Current Research

Assessing the Effect of Underreporting Energy Intake on Dietary Patterns and Weight Status

REGAN L. BAILEY, MS, RD; DIANE C. MITCHELL, MS, RD; CARLA MILLER, PhD, RD; HELEN SMICIKLAS-WRIGHT, PhD

ABSTRACT

Objectives To identify misreporting among older rural adults using a prediction algorithm and to compare dietary patterns of underreporters and plausible reporters.

Design In this cross-sectional study, diet information was assessed by five 24-hour recalls collected over 10 months. All foods were classified into 24 food subgroups. Demographic, health, and anthropometric data were collected via home visit.

Setting Rural Pennsylvania.

Subjects One hundred seventy-nine community-dwelling adults, aged 66 to 87 years.

Statistical analysis Cluster analysis.

Results Underreporters (n=43) were more likely than plausible reporters (n=133) to be overweight and less educated but did not differ by sex. Underreporters consumed fewer servings across the majority of food groups. Two dietary patterns were determined for all and plausible reporters, in both cases one of higher and one of lower nutrient density. Using only plausible reporters to determine dietary patterns was very similar to using all reporters. The correlation between energy intake and weight status was improved for plausible-reporting women, but not men.

Conclusions Dietary patterns of plausible reporters were generally similar to that of all reporters; however, correlations with energy intake and weight status improved for women using only plausible reporters. Individuals may not accurately report dietary intake. Those obtaining diet reports should be aware of reporting errors before making decisions about dietary adequacy.

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R. L. Bailey is a National Institute on Aging predoctoral research fellow, D. C. Mitchell is coordinator of the Diet Assessment Center, C. K. Miller is associate director of the Penn State Diabetes Research Center, and H. Smiciklas-Wright is a professor, Nutritional Sciences Department, The Pennsylvania State University, University Park.

Address correspondence to: Regan L. Bailey, MS, RD, The Pennsylvania State University, Department of Nutritional Sciences, 5 Henderson Bldg, University Park, PA 16801. E-mail: rkb119@psu.edu

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Nutritional epidemiology is based on the premise that self-reported dietary intake is relatively accurate and reflective of habitual intake. Previous research in dietary assessment has indicated pervasive errors in self-reported energy intake (1-6). Energy intake should approximate energy expenditure in a weight-stable individual. However, underreporting of energy consumption ranges from 10% to 50% lower than estimated energy needs assessed by doubly labeled water and other validation studies (5,7-9). Doubly labeled water studies can determine inaccurate dietary reports in weight-stable individuals (5,6,8,10,11), but are quite expensive and difficult to perform and, therefore, not feasible with large sample sizes. For this reason, prediction algorithms for physiologically implausible dietary reports can be determined by comparing reported energy intake (rEI) to a multiple of basal metabolic rate (12,13). This method generally requires estimation of physical activity level that has been associated with low sensitivity (14) as well as underestimation errors up to 15% when compared with doubly labeled water studies (15). Recently, McCrory and colleagues developed a procedure for screening inaccurate dietary reporters without estimation of physical activity level and accounting for errors in rEI and predicted total energy expenditure (pTEE) using constants derived from doubly labeled water studies and biological variation (16). The primary goal of this study was to apply this prediction algorithm to assess the effect of reporting errors on food intake and dietary patterns among a sample of older adults.

Recent evidence suggests that overall dietary patterns, rather than single nutrients, are preferential for assessing health status (17-23). However, little is known about the role of inaccurate reporting of energy on food group intake or derivation of dietary patterns and consequent health outcomes (24-27). Given the emerging importance of dietary patterns, an objective of this study was to assess the effect of reporting errors on dietary patterns.

Previous research indicates that energy intakes of plausible reporters have stronger associations with measures of obesity as well as other health problems than does energy intake of all reporters (24-27). Furthermore, overweight individuals tend to underreport dietary intake (24,25,28-30) creating a bias in studies assessing a dietary etiology of obesity. Therefore, another objective of this study was to address the role of underreporting energy intake with indicators of weight status. The hypothesis was that using only plausible reporters to derive dietary patterns will result in different dietary patterns than using all reporters. Furthermore, as seen in other research, the hypothesis was that using only plausible reporters will result in better correlations of energy intake and weight status (ie, body mass index and waist circumference).

