**Food Away From Home: How much does it really influence diet quality?**

Lisa Mancino, Jessica E. Todd, and Biing-Hwan Lin*†

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* Economic Research Service, USDA—all of them

† The opinions expressed here are those of the authors and not necessarily those of the US Department of Agriculture

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**Abstract**

This study confirms that eating food away from home (FAFH) adversely affects dietary intake. By looking at changes within individuals' dietary intake over two days, thus controlling for self-selection issues, we find that FAFH causes increased caloric intake and reduced diet quality. Our estimates on the effect of specific meals show that lunch and dinner consumed away from home have the largest effect on total daily caloric intake, but that breakfast has the largest negative effect on total diet quality. In particular, eating breakfast away from home decreases intake of fruit, whole grains and dairy and increases the percent of calories from saturated fats and solid fats, alcohol and added sugar. Eating lunch and dinner away from home also reduce diet quality, affecting similar dietary components, with dinner away from home also reducing vegetable intake. Unlike past studies based on correlation analyses, this study shows how FAFH can have a causal impact on weight gain.

## Introduction

Despite enduring public health messages about the importance of a healthy diet and lifestyle, most Americans continue to choose low quality diets and obesity rates continue to rise. One oft cited reason for persistently poor diets may be that today's food environment offers many opportunities to select unhealthy foods. Busy schedules may also affect the quality of the food we eat, by changing the regularity with which we eat, the time available for meal preparation, and the consumption of foods prepared away from home. Consumers today spend an increasing share of total food expenditures of food away from home (FAFH). In 2007, families spent nearly 42 % of their food dollars on foods outside the home, up from 25% in 1970 (Clauson and Leibtag, 2008).

Noting that the share of calories from FAFH increased from 18 to 32% between 1977 and 1996, Guthrie et al (2002), examined the differences in the nutritional quality of food prepared at home (FAH) and FAFH. They found that FAFH was higher in total fat and saturated fat and lower in dietary fiber, calcium, and iron. Others have documented that diet quality is lower, or that body mass index (BMI)[1] is higher, among individuals who eat FAFH as compared to those who do not, suggesting that FAFH contributes to the obesity epidemic and decreases diet quality (Binkley 2008, Binkley 2000; Jeffery and French 1998; Bowman et al 2004; Bowman and Vinyard 2004; Clemens et al 1999; Paeratakul et al 2003). However, such cross-sectional comparisons fail to account for the fact that the choice of where to eat is not exogenously determined. Rather, this choice is based on preferences, prices, time constraints and other factors--the same factors that affect food choices, diet quality, and body weight. It may be that individuals who consume a high share of FAFH also prefer lower nutritional quality foods when eating at home. Or if the time demands of family and work raise demand for convenient foods, both at and away from home, and also reduce time available for physical activity, then BMI levels among individuals who eat more convenient foods would likely be higher than those who do not. Thus not accounting for these unobservable factors will bias the estimated impact of FAFH on caloric intake and diet-quality.

Other studies have attempted to overcome the issue of bias due to unobservables by estimating the effect of access or proximity to restaurants. Chou et al. (2004) take an historical approach and find the state-level growth in availability of restaurants explains the majority of the growth in weight over time. However, the study does not account for the fact that the growth in the number of restaurants is largely demand-driven and thus, is most likely correlated with diet preferences and other factors affecting food choice. Anderson and Matsa (2007) use instrumental variables and find that access to restaurants has little to no effect on weight. However, their study is limited to rural areas in a small number of states.

[1] Body Mass Index is a measure of height (in meters) divided by weight (in kilograms), squared.

The objective of this study is to provide more precise estimates on how food away from home affects both caloric intake and diet quality. We overcome the selection issue by employing a first-difference, or fixed-effects, estimator utilizing two days of dietary intake data. We assume that individual's preferences for diet quality are fixed over a short time –frame within individuals, but day-to-day variation in activities and other constraints affects consumption of FAFH. Because the two days of dietary recalls are typically collected 7 to 10 days apart, this is a reasonable assumption. This allows us to directly identify FAFH's daily effect on diet quality and energy consumption and thus, its potential impact on bodyweight and obesity.

While some past studies have attempted to control for the selection issue using fixed effects estimation (Bowman and Vinyard, 2004; Bowman et al 2004; Paeratakul et al, 2003; and Binkley, 2008), these studies limited FAFH consumption measures to either a dichotomous or frequency measure, only considered consumption of fast food (or a specific form of food away from home) and usually limited their sample to individuals that consume FAFH on one, but not both days of dietary recall. We improve on past studies by using a continuous measure of FAFH consumption, which provides an estimate of the marginal effect of increasing consumption of FAFH and allows us to include all sample individuals with two days of dietary recall. We also add to the literature by testing for differences in the effect by meal occasion, across the two periods covered by our data (1994-96 and 2003-04), as well as across various population subgroups, including gender, weight status and whether or not an individual was dieting.

The remainder of this report is structured as follows. Section 2 presents a brief review of previous research on the effect of FAFH on diet quality, Section 3 describes the data, sample and variable construction, section 4 describes the first difference estimator and section 5 presents the results. The paper concludes with a discussion of the results and their policy implications.

**Previous Research**

Researchers have investigated the link between the consumption of FAFH and both diet quality and obesity. A majority of this research has focused on documenting the correlations between FAFH and these outcomes. For example, using a small sample of women participating in a study on the relationship between smoking and energy balance, Clemens et al (1999) compared the diet quality of women by their eating out frequency, finding that women that eat out more frequently consume more energy, fat and sodium than those that eat out less frequently.

