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The Association between Total Folate Intakes and Depression amongst Three Racial/Ethnic Groups

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Abstract

Background and Purpose: Low dietary folate intake has been associated with depression outcomes, but few studies have been reported on the association in diverse populations. Using data from the National Health and Nutrition Examination Survey (NHANES), we examined the relationship between depression and folate intake from diet and supplementation in non-Hispanic whites, Hispanics and African Americans.

Methods: 3,687 adult respondents from the 2009–2010 NHANES cycle were included. Statistical methods for analyzing data from complex survey sample designs were used to assess differences by race/ethnicity in demographic, behavioral, dietary and depression variables and to assess the relationship between depression and folate, adjusting for confounding variables using multivariable logistic regression.

Results: We observed significant ($p < 0.01$) differences by race/ethnicity for all demographic, behavioral, dietary and depression variables, except for physical activity. The relationship between dietary folate and depression significantly differed by race/ethnicity (p = 0.03), with an inverse and significant association in Hispanics only (OR= 0.25; 95% CI= 0.09 – 0.70.; p for trend = 0.02).

Conclusion: These data suggest that a diet high in folate, such as from dark green leafy vegetables, may be associated with a reduced odds for depression, and specifically, Hispanics may benefit from nutrition education to potentially reduce depression in the population.

Keywords

Folate; Depression; Race; Ethnicity; Hispanic; NHANES

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Introduction

Depression, one of the most common mental health illnesses, affects 6.7% U.S. adults (SAMHSA, 2014). Prevalence of depression is higher in younger adults (10.3%, 18 – 25 years vs. 4.8%, >50 years) and in women compared to men (8.5% vs. 4.7%), with mixed results for various racial/ethnic groups; e.g., non-Hispanic whites have the highest prevalence compared with Hispanics and African Americans (SAMHSA, 2014). Treatment response can differ by severity of symptoms, with milder forms of depression largely unresponsive to antidepressants (Cameron et al., 2014). Similarly, the efficacy of alternative treatment options vary for mild forms of depression (Cooney et al., 2014; Sniezek and Siddiqui, 2013; van Hees et al., 2013). Further, the prevalence of major depression varies by ethnicity, with an estimated 3.5% of Hispanics, 18% of non-Hispanic whites and 11% of African Americans suffering from the condition according to the National Comorbidity Survey Replication study, a nationally representative survey (Breslau et al., 2006). Higher lifetime depression prevalence in non-Hispanic whites is consistently reported across most studies; however, when examining point prevalence and persistent, dysthymic disorder, African Americans and Hispanics have been shown to have higher persistence of depression than non- Hispanic whites (Breslau et al., 2005; Riolo et al., 2005; Breslau et al., 2006; Weaver et al., 2015; Riolo et al., 2005).

Diet and nutrition is one alternative treatment for preventing and addressing depression (Kaplan et al., 2015). Specifically, recent studies have investigated the relationship between folate from diet or supplementation and depression (Alpert & Fava, Nutrition Reviews, 2000; Jacka et al., 2012; Tolmunen et al., 2004). A prospective study on middle aged men in Finland (n = 47) showed that participants with low folate intake (below the median) had a higher risk of being discharged with a diagnosis of depression (RR = 3.04, 95% CI: 1.58, 5.86; adjusted for energy intake) compared with those above the median (Tolmunen et al., 2004). A meta-analysis by Gilbody et al. of 11 epidemiologic studies showed that the relationship between low folate status and depression is highly robust, appearing even after accounting for confounding variables, but that cohort and/or controlled studies are needed to further elucidate causality (Gilbody et al., 2007). Additionally, a meta-analysis by Taylor et al. (2004) included three randomized clinical trials (n = 247) that investigated the efficacy of folic acid supplementation in treating depression, measured via the Hamilton Depression Rating Scale (HDRS). Two of the three trials observed statistically significant effects for adding folate to other treatment and reported differing effects by gender (Coppen et al., 2000; Godfrey et al., 1990).

The Present Study

To our knowledge, no studies have yet assessed the role of dietary folate intake with depressive symptoms in a diverse, multi-ethnic population, other than for depression in pregnancy and older adults (Ramos et al 2004, Singh et al 2017, Skarupski et al 2010). Utilizing the National Health and Nutrition Examination Survey (NHANES), we assessed the relationship between folate -- from both diet and supplementation -- and depression and further investigated the folate/depression relationship within non-Hispanic whites, Hispanics and African Americans.