METHODS

Subjects and Data Collection

This study is part of the Geisinger Rural Aging Study, a nutritional risk screening study of individuals aged 65 years and older. This report is based on a Geisinger Rural Aging Study subset, details of which have been published elsewhere (31). The Geisinger Rural Aging Study subset was not significantly different from the larger screening study with regard to sex, age, demographics, or anthropometric measures; however, the cohort was less likely to report having a poor appetite and needing assistance with bathing, traveling, and food preparation. Study procedures were approved by the human investigation review boards at Geisinger Health Systems and the Pennsylvania State University.

Participants received home visits at baseline and 1 year for the collection of demographic, anthropometric (ie, height, weight, and waist circumference), and health data. The health assessment included questions about diagnosis of more than 30 disease states as well as use of prescription medication. During the home visit, the Mini Mental State Examination (32) and the Geriatric Depression Scale (33) were used for exclusion purposes. The Mini Mental State Examination is a validated tool to assess cognitive function and queries memory, attention, and orientation; the exclusion criteria was a total score of less than 23 (34). The Geriatric Depression Scale is a screening test for depression symptoms among elderly people; a score greater than six was used as the exclusion criteria. Two hundred persons provided baseline data; 179 provided all data through a 1-year follow-up study.

Anthropometric Data

Anthropometric data were collected by standardized procedures based on the National Health and Nutrition Examination Survey (35). Height and weight were measured using a digital scale (UC300, A&D Engineering, Mitpiltas, CA) and portable statiometer (Infant/Child/Adult Height Measuring Board, Shorr Productions, Olney, MD), respectively. Body mass index (BMI) was calculated as kg/m^2. Waist circumference was measured using a flexible, nonelastic measuring tape.

Dietary Intake

Dietary information was collected via five 24-hour dietary recalls on random days by telephone at 2-month intervals following the initial home visit. All interviews were performed by trained staff at the Pennsylvania State University Diet Assessment Center. All interviewers are required to complete 40 hours of intensive training and are subject to reliability tests. To assess reliability, a nutritionist administers three standard dietary recalls in a mock telephone interview to all newly trained interviewers. Reliability among interviewers is based on interclass correlation analysis of nutrient variables from the three tests where a high degree of reliability for all nutrients is a correlation of 0.95 or higher (36).

The Nutrition Data System (NDS) software (food database version 12A, nutrient database version 28, 1996, Nutrition Coordinating Center, Minneapolis, MN) was used for data collection and analyses using a multiple pass technique to facilitate recall (37). The NDS-Research software itself provides a structured, guided, controlled platform where questions, and probes are standard and the process of conducting the 24-hour recall is standard. Final calculations were completed using NDS-Research (version 4.03_31, 1999, Coordinating Center, Minneapolis, MN). The NDS-Research time-related database updates analytic data while maintaining nutrient profiles true to the version used for data collection. NDS is updated annually.

The rEI and nutrient intakes were determined from the average of the five dietary recalls. Daily food intakes were categorized into main groups according to the Food Guide Pyramid (38) and main groups were further disaggregated into 24 subgroups based on similarity of nutrient composition (39). The serving sizes from each of these subgroups were determined by the average of the five dietary recalls. Diet quality was calculated using the Healthy Eating Index (HEI) (40), a tool created by the US Department of Agriculture. The HEI is a measured score of 10 dietary components corresponding to the Food Guide Pyramid (38) and Dietary Guidelines for Americans (41). Components one through five measure the degree to which a person's diet conforms to the recommendations for the grains, vegetables, fruit, milk, and meat groups, including nonanimal protein sources. The five remaining components measure total fat and saturated fat consumption as a percentage of total food energy intake, cholesterol intake, sodium intake, and dietary variety. Each component has a potential score of zero to 10 with a range of possible HEI scores from zero to 100. HEI was used as an indicator of diet quality.

