Published in final edited form as:

J Nutr Health Aging. 2013 January ; 17(1): 19–25. doi:10.1007/s12603-012-0082-4.

DIETARY PATTERNS AND DIET QUALITY AMONG DIVERSE OLDER ADULTS: THE UNIVERSITY OF ALABAMA AT BIRMINGHAM STUDY OF AGING

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Abstract

Objectives—To characterize dietary patterns among a diverse sample of older adults (≥ 65 years). *Design:* Cross-sectional. *Setting:* Five counties in west central Alabama.

Participants—Community-dwelling Medicare beneficiaries (N=416; 76.8 ± 5.2 years, 56% female, 39% African American) in the University of Alabama at Birmingham (UAB) Study of Aging.

Measurements—Dietary data collected via three, unannounced 24-hour dietary recalls was used to identify dietary patterns. Foods were aggregated into 13 groups. Finite mixture modeling (FMM) was used to classify individuals into three dietary patterns. Differences across dietary patterns for nutrient intakes, sociodemographic, and anthropometric measurements were examined using chi-square and general linear models.

Results—Three dietary patterns were derived. A "More healthful" dietary pattern, with relatively higher intakes of fruit, vegetables, whole grains, eggs, nuts, legumes and dairy, was associated with lower energy density, higher quality diets as determined by Healthy Eating Index (HEI)-2005 scores and higher intakes of fiber, folate, vitamins C and B6, calcium, iron, magnesium, and zinc. The "Western-like" pattern was defined by an intake of starchy vegetables, refined grains, meats, fried poultry and fish, oils and fats and was associated with lower HEI-2005 scores. The "Low

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Conflict of Interest: There are no conflicts of interest to report.

Author Contributions: All authors participated in the study concept, design, editing, and revision of the manuscript. PYH, DCM, DLC, GLJ, TJH also contributed to the analysis and interpretation of the data.

produce, high sweets” pattern was characterized by high saturated fat, and low dietary fiber and vitamin C intakes. The strongest predictors of better diet quality were female gender and non-Hispanic white race.

Conclusion—The dietary patterns identified may provide a useful basis on which to base dietary interventions targeted at older adults. Examination of nutrient intakes regardless of the dietary pattern suggests that older adults are not meeting nutrient recommendations and should continue to be encouraged to choose high quality diets.

Keywords

Dietary pattern; finite mixture modeling; older adults

Introduction

Although aging is associated with declines of physiological and cognitive functions that contribute to ill health, longitudinal studies suggest that nutrition may be an important determinant of successful aging (1). Historically, studies have examined nutrients in isolation. Because nutrients are consumed in combination and foods are consumed as a component of meals, there has been considerable interest in the investigation of total diet (versus single, isolated nutrients).

Little research has been done on dietary patterns of older adults, and even less that reflects the diversity of older adult populations in the US. Yet, it is well-established that obesity is a major public health concern among older adults, with close to 35% being obese. For older African Americans, the obesity rates are even more alarming and are particularly high for women (50%) (2). Understanding the dietary practices of older adults may help target interventions to improve diet and weight status. The primary aim of this study was to identify food patterns in a sample of community-dwelling older adults living in Alabama.

Previous evidence suggests that sociodemographic characteristics are associated with dietary quality (3). However, the complexity of these relationships has not been well studied in older Americans. Therefore, a secondary aim was to determine predictors of diet quality (defined by both dietary patterns and Healthy Eating Index-2005 (HEI-2005)), including an examination of the association between body mass index (BMI) and dietary patterns.

Methods

Subjects

The University of Alabama at Birmingham (UAB) Study of Aging is a longitudinal, observational study designed to investigate racial disparities in life-space mobility associated with aging (4). Participants from the UAB Study of Aging initially included 1000 community-dwelling older non-Hispanic whites and African-Americans (≥ 65 years old) recruited between late 1999 to February 2001 from a stratified random sample (stratified by county of residence, gender, race) of Medicare beneficiaries living in rural and urban areas in five counties of central Alabama (4). Study procedures were approved by the UAB Institutional Review Board.

