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## The Diet Quality of Rural Older Adults in the South as Measured by HEI-2005 Varies by Ethnicity

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### Abstract

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The 2005 Dietary Guidelines have increased emphasis on Americans consuming a wide range of healthful foods and further reducing the consumption of less healthful ones. These recommendations are challenging for rural elders whose functional limitations, fewer resources, and limited access to foods negatively affect the quality of their diets. The purpose of this study was to characterize the diet quality of a multi-ethnic population-based sample of older adults (n=635) in the southern US. Data were collected via home visit; dietary intakes were assessed using a food frequency questionnaire and converted into Healthy Eating Index-2005 (HEI-2005) scores used to monitor adherence to Dietary Guidelines. The mean total HEI-2005 score was 61.9/100 with fewer than 2% meeting the recommended score of 80/100. After controlling for age, gender, marital status, poverty status, and education, African Americans (n=136) had higher total HEI-2005 scores compared to American Indians (n=195) and Non-Hispanic Whites (n=304) (64.5 vs. 60.1 and 61.1 respectively, p=.001). Certain HEI-2005 foods were consumed in greater amounts by particular groups, such as total fruit and meat and beans (African Americans), whole fruit and grains (African Americans and American Indians), milk (Non-Hispanic Whites), and calories from solid fat, alcohol, and added sugars (American Indians). The overall diet quality of these rural elders was not adequate as determined by the HEI-2005; however, intakes of dark green and orange vegetables were adequate, and many participants were in compliance with the added fat and sugar guidelines. Determination of factors that promote or prevent the consumption of healthful foods among rural elders may help tailor nutrition education programs for these vulnerable communities.

## Keywords

Older adults; diet quality; healthy eating index; rural diets

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Improved nutritional status is an important component of efforts to improve the health of older adults in living in rural areas (1) Rural older adults are more likely to be obese or overweight, have high rates of chronic disease, and are less likely to access preventive healthcare (1–3). The ability of rural elders to consume a healthful diet is affected by limitations faced by all older adults (4–10) coupled with lower educational and income levels and lack of proximity to stores and transportation (11). This increases the likelihood that rural older adults will consume diets that fail to meet recommendations for the types and quantities of foods (12–14).

We know that older adults living in rural areas, particularly ethnic minorities, have diets that fail to meet earlier USDA dietary recommendations (12–15). The Healthy Eating Index-2005 (HEI-2005) reflects current increased emphasis on grains, dark green and orange vegetables, certain oils, and energy from sweets, solid fats, and alcohol.(16) To date, the HEI-2005 has been used to examine diet quality of the general population of older adults (17) but not to assess the diets of rural elders.

This paper uses data from a population-based survey that included an assessment of the diet quality of a multi-ethnic older adult population. Its objectives are to (1) quantify overall and ethnic variations in diet quality as measured by the HEI-2005 and (2) compare the individual components of the HEI-2005 across ethnic groups.

## METHODS

### Sampling Plan and Recruitment

Between January 2006 and March 2008, the Rural Nutrition and Oral Health (RUN-OH) Study conducted a cross-sectional survey of the dietary intake of an ethnically diverse (African American, American Indian, and Non-Hispanic White) population of older adults in two rural North Carolina counties. Details of sampling and recruitment are presented elsewhere (18)

Individuals were considered eligible if they were 60 years or older, spoke English, were able to give informed consent, and were physically able to complete the interview. Of 5,445 selected dwellings, 39 were not screened, 4,647 were screened but did not include an eligible participant, and 859 included an eligible participant, yielding a screening rate of 99.3%. The eligible residents in 635 of the 859 eligible dwelling units completed the interview; 224 refused to participate, for a response rate of 73.9%.

### Data Collection

All data collection procedures were approved by the university's Institutional Review Board. Data collected in face-to-face interviews at participants' homes, lasting 1.5 to 2.5 hours, included the Block '98 Food Frequency Questionnaire (FFQ) (Nutrition Quest, Berkeley, California), which assesses usual intake of 110 foods. Participants were asked about typical frequency and portion sizes of foods eaten within the past year. Questions were read to participants. Cue cards with response categories were used if necessary. Interviewers completed 8 hours of training and 6 hours of practice interviews. Ten percent of interviews were verified by telephone and one interview every month was audio-recorded for each interviewer and reviewed by research staff.

Demographic data included sex, ethnicity, age, income, education, and marital status. Ethnicity was categorized as African American, American Indian, or white. Income was dichotomized as above or below the poverty line using current year federal poverty guidelines according to household size (19). Education categories were: (1) less than high school graduate, (2) high school graduate and (3) more than high school.