Screening for Plausible Reporters

As outlined by McCrory and colleagues (16), pTEE was calculated for each subject based on age, weight, height, and sex as follows:

$$\text{pTEE} = (7.377) - 0.073 \times (\text{age} + 0.0806) \times (\text{weight} + 0.0135) \times (\text{height} - 1.363 \times \text{sex}),$$

where age is in years, weight is in kilograms, height is in centimeters, and sex is coded as one for women and zero for men. Subjects' rEI is then divided by pTEE and multiplied by 100, and is expressed as a percentage. Thus, someone reporting energy intake equivalent to estimated energy expenditure would result in a percent pTEE of 100, underreporting would fall below 100% and overreporting would be expressed as >100%.

A standard deviation in the percent pTEE for the sample was calculated to account for within and between person variability of daily energy consumption.

The sample standard deviation is as follows:

$$\pm 1 \text{ standard deviation} = \sqrt{(\text{CV}^2\text{wEI/d})} + \text{CV}^2\text{wTEE}$$

where CV^2wEI is the squared value of the mean coefficient of variation in reported energy intake of the sample,

Table 1. Descriptive characteristics of plausible and underreporters of energy intake among a sample of older rural adults in Pennsylvania

	Plausible reporters (n=133)	Underreporters (n=43)
	←— % —→	
Men	44	51
Women	56	49
Tobacco use	7	19*
Educational attainment		
Less than high school	18	28
Graduate of high school	45	60
Some or more college	37	12*
	←— *Mean (lower and upper confidence limit)* —→	
Age (y)	73.4 (72.6-74.2)	73.5 (71.7-75.1)
Dietary intake		
Energy (kcal)	1,483.3 (1,411.5-1,551.1)	1,018.8 (932.7-1,104.9)***
Carbohydrate (g)	231.72 (221.2-242.3)	151.7 (141.3-162.0)***
Protein (g)	65.2 (62.3-68.5)	46.4 (42.7-50.2)***
Fat (g)	61.8 (58.1-65.5)	35.8 (32.8-38.9)***
Geriatric depression scale[a]	1.45 (1.11-1.79)	1.56 (1.01-2.14)
Mini Mental State Examination score[b]	28.4 (28.0-29.6)	26.8 (26.1-27.6)**
BMI[c]	27.4 (26.4-28.3)	31.2 (29.0-33.4)**
Waist circumference (cm)	88.1 (85.4-90.6)	96.2 (90.1-102.3)**
Comorbidities (n)	4.51 (4.03-4.99)	5.76 (2.60-4.62)*
Prescription medications (n)	2.85 (2.40-3.29)	3.61 (2.60-4.62)

[a]Range=0-15, lower score indicates less likely to develop depression.
[b]Range=0-30, lower score indicates poorer cognitive function.
[c]BMI=body mass index; calculated as kg/m^2.
*$P<0.05$.
**$P<0.01$.
***$P<0.001$.

d is the number of days of dietary intake, and $CVwTEE$ is the squared value of the coefficient of variation in predicted energy expenditure.

Standard deviation of percent pTEE is used to determine plausible and implausible reporting of energy intake. Several recommendations have been presented as appropriate cutoffs for determining plausible, under-, and overreporting (16,42). A ±2 standard deviation cutoff was chosen for this report (43). Using the two standard deviation cutoff would classify individuals that reported less than 55% or more than 145% of estimated energy needs as implausible reporters.

Statistical Analysis

Cluster analysis of food groups was employed to derive dietary patterns of all reporters and only plausible reporters. Limited sample size precluded pattern analysis of underreporters. PROC FASTCLUS (version 8, 1999, SAS Institute, Cary, NC), was used to create disjoint clusters based on least-squares estimation. Subjects are assigned exclusive cluster membership based on the Euclidean distance of data points from the cluster centroid in an iterative process. Thus, a cluster represents a dietary pattern of a group of individuals based on similarity of consumption of food groups. A two-cluster solution was selected based upon examination of scree plots of eigenvalues of the data as well as examination of plots of the within-cluster sum of squares against the number of clusters.

Cluster differences were examined using t tests and analysis of covariance. The covariates included in this analysis were age, sex, tobacco use, and regular alcohol consumption. Pearson correlations were also employed to assess relationships between anthropometric data and energy intake by reporting status. Statistical analysis was used to compare selected characteristics and food group and nutrient intake of the sample by reporting status. To assess differences between categorical variables χ^2 analysis was used. We used t tests to determine differences in regard to continuous variables. For all statistical tests the significance level was set at $P<0.05$.

