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Cooking at Home: A Strategy to Comply With U.S. Dietary Guidelines at No Extra Cost

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Abstract

Introduction—Cooking at home is associated with better diet quality. This study examined the frequency of home-cooked dinners versus eating out in relation to the Healthy Eating Index (HEI), and food expenditures.

Methods—The Seattle Obesity Study used a stratified random sample of 437 King County adults. In-person computer-assisted interviews collected sociodemographic and behavioral data during 2011–2013. HEI-2010 and 2005 were computed using Food Frequency Questionnaires. Multivariable regression analyses, conducted in 2015, examined associations among HEI scores, food expenditures, and frequency of cooking at home versus eating out variables.

Results—Frequent home-cooked dinners were associated with being married, unemployed, larger households, presence of children aged <12 years, and lower frequency of eating out, but unrelated to education or income. In adjusted models, frequent at-home cooking was associated with higher HEI-2010 (β=7.4, $p<0.001$), whereas frequent eating out was associated with lower HEI-2010 (β= −6.6, $p<0.001$). Frequent home cooking was linked with reduced per capita food expenditures overall ($330/month among low vs $273/month among high cooking group, $p<0.001$), and reduced away-from-home expenditures ($133 and $65, respectively), without any significant increase in at-home food expenditures. However, frequent eating out was associated with significantly higher per capita food expenditures overall ($261 in low vs $364 among high eating out group, $p=0.001$), and higher away-from-home expenditures.

Conclusions—Home-cooked dinners were associated with greater dietary guideline compliance, without significant increase in food expenditures. By contrast, frequent eating out was associated with higher expenditures and lower compliance. Home cooking may be a component of nutrition resilience.

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INTRODUCTION

Where food is consumed may affect diet quality, as measured by compliance with the Dietary Guidelines for Americans.[1–8] In multiple studies, meals prepared and eaten at home were associated with higher-quality diets and better health outcomes.[1,3,4,9–15] For example, the frequency of family dinners among adolescents had been positively associated with diet quality scores based on a modified 1995 Healthy Eating Index (HEI),[16] a measure of compliance with the Dietary Guidelines for Americans. Recent analyses of the National Health and Nutrition Examination Surveys[5,17,18] (NHANES 2007–2010) showed that frequent home-cooked dinners were associated with lower energy intakes and with lower consumption of sugar and fat.[7] However, not all the studies on family meals had uniformly positive outcomes.[19,20]

By contrast, consumption of away-from-home foods from fast food and full service restaurants was associated with more total dietary energy, more fat and saturated fat, and more sodium.[21] Meals eaten away from home have also been linked to obesity and weight gain.[1,2,22–26] The contribution of away-from-home foods to total calories rose from 18% in 1977–1978 to 32% in 1994–1996.[2] Currently, energy obtained from sources away from home is estimated between 16.9% and 26.3% of the total, depending on age.[27] Those calories include both quick and full service restaurants, and food from workplace cafeterias, other people, and vending machines. At the same time, less than 20% of U.S. adults meet the U.S. Department of Agriculture dietary guidelines, failing to consume adequate amounts of vegetables, whole grains, and low-fat dairy.[28]

The recent literature has identified economics as one of the underlying barriers to comply with dietary guidelines, given that higher-quality diets were found to be linked with higher diet costs.[29,30] However, studies have not yet linked frequency of home cooking versus eating away from home with food expenditures. The present hypothesis was that frequent home-cooked dinners would be associated with higher diet quality, but not with higher self-reported food expenditures.[31] By contrast, frequent meals eaten away from home would be associated with lower diet quality and higher self-reported food expenditures. In the Seattle Obesity Study, these variables were captured using questions on the frequency of home-cooked dinners, frequency of meals away from home, and self-reported food expenditures, based on the 2009–2020 NHANES Flexible Consumer Module.[32–36] Diet quality was captured using HEI scores, a measure of compliance with Dietary Guidelines for Americans. To the authors' knowledge, this is the first study to link the frequency of cooking at home versus eating out with the most recent federal measure of diet quality available (HEI-2010), as well as with self-reported food expenditures.