In 2004 (year 4), 733 surviving participants who were not living in a nursing home were eligible to participate in a follow-up in-home assessment. Of these, 622 (84.9%) agreed to participate in the home interview and provided complete dietary data. Nonparticipants did not differ from participants in terms of gender, urban/rural residence, or race ($p > .05$). However, nonparticipants were older, had lower levels of education and household incomes, lower life-space mobility, more chronic conditions and had lower scores on a cognitive screening test (p >.05) (5–7).

For the current analyses, we excluded those with symptoms suggestive of depression (Geriatric Depressive Score [GDS] ≥6; n=28) or cognitive assessment test score <24 (n=147) or both (n=27), and four participants who were missing height and/or weight measurements (5, 8). Analyses were performed with year 4 data from the remaining 416 individuals; 183 males and 233 females, respectively.

Data collection

In-home interviews were conducted at baseline to collect general health, anthropometric measures (height and weight), and sociodemographic information and to assess factors affecting life-space mobility. Counties classified as Metropolitan Statistical Areas at the time of data collection were considered urban as defined by the U.S. Office of Management and Budget (9). Diet was assessed during year 4 of the study using three unannounced 24-hour dietary recalls conducted by trained interviewers. Food intake data was entered into the Nutrition Data System for Research software (NDSR; Nutrition Coordinating Center, Minneapolis, MN), food database version 34 and 35, nutrient database version 4.06 and 5 and regenerated in NDSR 2008 for analysis. One of the features of NDSR is the ability to reanalyze data that is reflective of the marketplace at the time of data collection but with updated nutrient and other aspects of analysis, such as food group data, that was not available at the time of the original data collection. Data collected on vitamin and mineral supplement use was not included in analyses. Food and beverage codes were assigned to items in the individual food file dataset. Energy density was calculated as average energy (kcals) divided by average food weight (grams) (10). Overall HEI-2005 scores, which act as a summary measure of diet quality, were calculated for each individual using methods described by Miller et al. (11). Foods were aggregated into 13 groups on the basis of nutritional similarity and frequency of intake among the sample (Table 1). Food intake patterns were derived on the basis of average servings per 1000 kcal. Servings were based on the Dietary Guidelines for Americans, 2005 for foods that have recommendations (12). Food and Drug Administration (FDA) serving sizes were used for those without current recommendations (e.g., cookies, fruit drinks).

Statistical analysis

Statistical analyses for identification of food intake patterns were conducted using latent class cluster analysis (more generally known as finite mixture modeling (FMM)) in Latent Gold (version 4.5, Statistical Innovations Inc., Belmont, MA). FMM was performed to examine the clustering of dietary intake based on frequency of intake (servings per 1000 kcal). FMM is a data-reduction technique that uses a K-class latent variable to explain associations among a group of observed variables. In this particular case, each latent class is assumed to represent a dietary pattern. Dietary pattern models were evaluated for solutions specifying K=2–10. Selection of the model was based on comparison of the Bayesian Information Criterion (BIC) and interpretability of dietary patterns.[13] There has been evidence of high levels of low-energy reporting among older adults (14). Implausible energy reporters were identified in this sample using procedures described by McCrory et al. (15), which compares predicted energy expenditure with reported energy intake.

FMM, unlike cluster analysis, does not divide individuals into exclusive dietary patterns, such that each person only belongs to one and only one pattern, but rather, each individual has a probability of membership into each of the derived dietary patterns. Therefore, participants were assigned into patterns based on highest respective posterior class-membership probabilities. The average and median individual posterior class-membership probabilities ranged from 0.85 to 0.90 and 0.92 to 0.97, respectively. Model-predicted mean energy-adjusted servings and evaluation of nutrient intakes by food intake pattern were used to interpret and label the food patterns. Analysis of food patterns was also attempted by gender and race separately, but the sample sizes were insufficient to assure model stability.

Differences of nutrient intakes, sociodemographic and health characteristics across the food intake patterns were compared using chi-square and analysis of covariance for categorical and continuous variables, respectively using the Statistical Analysis System (SAS version 9.2, SAS Institute, Inc., Cary, NC). To examine the association between dietary pattern (dependent variable) and BMI, including the interaction between BMI and gender, we performed latent class multiple regression analysis using Latent Gold, adjusting for important covariates, including race, income, cognitive score, education and age. To investigate the probability of being classified into one dietary pattern versus another, the association between dietary pattern and BMI by gender was investigated using logistic regression and was plotted using estimated conditional probabilities (from Latent Gold output), based on model covariates mentioned above and odds ratios were calculated. An alpha-level of .05 was used as the threshold for statistical significance.

