Assessment of the diet quality of US adults in the Lower Mississippi Delta[1–3]

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ABSTRACT

Background: The Lower Mississippi Delta (LMD) is a region at high risk of nutritionally related diseases. Assessing LMD diet quality is important in policy making, monitoring service outcomes, and designing sustainable research interventions.

Objective: The purpose was to assess the diet quality of LMD adults by using the Healthy Eating Index (HEI) to *1*) identify potential and needed interventions, *2*) determine population subgroups needing special attention, and *3*) compare regional intakes with national intakes.

Design: Data were obtained from a representative cross-sectional telephone survey (n = 1699), Foods of our Delta Study 2000, by using the US Department of Agriculture's multiple-pass 24-h recall methodology and random-digital-assisted dialing with selection of one adult per household. The diet quality of LMD adults was compared with that of white and African American adults in the National Health and Nutrition Examination Survey (NHANES), 1999–2000.

Results: Age, race, and income of LMD adults affected overall diet quality. African Americans had lower grain, vegetable, milk, and variety scores than did whites. The consumption of grains and vegetables was associated with lower odds ratios for being overweight. The LMD adults had a lower HEI score than did the adults in NHANES 1999–2000 (60.1 compared with 63.4), and more LMD adults ate a poor diet (24.8% compared with 18.3%).

Conclusion: Low-income and young-adult households in the LMD are in need of nutrition interventions with an emphasis on increasing grain, fruit, and vegetable intakes. Because socioeconomic factors affect diet quality, a multimodal, longitudinal approach appears needed to improve nutritional health. *Am J Clin Nutr* 2007;86: 697–706.

KEY WORDS Lower Mississippi Delta, dietary assessment, diet quality, Healthy Eating Index, African American

INTRODUCTION

The assessment of diet quality in a population is important in policy making, in monitoring service outcomes, and in designing research interventions (1–3). Many factors influence diet quality, including variability in the nutrient content of foods (4–6) and in the daily intake of individuals (7). The assessment of diet quality increases in complexity as the number of nutrients and other food constituents believed critical to normal nutritive health and to chronic disease prevention increases (8, 9). The introduction of 4 Dietary Reference Intake (DRI) reference values has led to shifts in their use in dietary assessment (9–14). The Recommended Dietary Allowance (RDA) is no longer valid as the target intake for a group but is recommended only for individual intakes (15–18). Despite improved methods of nutrient assessment, important gaps remain in the assessment of overall diet quality.

For recently recognized nutrients and other food constituents, available food-composition data may not be sufficient to assess intakes in free-living humans (19, 20). Translation of 90 plus nutrient intakes into a comprehensive and meaningful nutritional assessment remains a challenge (21). Because people eat foods, not nutrients, an index that addresses servings of foods and that can be used by clinicians or consumers has its advantages. One such index is the Healthy Eating Index (HEI), which is available from the US Department of Agriculture (USDA) website and allows the entry and evaluation of a day's intake (22, 23). The HEI was validated with the use of plasma biomarkers in women in a diet and breast cancer study (24). Other practical HEI applications include the evaluation of dietary practices of food shoppers' attitudes (25), assessment of diet quality in pregnant women (26), measurement of dietary changes in school-based interventions (27), monitoring of dietary quality of low-income populations (28), evaluation of longitudinal adherence per *Dietary Guidelines for Americans* by American nurses (29) and male health professionals (30), examination of diet quality in prevention of eye disease (31), evaluation of diet quality with markers of inflammation and endothelial dysfunction (32), and monitoring of changes in diet quality in national nutrition surveys (7, 33–36).

The purpose of this study was to apply the HEI to assess diet quality in a regional high-risk population not previously studied in a nationwide survey—adults in the Lower Mississippi Delta

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Received July 13, 2006.

Accepted for publication April 10, 2007.

(LMD). The objectives were to identify potential food interventions that are most needed, determine population subgroups needing specific attention, and compare dietary intakes in the LMD with dietary intakes in the nation. These objectives further the mission of the LMD Nutrition Intervention (NIRI) to improve nutrition and subsequently health in the region through nutrition research and intervention methodology research.

METHODS

The HEI was chosen as a validated tool for overall diet quality assessment. The HEI has a maximum score of 100 based on 10 components of the *Dietary Guidelines for Americans*: 5 major food groups address the food pyramid servings (meat, fruit, vegetables, grains, and dairy products), 3 components address the reduction of fat, saturated fat, and cholesterol; 1 component addresses sodium intake; and 1 component addresses a variety of foods consumed (2). Each component is scored from 0 to 10, and all component scores are summed to yield a score between 0 and 100. A score of 10 means that the dietary guideline for that component has been fully met, and a score of 0 suggests a complete lack of adherence. Details for intermediate scoring of component scores that fall between 0 and 10 were previously described (2, 3, 22).

Data were drawn from the Foods of our Delta Study 2000 (FOODS 2000), conducted in 2000, and are described elsewhere (37, 38). In brief, FOODS 2000 was a baseline cross-sectional telephone survey of dietary intake in a representative sample of the population aged >3 y in 36 counties or parishes defining the LMD region. The dietary interview method used was drawn from the USDA Continuing Survey of Food Intakes by Individuals (CSFII) 1994–1996 and 1998. FOODS 2000 (37) used the same food coding used by the CSFII (39, 40), except that the recipes used were those without sodium added. The multiple-pass recall method used was designed to reduce the underreporting of foods consumed (40). Estimating the amount of salt used in recipes requires several additional trailer items and increases the burden of the respondent in the telephone interviews. Salt added at the table was not included in the computation of sodium intake.