METHODS

The Seattle Obesity Study was a primary data collection study on food environment, diets and health. A stratified address-based sampling scheme ensured adequate representation by geographic location and SES. The detailed methodology is provided elsewhere.[37] The study collected rich primary data on food shopping and eating behaviors, travel patterns, diets, and

health. Self-reported data on food-related attitudes, food shopping expenditures, socio-demographics, and physical activity were also collected.

Study Population

The initial sampling frame was based on 25,460 home addresses that were later matched to phone numbers. Recruitment was based on pre-notification postcards followed with up to three telephone calls. Eligible participants were English-speaking, aged 21–55 years, primary food shoppers of the household, and without any mobility issues. A total of 712 eligible respondents provided verbal consent and were invited to an in-person meeting, either at the study research site at the University of Washington or at their location of choice that was closer to their home. Of these, 516 (72.5%) agreed to enroll in the study. Data on sociodemographics, food-related behaviors, and self-reported food expenditures were collected using a computer-assisted health behavior survey. Participants were provided with a monetary incentive of $100 as a token of appreciation for successfully completing the baseline study protocols. These procedures were approved by the University of Washington IRB. The study sample was recruited from November 2011 to October 2013. The data were analyzed in 2015. The baseline data collection was completed by 516 respondents. However, after taking missing data for key variables into account (77 respondents with missing HEI variable data, and two with missing data on home-cooking question), the analytic sample consisted of 437 participants.

Measures

Demographic variables of interest were age, gender, race/ethnicity, marital status, household size, and employment status. SES indicators were education and household income. For analytic purpose, education was defined as: some college or less (<16 years), college graduate (16 years), and postgraduate (>16 years). Annual household incomes were collapsed into: ≤$50,000, $50,000–<$100,000, and ≥$100,000.

All the participants were asked: *During the past 7 days, how many times did you or someone else in your family cook food for dinner or supper at home?* The second question was: *How many meals prepared outside home do you eat each week? By meals, we mean breakfast, lunch or dinner. The meals can be prepared at places such as restaurants, fast food places, food stands, grocery stores or from vending machines.* The questions were based on the 2009–2010 NHANES Consumer Module. Based on the distribution of responses, the data were grouped into three frequency categories: low (zero to three times/week), medium (four to five times/week), and high (six or more times/week) for cooking at home, and separately for eating out variables.

A list of standard validated questions from the 2009–2010 NHANES module were used to collect self-reported data on monthly household food expenditures on all foods and beverages at all grocery stores combined, and on eating out. For example: *During the past 30 days, how much money (did your family/did you) spend at supermarkets or grocery stores?* These are widely used questions from NHANES, and were validated with objective household expenditure data from food shopping receipts.[38] Data from these questions were combined to compute the total monthly food expenditure.

The General Nutrition Assessment version of the Fred Hutchinson Food Frequency Questionnaire, administered during an in-person visit, was the primary dietary assessment tool. It is a standard validated tool to collect data on usual diets consumed by a respondent[39,40] that has been previously used in many large-scale studies.[41] Participants report the frequency of consumption and portion size of 125 line items over the past 1 year. Energy, nutrient intakes, and HEI scores were calculated using the University of Minnesota Nutrition Data Systems for Research software, version 2012.

The HEI-2010 was the primary diet quality measure of interest. It is the most recent diet quality measure available to assess compliance with the Dietary Guidelines for Americans.[42] HEI-2010 score tracks the 2010 Guidelines, and was based on component scores for total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, and empty calories.[43] HEI-2005 was used as another measure of diet quality used for sensitivity analyses. It measures compliance with 2005 dietary guidelines.[44] HEI-2005 components were total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fats, sodium, and calories from solid fats, alcohol, and added sugars.[44] Both scores had 12 components including nine adequacy and three moderation components, and both employed a 100-point scale. HEI scores range from 0 to 100, with higher scores indicating better diet quality. HEI scores >80 indicate a “good” diet, scores ranging from 51 to 80 reflect a diet that “needs improvement,” and HEI scores <51 imply a “poor” diet. For the present study, HEI-2010 served as the primary diet quality indicator. The analyses were replicated with HEI-2005 variables to ensure robustness of the study findings.

