

## Original Research

# Higher Healthy Eating Index-2005 Scores Associated with Reduced Symptoms of Depression in an Urban Population: Findings from the Healthy Aging in Neighborhoods of Diversity Across the Life Span (HANDLS) Study

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**ABSTRACT**

**Background** Depression affects more than 15 million Americans in a given year. Compared to physical health, less is known about the affect of diet quality on symptoms of depression.

**Objective** This study investigated the relationship between diet quality and reported symptoms of depression in a low-income urban population.

**Subjects/setting** Subjects included 1,118 African-American and white adults, aged 30 to 64 years, living in Baltimore, MD, and represented a subsample of the initial examination and recruitment phase of the Healthy Aging in Neighborhoods of Diversity across the Life Span study.

**Methods** Nutrition data were based on two 24-hour dietary recalls collected by trained interviewers using the US Department of Agriculture Automated Multiple Pass Method. Diet quality was calculated using the US Department of Agriculture Healthy Eating Index (HEI)-2005. Depressive symptoms were assessed by a trained

interviewer using the Center for Epidemiologic Studies Depression scale.

**Statistical analysis** Both linear and logistic regression analyses were used to examine whether or not diet quality was associated with depressive symptoms. The dependent variable was depressive symptoms and independent variables included HEI-2005, race, sex, age, education, income, and food-assistance program participation.

**Results** Mean HEI-2005 score was  $52.17 \pm 0.40$  (out of 100). Mean Center for Epidemiologic Studies Depression scale score was  $11.64 \pm 0.25$  (out of 40). Diet quality was significantly associated with reported symptoms of depression. However, income was a significantly stronger predictor of depression compared to diet quality, education, and sex.

**Conclusions** Registered dietitians should be aware of relationships between psychological status and nutritional health when assisting clients to better manage their food choices to improve their overall health and quality of life. *J Am Diet Assoc.* 2010;110:383-389.

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Major depression is the leading cause of disability in the United States, affecting 5% to 8% of the American adult population (1). The prevalence of depression is related to many factors, including but not limited to race, sex, age, and chronic illness. African Americans are over-represented in populations that are at risk for mental illness (2). They are less likely than whites to have a major depressive disorder, but when they do it is often more chronic and severe (2,3). Major depression is twice as frequent in women as men (2,4), and depression is a common disorder in later life (5). Chronic illnesses common in later life, such as Alzheimer's disease, heart disease, and cancer, among others, can actually trigger symptoms of clinical depression, and these illnesses sometimes cause symptoms of depression to be overlooked and left untreated (4).

Research regarding the possible influence of dietary patterns on symptoms of psychiatric diseases is limited (6). The National Alliance on Mental Illness states that "attention to diet" can result in better mental health (2). Specific dietary recommendations in relation to symptoms of psychiatric diseases have yet to be established and the direction of the relationship between dietary

choices and depression is unclear. It is not known whether dietary practices actually lead to depression or if depression causes poor dietary choices, which then may possibly worsen the condition.

Much of the current nutrition research examining diet and psychiatric health focuses on single nutrients or foods in relation to disease. Some findings indicate that individual nutrients or foods such as n-3 fatty acids, B vitamins, or vegetables may play a role in depression (6-11). However, due to the complexity of dietary intake as well as the possible interactions of different nutrients, it is often difficult to attribute the effects of a single dietary component to psychological well-being.

Examining dietary patterns rather than individual nutrients may be more appropriate for analyses in nutritional epidemiology (12,13). The term *dietary pattern* as used here reflects total diet rather than single nutrient components. A healthful diet defined by the World Health Organization's Healthy Diet Indicator score (14) was shown to be associated with a reduced prevalence of impaired cognitive function in men (15). Others have also found that healthful dietary patterns rather than intake of isolated nutrients or foods may be responsible for good overall cognitive function and fewer depressive symptoms (13,16,17).