### HEI-2005 Scoring

The HEI-2005 contains 12 components (16,20). These include cup equivalent (eq)/1000 kcals of total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes (after meat and bean component reach maximum values), and milk (dairy products including soy milk). Meat and beans (eggs, nuts, and soy foods excluding drinks), total grains, and whole grains are calculated in oz eq/1000 kcals. The amounts of oils (non-hydrogenated fats found in mayonnaise, margarine, salad dressing, nuts and seeds, and fish) and sodium, measured in g/1000 kcals, and the percent calories from saturated fat and solid fat, alcohol, and added sugar (SoFAAS) comprise remaining components. The percent of energy contributed by saturated fat was used as a surrogate for solid fat.

Completed FFQs were scanned by Nutrition Quest and gram amounts and calories for each FFQ item were provided along with standard output of daily micro- and macronutrients intakes and USDA food group servings. What's In The Foods You Eat *Search Tool*, (version 3.0, 2008, USDA, Beltsville, MD) was used to convert FFQ values to HEI components (21). This software utilizes the USDA Food and Nutrient Database for Dietary Studies (22) and provided additional information necessary to calculate HEI-2005 components.

The total HEI score, which ranges from 0 to 100, is the sum of scores for all components. A maximum score of 5 was given for meeting or exceeding recommended intake of total fruit, whole fruit, total vegetable, dark green and orange vegetables and legumes, total grains, or whole grains. A maximum score of 10 assigned for meeting or exceeding recommended amounts of milk, meat and beans, and oils and when saturated fat and sodium were *equal to or less* than recommended intake. The recommended percent of energy contributed by SoFAAS was assigned a score of 20 if it  $\leq 20\%$  of energy. Recommended levels for each score are included in Table 2.

## Statistical Analysis

All analyses incorporated the multistage cluster sampling design. Weighted sample sizes were used for all analyses and reported results. Rao-Scott Chi-Square test was used to quantify associations between ethnicity and gender, income, education, marital status, poverty, education and obesity. Linear regression models were used to test for ethnic differences for the continuous variables, HEI-2005 total and component scores after adjusting for the covariates, age, gender, marital status, poverty, and education. Statistical differences with  $p < 0.05$  were further assessed using orthogonal contrasts to test pair-wise differences. The dichotomous variables, those that met or did not meet recommendations for total HEI-2005 and component foods, were analyzed using logistic regression adjusted for covariates mentioned above. All statistical analyses were conducted using the Statistical Analysis Software (version 9.1, 2003, SAS Institute Inc, Cary, NC). Significance level was set at  $p < 0.05$ .

## RESULTS AND DISCUSSION

The total sample of 635 participants had a mean age ( $\pm$ SE) of  $71.5 \pm 0.4$  years. Women comprised 54.1 % of the sample. More women than men had incomes below the poverty level (36.4% vs. 23.2%,  $p = .04$ ). Educational attainment did not differ between men and women with 55.7% of the sample having less and 19.8% having more than high school education.

The mean total HEI-2005 score was  $61.87 \pm 0.72$ . African Americans had higher total HEI-2005 scores than other groups (Table 1). African Americans consumed more total fruit and meat and beans than American Indians and Whites (Table 1). Whites consumed fewer whole fruits and whole grains and more milk than either African Americans or American Indians. American Indians consumed fewer oils and more calories from SoFAAS than Whites and African Americans and less saturated fat and more total fruit than whites.

Fewer than 2% of these older adults had acceptable total HEI-2005 scores of 80 points or more (Table 2). African Americans were more likely to consume recommended amounts of total fruit [odds ratio (95%CI), 3.83 (1.52, 9.63)], meat and beans [2.19 (1.37, 3.51)] than whites. More American Indians met recommendations for whole grains than whites [2.72 (1.33, 5.60)] and fewer American Indians consumed recommended amounts of oils [0.12 (0.04, 0.39)] and calories from SoFAAS [0.51 (0.27, 0.97)] than whites. Whites were more likely to consume recommended amounts of milk than African Americans [0.23 (0.07, 0.78)] and American Indians [0.20 (0.05, 0.80)]. Only 15–30% of participants met requirements for total fruit, total vegetables, total grains, and whole grains. Sodium, saturated fat, milk, and non-hydrogenated oils were consumed in recommended amounts by fewer than 5% of participants.

