spend more, both at food stores and on eating out. These data are consistent with past studies. French *et al.*[4] found that higher-income households spent $163 per person per month on food, significantly higher than lower-income households who spent $100 per person per month. The corresponding numbers based on our present sample of Seattle–King County adults was estimated at $152 and $116, respectively. Consistent findings were obtained by income with both local[4,11] and national data from the US Bureau of Labor Statistics (BLS).[16] The US BLS report showed that households in the lowest-income quintile spent $3547 on food as compared with households in the highest-income quintile who spent $10 991 in 2011.[17] In the present study, the lowest-income households spent $8354 on food as compared with highest-income households who spent $10 947 on food. King County, WA, USA, has higher median incomes than the national average, and tend to have higher education attainment that may explain the observed differences.[18]

Second, the self-reported food expenditure data, obtained using standard NHANES questions, were validated against objective 2-week receipts using several methods. Whereas receipt-based food expenditures showed a sharp linear increase with SES, consistent with BLS data,[17] self-reported expenditures did not follow the same trend. The self-reported total food expenditures were lower by $19 as compared with receipt data among highest-income households (⩾ $100 000). It would appear that the highest-income households are more likely to underestimate their household food expenditures, whether knowingly or not. The same trends were observed among higher educated groups. The Bland–Altman plots, used for calculating agreement between two measurements, confirmed that there was an overall good agreement between self-reported and receipt-based food expenditures. However, the bias in expenditure data across two methods increases at higher expenditures. In addition, households with higher per capita food expenditures were more likely to underestimate their self-reported total food expenditures, and spending at both food stores and on eating out.

The method of quintiles (κ-coefficients) is a complementary method–comparison analysis classifying participants and taking level of spending into consideration. This method also showed moderate to good agreement. The agreement held for estimated expenditures at food stores and on eating out.

Households with higher food expenditures, both from receipts and self-reports, belonged to higher income and education groups. These groups also had significantly higher number of food receipts, particularly for eating out. These findings together imply that higher income and education groups tend to have higher number of food receipts and higher food expenditures. We speculate that higher SES households with more shopping occasions may find it harder to keep track of their food receipts, and thus are much more likely to underestimate their household food expenditures. In contrast, lower SES households with fewer receipts and lower food expenditures tend to estimate their food expenditures better. Another factor that may explain the observed differences might be the types of food purchased across socioeconomic groups. The authors speculate that in addition to returning more food expenditure receipts, higher-income households may purchase more costly items (for example, expensive meat and fruit) that will likely have greater proportional and absolute errors than lower cost items. It is likely that individuals spending more overall will have more such items that would likely increase measurement error. Interestingly, there was no bias in self-reported household food expenditures as compared with receipts, by the number of children in the household or other demographic variables such as age, gender or race/ethnicity.

The food expenditure questions in the FCBS module were included for the purpose of encouraging national research on diet quality in relation to dietary expenditures.[2] The present findings imply that the household food expenditures using NHANES questions act as a decent proxy for actual food expenditures collected using receipts. Although the self-reported expenditure measures tend to have higher variability among higher income and education levels, these methods are well suited for NHANES samples that are dominated by lower income and lower education groups, and is a better representation of the US population as a whole.

Even though receipts are the preferred method for estimating food expenditures,[12] they are unlikely to be incorporated in large national studies on diets and health. Food store receipts have been used to assess food purchases at the household level and so infer

Table 3. Agreement between 2-week food expenditures by receipts vs self-report

	Total food expenditures			*Food store expenditures*			*Eating-out expenditures*		
		Overall percent			*Overall percent*			*Overall percent*	
	κ	*Agreement*	P-*value*	κ	*Agreement*	P-*value*	κ	*Agreement*	P-*value*
All participants	0.51	79.2	< 0.0001	0.41	75.4	< 0.0001	0.49	78.40	< 0.0001
Highest education									
High school graduate or less	0.40	77.9	0.0002	0.27	72.3	0.0078	0.42	77.50	0.0003
Some college	0.52	80.3	< 0.0001	0.44	76.1	< 0.0001	0.32	72.48	< 0.0001
College graduates	0.50	78.9	< 0.0001	0.40	75.6	< 0.0001	0.54	81.05	< 0.0001
Annual household income									
< $50 000	0.56	81.5	< 0.0001	0.43	74.8	< 0.0001	0.39	74.50	< 0.0001
$50 000 to < $100 000	0.52	79.8	< 0.0001	0.43	77.1	< 0.0001	0.52	78.77	< 0.0001
⩾ $100 000	0.42	76.6	< 0.0001	0.35	74.0	< 0.0001	0.49	80.97	< 0.0001

diet quality.[5–10] However, the collection of food store and eating-out receipts over several weeks, followed by coding and analysis, is time and labor intensive. The present study showed that estimated food expenditures, a method now incorporated in national food and nutrition surveys, provide an adequate approximation.

The study had several limitations. First, the present analyses are based on the assumption that the total number of receipts received from each household truly reflected their 2-week food expenditures. Sensitivity analyses were conducted, excluding outliers in the number of receipts, to ensure robustness of results. Second, the receipts were not annotated, hence some of the items listed on store receipts may not have been only consumed by household members. Participants may have purchased food items to share with work colleagues or have invited guests to eat out at restaurants. However, study participants were specifically instructed to make a note whenever a given item was not purchased for household consumption. Third, the observed bias between receipt food expenditures and self-report are based on Seattle–King County adults who tend to be skewed toward higher income and higher educated.

Validating and improving tools used in NHANES is a high research priority. Poor dietary quality has been linked to a higher risk of obesity and diet-related chronic diseases.[19–21] The USDA 2010 Dietary Guidelines[22] recommends increasing the consumption of vegetables, fruits, whole grains and low-fat dairy products while reducing the consumption of sodium, added sugars and saturated fats. However, the recommended diets have been associated with higher costs.[23,24] Validation of existing tools to capture household food expenditures at the national level is a prerequisite to understand the role of nutrition economics in determining diets and health.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

This study was funded by the NIH Grants P20 RR020774-03, R01 DK076608-04 and R21 DK020774.

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