Measuring diet quality, usually defined as how well dietary intakes adhere to current recommendation, can be problematic (18). Although there is no single, universally accepted index of diet quality, an investigator can define diet quality by selecting nutritional elements considered most important in relation to health promotion and disease prevention (19,20). These elements are then combined into a diet quality index. Examples of such indexes are the Healthy Eating Index-2005 (HEI-2005) (21,22), assessing conformance to the 2005 Dietary Guidelines for Americans (18), and the Healthy Diet Indicator based on World Health Organization guidelines (14).

Considering that dietary patterns directly affect physical health, it is reasonable to expect that dietary patterns may affect symptoms of depression as well. Analyzing the diet quality of minority and low socioeconomic status (SES) populations in relation to reported depressive symptoms is especially important considering that these populations are at a higher risk of both low diet quality (23) and depression (24). The purpose of this study was to investigate the diet quality of low-income urban African-American and white adults in relationship to reported symptoms of depression. To our knowledge, this is the first study to explore the relationship between depressive symptoms and diet quality measured by the HEI-2005 in a relatively large sample of understudied individuals.

## METHODS

### Background of Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) Study

The HANDLS study was designed to examine the independent influences of race and SES on health outcomes, specifically cognitive performance, psychiatric risk factors, and cardiovascular and cerebrovascular diseases. HANDLS is a prospective longitudinal, multidisciplinary study, assessing not only physical parameters, but also

genetic, biologic, demographic, psychosocial, and psychophysiological parameters (25,26). Subjects were recruited as a fixed cohort of participants by household screenings from an area probability sample of 12 census segments in the city of Baltimore, MD. These tracts were selected because they are likely to yield representative distributions of African Americans and whites, men and women, and individuals with SES <125% federal poverty level and  $\geq$ 125% federal poverty level. To be included in the HANDLS study, participants must be between ages 30 and 64 years at baseline; be able to give informed consent; be able to perform at least five of the following evaluations: medical history, physical performance, cognitive testing, dietary recall, audio questionnaire, body composition, carotid doppler, or pulse wave velocity assessment; have valid picture identification; and have a verifiable address at time of entry. Exclusions include being pregnant at time of entry, having a diagnosis of acquired immune deficiency syndrome, and being within 6 months of active treatment of cancer (chemotherapy, biologic, or radiation).

### Sample

The data used in our study were generated from a subsample of the initial examination and recruitment phase collected from August 2004 to January 2008. During this time period, 28,404 households were visited and 6,469 individuals were found eligible to participate from 5,066 households. From the eligible pool, 3,042 were enrolled in the HANDLS study. Of these individuals, 2,154 (70.8%) completed the second phase of the baseline examinations. Only those individuals who completed two dietary recalls were used in this study. The study protocol was approved by the human subjects review boards at both Medstar Research Institute and the University of Delaware, and all participants provided written informed consent.

### Assessment of Depression

Symptoms of depression were assessed by a trained interviewer during the second phase of baseline examination, which occurred on the mobile research vehicles (26). The Center for Epidemiologic Studies Depression (CES-D) scale was used to identify individuals at risk for depression (27). This assessment took place during the mobile research vehicle examination phase (26). The CES-D scale consists of 20 descriptive statements referring to the frequency of depressive symptoms during the previous week (Table 1). Total scores range from 0 to 60, with higher scores denoting responses in the depressed range. A score of  $\geq$ 16 commonly indicates risk of depression (28,29). Although the CES-D scale does not provide a clinical diagnosis of major depression, it is considered a reliable and valid measurement tool, indicating the presence of depressive symptoms in an adult population (30).

### Dietary Recall Method

The nutrition data were based on the average of two 24-hour dietary recalls, recorded by a trained interviewer using the Automated Multiple Pass Method (AMPM), a method developed by the US Department of Agriculture (USDA) (31,32). The first recall was conducted during the

**Table 1.** Center for Epidemiologic Studies Depression (CES-D) scale statements<sup>a</sup> and mean scores<sup>b</sup> by statement for Healthy Aging in Neighborhoods of Diversity Across the Life Span study participants