The mean total HEI-2005 score was five points lower than the total HEI-2005 score of all Americans age 65 and older using the 2001–02 National Health and Nutrition Examination Survey (NHANES) (17). Our findings are consistent with a report comparing the diet quality of older adults living in the rural Lower Mississippi Delta Region (Delta) with a national sample (12). The mean total HEI score of the Delta older adults was approximately five points lower than that of the national sample.

African Americans in our sample had higher total HEI-2005 scores than other groups. Vitolins et al found no association between ethnicity and total HEI score among a sample of 122 older African American, American Indian, and white older adults residing in rural North Carolina (14). The Delta assessment found that older African Americans scored six points lower than comparable whites on the total HEI score (12). However, African Americans in our study had lower total HEI-2005 scores compared to all older Americans in the 2001–02 NHANES report (17) which used the HEI-2005 scoring system.

Our results for the individual HEI-2005 components can be compared to the findings from the HEI-2005 assessment of Americans age 65 and older (17). Similar to our report, the 2001–02 NHANES data showed that older Americans needed to eat more whole grains and milk, and less sodium and saturated fat. The NHANES report found low scores for dark green and orange vegetables and legumes and calories from SoFAAS (17). In contrast, we found that over 41% of our sample consumed recommended amounts of dark green and orange vegetables and legumes and 56% consumed 20% or less of their energy from SoFAAS. An examination of food consumption patterns of ethnically diverse older adults in rural North Carolina found that miscellaneous vegetables (summer squash, asparagus, okra and onions) were leading sources of fiber and folate and along with vegetables, such as green beans and collard greens, were consumed at least once a week by 50% by all groups (23). Rural communities may have an advantage in availability of or preferences for a variety of vegetables and less reliance for energy on convenience foods, such as snack foods, soft drinks, cookies, cakes and candy.

We reported that African Americans and American Indians reported consuming greater amounts of total and whole fruits than whites. An HEI assessment by Vitolins et al using six 24-hour recalls (14) found that whites and American Indians had mean HEI fruit scores lower than African Americans. Although not statistically significant, these results provide support that among our larger population-based sample that once income and education are adjusted for, African Americans may be consuming more fruits than Non-Hispanic Whites, consistent with previous findings among older adults living in Georgia (24). We also found that whites reported consuming fewer whole grains compared to other groups. In the report by Vitolins et al, African Americans and whites had comparable scores for consumption of all grains, while American Indians had higher scores ((14). Ellis et al. found that among older adults living in rural and urban counties in North Georgia (76% were white) that only 10% were consuming whole grains three or four times daily (25). The HEI assessment among the Delta population found comparable amounts of fruit intake between African Americans and whites and whites, had a higher intake of grains.(12) Our results suggest that African Americans and American Indians living in some rural counties may have food acquisition strategies that differ from whites and these approaches may mediate their intake of certain foods.

This study has limitations and strengths. Diet quality was measured using a FFQ rather than a single 24-hour recall. However, the FFQ was validated among this same population using six 24 hour recalls (26); the FFQ method may better reflect intake of foods consumed infrequently or seasonally; and this approach has been used to estimate diet quality (14,27). This study was a cross-sectional investigation. Thus, causal relationships cannot be established. A major strength was its large population-based sample with diversity of ethnicity, gender, and demographic characteristics. It is the first study to consider the diet quality of rural elders as it pertains to the 2005 USDA guidance (28).

## CONCLUSIONS

Although 98% of these older adults did not meet overall recommendations for a healthy diet, certain populations met recommended guidelines for individual HEI-2005 components. Approximately half of participants did not exceed recommended amounts of solid fats and sugar. Many African Americans reported consuming sufficient whole fruits and many American Indians consumed recommended amounts of whole grain foods. However, all groups need to increase consumption of non-hydrogenated oils and dairy products and decrease intake of sodium and saturated fat.

These results show that the underlying reasons for variations in diet quality among people of different ethnicities living in the same communities need to be better understood along with how social and community resources may mediate these effects for certain groups (9,29,30).

More knowledge of the effects of these differences may provide support for tailored guidance based on dimensions other than age, ethnicity, or gender in the design of culturally relevant nutrition programs for rural elders (31).