RESULTS

Using the method of McCrory and colleagues (16) yielded 133 plausible reporters (74.3%), 43 underreporters (24.0%), and three overreporters (1.7%). Given the low frequency of individuals determined to be overreporters, the three individuals were not included in subsequent analysis.

Descriptive characteristics of plausible reporters and underreporters are presented in Table 1. Plausible reporters had higher educational attainment than underreporters. They also had higher scores on The Mini Mental State Examination, a measure of cognitive ability, but were not different on the Geriatric Depression Scale.

Table 2. Daily servings of food groups by plausible and underreporters of energy intake among a sample of older rural adults in Pennsylvania[a]

	Plausible reporters (n=133)	Underreporters (n=43)
	Mean (lower and upper confidence limit)	
Bread	2.99 (2.78-3.12)	2.12 (1.86-2.39)***
Cereal	0.75 (0.64-0.87)	0.61 (0.43-0.80)
Pasta, noodles, rice	0.65 (0.51-0.78)	0.55 (0.38-0.72)
Sweet bread desserts	0.96 (0.84-1.1)	0.34 (0.21-0.47)***
Snacks	0.47 (0.37-0.57)	0.31 (0.20-0.42)*
Dark-green, deep-yellow vegetables	0.34 (0.28-0.40)	0.26 (0.17-0.35)
Other vegetables	1.07 (0.95-1.2)	0.69 (0.56-0.81)***
Starchy vegetables	1.02 (0.91-1.1)	0.71 (0.58-0.84)**
Vegetable soups/sauces/juices	0.23 (0.18-0.28)	0.22 (0.14-0.31)
Citrus, melon, berries	0.36 (0.28-0.44)	0.32 (0.18-0.46)
Fruit juice	0.44 (0.36-0.52)	0.40 (0.27-0.53)
Other fruit	1.07 (0.94-1.21)	0.69 (0.53-0.86)***
Milk	1.12 (0.96-1.28)	0.77 (0.58-0.97)**
Cheese	0.32 (0.26-0.38)	0.21 (0.15-0.27)**
Dairy desserts	0.45 (0.37-0.53)	0.22 (0.13-0.31)**
Red meat, beef, lamb	0.59 (0.52-0.66)	0.44 (0.35-0.53)**
Poultry	0.25 (0.21-0.29)	0.18 (0.11-0.24)*
Fish	0.15 (0.10-0.19)	0.09 (0.01-0.16)
Processed meats	0.42 (0.32-0.51)	0.29 (0.20-0.38)*
Nuts	0.09 (0.06-0.12)	0.03 (0.01-0.05)***
Beans	0.16 (0.12-0.20)	0.08 (0.03-0.20)*
Eggs	0.30 (0.23-0.36)	0.24 (0.14-0.33)
Fats and oils	4.58 (4.15-5.01)	2.61 (2.2-2.9)***
Sweets	2.69 (2.32-3.06)	1.32 (0.10-1.68)***

[a]Serving sizes from subgroups were determined by the average of the five dietary recalls.
*$P<0.05$.
**$P<0.01$.
***$P<0.001$.

Plausible reporters as a group had a lower BMI and waist circumference and were less likely to use tobacco. Underreporters indicated more disease states but did not report more use of prescription medication. Plausible reporters as a group had lower BMI and waist circumferences. In terms of diet, underreporters reported on the average 400 kcal less than plausible reporters (data not shown). All macronutrients were significantly lower among underreporters, with dietary fat being most notable (35.8 g vs 61.8 g).

Plausible reporters consumed more servings for 15 of the 25 food groups examined (Table 2). They reported more servings per day of bread, sweet breads (eg, muffins, doughnuts, and cakes), other vegetables (eg, tomatoes, lettuce, and celery), starchy vegetables, other fruit (eg, apples and bananas), all of the dairy subgroups, most of the meat groups, fats/oils, and sweets. In fact, plausible reporters had nearly twice the number of servings from several food groups including sweet breads, dairy desserts, and sweets. No food group differences were observed for cereals, pasta/noodles/rice, several fruit and vegetable groups, fish, and eggs.