Using data from the 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII), Bowman and Vinyard (2004) compared the total energy density, as well as intake of total energy, total fat, saturated fat, carbohydrates and added sugar between adults that report consuming any fast food and those that do not consume any fast food over two days of dietary recall. Bowman et al (2004) and Paeratakul et al (2003) conducted similar comparisons using the same survey for children. Binkley (2008) used the same data set and a similar approach, but analyzed separate impacts of fast food and table service restaurants on calories and grams of food consumed. All four studies found that individuals who report eating fast food have poorer diet quality than those who report not eating fast food. The study by Binkley also found a positive association between eating at a table service restaurant and caloric intake.

Using data from the 1987 and 1992 National Health Interview Survey (NHIS) and the 1999-2000 National Health and Nutritional Examination Survey (NHANES), Kant and Graubard (2003) found that the frequency of consuming commercially prepared meals was associated with higher intake of calories, total fat and saturated fat and lower intake of carbohydrates. Beydoun et al (2008) used the CSFII along with the companion Diet and Health Knowledge Survey

(DHKS), and found that greater weekly per capita expenditures on FAFH was associated with lower diet quality measures, including higher intake of total fat and saturated fat, lower fiber intake and lower HEI scores. This study also found that the relationship between FAFH and diet quality was significantly correlated with an individual's dietary knowledge, thus indicating a possible simultaneity between deciding what and where to eat.

To account for this simultaneity of decision making, a number of studies limited their comparisons to individuals that consume FAFH on one, but not both days or neither days, of dietary intake (Bowman and Vinyard 2004, Bowman et al 2004, Paeratakul et al 2003 and Binkley 2008). They then compared the mean diet quality on the day that FAFH was consumed to that on the day FAFH was not consumed. The idea being that the differences in diet quality across the two days would measure the "effect" of FAFH after controlling for individual characteristics that would affect preferences for diet quality and FAFH. There are two main problems with this comparison. First, only a small portion of the sample was included in the analysis (due to the requirement that FAFH is consumed on one and only one day). Second, the variation in the overall quantity of FAFH consumed was ignored because FAFH consumption is only measured dichotomously.

Ebbelling et al (2004) offered experimental evidence on the effect of fast food on diet quality. Enrolling 54 adolescents aged 13-17 in a controlled setting, they found that participants who were told to eat as much or as little fast food as desired consumed more than 60 percent of their estimated energy requirements at a single fast food meal. They also found that overweight participants ate significantly more calories from fast food than healthy weight participants, both in total and as a share of daily requirements. Analysis of dietary recall data on these same participants revealed that the overweight participants consumed 409 more calories on FAFH days. However, this study was limited by its small sample size and focused exclusively on fast food.

A few studies have tried to identify the causal effect using indirect measures of consumption of FAFH, such as access to restaurants and prices of both FAFH and FAH, however, their findings are not consistent. For example, Chou et al (2004) regress individual BMI and obesity status on the state-level number of restaurants and food prices. They find that the availability of restaurants as measured by the number per capita explains the majority of the growth in weight over time. It is important to note that the supply of restaurants is a function of demand, so their estimates may be biased upward due to the positive correlation between BMI and demand for FAFH.

Anderson and Matsa (2007) also estimated the effect of access to FAFH, using the distance to an interstate highway to instrument for access to restaurants. In contrast to Chou et al., Anderson and Matsa find that access to restaurants has no effect on BMI or obesity status. Despite the use of instrumental variables, their estimates may still be biased by unobservable factors. For example, it may be that people who live farther away from restaurants treat eating out as more of a special occasion than those who live close. As such, diners who make a special trip to eat away from home may also make more indulgent choices than those who can do so more regularly. Thus, if proximity to restaurants is used to proxy the impact of food away from home, this behavioral difference could lower its estimated effect. Moreover, since their study is limited to rural areas in a small number of states, the results are not generalizable.

**Data and Sample**

We use data from two national surveys covering the periods 1994-96 and 2003-04. The CSFII collected two nonconsecutive days of dietary recall data between 1994 and 1996 for a nationally representative sample of adults and children. Both days of intake were collected in person. This survey was later merged with the NHANES in 2002, but only began releasing both days of dietary intake after 2003. Thus, the 2003-04 NHANES and 1994-1996 CSFII are, to date, the most recent datasets containing two days of dietary intake for which a particular measure of diet quality can be constructed.[2] The 2005-6 NHANES intake data have been released, however, the corresponding MyPyramid Equivalent Database has not been released. In this study we use the MyPyramid database to evaluate dietary quality and therefore do not include the 2005-2006 NHANES. We limit our sample to adults age 20 and older.