In addition to dietary recalls, FOODS 2000 also asked participants to self-report whether they had ever been told by a physician that they had certain disease conditions, ie, cardiovascular disease, obesity, hypertension, diabetes, or osteoporosis (41). Participants also gave self reports of height and weight for body mass index (BMI) calculations to address body weight status.

This study also used data from the National Health and Nutrition Examination Survey (NHANES), conducted from 1999 to 2002 by the Centers for Disease Control and Prevention, National Center for Health Statistics (34, 35) to compare the HEI and its components scores with that of the respective LMD NIRI population scores. The NHANES 1999–2000 has the same food coding system as that of the CSFII. In the NHANES, dietary intake information was collected through an interviewer-assisted, 24-h dietary recall method.

The HEI scores for LMD adults aged ≥18 y were calculated by the USDA Center for Nutrition Policy and Promotion, Alexandria, VA. Non-Hispanic whites and African Americans who had complete dietary intake records for day 1 of the survey were included in the comparison.

Statistical analysis

In the FOODS 2000, a household base weight equal to the inverse probability of selection was assigned to each sampled telephone number. Data were adjusted to compensate for telephone numbers with unknown residential or eligibility status, the number of residential telephones in the household, and screener nonresponse. To account for nonresponse to the dietary interview, the weight of the nonparticipants was distributed to the participants within adjustment cells defined by age, race, and sex. Finally, estimates were calibrated to the 1990 Census Bureau estimates (1990). Jacknife weights were used in FOODS 2000 analyses (37, 42).

The NHANES survey design is a stratified, multistage probability sample of the civilian, noninstitutionalized US population (34, 35). The stages of sample selection are as follows: selection of Primary Sampling Units (PSUs), which are counties or small groups of contiguous counties; segments within PSUs consisting of a block or group of blocks containing a cluster of households; households within segments; and one or more participants per household. Survey design effects including full sample weights were used in the analyses of NHANES data to represent the population studied.

The study included adults aged ≥18 y, who had provided height and weight information. The socioeconomic characteristics analyzed included sex (males, females), age groups (18–39, 40–59, and ≥60 y), race (non-Hispanic whites or whites and non-Hispanic blacks or African Americans), educational level (less than high school, high school, general education development, trade school completed, college-level education), and annual household income (<$15 000, $15 000–$29 000, and ≥$30 000). For logistic regression analyses, the adults were grouped into body-weight categories on the basis of BMI values: normal weight (BMI: 19–25) or overweight (BMI: ≥25). BMI is defined as weight (in kg)/height squared (in m).

The percentages of adults in each socioeconomic group were estimated. The mean HEI and the HEI component scores (**Table 1**) and the percentages of adults in each socioeconomic group meeting the dietary recommendations (getting the maximum score of 10 for the respective component) (**Table 2**) were estimated. Pairwise mean comparisons were made within socioeconomic groups in Tables 1 and 2 to examine the differences in eating patterns and overall diet quality within socioeconomic groups. A multiple logistic regression model having the 10 component scores and adjusting for variation among socioeconomic groups was used to examine the association between HEI components and overweight status (**Table 3**).

The percentages of adults in each socioeconomic group eating either a good diet or a poor diet were estimated (**Table 4**). Pairwise mean comparisons were made within each socioeconomic group to examine possible differences. Also, multiple logistic regression models adjusting for socioeconomic variables were used to estimate the odds ratios for eating a good diet or eating a poor diet to examine which socioeconomic groups were more likely to eat a good diet or a poor diet (Table 4).

A comparison of the dietary status of FOODS 2000 adults with the white and African American adults in the US population was made (**Table 5**). Mean HEI and its component scores, percentages of whites and African Americans meeting the dietary recommendations, and percentages of participants eating either a

TABLE 1
Mean Healthy Eating Index (HEI) and selected component scores of adults aged ≥18 y by socioeconomic group: FOODS 2000[1]

