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Separating what we eat from where: Measuring the effect of food away from home on diet quality ☆

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ABSTRACT

Many argue that food away from home (FAFH) is a contributing factor to the obesity epidemic, showing that body mass index and consumption of FAFH are positively correlated. However, correlation analyses using a simple regression approach, such as the Ordinary Least Squares (OLS), do not prove that FAFH causes weight gain. We use a first-difference estimator to establish a causal relationship between FAFH and dietary intakes. Using dietary recall data from the 2003–2004 National Health and Nutrition Examination Survey and the 1994–1996 Continuing Survey of Food Intakes by Individuals, we find that FAFH does indeed increase caloric intake and reduce diet quality, but that the effect is smaller than if estimated using OLS. Thus, models based on associations are likely biased upward, as much as 25% by our estimates.

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Introduction

Despite repeated 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 frequently cited reason for persistently poor diets is today's food environment, which offers many opportunities to make unhealthy food choices. Busy schedules may also affect the quality of the food we eat by changing the regularity with which we eat, time available for meal preparation, and consumption of foods prepared away from home. Consumers today spend an increasing share of their food expenditures on 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 (Clausen and Leibtag, 2008).

This increased consumption of FAFH has often been cited as a contributor to obesity and low diet quality among Americans. The bulk of existing research investigating this link, however, has focused on documenting correlations by showing that poor diet quality or high body mass indices (BMI) are associated with greater consumption of FAFH (Binkley et al., 2000; Clemens et al., 1999; Guthrie et al., 2002; Paeratakul et al., 2003; Bowman et al., 2004; Bowman and Vinyard, 2004; Binkley, 2008). Such correlations, however, do not account for the fact that the choice of *where* to eat is jointly determined with the choice of *what* to eat. Thus, while individual preferences, food prices, income and time constraints influence FAFH consumption, diet quality and weight, FAFH consumption may or may not have direct influence on either diet quality or 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 the fact that people simultaneously decide what to eat and where to get it will bias the estimated impact of FAFH on diet quality. Correlation analysis also obscures the possibility that individuals compensate less healthy FAFH choices with healthier choices at other meals throughout the day.

Unbiased measures of the impact of FAFH on diet quality and calories consumed are needed to accurately assess the efficacy of proposed policies for improving diet quality. For example, if poor dietary choices are just more prevalent among certain individuals, regardless of where they get their food, then mandatory FAFH labeling requirements may have little impact. If, on the other hand, 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 FAFH labeling and consumer 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). As such, making information on the

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nutrient content of FAFH more prominent may make it easier for people to achieve their own dietary goals.

This study provides more precise estimates on how food away from home affects both caloric intake and diet quality. We overcome much of the endogeneity issue by employing a fixed effect estimator utilizing 2-day dietary intake data. We assume that overall preferences for diet quality are fixed over time within individuals, but day-to-day variation in activities and other constraints affects consumption of FAFH. Because the dietary recalls are collected within a short period of time, typically 7–10 days apart, this is a reasonable assumption. This allows us to identify FAFH's daily effect on diet quality and energy consumption.

Data and estimation approach

This analysis is based on two nonconsecutive days of dietary recall data from the 2003–2004 National Health and Nutrition Examination Survey (NHANES)[1] and the 1994–1996 Continuing Survey of Food Intakes by Individuals (CSFII). We focus our analysis on adults, so limit our sample to respondents age 20 and older. We use the 2-day dietary recall sample weights for both NHANES and CSFII and use STATA 10.1 to account for the complex survey design of each survey. Specifically, we use data on the primary sampling unit, survey round (NHANES or CSFII) and strata identifiers to adjust standard errors. As dependent variables, we focus on two indicators of diet quality. The first is the change in an individual's total daily caloric intake. The other dependent variable is the change in an individual's total Healthy Eating Index (HEI-2005) score, which measures how well an individual's diet adheres to the 2005 Dietary Guidelines for Americans on each dietary recall day (USDHHS/USDA, 2005; Guenther et al., 2007). The HEI score ranges from 0 to 100 points, indicating 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 1000 calories. For oils and sodium, the densities measure the grams per 1000 calories. For saturated fat and SoFAAS, densities measure the percent of daily calories.