As dependent variables, we include various measures of diet quality. We use total daily caloric intake as well as the total HEI-2005 score, developed by the Center for Nutrition Policy and Promotion (CNPP), US Department of Agriculture. The HEI-2005 score measures how well an individual's diet adheres to the 2005 Dietary Guidelines for Americans (USDA/USDHHS 2005; Guenther et al 2007). This total score is the sum of an individual's score on twelve 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 calories from solid fats, alcoholic beverages, and added sugars (SoFAAS). These component scores are created using a density approach. For fruits, vegetables, grains, milk, meat and beans, densities reflect the cup or ounce equivalents per 1,000 calories. For oils and sodium, the densities measure the grams per 1,000 calories. For saturated fats and SoFAAS, densities measure the percent of daily calories. For this analysis we focus on the component densities

[2] The NHANES collect the second day of the dietary recall through a telephone interview.

where current dietary intake is lacking: total fruit, whole fruit, total vegetables, dark green and orange vegetables, whole grains, and dairy. We also look at component densities where current intake is excessive: saturated fat, sodium and SoFAAS (Guenther et al, 2008).[3]

We use the reported source from which each food was obtained to define whether a food is a FAFH item. Meals were then classified as FAFH if the majority of calories, excluding beverages, came from fast food, table service restaurants, cafeterias or taverns. We used the respondent's stated definition of an eating occasion to classify each meal as either breakfast, lunch, dinner or a snack. Because eating patterns may change on weekends, we also controlled for whether or not an intake day occurred on a Saturday or Sunday. Two-day sample means for our explanatory, dependent and selected demographic variables are reported in Table 1. As will be explained later, the demographic variables are used to test whether the effect of FAFH varies by population sub-groups. These summary statistics show that, after pooling both surveys, the average respondent consumed 2087 calories, had an HEI score of 51.5 (out of 100) and ate 1.32 meals away from home. Forty-two percent of the sample reported a healthy weight (BMI<25), while 24 percent reported being obese (BMI>30).

**Estimation Approach**

If FAFH consumption is completely exogenous to an individual's preferences for diet quality, we can estimate the effect of FAFH on diet quality for individual *i* using OLS:

$$DQ_i = \alpha + \boldsymbol{\beta}\mathbf{X}_i + \gamma FAFH_i + \mu_i \quad (1)$$

[3] The HEI-2005 includes three additional components for the pyramid equivalents per 1000 calories of total grains, meat and bean, and oil.

where DQ is some measure of diet quality, X is a vector of control variables that affect diet quality and FAFH is the number of meals from FAFH and μ is an identically and independently distributed (i.i.d.) stochastic error term.

If however, FAFH is correlated with the error term, the estimates of γ will be biased. Instead, we must separate the choice over the amount of FAFH from the individual's unobservable preference for nutrition and diet quality that may affect both FAFH and diet quality. If we assume that preferences for nutrition and diet quality are fixed over short-periods of time, we can employ a fixed-effects estimator to eliminate this bias. By decomposing the error term into an unobserved individual fixed effect ($\mu_i$) and a stochastic component ($\varepsilon_{i,t,}$) and using observations at two different times for each individual, we can subtract the first observation from the second:

$$\Delta DQ_i = \gamma(\Delta FAFH_i) + \Delta\varepsilon_i \quad (2)$$

This first difference model removes the individual fixed effects (and any other time-invariant characteristics) and allows us to estimate the effect of an increase in the number of meals consumed from FAFH on the measure of diet quality. To isolate the impact of FAFH, we incorporate changes in meal patterns, such as snacking and eating breakfast, and whether consumption was observed on a weekday or weekend:

$$\Delta DG_i = \gamma(\Delta FAFH_i) + \sum_{j=1}^{4}\phi_j(\Delta MEAL_{ij}) + \beta(\Delta weekend_i) + \Delta\varepsilon_i \quad (3)$$

where each *j* represents a particular meal (breakfast, lunch, dinner or snack). Thus, γ provides an estimate of the average effect of obtaining one additional meal from FAFH on diet quality.

However, the effect of FAFH on diet quality may differ depending on which meal or meals an individual obtains from FAFH. We replace the change in the number of meals from FAFH in equation (3) with separate indicators for whether each type of meal was consumed from FAFH.

$$\Delta DG_i = \sum_{j=1}^{4} \phi_j (\Delta MEAL_{ji}) + \sum_{j=1}^{4} \theta_j (\Delta MEAL_{ji})(FAFH_{ji}) + \beta(\Delta weekend_i) + \Delta\varepsilon_i \qquad (4)$$

In equation (4) each $\theta_j$ estimates the effect of consuming the particular meal from FAFH on diet quality. Identifying if there are particular meals in which the effects of eating away from home are particularly strong can help policy makers to design more effective interventions to improve decision-making.

After running estimates on the pooled data, we estimate equation (4) separately for the 1994-96 and 2003-04 samples to detect whether the effect of eating out on dietary quality has changed over time. Our approach is motivated by recent changes in the commercial food service industry. For example, many municipalities have instituted legislation or regulation modifying the types of information provided to consumers in fast food and other restaurants. In addition, many restaurants have begun to provide nutritional information for menu items, as well as to modify their menu choices. These supply-side changes may have changed how FAFH affects overall diet quality.

The effect of FAFH may also vary across demographic groups. Several studies have found that men and women differ significantly in dietary patterns (Binkley et al, 2000; Kuchler and Lin, 2002). In addition, other individual characteristics may modify how an individual responds to the cues and choices in restaurants or compensates at meals from FAH, affecting how much FAFH affects overall diet quality. We investigate the possibility of this heterogeneity of impact by estimating equation (4) separately for various subgroups and comparing the estimated coefficients on specific meals consumed away from home. We compare obese individuals (defined as those whose BMI is at least 30) to normal weight individuals (defined as those whose BMI is less than 25). However, BMI is not always an accurate gauge of adiposity, primarily because muscle weighs more that fat. Thus two individuals measuring the same height and BMI could still have drastically different levels of body fat. As such, we also compare individuals who perceive themselves to be overweight to those who do not. We also compare individuals on a low calorie or low fat diet to those who are not.