Statement	All participants (n=1,118)	Women (n=621)	Men (n=488)
	<i>mean ± standard error of the mean</i>		
1. I was bothered by things that usually don't bother me.	0.73 ± 0.03	0.80 ± 0.04	0.65 ± 0.04
2. I did not feel like eating; my appetite was poor.	0.72 ± 0.03	0.84 ± 0.04	0.57 ± 0.04
3. I felt that I could not shake off the blues even with help from my family or friends.	0.77 ± 0.03	0.87 ± 0.04	0.65 ± 0.04
4. I felt I was just as good as other people.	1.53 ± 0.03	2.44 ± 0.04	2.50 ± 0.04
5. I had trouble keeping my mind on what I was doing.	1.13 ± 0.03	1.23 ± 0.04	1.01 ± 0.04
6. I felt depressed.	0.89 ± 0.03	0.97 ± 0.04	0.78 ± 0.05
7. I felt that everything I did was an effort.	1.35 ± 0.04	1.38 ± 0.05	1.32 ± 0.05
8. I felt hopeful about the future.	1.72 ± 0.03	2.24 ± 0.04	2.33 ± 0.04
9. I thought my life had been a failure.	0.57 ± 0.03	0.64 ± 0.04	0.49 ± 0.04
10. I felt fearful.	0.51 ± 0.02	0.55 ± 0.03	0.47 ± 0.03
11. My sleep was restless.	1.23 ± 0.03	1.32 ± 0.05	1.12 ± 0.05
12. I was happy.	1.75 ± 0.03	2.24 ± 0.04	2.26 ± 0.04
13. I talked less than usual.	0.95 ± 0.03	0.91 ± 0.04	1.00 ± 0.05
14. I felt lonely.	0.85 ± 0.03	0.90 ± 0.04	0.78 ± 0.05
15. People were unfriendly.	0.60 ± 0.03	0.58 ± 0.03	0.62 ± 0.04
16. I enjoyed life.	1.46 ± 0.02	2.50 ± 0.03	2.60 ± 0.03
17. I had crying spells.	0.48 ± 0.03	0.66 ± 0.04	0.26 ± 0.03
18. I felt sad.	0.81 ± 0.03	0.92 ± 0.04	0.66 ± 0.04
19. I felt that people dislike me.	0.44 ± 0.02	0.45 ± 0.03	0.41 ± 0.03
20. I could not get "going."	0.78 ± 0.03	0.86 ± 0.04	0.68 ± 0.04
Total sample score	11.64 ± 0.25	12.66 ± 0.35****	10.69 ± 0.34****

<sup>a</sup>Individuals are instructed to respond to the statements in reference to the previous week. Possible responses to the statements and score include: rarely or none of the time (less than 1 day); some or a little of the time (1-2 days); occasionally or a moderate amount of time (3-4 days); most or all of the time (5-7 days).

<sup>b</sup>Scoring: 0 for answers referring to rarely, 1 for answers referring to some of the time, 2 for answers referring to occasionally, and 3 for answers referring to most of the time. The scoring of positive items is reversed. Possible range of scores is 0 to 60, with higher scores indicating the presence of more symptomatology.

\*\*\*\*Statistically significant at  $P < 0.0001$ .

in-home interview, and the second recall was collected 4 to 7 days later during the mobile research vehicle examination. Foods and beverages were coded and analyzed using USDA Survey net system and the Food and Nutrient Database for Dietary Studies 3.0 (33).

### Diet Quality

Diet quality was calculated using the USDA's HEI-2005 (21,22). The HEI-2005 (20) (Table 2) is a revised version of the original Healthy Eating Index that was created by the Center for Nutrition Policy and Promotion in 1995 (34). There are 12 components—total fruit; whole fruit; total vegetables; dark-green and orange vegetables and legumes; total grains; whole grains; milk; meat and beans; oils; saturated fat; sodium; and energy from solid fat, alcohol, and sugar. The higher each score, the more the diet corresponds with the 2005 Dietary Guidelines for Americans, and the better the diet quality (18,22). The maximum score is 100. HEI-2005 total scores for "exemplary menus" based on the Dietary Approaches to Stop Hypertension eating plan and the American Heart Association's No Fad Diet were 99.8 and 98.6, respectively (35). However, the total mean HEI-2005 score of typical diets consumed by nationally representative samples of the US population is approximately 58 (36).