Statistical Analysis

First, descriptive statistics characterized the sociodemographic profile of respondents by frequency of cooking at home versus eating out. A series of chi-square tests provided *p*-values for statistical significance. Second, a series of bivariate linear regressions examined the associations of cooking at home versus eating out frequency, each with HEI scores. ANOVAs and *t*-tests were conducted to indicate statistical significance. Third, a series of multivariable linear regressions examined the frequency of cooking at home with HEI-2010, after adjusting for key covariates. Frequency of cooking dinner at home served as the primary independent variable, and HEI-2010 was the primary dependent variable. Model 1 adjusted for age, gender, race/ethnicity, marital status, household size, and employment status. To ensure that these associations persisted after taking SES into account, income and education were added as covariates in Model 2. These analyses were repeated with frequency of eating out as the primary independent variable, adjusting for covariates. Fourth, additional multivariable linear regressions with robust SEs examined the frequency of each —home cooking versus eating out—with per capita food expenditures. Adjusted marginal means of total food expenditures, and expenditures at home versus away from home were computed. Fifth, additional descriptive analyses were conducted to test these associations by each of the 12 HEI-2010 components separately. A series of ANOVAs provided the overall *p*-value for statistical significance. All the statistical analyses were conducted using Stata, version 13.0.

RESULTS

Participant distribution is summarized in Table 1. The sample was predominantly female (70%), aged <50 years (60%), white (85.6%), and married (56.8%). About 69% completed at least a college degree (≥16 years), 71% had household incomes ≥$50,000, and 75% were employed. Most were from households of two or more people (72%), and 29.5% had children aged <12 years living with them.

About half the sample (50.6%) frequently cooked dinner at home (six or more times/week), with one third (34.3%) cooking four to five times/week, and only 15.1% cooking rarely (zero to three times/week). There were no significant differences in frequency of cooking at home by age, gender, race/ethnicity, income, or education (p>0.05 for each) (Table 1). By contrast, significant differences in cooking frequency were observed by marital status, household size, number of children in the household, employment status, and frequency of eating out (overall p<0.05 for each). The proportion of married respondents rose significantly from 40% among the low cooking frequency group to 54.7% among the medium to 63.4% among the highest cooking frequency group. Similar trends were observed with greater household size, the presence of children in the household, and being unemployed (p<0.05 for each). For example, the proportion of unemployed respondents rose from 12.1% to 27.2% from low to high cooking-frequency group. The proportions for the employed, on the other hand, dropped significantly from 87.9% to 72.9% respectively.

Appendix Table 1 contrasts these sociodemographic trends by frequency of eating out. Unmarried respondents, one-person households and those without children, and the employed were significantly more likely to eat out (overall p<0.05 for each).

The bivariate associations between eating behaviors and HEI scores are presented in Appendix Table 2. Though higher frequency of cooking at home was linked with higher HEI-2010 scores (with the substantial difference of 7 points between low and high cooking groups, and 3.3 points between medium and high cooking groups), higher frequency of eating out was associated with significantly lower HEI scores (with a 6-point decline in HEI scores from low to high eating out groups, and an almost 2-point decline from medium to high eating out groups). Similar, but slightly weaker, associations were observed with HEI-2005.

The multivariable associations are presented in Table 2. A dose–response association was observed such that HEI-2010 rose together with the frequency of cooking dinner. HEI-2010 rose by 4.63 points from the lowest to medium frequency category (95% CI=1.68, 7.58) and rose by 7.68 units going from the lowest to the highest frequency category (95% CI=4.93, 10.42), adjusting for demographic variables (Model 1). These associations remained robust even after adding income and education to the model (β=4.55, 95% CI=1.58, 7.51 for medium cooking frequency; β=7.44, 95% CI=4.70, 10.17 for highest cooking frequency; Model 2).