**Effect of FAFH on Diet Quality**

*People eat more calories and eat less healthfully on days when they eat at least one meal away from home*

Our results indicate that, even after controlling for self-selection issues using first-difference estimation, FAFH has a significant adverse impact on various measures of diet quality. Using the model described in equation (3), we find that each meal away from home is estimated to add 130 calories to total daily calories, and lower HEI scores by 2 points (Table 2). It is important to note that these estimates are lower than those obtained from on OLS regression of daily calories or HEI on the number of meals consumed away from home. The OLS estimates are roughly 25 to 28 percent larger than the first-difference estimates, which is consistent with the idea that energy intake and diet quality are inversely correlated with eating FAFH. Thus, it is important to control for unobserved differences in preferences for both diet quality and FAFH. Using the first-difference estimates, we find that eating one meal away from home each week, other things being equal, would translate to roughly two extra pounds each year. In 2005-2006, NHANES data indicate that individuals age 20 and older consumed on average, 4 meals away from home, per week. If 2 of these four away-from-home meals were replaced by at-home meals, an individual can shed 4 pounds in a year.[4]

*While eating out for lunch adds the most to daily calories, breakfast away from home takes the biggest bite out of diet quality*

We next examine how the impact of FAFH varies depending on which meals are consumed away from home using the model specified in equation (4). We find that eating lunch away from home has the largest impact on total daily calories, while breakfast has the smallest (Table 3). Eating breakfast away from home would add just over 72 more calories to total daily calories while lunch would add 157. Eating dinner away from home would add 137 calories, while a snack contributes 107 calories. Although the calorie impact is lowest for breakfast, its impact on an individual's total HEI score is the largest, reducing it by more than 4 points (a decrease of 9% from the mean of 51.5). Looking at the impact on specific components included in the HEI, we see that this drop from eating breakfast away from home comes from significantly less intake of fruit, whole-fruit, whole-grains and dairy and increased intake of saturated fat and SoFAAS.

*On the bright side, many of FAFH's adverse effects on diet quality may be shrinking*

We ran separate estimates on 1994-1996 CSFII and NHANES 2003-2004 data to test whether the impact of FAFH on our outcome measures had changed significantly over this

[4] Two meals translate to 260 additional calories per week or a total of 13520 calories a year. Assuming one pound equals 3500 calories, the total is 3.86 pounds a year.

period (Table 4). Overall, there are only a handful of significant differences between these two time periods. We find that dinner away-from-home has a greater impact on caloric intake in 2003-2004 compared to the earlier survey, but that there has been no change in FAFH's overall impact on diet quality (Table 4). Looking at components, however, we find that some of the negative impacts of FAFH on diet quality have diminished over time. The negative impact of eating breakfast away from home on whole-grain intake is significantly lower in the 2003-2004 data. This may be due to the increasing supply of whole-grain foods around this same time (Mancino et al, 2008). The impact of snacks away from home on saturated fat intake has improved, as has the impact of dinner away from home on per-calorie daily density of dairy and SoFAAs. The one exception to the reduced negative impact of FAFH in the more recent period is the effect on sodium. In 1994-1996, lunch away from home reduced daily sodium density, but in 2003-2004, this effect no longer existed.

*The effect of FAFH on calories and diet quality is roughly the same for men and women.*

We were also interested in how the impact of FAFH differed by gender. While the point estimates of the impact of each meal away from home on total energy intake for the day is larger for men, the differences between the estimates for men and women are not statistically significant (Table 5). The main differences we do observe between men and women are in the effect of eating lunch away from home on consumption of total fruit and whole fruit. For both genders, consuming lunch away from home reduces the density of fruit consumed, but women reduce their intake even more than men. Thus, it appears that there is not a distinct difference in how FAFH influences the energy intake or diet quality between men and women.

*Compared to healthy weight individuals, obese diners either eat more calories when eating FAFH or are less likely to compensate for these extra calories throughout the day*

As FAFH has been cited as a primary cause of obesity, we ran additional estimates to determine if FAFH has a more pronounced impact on individuals who are obese as compared to those with a healthy weight. While NHANES includes both measured and self-reported BMI, the CSFII only includes the latter. Thus we separated our sample based on self-reported BMI by the cutoffs for healthy weight, overweight, and obese. Since BMI is not a perfect measure of adiposity, we dropped overweight individuals from this comparison (25<=BMI<30) and compared individuals with BMI in the healthy weight range (BMI < 25) to those in the range that would classify them as obese (BMI >=30). In terms of caloric intake, the difference between healthy-weight individuals and obese individuals is stark (Table 6). For every meal except breakfast, the effect of FAFH on daily caloric intake is significantly lower for individuals with a healthy weight. While eating lunch away from home is estimated to add over 270 calories to an obese person's daily intake, it is estimated to add only 70 calories to a healthy weight person's intake. This supports other studies that find obese individuals do not compensate their increased caloric intake at one meal with reduced intake throughout the rest of the rest of the day (see for example, Ebbelling et al, 2004). It is interesting to note that the impact of FAFH on other markers of diet quality do not differ significantly between these subgroups. This suggests the difference in overall caloric intake from FAFH stems from portion size and lack of compensation throughout the day.