Presentation of overall dietary patterns is typically based on all participants in a study. In this study the dietary patterns of all reporters were compared with that of only plausible reporters (overreporters were not included in any analysis) (Table 3). Two dietary patterns (ie, clusters) were determined for both all and plausible reporters (Table 3). In both cases, there was a dietary pattern (ie, Pattern 1) with a lower HEI and a second pattern with a higher HEI and food group intake consistent with national guidelines (ie, Pattern 2). The food subgroups highlighted in bold were consistent across clusters for all reporters and plausible reporters. For example, more bread, sweet breads, dairy desserts, processed meat, eggs, fats/oils, and sweets and lower intakes of cereals as well as four of the six fruit and vegetable subgroups were consistently found in Pattern 1. For the most part, dietary patterns were relatively stable regardless of energy reporting status.

Although dietary patterns were substantially similar for all and plausible reporters, differences were noted for seven food groups. Pattern 1 of all reporters, but not plausible reporters, was characterized by fewer servings of other vegetables, milk, poultry, fish, and beans. Pattern 1 of plausible reporters, but not all reporters, was characterized by more servings of starchy vegetables and nuts.

Correlations between energy intake and anthropometric data were much stronger for women when using only plausible reporters. The correlation coefficient for energy intake and BMI of all women was -0.13 ($P=0.18$) and 0.25 ($P=0.03$) using only plausible reporters. Female plausible reporters had significantly lower BMI (27.3 vs 31.2; $P<0.01$) and waist circumference (88.1 vs 96.2 cm; $P<0.01$) than underreporters. Male plausible reporters also had a significantly lower BMI (29.9 vs 28.1; $P<0.01$) but not waist circumference (106.4 vs 102.9 cm; $P<0.01$) than underreporters. However, using only plausible reporting men did not improve correlations between anthropometric data and energy intakes.

DISCUSSION

This study was designed to determine the extent of errors in reporting energy intake among a sample of older adults and to assess the effect of these reporting errors on dietary patterns and markers of weight status. Approximately 25% of this sample was classified as underreporters, whereas overreporting was virtually nonexistent. No sex differences were seen in the prevalence of underreporting; this is in contrast to many other studies that have indicated women are much more likely to underreport (26,44,45). Weight status and education were subject characteristics predictive of implausible reporting (ie, underreporting energy) in this sample and others (5,7,8,24,26,42,43,44,46). Weight status is consistently associated with underreporting of energy intake and may be related to a desire for weight loss (47) or due to dietary restraint (48,49). Underreporters in this study, as in others (50-52), had a lower level of educational attainment and poorer cognitive function. Underreporters were also more likely to smoke or use other tobacco products (15,24). This study supports previous work indicating

Table 3. Mean food group servings of older rural adults in Pennsylvania within each dietary pattern for plausible and all reporters of energy intake[a]