	HEI and component scores													
Socioeconomic subgroup	HEI	97% CI	Grain score	97% CI	Vegetable score	97% CI	Fruit score	97% CI	Dairy score	97% CI	Meat score	97% CI	Variety score	97% CI
All adults (n = 1699)	60.0	59.2, 60.7	5.9	5.7, 6.0	5.4	5.2, 5.6	3.0	2.8, 3.2	4.0	3.8, 4.2	7.1	7.0, 7.3	6.9	6.7, 7.1
Sex														
Males (n = 628)	59.2[a]	58.0, 60.3	6.1[a]	5.9, 6.3	5.5[a]	5.2, 5.9	2.7[a]	2.3, 3.0	4.3[a]	3.9, 4.7	7.6[a]	7.4, 7.8	7.3[a]	7.0, 7.5
Females (n = 1071)	60.7[a]	59.6, 61.7	5.7[a]	5.5, 5.9	5.3[a]	5.0, 5.5	3.3[a]	3.0, 3.6	3.8[a]	3.6, 4.0	6.7[b]	6.5, 7.0	6.6[b]	6.3, 6.9
Age														
18–39 y (n = 633)	58.6[a]	57.5, 59.7	5.8[a]	5.6, 6.1	5.3[a]	5.0, 5.7	2.4[a]	2.0, 2.7	4.0[a,b]	3.6, 4.3	7.2[a]	6.9, 7.5	6.7[a]	6.4, 7.1
40–59 y (n = 608)	58.9[a]	57.6, 60.2	5.6[a]	5.3, 6.0	5.4[a]	5.1, 5.8	2.8[a]	2.4, 3.2	3.7[a]	3.4, 4.0	7.3[a]	7.0, 7.5	6.7[a]	6.4, 7.1
≥60 y (n = 457)	64.0[b]	62.4, 65.6	6.3[a]	6.0, 6.6	5.4[a]	5.1, 5.8	4.3[b]	3.9, 4.7	4.6[b]	4.2, 5.0	6.8[a]	6.5, 7.1	7.5[b]	7.2, 7.9
Race														
Whites (n = 842)	61.0[a]	60.0, 62.1	6.1[a]	5.8, 6.3	5.9[a]	5.7, 6.2	2.7[a]	2.4, 3.0	4.7[a]	4.4, 5.0	7.1[a]	7.0, 7.3	7.2[a]	7.0, 7.5
African Americans (n = 857)	58.7[b]	57.5, 59.8	5.6[a]	5.4, 5.8	4.8[b]	4.4, 5.1	3.4[a]	3.0, 3.7	3.2[b]	2.9, 3.5	7.1[a]	6.9, 7.4	6.6[b]	6.2, 6.9
Income														
$0–$14 999 (n = 480)	58.6[a]	57.1, 60.1	5.6[a]	5.3, 5.9	4.8[a]	4.4, 5.3	3.0[a]	2.6, 3.5	3.7[a]	3.3, 4.1	6.8[a]	6.5, 7.1	6.2[a]	5.8, 6.7
$15 000–$29 999 (n = 409)	60.3[a]	58.8, 61.9	6.1[a]	5.8, 6.4	5.0[a]	4.5, 5.5	3.0[a]	2.5, 3.4	3.9[a]	3.4, 4.3	7.1[a,b]	6.8, 7.5	7.0[a,b]	6.5, 7.4
≥$30 000 ($n$ = 604)	60.9[a]	59.7, 62.0	6.0[a]	5.8, 6.3	6.0[b]	5.7, 6.3	2.9[a]	2.6, 3.2	4.3[a]	3.9, 4.7	7.4[b]	7.2, 7.7	7.4[b]	7.0, 7.7
Education														
Less than high school (n = 423)	59.3[a]	57.7, 60.9	5.8[a]	5.4, 6.1	4.8[a]	4.4, 5.2	2.8[a]	2.3, 3.3	3.8[a]	3.3, 4.2	7.2[a]	6.8, 7.5	6.7[a]	6.3, 7.1
High school, GED, trade school (n = 625)	59.2[a]	58.3, 60.1	5.8[a]	5.6, 6.0	5.4[a]	5.1, 5.7	2.8[a]	2.5, 3.1	4.0[a]	3.7, 4.3	7.0[a]	6.8, 7.3	6.7[a]	6.5, 7.0
College (n = 630)	64.5[b]	62.7, 66.3	6.4[a]	6.0, 6.8	6.4[b]	5.9, 6.8	4.1[b]	3.6, 4.7	4.7[a]	4.2, 5.2	7.5[a]	7.1, 7.8	8.1[b]	7.8, 8.5

[1] n = 1699. Only non-Hispanic whites and non-Hispanic African Americans are included in the analyses. There were 206 adults with no data on household income, 1 adult with no age data, and 21 adults with no data on education. FOODS 2000, Foods of our Delta Study 2000; GED, General Educational Development. Means in a column with different superscript letters are significantly different ($P < 0.03$) based on correction for multiple comparisons.

good diet or a poor diet were estimated. Mean comparisons were made between FOODS 2000 and NHANES 1999–2000.

Survey design effects were used in the data analyses so that the results would be representative of the population subgroups studied; therefore, all statistics reported in this paper are weighted. A priori $\alpha = 0.05$ level of significance was used to compare means reported in the study. Because multiple comparisons were made in the pairwise mean comparisons, the 97% CIs for means and percentages are reported in the tables. The SURVEY DATA ANALYSIS SYSTEM software was used for the data analyses (SAS-Callable SUDAAN release 9.0.1 for WINDOWS, Research Triangle Institute, Research Triangle Park, NC).

RESULTS

Sex

No differences were noted between males and females in overall diet quality measured as HEI (Table 1). Males had a greater variety in their diets and had better meat scores than did females. Although females tended to eat more fruit than did males (Table 1) and more females than males met fruit recommendations (Table 2), fruit intakes of both sexes were very low (3.3 and 2.7, respectively). Females also ate a diet lower in cholesterol and, hence, had a higher cholesterol score than did males (8.1 ± 0.12 compared with 6.3 ± 0.19). The total fat, saturated fat, and sodium scores not shown in Tables 1-4 did not differ by sex.

Age

Adult aged ≥60 y ate a better-quality diet than did the younger adults (Table 1). They also ate more fruit, ate more dairy products, and ate a greater variety of foods than did the other age groups. A higher percentage of older adults met the dietary recommendations for fruit and dairy products (Table 2).

Race

African American adults had significantly lower HEI, vegetable, dairy, and variety scores than did white adults in the LMD (Table 1). No significant differences were noted in grain, fruit, cholesterol, total fat, meat, and saturated fat scores between races. Also, a higher percentage of white Americans met the recommendations for vegetable and dairy groups than did African Americans (Table 2). No significant differences were noted between races in the percentages of adults meeting grain, fruit, meat, and dietary variety recommendations.

Household income

Higher household income was associated with eating a diet high in variety (Table 1). Households with incomes of $30 000 had a significantly higher mean variety score than did those with an income <$15 000. Also, the high-income households had a higher vegetable score than did the medium- and low-income households. Overall HEI scores and all other components were not significantly different by household income. Except for the vegetable recommendations in the highest income group, the percentages of those scoring 10 points did not differ significantly by income grouping, as shown in Table 2.