Methods

Study Design

NHANES is an ongoing cross-sectional survey conducted by the National Center for Health Statistics at the Centers for Disease Control and Prevention (CDC) that collects data on the health and nutritional status of U.S. adults and children using probabilistic, multistage sampling and oversampling to achieve a nationally representative sample of the resident civilian non-institutionalized US population. The interview component of NHANES ascertains information on demographic, socioeconomic, and health-related factors and includes a 24-hour dietary recall assessment. Detailed information on survey design and methodology is available at http://www.cdc.gov/nchs/nhanes.htm.

Sample

The 2009–2010 cycle of NHANES included a nationally representative sample of 10,537 participants. We limited our analysis to adults (ages 20 years and older, n = 6,218) who participated in the dietary assessment (n = 6,059) and whose dietary data were deemed reliable (n = 5,762); per the NHANES definition, this required that all relevant variables associated with the 24-hour dietary recall contain a value. Additionally, we restricted our analysis to participants with nonmissing data on depression, supplementation, and all variables considered as potential confounders, resulting in an analysis population of 3,687. The CDC Institutional Review Board approved NHANES and all participants provided written informed consent. The study protocol review was conducted and approved by the Internal Review Board (IRB) of the California State University, Fullerton (HSR# 16–0221).

Measures

Depression Classification.—In the “Mental Health – Depression Screener” portion of the NHANES interview, the 9-item Patient Health Questionnaire (PHQ-9) was used to ascertain the frequency of depression symptoms during the previous 2 weeks. Possible responses to each question were “not at all,” “several days,” “more than half the days” and “nearly every day” with respective scores of 0, 1, 2, and 3. A total score, ranging from 0 to 27, was derived by summing over the 9 items. A score of 10 or higher was used to indicate depression, a method that has been validated and is commonly used in research settings (Manea et al. 2012).

Dietary Folate.: Dietary folate intake (μg/day), an NHANES-derived variable, was obtained from the Total Nutrient Intakes data set. Dietary intakes were reported via a 24-hour dietary recall in which respondents reported individual foods (and drinks) consumed during the midnight-to-midnight 24-hour period prior to the in-person dietary interview. Coding of interview data and conversion to total nutrient intakes were conducted by NHANES using the USDA Food and Nutrient Database for Dietary Studies, 5.0 (FNDDS 5.0) (http://www.ars.usda.gov/ba/bhnrc/fsrg). The FNDDS 5.0 nutrient values were based on the USDA National Nutrient Database for Standard Reference, release 24 (http://www.ars.usda.gov/nutrientdata).

Folate from Supplements.—Folate supplemental intake/use (μg/day), also an NHANES-derived variable from the Total Dietary Supplements data set, was ascertained via the 24-hour dietary recall. Coding of interview data and conversion to total nutrient intakes were done by NHANES using their in-house NCHS Product Label Database.

Other Variables.—Age, gender, race/ethnicity, marital status, education level, and socioeconomic status (SES) as measured by income-to-poverty ratio were obtained from the Demographic Variables & Sample Weights data set. NHANES categorizes race/ethnicity into four groups: non-Hispanic white, Hispanic, African American and other/multi-racial. The NHANES categories of marital status were used as follows: married, widowed, divorced, separated, never married, and living with a partner. Education level was coded as 0 for < 9^{th} grade, 1 for 9^{th} to 11^{th} grade, 2 for high school graduate or General Equivalency Diploma, 3 for some college or Associate of Arts degree, and 4 for Bachelor's or post-graduate degree. BMI (kg/m^2) and physical activity for deriving "metabolic hours" was obtained from the Body Measures and Physical Activity data sets, respectively. "Metabolic hours" was derived for each respondent as the weighted sum of "moderate" (work, walk/bicycle, recreational) and "vigorous" (work, recreational) hours/week of physical activity, with weights of 4 for moderate and 8 for vigorous activity (https://wwwn.cdc.gov/Nchs/Nhanes/2009–2010/PAQ_F.htm# Appendix_1). Smoking status was obtained from the Cigarette Use data set and was coded as 0 for "never," 1 for "former," and 2 for "current." Alcohol consumption was expressed as drinks/day over the 1-month period prior to the interview and was obtained from the Alcohol Use data set. Use of anti-depressants during the 1-month period prior to the interview, coded as "yes" or "no," was self-reported and was derived by cross-referencing the Prescription Medications data set with the Drug Information data set to select records with first- level category name "Psychotherapeutic Agents" and second-level category name "antidepressants" according to the Multum Lexicon Therapeutic Classification Scheme (http://www.multum.com).