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**Table 1**

Total Healthy Eating Index-2005 score and the estimated intake of Healthy Eating Index-2005 component foods among participants in a study to evaluate diet quality among rural older adults, by ethnicity.<sup>a</sup>

Healthy Eating Index-2005 Category (units)	African American (N=136)	American Indian (N=195)	Non-Hispanic White (N=304)	P value
	←mean ± standard error <sup>b</sup> →			
Total Score (0–100 points)	64.46 ± 0.98 <sup>y</sup>	60.05 ± 0.98 <sup>x</sup>	61.11 ± 1.21 <sup>x</sup>	0.001
Total Fruit (cup eq/1000 kcal)	0.69 ± 0.04 <sup>z</sup>	0.55 ± 0.04 <sup>y</sup>	0.42 ± 0.03 <sup>x</sup>	<0.001
Whole Fruit (cup eq/1000 kcal)	0.42 ± 0.03 <sup>z</sup>	0.36 ± 0.02 <sup>y</sup>	0.27 ± 0.02 <sup>x</sup>	<0.001
Total Vegetable (cup eq/1000 kcal)	0.89 ± 0.06	0.81 ± 0.04	0.87 ± 0.05	0.28
Dark Green and Orange Vegetables and Legumes (cup eq/1000 kcal)	0.51 ± 0.04	0.42 ± 0.03	0.47 ± 0.05	0.06
Total Grains (oz/1000 kcal)	2.55 ± 0.08	2.56 ± 0.09	2.54 ± 0.08	0.97
Whole Grains (oz/1000 kcal)	1.08 ± 0.06 <sup>y</sup>	1.10 ± 0.08 <sup>y</sup>	0.82 ± 0.06 <sup>x</sup>	<0.001
Milk (cup eq/1000 kcal)	0.41 ± 0.03 <sup>x</sup>	0.41 ± 0.04 <sup>x</sup>	0.55 ± 0.05 <sup>y</sup>	0.03
Meat and Beans (oz eq/1000 kcal)	2.56 ± 0.10 <sup>y</sup>	2.27 ± 0.10 <sup>x</sup>	2.12 ± 0.05 <sup>x</sup>	<0.001
Oils (g eq/1000 kcal)	5.48 ± 0.46 <sup>y</sup>	3.83 ± 0.37 <sup>x</sup>	6.78 ± 0.49 <sup>y</sup>	<0.001
Saturated Fat (% of kcal)	10.89 ± 0.24 <sup>xy</sup>	10.66 ± 0.21 <sup>x</sup>	11.41 ± 0.13 <sup>y</sup>	0.004
Sodium (mg/1000 kcal)	1350 ± 31.09	1285 ± 24.01	1328 ± 25.64	0.17
Calories from Solid Fat, Alcohol, and Added Sugar (% of kcal)	26.52 ± 0.85 <sup>x</sup>	30.66 ± 0.85 <sup>y</sup>	28.11 ± 0.99 <sup>x</sup>	<0.001

<sup>a</sup> Adjusted for age, gender, marital status and poverty status.

<sup>b</sup> Different letters in rows indicate differences between means (P<.05) using orthogonal contrasts to test pair-wise differences.



Percent meeting recommendations for the Total Healthy Eating Index-2005 Score and Healthy Eating Index-2005 component foods among participants in a study to evaluate diet quality of rural older adults, by ethnicity<sup>a</sup>.

Table 2

HEI Category (recommendation)	Total	African American	American Indian	Non-Hispanic Whites	P value
Total Score (≥80)	1.62	2.42	1.48	1.18	0.61
Total Fruit(≥0.8 cup eq/1000 kcal)	16.99	29.41	15.94	9.80	0.006
Whole Fruit (≥0.4 cup eq/1000 kcal)	32.45	42.06	32.67	23.94	0.07
Total Vegetable (≥1.1 cup eq/1000 kcal)	21.10	26.94	17.15	20.02	0.12
Dark Green and Orange Vegetables and Legumes (≥0.4 cup eq/1000 kcal)	41.06	52.69	28.65	43.01	<0.001
Total Grains (≥3.0 oz/1000 kcal)	27.89	29.47	24.78	29.60	0.60
Whole Grains (≥1.5 oz/1000 kcal)	16.73	18.33	23.89	10.33	0.02
Milk (≥1.3 cup eq/1000 kcal)	2.97	1.93	1.68	7.76	0.02
Meat and Beans(≥2.5 oz eq/1000 kcal)	36.22	46.37	34.94	28.29	0.005
Oils (≥12 g eq/1000 kcal)	4.27	5.30	1.35	10.38	0.002
Saturated Fat (≤7 % of kcal)	1.14	1.69	1.38	0.64	0.57
Sodium (≤700 mg/1000 kcal)	0.00	0.00	0.00	0.00	—
Calories from Solid Fat, Alcohol, and Added Sugar (≤20% of kcal)	56.12	67.53	41.72	58.39	0.003

<sup>a</sup> Adjusted for age, gender, marital status, education, and poverty status.