	All Reporters[b] (n=179)		Plausible Reporters (n=133)	
	Pattern 1[c] (n=107)	Pattern 2[c] (n=72)	Pattern 1[c] (n=88)	Pattern 2[c] (n=45)
	←——— Least square means (95% confidence interval) ———→			
Bread	**3.15 (2.95-3.34)[d]**	**2.22 (1.98-2.46)*****	**3.49 (3.15-3.83)**	**2.73 (2.49-2.97)*****
Cereal	**0.52 (0.41-0.64)**	**1.06 (0.91-1.20)***	**0.71 (0.51-0.91)**	**0.78 (0.63-0.92)***
Pasta, noodles, rice	**0.61 (0.47-0.76)**	**0.64 (0.50-0.82)**	**0.64 (0.46-0.82)**	**0.61 (0.46-0.75)**
Sweet bread desserts	**0.94 (0.82-1.05)**	**0.67 (0.52-0.81)****	**0.98 (0.84-1.12)**	**0.91 (0.67-1.15)*****
Snacks	**0.45 (0.35-0.55)**	**0.40 (0.28-0.53)**	**0.47 (0.28-0.67)**	**0.46 (0.35-0.57)**
Dark-green, deep-yellow vegetables	**0.20 (0.14-0.26)**	**0.52 (0.45-0.60)*****	**0.24 (0.18-0.31)**	**0.38 (0.30-0.46)*****
Other vegetables	0.83 (0.71-0.96)	1.19 (1.04-1.35)***	1.07 (0.86-1.29)	1.07 (0.92-1.22)
Starchy vegetables	1.02 (0.91-1.14)	0.87 (0.72-1.01)	1.20 (1.00-1.40)	0.92 (0.79-1.04)*
Vegetable soup/sauce/juice	**0.23 (0.17-0.28)**	**0.23 (0.16-0.30)**	**0.17 (0.11-0.24)**	**0.26 (0.19-0.32)**
Citrus, melon, berries	**0.27 (0.19-0.36)**	**0.47 (0.36-0.58)*****	**0.27 (0.18-0.36)**	**0.37 (0.29-0.45)****
Fruit juice	**0.32 (0.23-0.41)**	**0.58 (0.47-0.69)*****	**0.42 (0.29-0.55)**	**0.44 (0.34-0.55)****
Other fruit	**0.76 (0.63-0.90)**	**1.33 (1.16-1.50)*****	**0.88 (0.66-1.11)**	**1.16 (1.00-1.33)****
Milk	0.83 (0.67-1.00)	1.39 (1.19-1.60)***	1.08 (0.81-1.36)	1.13 (0.93-1.34)
Cheese	**0.30 (0.24-0.37)**	**0.29 (0.21-0.37)**	**0.26 (0.16-0.36)**	**0.33 (0.27-0.39)**
Dairy desserts	**0.46 (0.38-0.54)**	**0.30 (0.20-0.41)***	**0.53 (0.38-0.68)**	**0.40 (0.31-0.49)*****
Red meat, beef, lamb	**0.58 (0.51-0.66)**	**0.51 (0.42-0.61)**	**0.70 (0.58-0.82)**	**0.52 (0.44-0.61)**
Poultry	0.18 (0.14-0.23)	0.31 (0.25-0.37)***	0.25 (0.18-0.33)	0.23 (0.18-0.28)
Fish	0.10 (0.05-0.15)	0.20 (0.13-0.26)**	0.13 (0.06-0.21)	0.14 (0.09-0.18)
Processed meats	**0.50 (0.41-0.59)**	**0.22 (0.10-0.33)*****	**0.43 (0.29-0.57)**	**0.37 (0.28-0.45)*****
Nuts	0.09 (0.06-0.12)	0.06 (0.02-0.09)	0.09 (0.05-0.13)	0.06 (0.04-0.09)**
Beans	0.09 (0.05-0.14)	0.21 (0.15-0.27)*	0.15 (0.09-0.21)	0.15 (0.10-0.20)
Eggs	**0.33 (0.26-0.40)**	**0.20 (0.11-0.29)***	**0.46 (0.32-0.59)**	**0.21 (0.14-0.26)****
Fats and oils	**4.68 (4.26-5.09)**	**3.22 (2.71-3.73)****	**7.25 (6.58-7.91)**	**3.2 (2.95-3.45)*****
Sweets	**2.66 (2.28-3.05)**	**2.09 (1.61-2.57)**	**2.78 (2.10-3.46)**	**2.64 (2.19-3.08)**
Healthy Eating Index (HEI)	**67 (65-69)**	**74 (72-76)*****	**67.7 (66.0-69.3)**	**75.5 (73.5-77.6)*****

[a]Serving sizes from subgroups were determined by the average of the five dietary recalls.
[b]All reporters does not include the three participants excluded as overreporters.
[c]Pattern 1 is associated with lower quality nutrient profiles and HEI scores, and food choices not consistent with national guidelines; Pattern 2 is associated with higher overall nutrient profiles and HEI scores, and food choices consistent with national guidelines.
[d]Food items highlighted in bold represent consistent findings with all reporters and plausible reporters.
*$P<0.05$.
**$P<0.01$.
***$P<0.001$.

weight status, education, and smoking status are characteristics consistently associated with underreporting and suggestive of systematic errors of underreporting.