### Statistical Analyses

To investigate whether or not diet quality is associated with reported symptoms of depression, both linear regression analysis with no CES-D cut-off point and then logistic regression analysis with a CES-D cut-off point of 16 were used. The dependent variable was depressive symptoms. The independent variables included HEI-2005, race, sex, age, education, income, and food-assistance program participation. To test the effect of diet quality and of socioeconomic factors on CES-D, several models were run. A model was run with HEI-2005 alone as the independent variable, then a model was run with HEI-2005 with the socioeconomic variables of income, education, sex and race. Two- and three-way interaction terms between socioeconomic variables and sex and race were also included in the model with HEI-2005 and the socioeconomic variables. All  $P$  values were based on two-sided tests, and  $P < 0.05$  was considered statistically significant. Because age and food-assistance program participation were not significant in any of the models, these variables were dropped from the models and the analyses were rerun.

An analysis of variance test of difference between two additional models was also performed. CES-D was the dependent variable. The independent variables of the

**Table 2.** Mean  $\pm$  standard error of the mean (SEM) Healthy Eating Index-2005 component scores for Healthy Aging in Neighborhoods of Diversity Across the Life Span study participants by sex and race

Component	Maximum score <sup>a</sup>	Total n=999	Women n=565	Men n=434	Women		Men	
					White n=215	African American n=350	White n=167	African American n=267
← mean ± SEM →								
Total fruit (includes 100% juice)	5	2.51 ± 0.06	2.60 ± 0.08	2.38 ± 0.09	2.74 ± 0.12	2.52 ± 0.10	2.46 ± 0.14	2.32 ± 0.11
Whole fruit (not juice)	5	2.57 ± 0.06	2.71 ± 0.09	2.39 ± 0.09	3.00 ± 0.14	2.53 ± 0.11	2.64 ± 0.16	2.24 ± 0.12
Total vegetables	5	3.99 ± 0.04	4.08 ± 0.06	3.87 ± 0.07	4.14 ± 0.09	4.04 ± 0.07	3.90 ± 0.10	3.85 ± 0.08
Dark-green and orange vegetables and legumes	5	1.76 ± 0.06	1.96 ± 0.08	1.49 ± 0.08	2.02 ± 0.13	1.93 ± 0.11	1.38 ± 0.13	1.56 ± 0.11
Total grains	5	4.03 ± 0.03	4.05 ± 0.04	4.01 ± 0.05	4.11 ± 0.07	4.01 ± 0.06	4.23 ± 0.08	3.87 ± 0.06
Whole grains	5	1.34 ± 0.04	1.43 ± 0.06	1.24 ± 0.06	1.68 ± 0.10	1.27 ± 0.07	1.46 ± 0.11	1.10 ± 0.07
Milk	10	4.00 ± 0.09	4.14 ± 0.12	3.83 ± 0.12	5.18 ± 0.21	3.50 ± 0.14	4.98 ± 0.21	3.11 ± 0.13
Meat and beans	10	9.00 ± 0.06	8.88 ± 0.09	9.17 ± 0.08	8.24 ± 0.17	9.27 ± 0.009	8.76 ± 0.15	9.42 ± 0.09
Oils	10	5.71 ± 0.10	5.87 ± 0.13	5.50 ± 0.14	5.84 ± 0.21	5.88 ± 0.16	5.47 ± 0.23	5.52 ± 0.18
Saturated fat	10	5.43 ± 0.10	5.52 ± 0.14	5.31 ± 0.15	5.20 ± 0.23	5.72 ± 0.17	5.12 ± 0.24	5.43 ± 0.20
Sodium	10	4.12 ± 0.09	4.12 ± 0.12	4.12 ± 0.13	3.95 ± 0.19	4.21 ± 0.15	3.79 ± 0.22	4.33 ± 0.17
SoFAAS <sup>b</sup>	20	7.71 ± 0.19	7.89 ± 0.26	7.49 ± 0.29	8.56 ± 0.45	7.47 ± 0.31	8.28 ± 0.48	6.99 ± 0.36
Total	100	52.17 ± 0.40	53.23 ± 0.54 <sup>v</sup>	50.79 ± 0.56 <sup>v</sup>	54.66 ± 0.92 <sup>wx</sup>	52.35 ± 0.67 <sup>wy</sup>	52.48 ± 0.97 <sup>z</sup>	49.74 ± 0.68 <sup>xyz</sup>