Education

LMD adults with a college education had a significantly higher HEI, vegetable, fruit, and variety score than did those with less education (Table 1). The other components scores did not differ

TABLE 2
Percentages of adults aged ≥18 y meeting food group and food variety recommendations by socioeconomic groups; FOODS 2000[1]

Socioeconomic subgroup	Adults meeting food group recommendations											
	Grain	97% CI	Vegetable	97% CI	Fruit	97% CI	Dairy	97% CI	Meat	97% CI	Variety	97% CI
	%											
Sex												
Men	17.5[a]	14.2, 20.9	26.2[a]	22.2, 30.1	8.8[a]	6.4, 11.2	19.6[a]	16.1, 23.1	40.9[a]	36.9, 44.9	45.7[a]	41.4, 50.0
Women	13.4[a]	10.9, 15.9	20.7[a]	17.7, 23.8	13.6[b]	11.6, 16.2	12.8[b]	10.4, 14.7	29.9[b]	26.3, 33.4	38.5[a]	34.8, 42.3
Age												
18–39 y	16.2[a]	12.7, 19.8	23.9[a]	20.3, 27.5	6.7[a]	4.0, 9.3	14.8[a,b]	11.6, 17.9	35.6[a]	31.5, 39.8	39.9[a]	35.3, 44.6
40–59 y	14.6[a]	11.4, 17.9	23.3[a]	19.1, 27.4	10.3[a]	7.4, 13.2	14.1[a]	11.4, 16.8	36.9[a]	32.2, 41.5	39.5[a]	34.5, 44.6
≥60 y	14.8[a]	11.0, 18.6	22.1[a]	18.0, 26.3	21.1[b]	16.3, 25.8	20.9[b]	16.9, 24.8	30.8[a]	25.2, 36.4	48.9[a]	42.9, 54.8
Race												
African Americans	14.0[a]	11.4, 16.7	18.8[b]	15.3, 22.3	12.7[a]	10.2, 15.2	9.2[b]	6.8, 11.6	35.0[a]	31.4, 38.5	38.4[a]	33.9, 42.9
White	16.4[a]	13.6, 19.1	26.9[a]	23.6, 30.3	10.3[a]	8.0, 12.5	21.5[a]	17.9, 25.1	35.0[a]	31.3, 38.6	44.7[a]	41.0, 48.4
Income												
$0–$14 999	14.7[a]	10.3, 19.0	17.6[a]	13.4, 21.8	12.2[a]	8.8, 15.6	12.8[a]	8.8, 16.8	32.7[a]	27.5, 37.9	34.0[a]	28.5, 39.4
$15 000–$29 999	16.4[a]	12.0, 20.9	17.9[a]	12.6, 23.3	11.6[a]	7.8, 15.5	13.9[a]	8.8, 19.0	31.8[a]	25.8, 37.8	38.2[a,b]	31.1, 45.3
≥$30 000	16.7[a]	13.7, 19.7	29.2[b]	24.3, 34.1	10.7[a]	8.0, 13.5	18.6[a]	15.1, 22.1	38.1[a]	34.0, 42.3	48.1[b]	43.2, 53.0
Education												
Less than high school	13.8[a]	9.4, 18.1	18.7[a]	13.7, 23.8	9.7[a]	6.2, 13.1	16.4[a]	11.6, 21.2	34.9[a]	29.6, 40.1	34.3[a]	28.4, 40.1
High school, GED, trade school	15.2[a]	12.9, 17.6	23.6[a]	20.0, 27.3	10.9[a]	8.4, 13.4	15.5[a]	12.5, 18.5	33.9[a]	29.9, 37.9	40.1[a]	36.7, 43.5
College	19.5[a]	13.6, 25.3	29.4[a]	23.0, 35.8	16.5[a]	11.6, 21.3	18.6[a]	12.5, 24.7	38.9[a]	32.9, 44.9	61.3[b]	54.2, 68.3

[1] $n = 1699$; specific n values for each socioeconomic subgroup are given in Table 1. Only non-Hispanic whites and non-Hispanic African Americans were included in the analyses. There were 206 adults with no data on household income, 1 adult with no age data, and 21 adults with no data on education. FOODS 2000, Foods of our Delta Study 2000; GED, General Education Development. Means in a column with different superscript letters are significantly different ($P < 0.03$) after adjustment for multiple comparisons.

significantly between educational groups. Only the percentage of participants scoring a perfect 10 for dietary variety appeared to differ by education level, as shown in Table 2.

TABLE 3
Multiple logistic regression analyses of the overweight status of adults aged ≥18 y, by Healthy Eating Index (HEI) component scores, adjusted for socioeconomic and demographic characteristics: FOODS 2000[1]

HEI component	Dependent variable = being overweight		
	Odds ratio	95% CI	*P*
Grain score	0.93	0.88, 0.98	0.01
Vegetable score	0.92	0.88, 0.97	0.002
Fruit score	1.02	0.98, 1.06	NS
Milk score	1.00	0.97, 1.04	NS
Meat score	1.07	1.03, 1.13	0.006
Total fat score	0.96	0.92, 1.01	NS
Saturated fat score	1.06	1.01, 1.11	0.01
Cholesterol score	1.05	1.01, 1.09	0.02
Sodium score	0.97	0.92, 1.01	NS
Variety score	1.03	0.99, 1.08	NS

[1] $n = 1672$; 27 adults did not have BMI values. The model was adjusted for sex, age, race, education, income, and region. HEI component scores for odds ratios with 95% CIs that do not include 1.00 had a significant effect on overweight status at an $\alpha = 0.05$ level of significance. Being overweight was the dependent variable and was defined as having a BMI of ≥25. FOODS 2000, Foods of our Delta Study 2000.