Separate multivariable regression analyses were conducted with frequency of eating out and the HEI-2010 variable. HEI-2010 score declined by 4.96 points from low to medium frequency (95% CI= −7.46, −2.45), and dropped by 5.74 points going from the lowest to

highest frequency (95% CI= −8.34, −3.14) of eating out. Consistent results were obtained with the HEI-2005 variable for both home cooking and eating out (Table 2).

Figure 1 shows change in each of the 12 HEI-2010 components by frequency of cooking dinner at home (A) and eating out (B). Most of the HEI components showed significant improvements, except for refined grains, total protein, and dairy. Importantly, frequent home cooking was linked to fewer empty calories and lower sodium intakes. By contrast, frequent eating out was associated with lower HEI component subscores. Total protein was the only exception.

Table 3 examined the frequency of home cooking versus eating out in relation to self-reported food expenditures obtained using standard NHANES questions. Frequent cooking at home was marginally associated with per capita food expenditures at home ($195 per person per month among the lowest cooking group to $180 among the medium and $208 among the highest cooking group). However, there was a sharp decline in food expenditures away from home ($133, $108, and $65, respectively, $p<0.001$), as well as overall food expenditures ($330, $291, and $273, respectively, $p<0.05$). By contrast, frequent eating out was not associated with a significant decrease in home spending, but added greatly to food expenditures away from home ($64, $101, and $171 for the low, medium, and high eating out groups, respectively, $p<0.001$), as well as to overall monthly expenditures ($261, $305, and $364 per person per month, respectively, $p=0.001$).

DISCUSSION

Consistent with past reports, based on NHANES 2007–2010 data,[45] the frequency of cooking dinner at home was strongly and independently associated with higher HEI-2010 and HEI-2005 scores. The strongest results were obtained for the empty calorie HEI subscores, supporting the notion that home-cooked dinners were associated with diets lower in calories, sugar, and fat.[7] The data were robust after adjusting for household demographics, education, income, and employment. This is significant, as higher HEI scores are generally associated with higher SES, education, and income. By contrast, cooking dinner at home depends more on family size and the number of children.

Importantly, frequent home-cooked dinners were not associated with higher self-reported food expenditures in this study. The small increase in at-home spending was more than offset by significantly lower spending on foods away from home. Cooking dinners at home may be an effective strategy to reduce the consumption of empty calories, and improve diet quality within the budget.[21,46] Many past studies have noted that some of the barriers to the adoption of healthier diets may be economic, given that higher dietary HEI scores are associated with higher monetary diet costs.[24,47] The present observation that more-frequent home-cooked dinners were strongly associated with higher HEI scores at no extra self-reported cost has multiple implications for public health policies. First, interventions to improve diet quality should target home-cooked meals. Second, such interventions should be accompanied with nutrition education on how to increase home-cooked meals while maintaining or reducing the food budget. It is worth noting that Supplemental Nutrition Assistance Program Education has increasingly featured recipes, cooking lessons, and other

resources to promote home-cooked meals.[48] Low income recipients of food assistance[48] may need to address other potential barriers to cooking dinners at home, including lack of time, lack of cooking skills, or the sheer convenience of eating out.[49]

An extensive literature that goes beyond home-cooked dinners suggests that family meals in general are further associated with positive behavioral and psychological outcomes, especially among children.[3,11–18] However, a systematic review of the association between family meals and adolescent health outcomes noted that many effects were attenuated by family cohesion.[19] The present study, focused on diet quality and cost, suggests that frequent home-cooked dinners may allow families to eat better for less.[31]

In the present data, frequent meals eaten away from home were strongly associated with lower HEI scores. This is consistent with a past study where meals away from home were associated with more calories, sodium, and fat.[21] One important new finding in this study was that more-frequent meals away from home were associated both with lower-quality diets and higher self-reported food expenditures. The present results are broadly consistent with published analyses of NHANES data.[5,7] The 2015 Dietary Guidelines Advisory Committee noted that the convenience of eating prepared foods away from home could add to the family's food budget.[50]

The time spent on preparing food at home also decreased significantly from 1965 to 2007, especially among lower-income groups.[51] In a Seattle-based study, the time spent on preparing meals was associated with more frequent consumption of vegetables and fruit.[4] However, time may not be the only relevant factor. Given the benefits of eating at home,[6] continued teaching of nutrition and cooking skills assumes a new public health importance.