Results

Sample characteristics

Our sample was 39% African American and 56% female. A total of 69% completed high school or greater, 46% lived in rural areas and 53% were married. Mean age (± standard deviation) of the 416 participants was 76.8 ± 5.2 years and mean BMI (kg/m^2) was 28.3 ± 5.4 and 28.3 ± 6.2 for men and women, respectively (p =.94). (Table 2) BMI did vary across race and gender, with African American women being the heaviest (mean BMI=31.1 +/− 6.8 kg/m^2, p<.001) (Data not shown.)

Description of the dietary patterns

Food patterns derived with only those identified as plausible energy reporters (n=344) were similar to the overall sample, thus, results from the full sample (n=416) are presented. There were no statistically significant differences for gender, marital status, or self-reported health between those characterized as implausible and plausible energy reporters (data not shown). Ultimately, a three-class solution was selected. Mean servings of food groups per 1000 kilocalories across dietary patterns are shown in Table 3. The “Western-like” dietary pattern (41.3%) was characterized by a relatively higher intake of fats and oils, refined grains, poultry and fish and a relatively lower intake of dairy products compared to the overall sample. The second dietary pattern was represented by low intake of fruits and vegetables, including starchy vegetables and highest intake of sweets and therefore was labeled the “Low produce, high sweets” (40.4%) pattern. The third dietary pattern (18.3%) included individuals with relatively higher intakes of fruits, vegetables, whole grains, other protein sources (eggs, nuts, legumes) and dairy products. This group consumed a relatively healthier pattern and was therefore labeled “More healthful”. Although those in the “Western-like” pattern reported higher poultry and fish consumption, it is noteworthy that these foods were more likely to be fried in comparison to the “More healthful” pattern.

Table 3 shows the mean daily nutrient intakes for the food intake patterns. Those in the “Western” dietary pattern reported significantly lower vitamin B12 and calcium intakes compared to the other patterns. The “Low produce, high sweets” pattern was characterized by high saturated fat, and low dietary fiber and vitamin C intakes. The “More healthful” pattern reported higher micronutrient and lower fat and saturated fat intakes and also had the lowest energy density (1.43 kcal/g ± 0.33) compared to the other food patterns. Although the

"Western" pattern reported the lowest energy intake, it was not statistically different from that reported by the "More healthful" pattern. The mean reported nutrient intakes for all dietary patterns in the present study, including the "More healthful" pattern, were all below Dietary Reference Intakes (Table 3). Irrespective of the dietary pattern, fewer than 10% of participants exceeded the 2005 RDA and AI recommendations for fiber, vitamin D and magnesium.

Dietary patterns and sociodemographic characteristics

We observed significant differences in demographic and health characteristics across the three patterns (Table 4). Gender distribution across dietary patterns was significantly different, with more females in the "More healthful" dietary pattern. Those in the "More healthful" dietary pattern were also more likely to be better educated, Non-Hispanic white, report higher incomes and better quality diets (higher and more favorable HEI-2005 scores) compared to the other two dietary patterns. There were no statistically significant differences across patterns for age, mean BMI, marital status or GDS. Although not statistically different, those characterized by the "More healthful" dietary pattern reported higher levels of physical activity, better health, and were more likely to be "never smokers".

In examining the association between dietary patterns and BMI, we found that there was a significant interaction with gender when controlling for race, income, cognitive status, education, and age (p =.02). Figure 1 illustrates the relationship between probability of being classified into a dietary pattern and BMI for males and females. For men, there was an inverse relationship between BMI and the probability of being characterized by the Western dietary pattern, such that as BMI increased, the probability of being classified into this pattern decreased. A similar relationship was seen for the "Low produce, high sweets" dietary pattern and BMI for men. In contrast, for women, a positive relationship was seen between BMI and the probability of being characterized by the "Western-like" dietary pattern, such that as BMI increased, this probability increased. This relationship also was similar for the "Low produce, high sweets" pattern. Odds ratios were also calculated. As an example, the odds of being in the "Western-like" dietary pattern, compared to the "More healthful" pattern, was 1.63 for males for individuals at the mean BMI (28.3 kg/m^2) and decreased to 1.44 for males with a BMI value of 35 (NIH Class I obesity cut-off). On the other hand, for a female with the mean BMI (28.3 kg/m^2), the odds of being classified in the "Western-like" dietary pattern was 1.07; however, when BMI increased to 35, these odds increased to 1.52.