<sup>a</sup>Standards for the maximum score and zero score are available at: <http://www.cnpp.usda.gov/Publications/HEI/healthyeatingindex2005factsheet.pdf> (21).

<sup>b</sup>SoFAAS=Solid fat, alcohol, and added sugar.

<sup>v,w,x,y,z</sup>Means with the same superscript are statistically different at  $P < 0.05$ .

baseline model included sex, race, education, and income. Then diet quality was added to the baseline model to observe what happens to the coefficients of education and income.

All statistical analyses were carried out using the SAS statistical analysis computer package (version 9.1, 2002-2003, SAS Institute, Inc, Cary, NC).

## RESULTS

### Characteristics of Sample Participants

The study sample consisted of 1,118 people between ages 30 and 64 years, 250 (22%) white women, 373 (33%) African-American women, 196 (18%) white men, and 299 (27%) African-American men. The mean age of the population was  $48.35 \pm 0.27$  years. Approximately 36% of the population had <12 years of education, 31% completed high school degree or equivalent, and the remaining 33% had  $\geq 1$  years of college. Approximately one third of the study sample (31%) reported a total household income in the last 12 months of <\$10,000, 23% reported \$10,000 to <\$20,000, 28% reported \$20,000 to <\$50,000, and 18% reported  $\geq$ \$50,000. Only 75 participants reported an income of  $\geq$ \$75,000. Sixty-nine percent of individuals reported receiving an income from an employer within the past 12 months. Approximately 22% of the sample indicated that they did not have enough money, food stamps, or Special Supplemental Nutrition Program for Women, Infants, and Children vouchers to buy enough food to eat. Twenty-three percent reported that they had inadequate money, food stamps or Special Supplemental Nutrition Program for Women, Infants, and Children vouchers to

obtain the kinds of foods they wanted or needed. However, only 11% of the sample reported they had insufficient food to eat because the kinds of food they wanted were unavailable.

### Depression Scores

The mean score for each depression statement, along with the total mean score, are presented in Table 1. The mean score on the CES-D was  $11.64 \pm 0.25$ , with a minimum score of 0 and a maximum score of 40. Women scored significantly higher on the depression scale than men (mean CES-D scores of  $12.66 \pm 0.35$  and  $10.69 \pm 0.34$ , respectively;  $P < 0.0001$ ), meaning women reported significantly more depressive symptoms than men (Table 1).

Whites reported fewer symptoms of depression than African Americans, although the difference was not significant (23.3% vs 25.3%, respectively). White women scored highest on the CES-D, whereas white men scored lowest. There was a significant difference in the depressive symptoms between the sexes for both races (African Americans  $P = 0.0368$ , whites  $P = 0.0002$ ). The percentage of the sample at risk for depression ranged from 19% for white men to 35% for white women. The percentage of women at risk for depression symptoms was higher than that of men, regardless of race.

### Diet Quality

Mean scores for each component and total HEI-2005 score are presented in Table 2 for the total sample, by sex, and then by sex-race group. The overall mean HEI-2005



score was  $52.17 \pm 0.40$ , the minimum score was 20, and the maximum score was 92. The HEI-2005 score for women was significantly higher than men ( $P=0.0017$ ). The mean HEI-2005 scores of white participants were significantly higher than African Americans ( $53.70 \pm 0.67$  vs  $51.22 \pm 0.48$ , respectively;  $P=0.0019$ ). The mean HEI-2005 score for African-American men was significantly lower than all other sex-race groups (Table 2). The mean HEI score for African-American women was significantly lower than that of white women (Table 2).