Self-reported health and disease

Adults who reported poor health conditions had lower vegetable and dietary variety scores than did those who reported being in good to excellent health, but neither overall HEI nor any other component showed any other relation to self-reported health (data not shown in tables). Adults who had been told that they had a disease by a doctor had a higher HEI and fruit scores than did those with who reported no disease and were more likely to have a good diet and meet the recommended number of servings of vegetables (data not shown).

HEI and overweight status

BMI computed on the basis of self-reported height and weight showed that there were 31.7% normal-weight (BMI < 25), 33.8% overweight (BMI >25 to <30), 30.1% obese (BMI >30 to <40), and 4.4% extremely obese (BMI > 40) adults the in LMD. The results of the logistic regression analyses of overweight status by HEI component scores, adjusted for socioeconomic and demographic groups, are shown in Table 3. Eating more grains and vegetables was associated with a lower likelihood of being overweight, and eating more meat and foods high in saturated fat and cholesterol was associated with a higher likelihood of being overweight. No significant associations were noted between fruit, dairy, dietary variety, total fat, and sodium scores and overweight status.

TABLE 4
Socioeconomic and demographic characteristics of adults aged ≥18 y eating a good diet or a poor diet and multiple logistic regression analysis of eating a good diet or a poor diet adjusted for socioeconomic and demographic characteristics: FOODS 2000[1]

	Adults eating a good diet[2]		Dependent variable = eating a good diet[2]			Adults eating a poor diet[3]		Dependent variable = eating a poor diet[3]		
Socioeconomic variable and subgroup	Weighted percentage	97% CI	Odds ratio	97% CI	*P*	Weighted percentage	97% CI	Odds ratio	97% CI	*P*
	%					%				
Sex										
Men	4.9[a]	3.0, 6.8	0.69	0.38, 1.24	0.66	25.4[a]	21.0, 29.9	1.01	0.72, 1.41	0.95
Women	8.1[a]	5.9, 10.3	1.00			24.3[a]	20.8, 27.7	1.00		
Age										
18–39 y	2.2[c]	0.78, 3.7	1.00			24.9[a,b]	20.5, 29.3	1.00		
40–59 y	6.3[b]	4.1, 8.5	2.08	0.93, 4.64	0.046	29.2[b]	24.8, 33.6	1.46	1.06, 2.01	0.011
≥60 y	14.3[a]	9.9, 18.8	8.56	3.67, 19.9	< 0.0001	17.7[a]	12.9, 22.4	0.62	0.41, 0.93	0.012
Race										
African Americans	5.4[a]	3.6, 7.2	1.07	0.54, 2.1	0.83	28.0[a]	23.1, 32.9	1.16	0.79, 1.69	0.39
White	7.6[a]	5.4, 9.8	1.00			22.2[a]	19.0, 25.3	1.00		
Income										
$0–$14 999	4.9[a]	2.6, 7.3	0.56	0.27, 1.18	0.09	28.1[a]	22.2, 33.9	1.25	0.82, 1.90	0.24
$15 000–$29 000	5.9[a]	2.6, 9.3	0.69	0.32, 1.48	0.29	23.6[a]	17.5, 29.7	1.06	0.72, 1.55	0.74
≥$30 000	8.0[a]	4.9, 11.1	1.00			21.6[a]	18.0, 25.2	1.00		
Education										
Less than high school	4.6[a]	2.3, 6.9	0.26	0.11, 0.58	0.0004	28.0[a]	22.0, 34.1	2.16	1.17, 4.01	0.0073
High school, GED, trade school	6.0[a,b]	4.2, 7.9	0.47	0.28, 0.79	0.0018	25.7[a]	22.4, 29.1	1.87	1.06, 3.30	0.0168
College	12.9[b]	7.6, 18.1	1.00			15.3[b]	9.2, 21.4	1.00		
Region										
Louisiana	7.4[a]	4.4, 10.3	0.67	0.33, 1.35	0.21	23.4[a]	16.7, 30.1	1.07	0.67, 1.69	0.76
Mississippi	5.2[a]	3.7, 6.8	0.61	0.38, 0.96	0.0183	26.6[a]	22.6, 30.5	1.19	0.84, 1.70	0.27
Arkansas	8.0[a]	5.4, 10.5	1.00			23.7[a]	19.0, 28.4	1.00		

[1] $n = 1699$. Only non-Hispanic whites and non-Hispanic African Americans were included in the analysis. In the multiple logistic regression analyses, women aged 18–39 y, whites, adults living in households with an income ≥$30 000, adults with a college education, and adults living in Arkansas were the reference categories. FOODS 2000, Foods of our Delta Study 2000; GED, General Educational Development. Means in a column with different superscript letters are significantly different ($P < 0.03$) adjusted for multiple comparisons.
[2] A good diet is defined as having a Healthy Eating Index (HEI) score of ≥80.
[3] A poor diet is defined as having an HEI score of <51.

Food Guide Pyramid recommendations

The percentages of LMD adults, in different socioeconomic groups, whose diets were rated as good (HEI score >80) or poor (HEI score <51) and the odds ratios for eating a good or poor diet are shown in Table 4. The analyses showed that sex did not affect the percentages of males and females who ate a good or a poor diet or the likelihood of eating a good or a poor diet. Adults aged ≥60 y were 8 times as likely to eat a good diet and 38% were less likely to eat a poor diet compared with young adults between the ages of 18 and 39 y. Adults having less than a college level education, as compared with adults having a college education, were only half as likely to eat a good diet but were twice as likely to eat a poor diet Compared with adults living in Arkansas, adults living in Mississippi were 39% less likely to eat a good diet. Nevertheless, about a fourth of those living in the 3 regions (Louisiana, Mississippi, and Arkansas) ate a poor-quality diet, especially adults aged <60 y.