Statistical Methods.—Analyses were done using SAS procedures SURVEYFREQ, SURVEYREG and SURVEYLOGISTIC (SAS v9.4, SAS Institute, Cary, NC, USA) to account for the stratified, multistage probability cluster sampling design of NHANES. The NHANES stratification variable (SDMVSTRA) and Primary Sampling Unit (SDMVPSU) were used as the strata and sampling unit variables, respectively. NHANES provides sampling weights to be used in analyses that account for oversampling of certain subgroups, differences between the sample and the population due to nonresponse, and population sizes, i.e., the weights allow each NHANES respondent to represent multiple people from the population from which they were sampled. NHANES provides sampling weights to be used specifically for dietary analyses, which also account for the fact that not all participants completed the dietary interview and that different days of the week were represented in the 24-hour periods for which dietary intake was assessed.

Analyses by race/ethnicity were performed using the DOMAIN statement in the SAS survey procedures and included all four race/ethnicity categories; however, stratified results are presented only for the categories of non-Hispanic white, Hispanic, and African American, and global F tests were used to test for differences by race/ethnicity using only these

subgroups of interest for the present analysis. All statistical tests were two-sided with .05 significance levels.

Dietary folate intake for each respondent was expressed as the respondent's residual value from the linear regression of total folate intakes on energy intake (kcal/day), i.e., the difference between the respondent's actual dietary folate intake and that predicted by his or her total energy intake. This approach isolates the effect of dietary folate intake from factors closely associated with total energy intake that may be related to depression (e.g., body size, metabolic efficiency) without directly modeling total energy intake, which is correlated with total folate intake (Willett et al, 1997).

For the multivariable analyses discussed below, a categorical variable for dietary folate intake was derived based on quartiles of the distribution of residuals. A categorical variable was also derived for folate supplementation, with "no exposure" as the reference group and two additional groups defined as "low exposure" (> 0 but ≤ 680 μg/day, an obvious cutoff based on the data distribution) and "high exposure" (> 680 μg/day, i.e., atypical use). A categorical variable was derived for total folate intake (from either diet or supplements) using the same approach as described above for dietary folate intake.

Multivariable logistic regression was used to assess the association between the binary dependent variable depression and the independent variable (IV) folate, expressed as quartile of dietary folate intake residual, category of folate supplement usage, and quartile of total folate intakes (diet plus supplement) residual in three separate analyses. The analysis population included only respondents with non-missing data on dietary folate intake, folate supplementation, and all variables evaluated as potential confounders, chosen based on literature review of known factors associated with depression: age, gender, race/ethnicity, education level, marital status, SES, BMI, use of anti-depressants, metabolic hours, smoking status, alcohol consumption, dietary vitamin B6 intake (μg/day), vitamin B6 (mg/day) from supplements, dietary vitamin B12 intake (μg/day) and vitamin B12 from supplements (μg/day). From the list of potential confounders, covariates to be included in the ultimate model were selected using as a manual process that considered collinearity, statistical and clinical significance, influence, model fit (as measured by the score statistic), predictive ability (as measured by the c statistic), and model parsimony.

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each category of exposure with the lowest exposure category as the reference group. P-values for trend were based on categories of exposure modeled as continuous variables. The same set of covariates, selected as described above, were used for all analyses (except that race/ethnicity was not included as a covariate for analyses within race/ethnicity). Covariates were modeled as either continuous (age, education level, SES, BMI, metabolic hours, smoking status, alcohol consumption, dietary and supplement intakes of vitamins B6 and B12) or categorical (gender, race/ethnicity, marital status, use of anti-depressants) variables.