### Relationship between Depression and Diet Quality

The findings of the linear regression using only HEI-2005 as the independent predictor revealed that diet quality was inversely and significantly associated with reported symptoms of depression (adjusted  $R^2=0.03$ ,  $P<0.0001$ ). Individuals with higher-quality diet reported fewer symptoms of depression. A bivariate  $R^2$  is seldom very big and the value 0.03 corresponds to a correlation of about 0.17. This relationship is highly statistically significant. In addition, the Wald  $\chi^2$  in the logistic regression analysis, dichotomizing the CES-D scores as  $<16$  or  $\geq 16$ , was significant for HEI-2005 ( $P=0.0002$ ). The odds ratio point estimate indicated each unit increment (1.0) on HEI reduces the odds of depressive symptoms ( $\text{CES-D} > 16$ ) by a factor of 0.98. This increment is not a large decrease, but the standard deviation of HEI is about 12.5. An increase of one HEI standard deviation generates a predicted decline in the odds of depressive symptoms by a factor of 0.863.

When socioeconomic variables (education, income), sex, and race were added to the model in which diet quality (HEI-2005) alone predicted CES-D score, diet quality, male sex, education, and income were all significant predictors of CES-D (adjusted  $R^2=0.14$ ,  $P<0.0001$ ). All four variables were negatively related to CES-D score. For example, controlling for all the other regressors, the average CES-D score for men was lower than the average for women. Or, controlling for all the other regressors, as diet quality increases, depressive symptoms (CES-D score) decline. The inverse effect of HEI-2005 on depressive symptoms was attenuated appreciably when SES variables, sex and race were added to the model containing CES-D as the only regressor. The parameter estimate for HEI-2005 declined by approximately 35%, but it remained statistically significant.

The analysis of variance test of difference was performed to determine if diet quality had a mediator effect on the relationships between demographic factors and depressive symptoms. Sex, education, and income all are associated with significant effects on both HEI-2005 (coefficients not shown) and CES-D score, including control for HEI-2005. And HEI-2005 has a significant effect on CES-D score controlling for sex, education, race, and income. This pattern implies that CES-D score functions as a mediator between exogenous variables (SES and sex) and the measure of depression (CES-D score).

Linear regression analyses were performed with interaction terms to determine whether or not the effect of HEI-2005 on depression was modified by race, sex, income, and education. None of the interactions was significant.

### DISCUSSION

Both depression and poor diet, independently, have been linked with increased morbidity and mortality and reduced quality of life (37-40). In this study, diet quality was found to be significantly associated with reported symptoms of depression. The findings support studies reporting an association between overall diet, rather than individual nutrients or foods, and psychological well-being (6,13,15,17,41-46). The inverse effect of HEI-2005 on depressive symptoms was attenuated appreciably by income but remained statistically significant. Women have higher CES-D scores than men, and education is inversely related to CES-D scores. These associations hold under control for race and SES. Based on the results of the analysis of variance test, diet quality does have a mediator effect on the relationship between demographic factors and depressive symptoms.

Poverty and low education levels are consistent predictors of depressive symptoms (47). Food insecurity has also been related to symptoms of depression (48). Compared to national statistics, the study sample has lower income and education levels (49,50), putting them at a higher risk for poor diet quality (23) and depression (24,51), independently. Although there was some income variation between subjects, none of the participants could be considered affluent. More than 50% of the HANDLS sample in this study reported a total household income in the last 12 months of less than \$20,000 and another 28% reported an income between 20,000 and  $< \$50,000$ . Thus the income of most HANDLS participants in this study was less than the median income of an American household in 2006, which was \$48,201 (49). In addition, in 2006, 85.5% of Americans had a high school diploma or more (50), whereas only 64% of the sample completed high school or the equivalent. At lower education levels, the likelihood of depression increases (24). In this study, the influence of socioeconomic factors (income and education) lessened the influence of diet quality on reported symptoms of depression.