Comparison of FOODS 2000 and NHANES 1999–2000

A comparison of the diet quality of non-Hispanic whites and African American adults aged ≥18 y in the FOODS 2000 survey, conducted in the 36 counties designated as the LMD, and the NHANES 1999–2000 national survey is shown in Table 5. The total adult population and the white adult population in the LMD had significantly lower mean HEI and dietary component scores for vegetable, fruit, dairy products, and variety than did their NHANES counterparts. In contrast, the African American adult population in the LMD had no significant differences in mean HEI and dietary component scores from their NHANES counterparts, except for their poorer total fat scores. A lower percentage of the LMD adults met grain recommendations overall, but this difference was not sustained in race comparisons. Mean sodium scores in the FOODS 2000 survey were significantly higher than those in their NHANES counterparts, but this finding may have been an artifact of the different methods related to salt used in recipes in the 2 surveys.

The most striking difference in diet quality between all LMD adults and their national counterparts was in not meeting the grain, dairy, or dietary variety recommendations. The percentage of LMD adults who had HEI scores >51 but <80, which suggested that their diets "need improvement" (68.6%; 97% CI: 65.7, 71.4%), was not significantly different from their NHANES counterparts (71.5%; 97% CI: 69.2, 73.9%). A significantly higher percentage of the total LMD adult population than of the NHANES adults had diets rated as poor (24.8% compared with 18.3%). The percentage of LMD adults rated as having a

TABLE 5
Pairwise comparison of mean Healthy Eating Index (HEI) scores, mean HEI component scores, and percentage of adults meeting food recommendations for a good diet or a poor diet between adult participants aged ≥18 y in the Lower Mississippi Delta (LMD) FOODS 2000 survey and in the NHANES 1999–2000 survey[1]

	All adults		Whites		African Americans	
Data source and HEI and its components	Mean	97% CI[2]	Mean	97% CI[2]	Mean	97% CI[2]
Mean HEI and mean HEI component scores						
HEI						
LMD	60.0	59.2, 60.7	61.0	60.0, 62.1	58.7	57.5, 59.8
NHANES	63.1[3]	61.9, 64.4	63.7[4]	62.2, 65.2	59.8	58.7, 60.8
Grain						
LMD	5.9	5.7, 6.0	6.1	5.8, 6.3	5.6	5.4, 5.8
NHANES	6.4[3]	6.2, 6.6	6.5[4]	6.3, 6.7	5.7	5.4, 6.0
Vegetables						
LMD	5.4	5.2, 5.6	5.9	5.7, 6.2	4.8	4.4, 5.1
NHANES	6.4[3]	6.1, 6.6	6.5[5]	6.3, 6.8	5.2	4.9, 5.6
Fruit						
LMD	3.0	2.8, 3.2	2.7	2.4, 3.0	3.4	3.0, 3.7
NHANES	3.6[4]	3.2, 4.0	3.6[3]	3.2, 4.1	3.6	3.3, 3.9
Dairy products						
LMD	4.0	3.8, 4.2	4.7	4.4, 5.0	3.2	2.9, 3.5
NHANES	5.7[3]	5.5, 6.0	6.0[3]	5.8, 6.3	3.7	3.3, 4.0
Meat						
LMD	7.1	7.0, 7.3	7.1	7.0, 7.3	7.1	6.9, 7.4
NHANES	6.9[4]	6.7, 7.0	6.8[4]	6.6, 7.0	7.2	7.0, 7.5
Total fat						
LMD	6.0	5.8, 6.2	6.0	5.7, 6.2	6.1	5.8, 6.4
NHANES	6.7[3]	6.4, 6.9	6.6[3]	6.3, 6.9	7.1[5]	6.6, 7.5
Saturated fat						
LMD	6.5	6.2, 6.7	6.3	5.9, 6.6	6.7	6.4, 7.0
NHANES	6.5	6.2, 6.7	6.4	6.1, 6.6	7.2	6.8, 7.6
Cholesterol						
LMD	7.2	7.0, 7.5	7.4	7.1, 7.6	7.1	6.8, 7.4
NHANES	7.5	7.3, 7.7	7.6	7.3, 7.8	7.1	6.7, 7.4
Sodium						
LMD	7.9	7.7, 8.0	7.7	7.4, 7.9	8.1	7.9, 8.4
NHANES	5.7[3]	5.5, 5.9	5.6[3]	5.4, 5.9	6.4[3]	6.0, 6.7
Variety						
LMD	6.9	6.7, 7.1	7.2	7.0, 7.5	6.6	6.2, 6.9
NHANES	7.8[5]	7.6, 8.1	8.0[3]	7.7, 8.3	6.7	6.4, 6.9
Adults meeting Food Guide Pyramid recommendations (%)						
Grain						
LMD	15.3	13.5, 17.1	16.4	13.6, 19.1	14.0	11.0, 17.0
NHANES	20.1[5]	17.5, 22.6	20.7	17.8, 23.7	15.6	11.9, 19.3
Vegetables						
LMD	23.2	20.7, 25.8	26.9	23.6, 30.3	18.8	15.3, 22.3
NHANES	30.9[3]	28.2, 33.5	32.4[4]	29.5, 35.4	20.7	17.0, 24.4
Fruit						
LMD	11.4	9.7, 13.0	10.3	8.0, 12.5	12.7	10.2, 15.2
NHANES	15.6[4]	12.8, 18.4	15.4[4]	12.2, 18.5	16.9	14.0, 19.8
Dairy products						
LMD	15.9	14.0, 17.9	21.5	17.9, 25.1	9.2	6.8, 11.6
NHANES	28.7[3]	25.8, 31.6	31.1[3]	27.8, 34.4	13.2	10.2, 16.2
Meat						
LMD	35.0	32.4, 37.5	35.0	31.3, 38.6	35.0	31.4, 38.5
NHANES	33.1	30.7, 35.5	32.3	29.7, 34.9	38.2	34.4, 42.1
Total fat						
LMD	29.3	26.7, 31.8	30.7	27.2, 34.1	27.6	23.4–31.8
NHANES	35.6[5]	32.8, 38.5	34.8	31.9, 37.8	41.0[3]	35.3, 46.7
Saturated fat						
LMD	37.9	35.0, 40.8	37.8	34.0, 41.5	38.1	33.5, 42.7
NHANES	41.1	38.2, 43.9	39.6	36.6, 42.6	50.5[3]	45.2, 55.9
Cholesterol						
LMD	63.7	61.2, 66.3	64.1	60.7, 67.6	63.2	59.6, 66.8
NHANES	66.6	64.3, 68.8	67.2	64.7, 69.7	62.3	58.4, 66.3
Sodium						
LMD	55.0	52.2, 57.7	50.6	47.2, 54.0	60.2	56.1, 64.2
NHANES	29.7[3]	27.4, 32.1	28.6[3]	26.1, 31.1	37.1[3]	32.9, 41.3