Although it is important to understand the participant characteristics associated with underreporting, it is equally critical to examine the effect of implausible reporting on food group intake and derivation of dietary patterns. Previous studies have indicated implausible reporters tend to selectively underreport foods perceived as unhealthful such as fats, sweets, and snacks and were more likely to report similar intakes of healthful foods as plausible reporters (29,51,53,54). Underreporters in this study did have lower intakes of many foods perceived as unhealthful (ie, dairy desserts and sweet breads such as doughnuts and muffins); however, they also had lower servings from food groups perceived as healthful, such as other fruits (ie, apples, pears, grapes, and bananas). Therefore, it is not as obvious that underreporting of undesirable foods was truly selective in this sample of older adults as in many other studies (29,51,53,54).

Cluster analysis was used to examine dietary patterns of all reporters and only those identified as plausible reporters. The majority of food groups identified in the more healthful dietary pattern was consistently found when using all and only plausible reporters. Similarly, the majority of food groups identified with the less healthful dietary pattern remained consistent when using both all and plausible reporters. The underreporting of food group intake did not substantially alter the dietary patterns found within this sample. This is likely related to the fact that underreporters had lower intakes of many food groups, suggesting omission, less frequent consumption, or smaller portion size estimation. Krebs-Smith and colleagues (51) indicated that underreporters have up to 40% smaller portion sizes than plausible reporters.

Although dietary patterns of plausible reporters were not vastly different from all reporters, the correlation improved between energy intake and anthropometry among female plausible reporters. Energy intake was not significantly related to BMI using all reporters. However, when this relationship was examined using only plausible reporters, the correlation was dramatically improved for women. Interestingly, Johnson and colleagues (28) also found a sex difference only among female participants for whom percent body fat was negatively correlated with underreporting of energy intake ($r=-0.42$, $P=0.001$). Underreporting increased with the amount of adiposity in women with no physiological variables correlated to underreporting of energy intake in men (28). Other studies indicate the use of plausible reporters exclusively yields better correlations between diet and health outcomes, particularly markers of weight status (16,26,42). Overweight and obese individuals are more likely to provide inaccurate reports of dietary intake (24,25,28-30); this creates a significant bias when examining the dietary etiology of obesity.

Understanding energy balance in older adults is essential as they are frequently at health risk due to extremes in nutritional status (underweight and overweight/obese). Traditionally, low weight and weight loss were of primary concern among older adults because of risk for earlier mortality (55-57). More recently overweight and obesity have been an issue among the older adult population. Overweight and obesity are associated with increased risk for many diseases including hypertension, diabetes, sleep apnea, cancer, gallbladder disease, musculoskeletal disorders, and pancreatitis (58-61). To understand the influence of nutrition on chronic diseases of older adults we must first address the issues of erroneous dietary reporting. In this study, approximately one fourth of older adults (23%) did not adequately report an energy intake within two standard deviations of predicted needs to maintain body weight (based on a prediction algorithm using age, weight, height, and sex and energy intakes derived from five 24-hour recalls). Despite underreporting, dietary patterns were not drastically different. Further research is needed to explore dietary patterns of all reporters in a sample and to compare to the dietary patterns of only plausible reporters in other samples particularly because this sample is homogenous, consisting of primarily non-Hispanic white, older individuals. The extent of reporting errors should be addressed before conclusions about dietary patterns and health outcomes are stated.

This may limit the generalizability to other populations. However, consistent characteristics of underreporters (ie, overweight and less educated) found in other studies with more diverse samples were observed in this sample (24,25,28-30,50-52). This study contributed to the growing body of literature that suggests subject characteristics (ie, education and weight status) are related to reporting errors, these factors should be used to control for or taken into account in statistical models when examining relationships with diet and health. The unique contribution of this report is that despite errors in reporting dietary intake, dietary patterns were generally stable.

CONCLUSIONS

Dietary patterns reflect overall intake of foods and food groups regularly consumed. Food and nutrition professionals obtaining diet reports must be aware that individuals may not accurately report dietary intake, with underreporting errors being much more likely than overreporting. Underreporting may confound conclusions about diet and may lead researchers to draw incorrect conclusions. Underreporting of specific foods is likely to have an influence on nutrient intakes and alter relationships between energy intake and anthropometry.

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