Discussion

In this study of older adults in the UAB Study of Aging, we identified three dietary intake patterns: "Western-like", "Low produce, high sweets" and "More healthful". Relationships of the patterns of food intake to differences in diet quality as measured by the HEI-2005 were evaluated, both as total HEI score and as individual component scores. The "More healthful" dietary pattern was associated with the highest total HEI-2005 score compared to the other two patterns. When HEI-2005 component scores were examined (data not shown), the "More healthful" pattern had significantly more favorable scores for total and whole fruit, whole grains, milk, oils, sodium, and calories from solid fats, alcoholic beverages and added sugars, therefore contributing to an overall higher HEI-2005 total score. Higher component scores for fruits and vegetables for those in the "More healthful" dietary pattern were consistent with the low energy density (1.43 kcal/g ± 0.33). Mean overall total HEI-2005 score for all three dietary patterns was 57.9 ± 12.4 which was comparable to adults from NHANES 2001–2002 (mean HEI = 58.2, 95% CI: 56.6–59.9) (16). However, when our sample was compared to only the older adults (≥ 65 years old) of the 2001–2002 NHANES data, the mean HEI-2005 total score from the UAB Study of Aging participants was 10 points less (57.9 UAB vs. 67.6 NHANES) (17). These observations are comparable to a previously reported sample of multi-ethnic older adults in the South that had a mean total HEI-2005 score of 61.9 (18), suggesting that the dietary quality of older adults living in the South may be more compromised than that of a national sample.

Examination of sociodemographic and lifestyle characteristics by dietary pattern revealed that the strongest predictors of better diet quality were female gender and non-Hispanic white race. Perhaps our most important observation was that the significant interaction found between BMI and gender for probability of dietary pattern membership suggested that there was a stronger relationship between BMI and dietary pattern for women compared to men. This supports other studies which highlight that the relationship between dietary pattern and BMI might vary between sexes (19–21). Schulze and colleagues described a positive relationship between BMI and the “Alcohol” dietary pattern for men. However, for women in this same study, a positive relationship between BMI and dietary pattern was found for the “Plain cooking”, “Bread and sausage” and “Low fat dairy” dietary patterns. Findings from this and other studies, suggests that food choice may be mediated by gender. The gender difference could also be explained by differences in marital status. A much higher percentage of males in the sample were married (79%) and fewer widowed (14%) compared to females (married: 32%; widowed: 58%). Other studies have indicated that marital status and living arrangements are related to diet quality (22, 23). Previous work using the UAB Study of Aging data derived from baseline data (N=1000) found that African American women experienced the greatest nutritional risk, and that each ethnic-gender groups’ nutritional risk was influenced by different factors (24). Although in our study, we were not able to analyze patterns by gender due to sample size constraints.

Although not significantly associated, those who reported higher levels of physical activity and excellent/good health and were “never smokers” were more likely to be characterized by the “More healthful” dietary pattern. Relationships among food intake and sociodemographic characteristics suggest that sound dietary choices are associated with a healthier lifestyle. These findings are similar to previous studies that show positive associations between education, income and diet quality (25, 26). Our current study differs from the aforementioned papers in that food intake was defined by dietary patterns, an approach that is thought to capture total diet, and that results are limited to only older adults.

The differences in reported energy consumption among the 3 dietary patterns are noteworthy. The relatively high energy intake of the “Low produce, high sweets” pattern is likely a reflection of intake of dessert-like (high energy-dense) foods and lower consumption of high water content (and therefore low energy dense) fruits and vegetables. Interestingly, the pattern labeled “Western-like” was characterized by the lowest energy intake. While we did perform an analysis to screen for implausible energy reporting using the McCrory equation (15), it remains possible that there was greater underreporting of energy intakes among those classified by the “Western-like” dietary pattern. It is unclear whether this procedure is valid in this population as the equation has only been validated in weight-stable samples (15). (In our sample, 34% and 25% of participants reported gaining or losing weight in the last six months, respectively, suggesting that this group is not weight stable. (Data not shown.) However, when Bailey et al. assessed the effect of underreporting energy intake on dietary patterns and weight status in a sample of older adults, they found that including implausible energy reporters did not significantly affect derived dietary patterns compared to patterns derived using only plausible reporters (27).