When comparing individuals who perceive themselves to have a healthy bodyweight (our alternative measure of body weight) to those who perceive themselves to be overweight, we find impact of FAFH on total daily calories is generally smaller for individuals with a healthy weight, although the difference between groups is only significant for lunch eaten away from home (Table 7). Thus, despite the fact that an individual considers himself or herself to be above their ideal weight, eating away from home significantly increases his or her total caloric intake. As in our previous comparison, we find that the effect of FAFH on diet quality is not significantly different over time or across demographics, with a couple of exceptions. First, eating breakfast away from home has a larger negative impact on total diet quality among those that perceive themselves to be of healthy weight; the difference between the two groups is nearly 2 HEI units. However, the only component where a significant difference between the two groups is observed is whole grains. In contrast to the total HEI score, eating a snack away from home reduces the density of whole grains among those that perceive themselves to be overweight, but not for those who perceive themselves to have a healthy weight. These results reinforce the idea that portion size and lack of compensation through the day are the mechanisms by which FAFH compromises diet quality among the overweight.

*Even dieters get in to trouble when eating away from home*

Finally, we compare the effects for individuals who report they are on a low-fat or low-calorie diet against those who do not report being on these diets. Again, we find that eating breakfast, lunch or snacks away from home increases total daily caloric intake even for individuals trying to watch their total daily calories (Table 8). However, the difference in the impact is significant only for breakfast away from home. In contrast to our comparisons by weight status, we find significant differences in the impact of FAFH on HEI and component densities. Interestingly, we find that the adverse impact of FAFH is significantly greater for individuals on a diet. Specifically, eating breakfast or lunch away from home increases the percent of calories from saturated fat, and eating breakfast or snacks away from home increases the percent of calories from SoFAAS.  This may indicate that dieters have more trouble compensating for the relatively less healthy food available away from home, or are more likely to splurge in the more tempting environment. Requiring nutritional information in restaurants or increasing the availability of healthier choices may be particularly beneficial for this group.

**Discussion**

Our findings suggest that individuals either do not or cannot compensate for the lower diet quality when eating out. Even after controlling for individual differences in dietary awareness and food preferences, we still find that people choose less healthful foods when eating away from home. We also find that the effect of FAFH on caloric intake persists and may even become more pronounced among individuals who, theoretically, should have strong incentives to make healthy FAFH choices, such as dieters and those who are obese.

These findings show that the concern about FAFH as a factor in the obesity epidemic is warranted. They also suggest that increasing transparency regarding calorie and nutrient content in FAFH could help to reduce FAFHs negative impact on diet quality. If individuals unknowingly eat less healthfully when eating away from home and do not know how to compensate for this indulgence over the rest of the day, then making information on the nutrient content of FAFH more prominent may make it easier for people to act on their own dietary intentions.  Also education on ways to make more healthful choices when choosing FAFH could have significant payoff, especially if problems of self-control are exacerbated when eating FAFH (Cutler et al 2003; Mancino and Kinsey 2008).

With increasing attention on FAFH's possible role in promoting poor diet quality and weight gain in the country, many restaurants have voluntarily added healthier items to their menus or have provided nutritional information (CSPI, 2003; Warner, 2005). This increased availability of healthier options as well as additional information may have modified the effect of FAFH by allowing individuals to make choices more consistent with their choices at home. We find that for some nutrients, the adverse effect of FAFH has improved over time. This trend may have continued and calls for updating our analysis when more recent data become available.

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**Tables and Figures**

**Table 1: Summary Statistics—Two-day means, 1994-6 and 2003-4**

| | Adults (N = 13429) | |
|---|---|---|
| **Dependent Variables** | **Mean** | **SE** |
| Energy (kcal) | 2087.02 | 13.35 |
| HEI 2005 | 51.50 | 0.33 |
| Fruit density (cup equiv. per 1,000 kcal) | 0.53 | 0.02 |
| Whole fruit density (cup equiv. per 1,000 kcal) | 0.34 | 0.01 |
| Whole grain density (ounce equiv. per 1,000 kcal) | 0.37 | 0.01 |
| Dairy density (cup equiv. per 1,000 kcal) | 0.71 | 0.01 |
| Vegetable density (cup equiv. per 1,000 kcal) | 0.89 | 0.01 |
| Dark green, orange density (cup equiv. per 1,000 kcal) | 0.14 | 0.00 |
| Percent saturated fat (percent of energy) | 11.12 | 0.08 |
| Sodium density (grams per 1,000 kcal) | 1668.27 | 8.40 |
| Percent SoFAAS (percent of energy) | 35.93 | 0.28 |
| **Explanatory Variables** | | |
| Breakfast | 0.88 | 0.01 |
| Lunch | 0.79 | 0.01 |
| Dinner | 0.96 | 0.00 |
| Snack | 1.32 | 0.02 |
| Number of meals away from home | 0.67 | 0.01 |
| Breakfast away from home | 0.08 | 0.00 |
| Brunch away from home | 0.01 | 0.00 |
| Lunch away from home | 0.25 | 0.01 |
| Dinner away from home | 0.23 | 0.00 |
| Snacks away from home | 0.10 | 0.00 |
| **Demographic Subgroups** | | |
| Male | 0.48 | 0.01 |
| NHANES (observed in 2003-04) | 0.53 | 0.02 |
| Obese (BMI >=30)[a] | 0.24 | 0.01 |
| Healthy weight (BMI <25)[a] | 0.42 | 0.01 |
| Perceived overweight[b] | 0.54 | 0.01 |
| On a low calorie or low fat diet | 0.10 | 0.00 |

a. Sample size = 13118 for adults; b. Sample size = 9755

**Table 2: Comparison of first-difference to OLS results, Effect of number of meals from FAFH on Energy and HEI for Adults**