Limitations

The present approach, based on standard food expenditure questions from NHANES, extends and complements past studies[24,52–54] where individual-level diet costs were estimated by joining retail food prices to dietary intake data.[55] However, there were limitations. First, the cross-sectional nature of the present database limited the ability to draw causal inferences. Second, both the frequency of cooking at home and HEI scores were based on self-reported data that are subject to bias. Third, the present data did not permit any conclusions about the impact of cooking at home versus eating out on long-term diet quality and health. However, the present data are consistent with observations from national level studies.[7]

CONCLUSIONS

More-frequent home-cooked dinners were associated with higher-quality diets at no extra cost. By contrast, frequent meals away from home were associated with lower-quality diets and higher self-reported food expenditures.[4,56] Lack of time, nutrition knowledge, and cooking skills are powerful deterrents to cooking at home.[23] Public policies aimed at promoting healthier diets on a budget, a priority for the U.S. Department of Agriculture, need to take these multiple considerations into account.[57]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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AT led the data analyses and assisted in conceptualizing the manuscript, data interpretation, and manuscript writing. AA led the study data collection and assisted in conceptualizing the manuscript, data analyses, data interpretation, and manuscript writing. WT assisted in data collection and data analyses. AD was the study Principal Investigator; he led the study design, data collection, conceptualization of the manuscript, and manuscript writing. All the authors reviewed and approved the submitted version of the manuscript.