While it is difficult to make direct comparisons among dietary pattern studies, findings from our study were similar when compared to other dietary pattern studies of older adults in that more favorable dietary patterns are associated with higher diet quality (18, 28, 29). Schroder and colleagues (29) reported that older adults consuming a low energy density diet were more likely to meet recommended intakes for total and saturated fat, cholesterol, fiber, vitamins C, E and B6 and thiamin, riboflavin, folate, calcium and magnesium.

Methodological aspects

To the best of our knowledge, our study was the first to illustrate the utility of FMM as an approach to dietary pattern analysis in a sample of older adults. FMM offers advantages over the more traditional methods of dietary pattern analysis. Unlike cluster analysis, FMM produces model fit statistics, such as the BIC to help determine the appropriate number of classes (i.e., dietary patterns). Conceptually, the goals of FMM and cluster analysis are similar in that the aim is to classify individuals into groups (i.e., dietary patterns). However, instead of "assigning" individuals exclusively into only one food pattern as in cluster analysis, FMM produces posterior probabilities of class membership for each individual, which can be used for model evaluation. Nagin provides >0.7 as an acceptable cut-point for posterior membership-class probability values (30). In our study, median posterior probabilities ranged from 0.92 to 0.97. Furthermore, the use of FMM has a major advantage over food frequency questionnaires in that it examines all foods and quantities consumed as a part of the whole diet.

Limitations of this investigation include an inadequate sample size to suitably examine dietary patterns by subgroups (e.g., gender, race). Our use of cross-sectional data limits our ability to determine causal relationships between dietary and lifestyle factors in this population. Although our sample resided in Alabama, they were all Medicare beneficiaries; and since over 95% of the United States older adult population receives Medicare benefits, it can be argued that they are representative of Medicare recipients of that region (31, 32). Despite these limitations, our study used multiple 24-h recalls to measure diet and includes a representative, diverse sample of older adults who are thought to be at nutritional risk.

This study identified three meaningful dietary patterns using FMM. It is noteworthy that for each dietary pattern characterized, the percentage of individuals meeting nutrient recommendations was generally below 50%, often much lower. These findings suggest that improvement in diet quality among these older adults is warranted. Future studies should attempt to examine changes in dietary patterns over time and relationships to health outcomes and longevity.

Acknowledgments

The authors would like to thank John Dziak, PhD (The Methodology Center, The Pennsylvania State University) for his assistance with the statistical analyses. The study described was supported in part by award no. R01 AG15062, "Mobility Among Older African Americans and Whites – the UAB Study of Aging," P30AG031054, the Deep South Resource Center for Minority Aging Research, from the National Institute on Aging, the GCRC Grant M01 RR-00032, the CTSA Grant #5UL1RR025777 from the National Center for Research Resources, and by US Department of Agriculture no. 1950-51530-010-00. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Aging or the National Institutes of Health.

Sponsor's Role: Sponsors provided research funding only.

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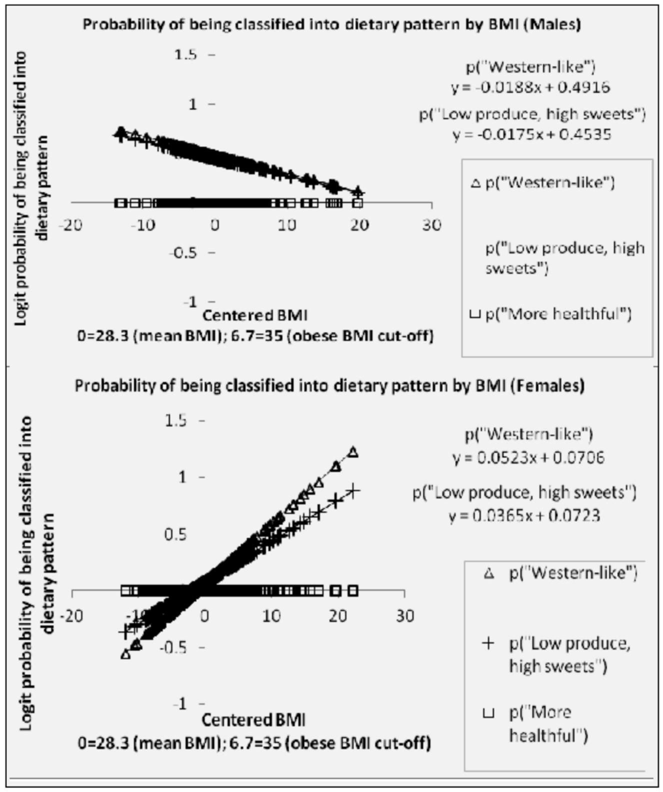