| | Energy | | HEI | |
|---|---|---|---|---|
| | (First difference) | (OLS†) | (First Difference) | (OLS†) |
| Number of meals FAFH | 130.425*** | 162.756*** | -1.999*** | -2.549*** |
| | (12.86) | (20.69) | (0.23) | (0.19) |
| Breakfast | 190.751*** | 194.237*** | 1.897*** | 5.018*** |
| | (30.76) | (29.30) | (0.44) | (0.43) |
| Lunch | 239.980*** | 262.092*** | 2.201*** | 4.523*** |
| | (24.31) | (31.77) | (0.42) | (0.38) |
| Dinner | 295.109*** | 295.561*** | 2.522*** | 3.689*** |
| | (29.66) | (36.78) | (0.41) | (0.47) |
| Snack | 157.562*** | 164.109*** | 0.243* | 0.320** |
| | (9.69) | (10.26) | (0.14) | (0.13) |
| Weekend | 107.801*** | 127.262*** | -1.331*** | -0.975* |
| | (17.92) | (29.23) | (0.37) | (0.52) |
| Constant | -61.741*** | 1,280.608*** | 0.806*** | 37.093*** |
| | (10.53) | (136.86) | (0.17) | (1.63) |
| | | | | |
| Observations | 13429 | 13429 | 13429 | 13429 |
| R-squared | 0.10 | 0.29 | 0.03 | 0.14 |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

† OLS models also control for gender, age, low income status and race/ethnicity.

**Table 3: Effect of specific meals consumed from FAFH on energy, HEI and component densities, First-difference model**

| | Energy | HEI | Fruit density | Whole fruit density | Whole grain density | Dairy density | Vegetable density | Dark green, orange density | Percent saturated fat | Sodium density | Percent SoFAAS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Breakfast away from home | 72.703* | -4.452*** | -0.094*** | -0.076*** | -0.085*** | -0.084** | -0.008 | 0.000 | 0.891*** | 19.461 | 3.245*** |
| | (40.14) | (0.72) | (0.03) | (0.02) | (0.02) | (0.03) | (0.03) | (0.01) | (0.23) | (34.55) | (0.78) |
| Lunch away from home | 157.418*** | -2.016*** | -0.119*** | -0.107*** | -0.099*** | -0.059** | 0.007 | -0.015** | 0.312** | -53.579** | 1.828*** |
| | (16.51) | (0.42) | (0.02) | (0.02) | (0.01) | (0.03) | (0.02) | (0.01) | (0.12) | (23.49) | (0.29) |
| Dinner away from home | 136.630*** | -1.856*** | -0.079*** | -0.055*** | -0.046*** | 0.029 | -0.070*** | -0.041*** | 0.327*** | 0.634 | 1.932*** |
| | (25.95) | (0.40) | (0.02) | (0.02) | (0.01) | (0.02) | (0.02) | (0.01) | (0.11) | (22.76) | (0.35) |
| Snack away from home | 106.851*** | -1.094*** | -0.047** | -0.035** | -0.019 | -0.035 | 0.002 | 0.004 | -0.050 | 8.795 | 1.297*** |
| | (38.05) | (0.39) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.01) | (0.12) | (22.51) | (0.37) |
| Breakfast | 195.146*** | 2.213*** | 0.103*** | 0.055*** | 0.114*** | 0.063*** | -0.064*** | -0.007 | 0.072 | -20.867 | -1.526*** |
| | (31.03) | (0.41) | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) | (0.01) | (0.12) | (25.34) | (0.38) |
| Lunch | 223.994*** | 2.174*** | 0.016 | 0.039* | 0.041** | 0.046** | 0.017 | 0.011 | 0.071 | 75.080*** | -1.765*** |
| | (23.56) | (0.40) | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) | (0.01) | (0.14) | (22.62) | (0.33) |
| Dinner | 291.657*** | 2.527*** | -0.011 | -0.013 | 0.003 | 0.028 | 0.090*** | 0.036*** | 0.080 | 68.275*** | -2.221*** |
| | (29.70) | (0.41) | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) | (0.01) | (0.14) | (24.58) | (0.46) |
| Snack | 158.806*** | 0.182 | 0.042*** | 0.040*** | -0.001 | 0.008 | -0.058*** | -0.006** | -0.096* | -65.555*** | 1.041*** |
| | (10.06) | (0.15) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.00) | (0.05) | (9.76) | (0.16) |
| Weekend | 109.858*** | -1.306*** | -0.035** | -0.031** | -0.017 | -0.018 | -0.032** | -0.007 | 0.314*** | -28.450* | 1.299*** |
| | (17.79) | (0.37) | (0.02) | (0.01) | (0.01) | (0.02) | (0.02) | (0.01) | (0.08) | (14.35) | (0.34) |
| Constant | -61.847*** | 0.808*** | 0.036** | 0.035*** | 0.023*** | 0.016 | 0.026** | 0.009** | 0.003 | 41.982*** | -1.071*** |
| | (10.42) | (0.17) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.00) | (0.07) | (9.72) | (0.17) |
| Observations | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 | 13429 |
| R-squared | 0.10 | 0.04 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.04 |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 4: Effect of FAFH meals on energy and diet quality, by survey year, first-difference estimates**