Results

After weighting data from 3,687 respondents, the estimated population distribution of race/ethnicity was 72.1% (SE 3.3%) non-Hispanic white, 12.4% (2.7%) Hispanic, 10.4% (0.9%) African American, and 5.2% (0.8%) other races/ethnicities. Demographic, behavioral, dietary and depression data [including respective % (± SE), median (SE) or mean (SE)] are shown in Table 1, which also shows differences across ethnic groups. Significant ($p < 0.001$) differences by race/ethnicity were observed for all variables except physical activity (metabolic hours). Descriptively, compared to non-Hispanic whites, Hispanics were younger [38.9 (0.60) years vs. 47.4 (0.62) years)] and had a higher proportion of males [57.3% (1.51) vs. 50.6% (1.47)], lower SES [1.37 (0.087) vs. 3.61 (0.103)], lower dietary folate intake [(196 (8.7) vs. 207 (4.0)], a higher proportion of folate supplementation non-use [77.4% (1.80) vs. 58.9% (1.58)], a higher proportion of non-smokers [58.4% (1.56) vs. 50.1% (2.52)], and a higher proportion classified as depressed [11.5% (1.37) vs. 6.7% (0.84)]. A similar pattern was observed for African Americans compared to non-Hispanic whites, with African Americans, descriptively, having even lower dietary [163 (6.5) vs. 207 (4.0) μg/day) and total [197 (10.5) vs. 329 (13.1) μg/day)] folate intakes and a higher proportion classified as depressed [(14.4% (0.92) vs. 6.7 (0.84).

Table 2 presents data on the associations between depression and dietary folate intake, supplemental folate intake and total folate intakes, both overall and by race/ethnicity. Although dietary, supplemental and total folate intakes were generally inversely associated with depression, no significant associations were observed in the analyses including all race/ethnicity groups. For dietary folate, there was a significant interaction with race/ethnicity ($p = 0.03$). Stratified analyses showed a statistically significant association between dietary folate and depression for Hispanics, with a significantly reduced odds of depression for the highest quartile compared with the lowest quartile of residual (OR: 0.25; 95% CI: 0.09 – 0.70, $p = 0.01$ for the highest quartile; $p = 0.02$ for trend). The highest quartile for total folate intakes, both overall and within all three race/ethnicity groups, was inversely associated with the odds of depression, but did not reach significance at the 0.05 level.

Discussion

Using a large, cross-sectional, nationally representative sample, we showed that the median total folate intakes for Hispanics and African Americans were nearly 30% and 50% less, respectively, than for non-Hispanic whites. In addition, proportions with depression classification were higher in both ethnic minorities compared to non-Hispanic whites, with the proportion in African Americans being over twice that in non-Hispanic whites. Importantly, in Hispanics, we showed that the highest quartile of dietary folate residual was significantly associated with a 75% odds reduction of being classified as depressed.

Previous studies have also shown differences in folate intake by racial/ethnic groups, and by specific sub-groups (Rai et al., 2015, Tinker et al. 2010, Bentley 2006). In our study, descriptively, African Americans had the lowest dietary folate and total folate intakes compared to non-Hispanic whites and Hispanics. A recent NHANES investigation on women of childbearing age also showed that African American women had the lowest

dietary intakes of several macro and micro-nutrients, including folate (Rai et al., 2015). Other studies that analyzed data from earlier NHANES cycles on total folate intakes, pre- and post-folic acid fortification, also indicated racial/ethnic disparities, showing that African Americans and Mexican-Americans continued to have lower folate intakes compared to non-Hispanic whites, even after postfortification (Bentley et al. 2006). Therefore, our findings from the 2009–2010 NHANES cycle are in agreement with previous reported NHANES studies, that African-Americans and Hispanics lag behind non-Hispanic whites in folate consumption, and suggest that further targeted efforts need to be made to improve dietary intakes in racial/ethnic minority groups.

Several studies have investigated racial/ethnic differences in depression (Breslau et al., 2005; Riolo et al., 2005; Breslau et al., 2006; Weaver et al., 2015). A majority of studies show increased depression in non-Hispanic whites compared with other ethnic minority groups (Breslau et al., 2006); however, in African Americans, once diagnosed, the disease is more severe and chronic (Williams 2007). Our study suggests that, descriptively, both Hispanics and African Americans have higher rates of depression compared with non-Hispanic whites, with the proportion classified as depressed in African Americans being twice that in non-Hispanic whites. These results support data from earlier NHANES III cycles (1988 – 1994), which also found that African and Mexican Americans had higher lifetime prevalence of dysthymic disorder compared to whites (Riolo et al., 2005). Another study found that mood disorders were significantly more persistent in Hispanic and African American participants, compared to white participants (Breslau, 2005). Conflicting results of depression by ethnicity may be due to measuring depression prevalence vs. dysthymic disorders, differences in survey instrumentation in depression diagnoses, study population samples and design (i.e., NHANES vs. other large cross-sectional samples and studies using small sample sizes), and potential underreporting by underrepresented racial/ethnic groups. In addition, our observation of an association between dietary folate and depression, but not supplemental folate or total folate intakes, may be due to the varying absorption, bioactivity and function of synthetic folate (supplemental folate) vs. natural food folate (dietary folate).