Figure 1.

Probability of being characterized by dietary pattern based on BMI and gender

Note: Y-axis is the logit probability from the logistic regression.

Table 1

Description of food groupings used to derive dietary patterns of the UAB Study of Aging

Food group name	**Food items**
Fruit	Citrus fruit and juice, fruit juice, other fruit
Vegetables	Dark green and deep yellow vegetables, tomatoes, vegetable juice, other vegetables (celery, cabbage, squash, cucumber, mushrooms, cauliflower, okra, etc.), fried vegetables, vegetable-based savory snack
Starchy vegetables	White potatoes, fried potatoes, other starchy vegetables (peas, lima beans, corn)
Whole grains	Flour, bread, rolls, quick breads, corn muffins, tortillas, crackers, pasta, cereal, snack bars, and snack chips made with whole grain or some whole grain; and popcorn
Refined grains	Flour, bread, rolls, quick breads, corn muffins, tortillas, crackers, pasta, cereal, snack bars, and snack chips made with refined grains
Sweets	Cakes, cookies, pies, pastries, frozen dairy dessert, pudding, sweet sauces, candy (chocolate and non-chocolate), syrup, honey, jam, jelly, preserves, sugar, frosting and glaze
Meats	Beef, pork (fresh and cured), lamb, game, organ meats, cold cuts and sausage
Poultry, fish	Poultry, fish, shellfish
Other protein sources	Legumes, eggs, egg substitute, nuts and seeds, nut and seed butters
Dairy products	Milk, milk beverages, flavored milk, yogurt, cheese
Miscellaneous	Salad dressing, sauces, condiments, pickled foods, non-dairy creamer
Oils	Margarine, oil
Fats	Butter, shortening, gravy and cream

Table 2

Characteristics of the UAB Study of Aging participants (n=416)[a,b]

Characteristics	Men	Women
No. of subjects	44% (183)	56% (233)
Age, y	76.3 ± 5.0	77.1 ± 5.5
BMI, kg/m^2	28.3 ± 5.4	28.3 ± 6.2
BMI categories		
Underweight, BMI <18.5 kg/m^2	1.6% (3)	1.7% (4)
Normal, BMI 18.5–24.9 kg/m^2	26.8% (49)	30.9% (72)
Overweight, BMI 25–29.99 kg/m^2	40.4% (74)	34.3% (80)
Obese, BMI ≥30 kg/m^2	31.2% (57)	33.0% (77)
Race		
Non-Hispanic white	60.1% (110)	62.2% (145)
African American	39.9% (73)	37.8% (88)
Living in rural area	44.8% (82)	47.2% (110)
Education		
<High school	31.7% (58)	30.9% (72)
Graduated from HS	26.8% (49)	32.2% (75)
Some college or greater	41.5% (76)	36.9% (86)
Married[c]	78.7% (144)	32.2% (75)
Self-reported physical activity[c]		
Not active/minimally active	15% (27)	24% (57)
Moderately active	36% (65)	35% (81)
Active	50% (91)	41% (95)
Self-reported health		
Fair/poor	14% (26)	20% (47)
Good	68% (124)	62% (145)
Excellent/very good	18% (33)	18% (41)
Smoking status[c]		
Never smoker	31.2% (57)	53.6% (98)
Former smoker (quit >4 y ago)	5.5% (10)	9.8% (18)
Former smoker (quit ≤ 1 y ago)	64.4% (150)	29.2% (68)
Current smoker	1.3% (3)	5.2% (12)