| | Breakfast away | | Lunch away | | | Dinner away | | | Snack Away | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003-2004 | 1994-1996 | 2003-2004 | 1994-1996 | | 2003-2004 | 1994-1996 | | 2003-2004 | 1994-1996 | |
| Energy | 28.977 | 123.311*** | 161.800*** | 151.896*** | | 200.181*** | 66.976** | | 94.993 | 122.865*** | |
| HEI | -4.643*** | -4.239*** | -2.234*** | -1.704*** | | -1.671** | -1.920*** | | -1.274 | -0.984*** | |
| Fruit density | -0.101** | -0.085** | -0.135*** | -0.099*** | | -0.080*** | -0.077*** | | -0.054 | -0.044** | |
| Whole fruit density | -0.086** | -0.065** | -0.123*** | -0.086*** | | -0.049 | -0.060*** | | -0.058 | -0.023 | |
| Whole grain density | -0.042 | -0.139*** | -0.082*** | -0.116*** | | -0.040 | -0.048*** | | -0.049 | -0.002 | |
| Dairy density | -0.065 | -0.107*** | -0.048 | -0.067*** | | 0.083* | -0.030* | ++ | -0.081 | -0.005 | |
| Vegetable density | 0.011 | -0.028 | 0.024 | -0.015 | | -0.060 | -0.075*** | | 0.015 | -0.006 | |
| Dark green, orange density | 0.006 | -0.007 | -0.017 | -0.012 | | -0.043*** | -0.037*** | | 0.009 | 0.000 | |
| Percent saturated fat | 0.789* | 1.029*** | 0.264 | 0.383*** | | 0.284 | 0.357*** | | -0.452* | 0.180 | ++ |
| Sodium density | 9.516 | 31.598 | -15.870 | -97.371*** | + | 37.999 | -36.740 | | 34.741 | -4.438 | |
| Percent SoFAAS | 3.511** | 2.941*** | 1.640*** | 2.015*** | | 1.206** | 2.614*** | + | 1.078 | 1.371*** | |

Coefficient is significant at *** p<0.01, ** p<0.05, * p<0.1

Difference between 2003-2004 and 1994-1996 is significant at +++ p<0.01, ++ p<0.05, + p<0.1

**Table 5. Effect of FAFH meals on energy and diet quality, by gender, first-difference estimates.**

| | Breakfast away | | | Lunch away | | | Dinner away | | | Snack Away | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Females | Males | | Females | Males | | Females | Males | | Females | Males | |
| Energy | 31.183 | 101.611** | | 134.827*** | 182.014*** | | 113.133*** | 162.572*** | | 57.596 | 135.030** | |
| HEI | -4.103*** | -4.683*** | | -2.265*** | -1.670*** | | -2.077*** | -1.607*** | | -1.314 | -0.976** | |
| Fruit density | -0.066 | -0.114*** | | -0.152*** | -0.081*** | + | -0.103*** | -0.052** | | -0.040 | -0.053* | |
| Whole fruit density | -0.073* | -0.080*** | | -0.142*** | -0.065*** | ++ | -0.075*** | -0.031 | | -0.064*** | -0.016 | |
| Whole grain density | -0.040 | -0.118*** | | -0.088*** | -0.112*** | | -0.034 | -0.059*** | | -0.035 | -0.007 | |
| Dairy density | -0.047 | -0.114*** | | -0.055* | -0.060** | | 0.014 | 0.044* | | -0.020 | -0.045 | |
| Vegetable density | 0.007 | -0.024 | | 0.021 | -0.004 | | -0.114*** | -0.025 | | -0.020 | 0.020 | ++ |
| Dark green, orange density | 0.017 | -0.013 | + | -0.011 | -0.017* | | -0.059*** | -0.023** | | 0.016 | -0.007 | ++ |
| Percent saturated fat | 1.017*** | 0.784*** | | 0.336* | 0.284* | | 0.209 | 0.444*** | | 0.206 | -0.249 | |
| Sodium density | 21.635 | 17.602 | | -21.326 | -90.766*** | | 16.835 | -15.588 | | -8.053 | 25.425 | |
| Percent SoFAAS | 3.691*** | 2.837*** | | 2.132*** | 1.467*** | | 2.056*** | 1.789*** | | 1.367 | 1.300*** | |

Coefficient is significant at *** p<0.01, ** p<0.05, * p<0.1
Difference between male and female is significant at +++ p<0.01, ++ p<0.05, + p<0.1

**Table 6: Effect of FAFH meals on energy and diet quality, by weight status, first-difference estimates.**

| | Breakfast away | | | Lunch away | | | Dinner away | | | Snack Away | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy Weight | Obese | | Healthy Weight | Obese | | Healthy Weight | Obese | | Healthy Weight | Obese | |
| Energy | 82.523 | 83.217 | | 69.035** | 273.124*** | +++ | 115.084*** | 260.454*** | ++ | 72.895 | 259.226*** | ++ |
| HEI | -4.606*** | -3.775** | | -2.707*** | -1.337* | | -1.784*** | -1.429* | | -1.243* | -0.357 | |
| Fruit density | -0.033 | -0.150*** | | -0.116*** | -0.092*** | | -0.110*** | -0.076* | | -0.052* | -0.035 | |
| Whole fruit density | -0.032 | -0.123*** | | -0.115*** | -0.078*** | | -0.072*** | -0.048 | | -0.046* | -0.024 | |
| Whole grain density | -0.065** | -0.098** | | -0.134*** | -0.105*** | | -0.034 | -0.091*** | | 0.030 | -0.104*** | +++ |
| Dairy density | -0.073 | -0.025 | | -0.093*** | -0.042 | | 0.013 | 0.048 | | -0.036 | -0.064 | |
| Vegetable density | -0.019 | 0.035 | | 0.047 | -0.005 | | -0.074*** | -0.071** | | -0.031 | -0.01 | |
| Dark green, orange density | -0.014 | 0.017 | | -0.008 | -0.018 | | -0.052*** | -0.030** | | 0.013 | -0.002 | |
| Percent saturated fat | 0.938*** | 1.294*** | | 0.278 | 0.382 | | 0.279 | 0.339 | | 0.074 | 0.125 | |
| Sodium density | 46.156 | -44.559 | | -13.983 | -82.727 | | 36.989+ | -62.714*,+ | | -11.372 | 14.051 | |
| Percent SoFAAS | 3.694*** | 3.714** | | 2.076*** | 1.419** | | 1.812*** | 2.070*** | | 1.257* | 0.576 | |