(*Continued*)

TABLE 5 (*Continued*)

Data source and HEI and its components	All adults		Whites		African Americans	
	Mean	97% CI[2]	Mean	97% CI[2]	Mean	97% CI[2]
Variety						
LMD	41.9	38.9, 44.9	44.7	41.0, 48.4	38.4	33.9, 42.9
NHANES	56.2[3]	51.7, 60.6	58.8[3]	53.7, 63.8	39.0	35.4, 42.7
Adults eating a good diet, a diet in need of improvement, or a poor diet (%)[6]						
Eating a good diet						
LMD	6.6	5.1, 8.2	7.6	5.4, 9.8	5.4	3.7, 7.2
NHANES	10.1	7.7, 12.6	11.0	8.2, 13.9	4.2	2.4, 6.0
Eating a diet in need of improvement						
LMD	68.6	65.7, 71.4	70.2	67.0, 73.5	66.6	61.5, 71.6
NHANES	71.5	69.2, 73.9	71.8	68.9, 74.8	69.7	65.3, 74.1
Eating a poor diet						
LMD	24.8	22.1, 27.6	22.2	19.0, 25.3	28.0	23.1, 32.9
NHANES	18.3[5]	15.6, 21.0	17.1[4]	13.9, 20.4	26.1	22.3, 29.8

[1] Only non-Hispanic whites and non-Hispanic African Americans in the Foods of our Delta Study 2000 (FOODS 2000) and the National Health and Nutrition Examination Survey (NHANES) 1999–2000 were included in the analyses. The 2 surveys were treated as independent samples. Pairwise mean comparisons were made within groups (all adults, whites, and African Americans) in the 2 surveys. All adults in the LMD were compared with whites in NHANES 1999–2000 and African American adults, LMD whites with whites in NHANES 1999–2000, and LMD African Americans with African Americans in NHANES 1999–2000.

[2] No differences existed if the 97% CIs of 2 means overlapped in the pairwise mean comparisons.

[3–5] Significantly different from LMD (unadjusted): [3]$P < 0.0001$, [4]$P < 0.01$, [5]$P < 0.001$.

[6] A good diet is defined as having an HEI score ≥80. A poor diet is defined as having an HEI score <51. The percentage of participants eating a diet in need of improvement was computed by subtracting the percentage of those having a good diet and the percentage of those having a poor diet from 100.

good diet did not differ significantly from that of the NHANES adults (6.6% compared with 10.1%, respectively). The differences in scores and percentages were significant between the total LMD population and their NHANES counterparts and between the white LMD population and their NHANES counterparts. No differences were found between the African American LMD population and their NHANES counterparts. Nevertheless, the overall diet quality of the LMD African Americans was still lower than that of the LMD whites.

Another indicator to assess whether a dietary recommendation has been met is a value of 10 on a component score, ie, the food pyramid recommended number of servings was met. In national data, the dietary component score most frequently scored as a 10 was the cholesterol score, which was met by 66.6% of the overall population followed by the variety score that was met by 56.2% (Table 5). LMD adults also most frequently met the cholesterol score followed by the sodium score (Table 5). Only 41.9% of the LMD adults met the variety recommendation, only 35.0% met the meat recommendation, <25% met the vegetable recommendation, and <16% met the fruit, dairy, and grain recommendations. No racial differences existed in perfect grain, fruit, meat, sodium, or cholesterol scores. Approximately 1 in 5 LMD whites met the dairy recommendations compared with less than 1 in 10 of African American LMD adults (Table 5). Significant differences exist between the percentage of white and African American LMD adults meeting the recommended number of servings of vegetables (26.9% and 18.8%, respectively).

DISCUSSION

A dietary quality assessment based on HEI scores indicated a lower overall diet quality in the LMD, particularly concerning grains, vegetables, fruit, dairy products, meats, and dietary variety. Furthermore, the mean HEI scores for all demographic groups within the LMD fell well below the desired score of ≥80. With only half the percentage of LMD respondents rated as having a good diet and nearly twice as many being rated as having a poor diet compared with NHANES respondents, the lower overall diet quality in the LMD was evident. Scores for African Americans in the LMD were not significantly lower than those for the NHANES counterparts, but their HEI scores were still lower than those for whites in the LMD. Thus, the differences in the total population in the LMD from national surveys were due largely to the lower scores of the LMD whites. It is notable that African Americans had a higher fruit component score, but a substantial part of the difference was attributed to a higher consumption of citrus drinks (36% compared with 30% of food pyramid fruit servings).