[a]Characteristics are from Year 4 of Study of Aging, when dietary data was collected;

[b]Values are means ± SD for continuous variables and percentages (n) for categorical variables;

[c]Significantly different, $p < 0.05$

Table 3

Daily Servings of Food, Nutrient Intakes and Percent of UAB Study of Aging Participants (n=416) Meeting Nutrient Recommendations by Dietary Pattern

	Western-like (n=172)	By dietary pattern Low produce, high sweets (n=168)	More healthful (n=76)
Mean servings per 1000 kcal/day ± SD[a]			
Fruit	1.07 ± 1.29	0.85 ± 0.65	1.64 ± 1.10
Vegetables	1.20 ± 0.79	0.79 ± 0.44	1.59 ± 1.30
Starchy vegetables	0.55 ± 0.55	0.31 ± 0.24	0.37 ± 0.39
Whole grains	0.44 ± 0.63	0.87 ± 0.77	1.71 ± 0.83
Refined grains	2.80 ± 1.07	2.18 ± 0.84	1.35 ± 0.69
Sweets	0.94 ± 0.93	1.13 ± 0.72	0.85 ± 0.58
Meats	1.61 ± 1.20	1.40 ± 0.82	0.97 ± 0.67
Poultry, fish	1.66 ± 1.47	1.19 ± 1.00	1.07 ± 0.81
Other protein sources	0.54 ± 0.53	0.53 ± 0.47	0.76 ± 0.77
Dairy products	0.29 ± 0.29	0.66 ± 0.44	1.01 ± 0.69
Miscellaneous	0.84 ± 0.87	0.65 ± 0.39	0.83 ± 0.73
Oils	1.35 ± 1.14	0.95 ± 0.56	0.80 ± 0.79
Fats	0.74 ± 0.70	0.43 ± 0.35	0.43 ± 0.46
Energy-adjusted (per 1000 kilocalories) mean nutrient intakes ± SD[b, f]			
Total energy, kcal	1150.77 ± 385.52[c]	1370.48 ± 380.91[d]	1242.31 ± 342.07[c]
Carbohydrates, % energy	47.44 ± 8.51[c]	48.98 ± 6.94[c]	52.16 ± 8.77[d]
Protein, % energy	16.63 ± 4.04	15.85 ± 3.27	16.40 ± 3.03
Fat, % energy	36.97 ± 6.68[c]	35.99 ± 5.57[c]	33.27 ± 7.76[d]
Saturated fat, % energy	11.41 ± 2.62[b]	12.10 ± 2.53[d]	10.54 ± 2.88[e]
Alcohol, % energy	0.28 ± 1.82	0.70 ± 2.67	0.68 ± 2.08
Fiber, g	9.95 ± 3.90[c]	8.98 ± 2.65[d]	12.52 ± 3.89[e]
Folate, μg	305.80 ± 126.89[c]	310.89 ± 141.19[c]	396.93 ± 236.18[d]
Vitamin B6, mg	0.96 ± 0.32[c]	0.99 ± 0.40[c]	1.32 ± 0.69[d]
Vitamin B12, μg	2.20 ± 1.39[c]	3.54 ± 4.49[d]	3.78 ± 3.23[d]
Vitamin C, mg	54.41 ± 54.06[c]	40.00 ± 27.52[d]	72.30 ± 42.95[e]
Vitamin D, μg	2.56 ± 3.42[c]	3.04 ± 1.75[cd]	3.53 ± 2.23[d]
Vitamin E, mg	4.24 ± 2.06[c]	5.42 ± 10.04[c]	8.08 ± 10.18[d]
Calcium, mg	331.36 ± 121.12[c]	416.64 ± 149.48[d]	602.16 ± 327.47[e]
Iron, mg	7.97 ± 2.46[c]	8.35 ± 2.99[c]	10.10 ± 5.80[d]
Magnesium, mg	135.74 ± 33.07[c]	136.07 ± 30.19[c]	180.08 ± 40.69[d]
Zinc, mg	5.46 ± 2.53[c]	6.13 ± 3.52[c]	7.19 ± 4.33[d]
Energy density, kcal/g	1.66 ± 0.40[c]	1.74 ± 0.31[d]	1.43 ± 0.33[e]
HEI-2005 score[g]	53.7 ± 11.7[c]	56.7 ± 10.6[d]	70.3 ± 9.8[e]
Percent of participants meeting nutrient recommendations[g]			
Fiber[h]	2.9% (5)	1.2% (2)	9.2% (7)