Coefficient is significant at *** p<0.01, ** p<0.05, * p<0.1

Difference between subgroups is significant at +++ p<0.01, ++ p<0.05, + p<0.1

**Table 7: Effect of FAFH meals on energy and diet quality, by perceived weight status, first-difference estimates.**

| | Breakfast away | | | Lunch away | | | Dinner away | | | Snack Away | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Perceived healthy weight | Perceived overweight | | Perceived healthy weight | Perceived overweight | | Perceived healthy weight | Perceived overweight | | Perceived healthy weight | Perceived overweight | |
| Energy | 41.140 | 91.224* | | 49.788 | 220.904*** | +++ | 154.152*** | 122.139*** | | 50.137 | 108.129 | |
| HEI | -5.450*** | -3.578*** | ++ | -2.685*** | -1.329** | | -1.967*** | -2.039*** | | -1.013 | -1.081 | |
| Fruit density | -0.025 | -0.131** | | -0.129*** | -0.116*** | | -0.092*** | -0.073** | | -0.074** | -0.032 | |
| Whole fruit density | -0.019 | -0.111*** | | -0.117*** | -0.103*** | | -0.072*** | -0.039 | | -0.055** | -0.032 | |
| Whole grain density | -0.086** | -0.070** | | -0.118*** | -0.082*** | | -0.058** | -0.053*** | | 0.011 | -0.082* | + |
| Dairy density | -0.130* | -0.039 | | -0.045 | -0.072* | | 0.046 | 0.046 | | -0.062 | -0.053* | |
| Vegetable density | 0.027 | 0.017 | | 0.056 | -0.017 | | -0.075*** | -0.084** | | -0.002 | 0.023 | |
| Dark green, orange density | -0.008 | 0.016 | | -0.015 | -0.012 | | -0.036*** | -0.051*** | | 0.018 | 0.000 | |
| Percent saturated fat | 0.827** | 0.989*** | | 0.308 | 0.215 | | 0.510** | 0.153 | | -0.221 | -0.292 | |
| Sodium density | 13.516 | 16.512 | | -39.585 | -47.848 | | -8.749 | 23.375 | | 7.320 | 35.418 | |
| Percent SoFAAS | 4.026*** | 2.521** | | 2.281*** | 1.366** | | 2.145*** | 1.617** | | 0.980 | 1.462** | |

Coefficient is significant at *** p<0.01, ** p<0.05, * p<0.1
Difference between subgroups is significant at +++ p<0.01, ++ p<0.05, + p<0.1

**Table 8: Effect of FAFH meals on energy and diet quality, by dieting status, first-difference estimates.**

| | Breakfast away | | | Lunch away | | | Dinner away | | | Snack Away | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-dieter | Dieter | | Non-dieter | Dieter | | Non-dieter | Dieter | | Non-dieter | Dieter | |
| Energy | 46.985 | 309.996*** | +++ | 151.790*** | 201.852*** | | 142.940*** | 73.582 | | 106.345*** | 128.378 | |
| HEI | -4.158*** | -7.225*** | + | -2.060*** | -1.772 | | -1.780*** | -2.525** | | -0.994** | -2.341** | |
| Fruit density | -0.073** | -0.267** | | -0.114*** | -0.167*** | | -0.073*** | -0.136** | | -0.052** | -0.019 | |
| Whole fruit density | -0.059** | -0.228 | | -0.098*** | -0.180*** | | -0.045*** | -0.137** | + | -0.041** | -0.003 | |
| Whole grain density | -0.090*** | -0.039 | | -0.093*** | -0.146** | | -0.044*** | -0.059 | | -0.019 | -0.015 | |
| Dairy density | -0.092*** | 0.011 | | -0.042* | -0.208** | | 0.028 | 0.031 | | -0.037 | 0.000 | |
| Vegetable density | -0.001 | -0.062 | | 0.003 | 0.034 | | -0.059** | -0.173* | | 0.011 | -0.095 | |
| Dark green, orange density | -0.000 | 0.003 | | -0.016* | -0.004 | | -0.039*** | -0.062** | | 0.007 | -0.025 | |
| Percent saturated fat | 0.790*** | 1.966*** | + | 0.231 | 0.993*** | ++ | 0.333*** | 0.275 | | -0.105 | 0.609 | |
| Sodium density | 29.602 | -64.707 | | -44.326 | -132.447** | | 6.065 | -50.002 | | 7.721 | -5.780 | |
| Percent SoFAAS | 2.962*** | 5.964*** | + | 1.792*** | 2.300** | | 1.881*** | 2.483* | | 1.133*** | 3.304*** | + |

Coefficient is significant at *** p<0.01, ** p<0.05, * p<0.1
Difference between subgroups is significant at +++ p<0.01, ++ p<0.05, + p<0.1