After adjusting for confounders, we found that dietary folate residuals in the highest quartile was associated with a significantly reduced odds of being depressed compared with the lowest quartile of residuals, but for Hispanics only. Similar results have been observed in pregnant Latina women suggesting that folate inadequate and/or deficient intakes may be associated with increased depressive symptoms (Ramos et al 2004, Singh et al 2017). Ramos and colleagues in 2004 found that Latino women with plasma folate levels in the lowest tertile had significantly higher odds for depression compared to women in the highest tertile (OR:2.04, 95% CI: 0.3 – 3.02, $p < 0.001$). However, to our knowledge, this is the first study that has assessed the association between depression and folate from both diet and supplementation in a diverse, multi-ethnic population, including non-Hispanic whites, Hispanics and African Americans. Our findings of an association between dietary folate intake and depression in Hispanics only may be due to between racial/ethnic group differences in the complex network of enzymatic polymorphic variants associated with folate metabolism, specifically MTHFR and C677T allele, as well as due to Hispanic population/heritage differences (Ojeda-Granados et al 2017, Yang et al 2012); however,

analyses and adjustment of polymorphic variants in folate metabolism is beyond the scope of the present study.

Strengths and Limitations

Strengths of our study include the large sample size available via the NHANES open-source database, which provides increased power to detect clinically relevant differences, and the generalizability of results due to the nationally-representative NHANES survey data. Additionally, the study benefits from representation via oversampling of diverse racial/ethnic subgroups, such as Hispanics and African Americans, inherent in the NHANES survey methodology, enabling analyses by groups that are often underrepresented in the scientific literature. Limitations include the retrospective, cross-sectional design, which does not allow for causal inference, and self-reported data on depression, diet, and supplementation. Further, several other factors including known and unknown dietary constituents, behavioral factors, stress may also influence depression and should be investigated in future studies.

Conclusions

We showed that, for the 2009–2010 data cycle, there continues to be racial/ethnic disparities related to dietary and supplemental folate, and that increased dietary folate intake was associated with a 75% reduced risk of depression classification in Hispanics. These data suggest that consuming natural food folates from dark-green leafy vegetables and legumes may reduce depression, and that important targeted nutrition education and/or policy should focus on underrepresented racial/ethnic groups, specifically for Hispanics in our study, in order to reduce depression.

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Table 1

Demographic, Behavioral, Folate and Depression Data for all Groups, and Race/ethnicity

Baseline Parameter	All Races (N = 3687)		non-Hispanic White (N = 1928)		Hispanic (N = 959)		African American (N = 638)		*p*-value[1]
Age [mean (SE); yrs]	45.6	(0.59)	47.4	(0.62)	38.9	(0.60)	43.7	(1.14)	< 0.0001
Male [% (SE)]	51.5	(1.11)	50.6	(1.47)	57.3	(1.51)	50.0	(2.32)	0.0002
Income-to Poverty Ratio [median (SE)]	3.15	(0.108)	3.61	(0.103)	1.37	(0.087)	1.69	(0.129)	< 0.0001
Dietary Folate mcg/day [median (SE)]	202	(3.2)	207	(4.0)	196	(8.7)	163	(6.5)	< 0.0001
Supplemental Folate mcg/day [% (SE)]									< 0.0001
0	63.5	(1.49)	58.9	(1.58)	77.4	(1.80)	76.1	(173)	
> 0 and ≤ 680	27.6	(1.62)	30.9	(1.79)	15.9	(0.93)	19.4	(1.19)	
>680	9.0	(0.52)	10.3	(0.60)	6.8	(1–25)	4.5	(0.81)	
Total Folate mcg/day [median (SE)]	302	(9.7)	329	(13.1)	244	(9.5)	197	(105)	< 0.0001
Dietary Vitamin B12 mcg/day [median (SE)]	4.25	(0.084)	4.5 8	(0.102)	3.74	(0.188)	3.52	(0.162)	0.001
Dietary Vitamin B6 mg/day [median (SE)]	1.82	(0.032)	1.84	(0.040)	1.84	(0.059)	1.66	(0.036)	0.002
Depression = Yes [% (SE)]	8.l	(0.70)	6.7	(0.84)	11.5	(1.37)	14.4	(0.92)	0.0005
Used Anti-Depressants [% (SE)]	10.9	(0.76)	13.0	(0.99)	4.6	(1.00)	6.S	(1.05)	0.0007
Metabolic Hours [median (SE)]	23.9	(1.95)	24.0	(2.20)	25.8	(2.88)	19.2	(2.52)	0.18
Smoking Status [% (SE)]									0.006
Never	51.3	(2.11)	50.1	(2.52)	58.4	(1.56)	49.7	(2.22)	
Former	26.0	(1.69)	28.8	(2.13)	20.1	(1.23)	17.5	(2.11)	
Current	22.7	(1.07)	21.1	(1.18)	21.5	(1.50)	32.8	(2.80)	