HEI-2005 scores indicate how closely diets adhere to the 2005 Dietary Guidelines for Americans. Unlike the original HEI scores, the total scores for the HEI-2005 are not associated with specific ratings such as good, fair, or poor (52). Thus, the higher the score, the more closely the diet consume complies with healthful eating guidelines. The component scores of the HEI-2005 assess how closely consumption matches specific recommendations. These scores can be used to provide targeted recommendations for improving diet quality. None of the component HEI-2005 scores reached the maximum score for the total HANDLS sample or for race-sex subgroups (Table 2). Component scores for meat and beans, total grains, and total vegetables approached the maximum, but scores for all other components were below the target in the total HANDLS sample. Examination of the HANDLS dietary intakes indicated the majority of HANDLS participants are meeting protein recommendations through animal protein sources. However, animal products are the primary source of saturated fat, which is responsible for increasing the risk of developing chronic diseases such as cardiovascular disease, diabetes mellitus, and some cancers (41,42,53-55).

The median HEI-2005 score based on 2 days of dietary

recall for HANDLS participants was 51.00 out of a maximum score of 100. The diets of HANDLS participants appear to be of lower quality based on the mean HEI-2005 scores compared to the diets consumed by low-income (defined as <130% federal poverty level) participants of the National Health and Nutrition Examination Survey (NHANES) 2003-2004, a nationally representative US sample. NHANES 2003-2004 scores were based on 1 day of dietary intake data collected with USDA's AMPM method. The mean HEI-2005 score for low-income persons aged 2 years and older examined in the NHANES 2003-2004 was 56.5 (56). The component score for total grains for the low-income NHANES 2003-2004 sample did achieve the maximum, whereas the score for the meat and bean component approached the maximum score similar to the finding for the HANDLS sample (56).

Although race was not a significant predictor of CES-D score, sex was a significant predictor of CES-D in the regression models and also played a role in attenuating the HEI-2005–depression relationship, but its influence was less than that of income. Women in the sample scored significantly higher on the depression scale than men, suggesting women experience more depressive symptoms than their male counterparts. This finding is congruent with national statistics reporting the incidence of depression is two times higher in women than men (2,4). Although female HANDLS study participants also scored significantly higher on the HEI-2005 compared to the male HANDLS study participants, their scores were still below those reported for the NHANES 2003-2004 low-income samples.

### Limitations of Study

The HEI-2005 scores in this study were based on two nonconsecutive 24-hour dietary recalls. Two recalls provide more reliable information than one recall but there are still limitations to this dietary collection method. Recalls may be inaccurate and biased because of misreporting, primarily underreporting. Even though the AMPM method is valid, energy can be underestimated by 11% for a population of normal, overweight, and obese persons (31). The energy underestimation for normal-weight persons is about 3%, but the underestimation for overweight and obese persons has yet to be determined (31).

No causal link can be inferred from this cross-sectional study. It is unclear whether the cross-sectional association between measure of diet quality and depression is due to the effects of diet on depression, the effects of depression on diet, or both. However, the findings of this study are consistent with previous studies relating dietary patterns and depression (6,13,15,17), reinforcing the need for further research on the relationships between diet and depression. Future longitudinal data generated from the HANDLS study may provide insight regarding the direction and cause of the relationship between diet and depression.

### CONCLUSIONS

This study is the first analysis examining the relationship between diet quality measured by HEI-2005 and symptoms of depression in a diverse group of American

adults with low education and income levels participating in the HANDLS study. The data demonstrated that diet quality was significantly associated with reported symptoms of depression. As it is widely recognized that common symptoms of psychiatric disorders, such as depression, contribute to the burden of diseases, many of which have nutrition implications, greater collaboration between experts in the areas of depression and nutrition are warranted. When conducting nutrition assessments as part of the Nutrition Care Process, dietetics practitioners should be alert for depressive symptoms in their clients as they devise interventions to improve overall dietary patterns in their clients. This study highlights the importance of paying particular attention to the overall dietary patterns as well as individual nutrient status. Although this study did not examine the obesity issues of the HANDLS population, further outcomes generated from the HANDLS study in the area of depression and obesity will also be of interest to dietetics practitioners.

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