We use the reported source from which each food was obtained to define whether a food is a FAFH item. However, some meals contained foods from multiple sources. For example, an individual may have brought a lunch from home but purchased dessert from the work cafeteria. To account for these situations, we classified a meal as FAFH if the majority of calories, excluding beverages, came from fast food, table service restaurants, cafeterias or taverns. We use 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 and within individual differences for the two intake days for our explanatory and dependent variables are reported in Table 1.

If FAFH consumption on a given day, t, is exogenous to an individual's unobserved preferences that also influence diet quality, we can estimate the effect of FAFH on diet quality for day t using the Ordinary Least Squares estimator (OLS).

$$\mathrm{DQ}_{it} = \alpha + \beta \mathbf{X}_i + \gamma \mathrm{FAFH}_{it} + v_{it} \tag{1}$$

The coefficient on FAFH, γ, would provide an estimate of the effect of an increase in FAFH (let's say an additional meal away from home) on diet quality. If however, FAFH is correlated with the error term, estimates of how FAFH impacts diet quality will be biased (Green, 1990). With multiple days of dietary intake data, we can decompose the error term v_{it} into an individual error component μ_i that is time-invariant within individuals, and an additional stochastic component, ε_{it} that has the usual independent and identically distributed (iid) properties.

$$\mathrm{DQ}_i = \alpha + \beta \mathbf{X}_i + \gamma \mathrm{FAFH}_i + \mu_i + \varepsilon_{it} \tag{2}$$

For example, μ_i could be someone's unobservable preference for locally grown, vegetarian foods that affects both the incidence of eating food away from home and the foods chosen when eating at home. Not controlling for this unobservable, but relevant factor would then exaggerate FAFH's estimated influence on diet quality.

Thus, we must separate the choice over the amount of FAFH from the individual's overall preference for nutrition and diet quality. If we assume that these unobservable preferences μ_i are fixed over time, we can employ a fixed effect, or in our case since only 2-days of dietary recall are used, a first-difference estimator. This first-difference model removes all 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 that is not biased by these unobserved factors.[2] However, this method will not account for unobserved factors that vary over time, such as fluctuations in individuals' daily schedules, social obligations or appetite. To attempt to control for these unobserved time-varying factors, we incorporate changes in meal patterns, such as snacking and eating breakfast, and whether consumption was observed on a weekday or weekend:

$$\Delta \mathrm{DQ}_i = \gamma(\Delta \mathrm{FAFH}_i) + \sum_{j=1}^{4} \phi_j(\Delta \mathrm{MEAL}_{ij}) + \beta(\Delta \mathrm{weekend}_i) + \Delta \varepsilon_i \tag{3}$$

where $\Delta \mathrm{DQ}_i$ measures the change in diet quality for individual i. The subscript j represents a particular meal (breakfast, lunch, dinner or snack) and ε is an iid stochastic error term. Thus, the coefficient on ΔFAFH γ, will provide a less biased estimate of the average effect of obtaining one additional meal from FAFH on diet quality than estimates obtained from OLS estimation.

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 Eq. (3) with separate indicators for whether each type of meal was consumed from FAFH.

$$\Delta \mathrm{DQ}_i = \sum_{j=1}^{4} \phi_j(\Delta \mathrm{MEAL}_{ji}) + \sum_{j=1}^{4} \theta_j(\Delta \mathrm{MEAL}_{ji})(\mathrm{FAFH}_{ji}) + \beta(\Delta \mathrm{weekend}_i) + \Delta \varepsilon_i \tag{4}$$

In Eq. (4), the coefficient on each interaction term, θ_j, estimates the effect of consuming the particular meal from FAFH on diet quality. Differentiating the effects of FAFH meal occasions on diet quality may illuminate ways to design more effective interventions to improve decision making.

We first estimate Eqs. (3) and (4) with pooled 1994–1996 and 2003–2004 data. Then we estimate both equations separately for the 1994–1996 and 2003–2004 samples to detect whether the effect of eating out on dietary quality has changed over time. Our

[1] At present, we are not able to calculate Healthy Eating Index scores for the 2005–2006 NHANES data because the corresponding MyPyramid Equivalent database has not been released.

[2] Results of Hausman Tests checking for systematic differences between random and fixed effects estimators rejected the null hypothesis that the time-invariant error term is uncorrelated with other regressors. With either calories or diet quality as dependent variables, we were able to reject this hypothesis at $p < .0001$. For calories, the Chi-squared value was 35.34. For overall diet quality, this test statistic was 227.48.