	Western-like (n=172)	By dietary pattern Low produce, high sweets (n=168)	More healthful (n=76)
Folate[h]	26.2% (45)	45.8% (77)	48.7% (37)
Vitamin B6[h]	12.8% (22)	25.6% (43)	43.4% (33)
Vitamin B12[h]	41.9% (72)	68.5% (115)	68.4% (52)
Vitamin D	1.7% (3)	0.6% (1)	0% (0)
Calciumh	0.6% (1)	4.8% (8)	7.9% (6)
Magnesium	1.2% (2)	0.6% (1)	2.6% (2)
Iron[h]	52.3% (90)	72.6% (122)	75.0% (57)
Zinc[h]	10.5% (18)	25.6% (43)	36.8% (28)

[a]All mean servings were significantly different across dietary pattern at p <.05;

[b]Values in the same row with different superscript letters (c, d and e) were significantly different, p <.05;

[f]Analysis is adjusted for multiple comparisons using Bonferroni correction;

[g]Nutrient cut-offs based on 2005 Recommended Dietary Allowances and Adequate Intakes for vitamins and minerals;

[h]Significantly different, p <.05

Table 4

Selected Characteristics across the 3 Dietary Patterns among Participants of the UAB Study of Aging (n=416)[a]

Characteristic[b]	Western-like (n=172)	Low produce, high sweets (n=168)	More healthful (n=76)	p-value
Female *	52% (89)	55% (92)	68% (52)	0.047
Age, y	76.7 ± 5.2	76.8 ± 5.4	77.0 ± 5.4	0.948
Non-Hispanic White *	47% (80)	68% (114)	80% (61)	<0.001
BMI, kg/m^2	28.8 ± 6.4	28.1 ± 5.6	27.6 ± 5.4	0.269
BMI category[c]				
Normal, BMI 18.5–24.9 kg/m^2	27% (45)	32% (53)	31% (23)	0.568
Overweight, BMI 25–29.9 kg/m^2	37% (62)	36% (60)	43% (32)	
Obese, BMI ≥30 kg/m^2	36% (61)	32% (53)	27% (20)	
Education *				
<HS	39% (67)	27% (46)	22% (17)	0.011
Graduated from HS	31% (54)	27% (46)	32% (24)	
Some college or greater	30% (51)	45% (76)	46% (35)	
Income *				
Less than $12,000	39% (64)	19% (30)	18% (13)	<0.0001
$12,000–29,999	42% (69)	44% (68)	35% (25)	
$30,000–49,999	12% (19)	21% (32)	21% (15)	
$50,000 or more	7% (11)	16% (25)	25% (18)	
Lives alone	27% (47)	25% (42)	33% (25)	0.440
Self-reported physical activity				
Not active/minimally active	23% (39)	20% (33)	16% (12)	0.736
Moderately active	32% (56)	37% (62)	37% (28)	
Active		45% (77)	43% (73)	47% (36)
Self-reported health				
Fair/poor	20% (35)	13% (22)	21% (16)	0.178
Good	61% (105)	71% (120)	58% (44)	
Excellent/very good	19% (32)	15% (26)	21% (16)	
Lives in rural area	52% (90)	40% (67)	46% (35)	0.07
Married	52% (90)	57% (96)	43% (33)	0.138
Smoking status				
Never smoker	48% (83)	49% (83)	54% (41)	0.596
Former smoker	43% (74)	43% (72)	43% (33)	
Current smoker	9% (15)	8% (13)	3% (2)	
Cognitive Score *	27.1 ± 1.9[a]	27.7 ± 1.8[b]	28.0 ± 1.7[b]	0.0003
GDS	1.5 ± 1.2	1.5 ± 1.4	1.5 ± 1.3	0.996

[a]Characteristics are from Year 4 of Study of Aging, when dietary data was collected;

[b]Values are means ± SD for continuous variables and percentages (n) for categorical variables. Values in the same row with different superscript letters were significantly different, p <.05;

[c]Underweight BMI category was excluded due to extremely small frequency;

*Significantly different, $p < .05$

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