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Figure 1A

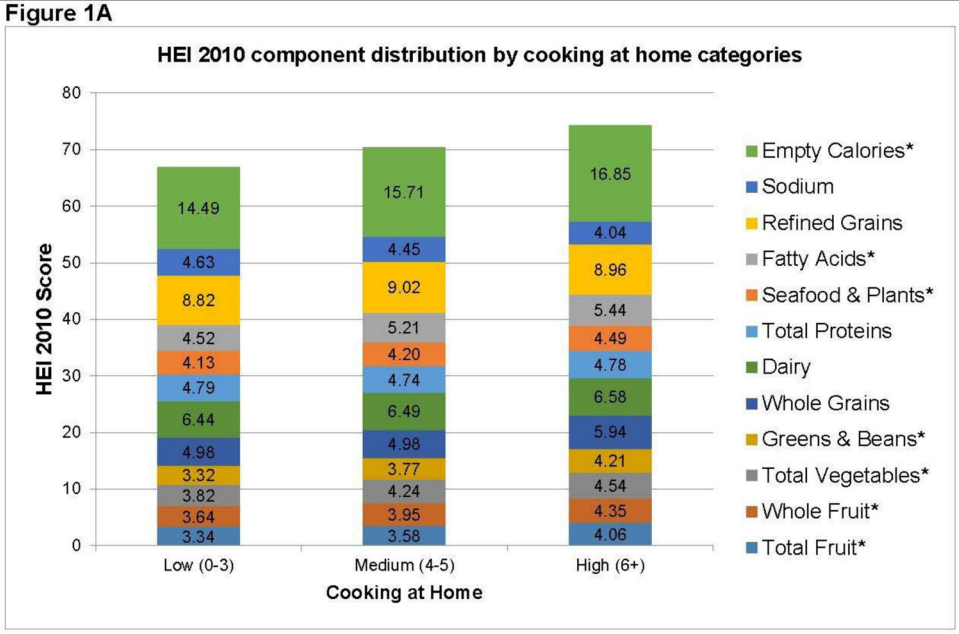

Figure 1B

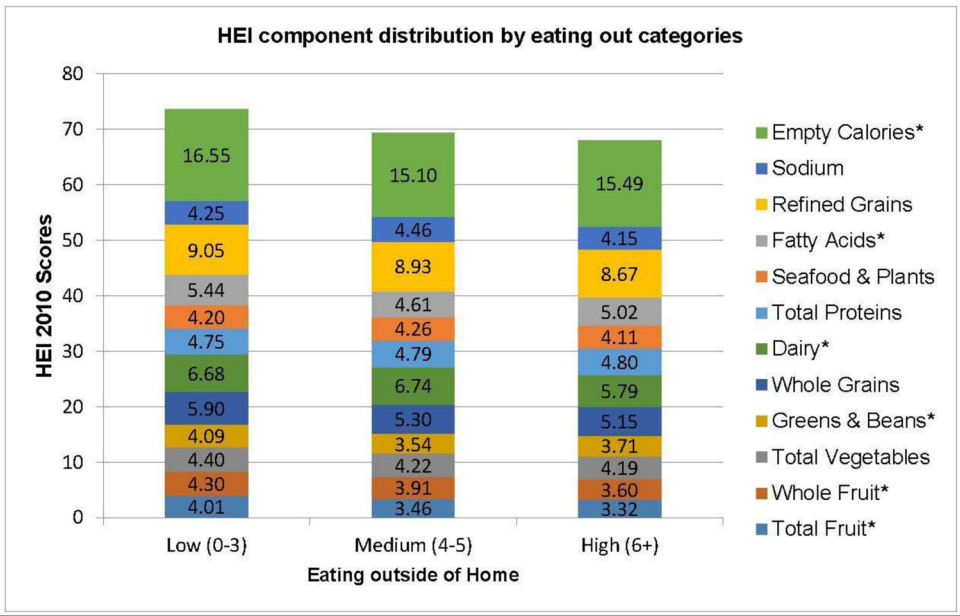

Figure 1.

Stacked graph of HEI 2010 components for frequency of: (a) cooking at home and (b) eating out by groups.

*Indicates statistically significant differences in mean HEI 2010 components at $p<0.05$.

HEI, Healthy Eating Index

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Table 1

Distribution of Frequency Cooking at Home by Sociodemographic Variables and Frequency of Eating Out

Variable		Weekly frequency of cooking dinner at home			
		Low 0–3/week	Medium 4–5/week	High 6+/week	Pearson chi^2 *p*-value
	All n=437 n (%)	n=66 n (%)	n=150 n (%)	n=221 n (%)	
Gender					
Men	131 (30.0)	22 (33.2)	47 (31.3)	62 (28.1)	
Women	306 (70.0)	44 (66.7)	103 (68.7)	159 (71.9)	0.650
Age categories (years)					
21–49	263 (60.0)	38 (57.6)	96 (64.0)	129 (58.4)	
≥50	174 (40.0)	28 (42.4)	54 (36.0)	92 (41.6)	0.500
Race/ethnicity					
White	374 (85.6)	57 (88.4)	127 (84.7)	190 (85.9)	
Non-white	63 (14.4)	9 (13.6)	23 (15.3)	31 (14.0)	0.920
Annual household income ($)					
<50,000	119 (27.2)	20 (30.3)	43 (28.7)	56 (25.3)	
≥50,000 – <100,000	158 (36.6)	27 (40.9)	57 (38.0)	74 (33.5)	
≥100,000	149 (34.0)	19 (28.8)	45 (30.0)	85 (38.5)	0.397
Education					
Some college or less (<16 years)	159 (36.4)	27 (40.9)	53 (35.5)	79 (35.8)	
College graduate (16 years)	151 (34.6)	23 (34.9)	57 (38.0)	71 (32.1)	
Post-graduate (>16 years)	149 (34.0)	16 (24.2)	40 (26.7)	71 (32.1)	0.579
Marital status					
Married	248 (56.8)	26 (40.0)	82 (54.7)	140 (63.4)	
Unmarried	189 (43.3)	40 (60.0)	68 (45.3)	81 (36.7)	**0.002**
Household size					
1 person	121 (27.7)	33 (50.0)	41 (27.3)	47 (21.3)	
2–6 people	316 (72.3)	33 (50.0)	109 (72.7)	174 (78.7)	**<0.001**
Children <12 years					
None	308 (70.5)	55 (83.3)	105 (70.0)	148 (67.0)	