Calculated using the SAS procedure SURVEYREG or SURVEYLOGISTIC (“male,” “depression,” and “used anti-depressants”) with race as the independent variable. For income-to-poverty ratio, supplemental folate, metabolic hours, and smoking status, the original variable was categorized and the category level was used as the dependent variable. For dietary folate, total folate, dietary vitamin B12, and dietary vitamin B6, the log-transformed variable was used as the dependent variable.

Table 2

The association [multivariable odds ratio (OR)[1]] between dietary folate, supplemental and total folate intake with depression for all races and the three race/ethnic groups.

	All Races (N = 3687)			Non-Hispanic white (N=1,928)			Hispanic (N = 959)			African American (N=638)		
Folate Variable:	**OR**	**(95% CI)**	**p-value**	**OR**	**(95% CI)**	**p-value**	**OR**	**(95% CI)**	**p-value**	**OR**	**(95% CI)**	***p*-value**
Diet (residual quartile)												
1st	1.00	--	--	1.00	--	--	1.00	--	--	1,00	--	--
2nd	0.91	(0.53, 1.54)	0.70	1.15	(0.46, 2.90)	0.75	0.87	(0.32,2,31)	0,76	0,73	(0.32, 1.67)	0.44
3rd	0.84	(0.56, 1.27)	0.39	1.04	(0.56,1,92)	0.89	0.64	(0.21, 1,97)	0,42	0,42	(0.17, 1.04)	0.06
4th	0.95	(0.59, 1.54)	0.83	1.48	(0.69, 3.18)	0.29	0.25	(0.09, 0,70)	0,01	0,87	(0.48, 1.58)	0.63
p trend			0.79			0.17			0.02			0.24
Supplement												
1st	1.00	--	--	1.00	--	--	1.00	--	--	1,00	--	--
2nd	0.90	(.53, 1.54)	0.74	0.69	(0.49, 1.48)	0.54	1.39	(0.52, 3,73)	0,49	0.69	(0.23,2.13)	0.50
3rd	0.69	(0.36, 1.29)	0.28	0.22	(0.26, 1.52)	0.28	1.00	(0.20, 5,09)	0,99	0,49	(0.14, 1.71)	0.24
p trend			0.24			0.23			0,76			0.32
Diet + Supplement (residual quartile) 1st												
2nd	0.67	(0.44, 1.03)	0.06	0.63	(0.32, 1.24)	0.17	0.69	(0.23,2,04)	0,48	0,60	(0.30, 1.20)	0.14
3rd	0.77	(0.47, 1.27)	0.28	0.99	(0.48, 2.04)	0.97	0.26	(0.09, 0,74)	0.02	0,82	(0.42, 1.59)	0.53
4th	0.73	(0.44, 1.22)	0.22	0.84	(0.40, 1.77)	0.63	0.63	(0.21, 1.95)	0,40	0,46	(0.15, 1.41)	0.16
p trend			0.37			0.92			0.19			0.14

[1]Covariatcs include: use of anti-depressants in past month. SES (income-to-poverty ratio), physical activity, smoking status, dietary B6 and race/ethnicity (only for all races combined). P-value for interaction with race/ethnicity = 0.03 for diet, 0.67 for supplement, and 0.46 for diet + supplement.