Whereas older adults, persons in higher-income households, and adults with a college education are more likely to eat a nutritious diet, older rural adults are likely to have a lower income and less education and are more likely to be the primary caregivers of their grandchildren than are their urban counterparts (43–47). These data suggest that, although unhealthy diets are not limited to one race, sex, age group, or educational level, demographic factors such as age, income, and educational level do influence the overall diet quality. An urgent need exists to promote nutritional health.

Low-income adults and adults with less than a college education were only half as likely to have a good diet than were adults with a higher income and adults who had completed high school. Household income influences the ability to purchase a variety of foods. Adults who had less than a high school education or who had received federal nutrition assistance were more likely to be living in low-income households. This may explain why these adults had lower fruit, vegetable, and variety scores and a low overall diet quality. Similar patterns were observed in national data (34, 35).

In support of our findings, a low income and a low educational level were associated with poor dietary practices in a study using South Carolina's 1994 Behavioral Risk Factor Surveillance System data (47). Others have noted that rural elderly are more likely to be poor than are their metropolitan counterparts (43–46). In rural areas, individuals aged >65 y account for 25% of the population but represent 40% of the nation's poor (44). Economic status is partly due to a lack of education and to fewer economic opportunities over a lifetime (46).

Despite receiving food assistance, adults in the lowest income level consistently had lower HEI scores. Lower income could be one reason for this finding because food assistance programs are intended to help a family acquire a healthy diet and not to provide a complete diet. A lack of nutrition knowledge and, hence, an inability to identify nutritious foods may be another reason for the lower intakes of fruit and vegetables. Limited availability of fruit and vegetables and a lack of accessibility to supermarkets may also be contributing factors (48–51). Other researchers have documented that the poor pay more for food because of a lack of large-chain supermarkets in their communities (52, 53). These findings underscore a need for nutrition interventions that help promote fruit, vegetable, and low-fat dairy consumption among these vulnerable populations. Low-income individuals in the NHANES and the LMD had lower intakes of fruit and vegetables and drank more whole milk that reduced or low-fat milk. The availability of skim and nonfat milk in rural areas can be problematic (54, 55). Nutrition interventions should include strategies that assist low-income adults in choosing nutritious foods while grocery shopping and promote environmental and public policies to improve availability and accessibility.

About half of the adults were told by their physicians that they had one or more health conditions, such as diabetes, high cholesterol, hypertension, osteoporosis, stroke, or heart disease, which indicated that a high proportion of the adult population needed immediate health and nutrition interventions (40, 56). Not surprisingly, these adults had relatively good diets, indicative of self-interest to improve their diet quality. The adverse effects of food insecurity on health have been well documented among adults in the LMD (56) and, subsequently, in the FOODS 2000 Survey (57–59). This population is defined as high risk, with 1 in 5 being food insecure and more than 1 in 4 having a household incomes <$15 000/y. These economic and demographic factors can easily lead to poorer food intake and lower HEI scores, and in turn, lead to poorer health.

Limitations

This study involved only one 24-h dietary recall rather than traditional 3-d dietary recalls. Basiotis et al (7) reported that HEI scores calculated from a 1-d dietary recall were lower than those calculated from a 3-d dietary recall, but not significantly so. The 1999–2000 NHANES used only 1 d of dietary intakes (36).

The FOODS 2000 trailer questions did not solicit specific information on the inclusion of salt in cooking. This decision was made to reduce respondent burden. The difficulty of collecting valid and reliable sodium intake data in a free living population has been recognized (60) and is perhaps the major obstacle in telephone surveys. Salt added at the table has never been used in the calculation of the HEI scores in national surveys.

Although baseline estimates of dietary intake are established from the FOODS 2000, the survey cannot provide trend analysis. The nationwide surveys from 1989 to 2000 suggest that Americans' eating patterns improved slightly from 1989 to 1996 but did not change from 1996 to 1999–2000 (2, 3, 36). Whether this same pattern has occurred in the LMD cannot be determined from these data.

The mode of survey administration differed. FOODS 2000 data were collected through a telephone survey, and the NHANES 1999–2000 were collected through in-person interviews. Some of the differences or lack of differences between the analyses shown in Table 5 could be attributed to these differences in administration. Although the HEI is currently under revision to more closely reflect the 2005 *Dietary Guidelines for Americans*, this study used the HEI criteria applicable to the 2000 *Dietary Guidelines for Americans* in existence at the time these data were collected.

Conclusion

A need for nutrition intervention is indicated among the low-income and younger households in the LMD. Food recommendations that need greater emphasis in nutrition interventions and among some subgroups include increased intakes of vegetables, fruit, and dairy products and a greater dietary variety; increased intakes of whole grains, vegetables, fruit, and dairy products are specifically recommended for African Americans and younger adults. Reductions in intakes of meat, saturated fat, and cholesterol are especially needed in the LMD, compared with national intakes, and in the overweight subpopulation of the LMD. Many factors appear to contribute to the poor diets in the LMD, including income, education, culture, and food availability and accessibility. A multimodal, longitudinal approach is likely needed to address the many challenges to healthy food choices. With half of the adults in this region reporting diet-related health conditions, interventions should target low-income and other vulnerable groups to improve diet quality and, thereby, promote better health.

Special appreciation is given to Kristy L Wallace and to Jeff Gossett for their technical assistance with manuscript preparation.

The authors' responsibilities were as follows—all of the authors participated in the design of the study, interpretation of the data, and writing of the manuscript. None of the authors had a personal or financial conflict of interest.

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