Variable		Weekly frequency of cooking dinner at home			
		Low 0–3/week	Medium 4–5/week	High 6+/week	Pearson chi^2 *p*-value
	All n=437 n (%)	**n=66 n (%)**	**n=150 n (%)**	**n=221 n (%)**	
1–4	129 (29.5)	11 (16.7)	45 (30.0)	73 (33.0)	**0.037**
Employment status					
Yes	326 (74.6)	58 (87.9)	107 (71.3)	161 (72.9)	
No	111 (25.4)	8 (12.1)	43 (28.7)	60 (27.2)	**0.025**
Frequency of eating out					
Low (0–3/week)	281 (64.3)	26 (39.4)	77 (51.3)	178 (80.5)	
Medium (4–5/week)	77 (17.6)	12 (18.2)	35 (23.3)	30 (13.6)	
High (6+/week)	79 (18.1)	28 (42.4)	38 (25.3)	13 (5.9)	**<0.001**

Notes: Boldface indicates statistical significance ($p<0.05$).

Table 2

Multivariate Associations of HEI 2010 and 2005 Scores With Frequency of Cooking at Home, Adjusting For Sociodemographic Variables

Variable	HEI-2010					
	Model 1			Model 2		
	β	*p*-value	95% CI	β	*p*-value	95% CI
Frequency of cooking dinner at home						
Low	Ref			Ref		
Medium	**4.63**	**0.002**	**(1.68, 7.58)**	**4.55**	**0.003**	**(1.58, 7.51)**
High	**7.68**	**0.001**	**(4.93, 10.42)**	**7.44**	**0.001**	**(4.70, 10.17)**
Frequency of eating out						
Low	Ref			Ref		
Medium	**−4.96**	**0.001**	**(−7.46, −2.45)**	**−5.08**	**0.001**	**(−7.49, −2.68)**
High	**−5.74**	**0.001**	**(−8.34, −3.14)**	**−6.64**	**0.001**	**(−9.19, −4.09)**
	HEI-2005					
Frequency of cooking dinner at home						
Low	Ref			Ref		
Medium	**3.98**	**0.006**	**(1.17, 6.80)**	**3.90**	**0.007**	**(1.07, 7.73)**
High	**7.37**	**0.001**	**(4.73, 10.01)**	**7.09**	**0.001**	**(4.41, 9.76)**
Frequency of eating out						
Low	Ref			Ref		
Medium	**−4.36**	**0.001**	**(−6.75, −1.96)**	**−4.36**	**0.001**	**(−6.72, −2.00)**
High	**−5.19**	**0.001**	**(−7.70, −2.69)**	**−5.66**	**0.001**	**(−8.11, −3.21)**

Notes: Boldface indicates statistical significance ($p<0.05$). These analyses were replicated with frequency of eating out variable. Model 1: adjusted for age, gender, race/ethnicity, marital status, household size, employment status. Model 2: Model 1 + annual household income + education

Table 3

Adjusted Mean Monthly Per Capita Food Expenditures by Frequency of Cooking-at-Home Versus Frequency of Eating-Out

Variable	Low (0–3/week)	Medium (4–5/week)	High (6+/week)	*p*-value
Frequency of cooking dinner at home (n=437)	**n=66 Mean (SE)**	**n=150 Mean (SE)**	**n=221 Mean (SE)**	
Per capita food expenditures ($/mo)				
Total	330 (18.4)	291 (21.5)	273 (10.4)	**0.033**
At home	195 (13.6)	180 (7.8)	208 (8.3)	0.051
Away from home	133 (11.9)	108 (7.8)	65 (16.3)	**0.001**
Frequency of eating out (n=437)	**n=281 Mean (SE)**	**n=77 Mean (SE)**	**n=79 Mean (SE)**	
Per capita food expenditures ($/mo)				
Total	261 (8.5)	305 (18.7)	364 (19.7)	**0.001**
At home	196 (6.8)	202 (13.1)	193 (13.1)	0.895
Away from home	64 (3.4)	101 (8.2)	171 (12.5)	**0.001**

Notes: The Mean expenditure values are adjusted for age, gender, race/ethnicity, marital status, household size, employment status, income, and education. Boldface indicates the significance level of difference in adjusted means across frequency categories.