Food Away from Home Consumption and Obesity: An Analysis by Service Type and by Meal Occasion

Gayaneh Kyureghian

Rodolfo M. Nayga, Jr.

George C. Davis

Biing-Hwan Lin

May 2007

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29 – August 1, 2007

Kyureghian is Graduate Research Assistant, Nayga and Davis are Professors, Department of Agricultural Economics, Texas A&M University, and Lin is Senior Economist, Economic Research Service, U.S. Department of Agriculture. Authors thank Oral Capps, Betsy Kuhn, Elise Golan and seminar participants at ERS-USDA for helpful comments. Any remaining errors are the responsibility of the authors.

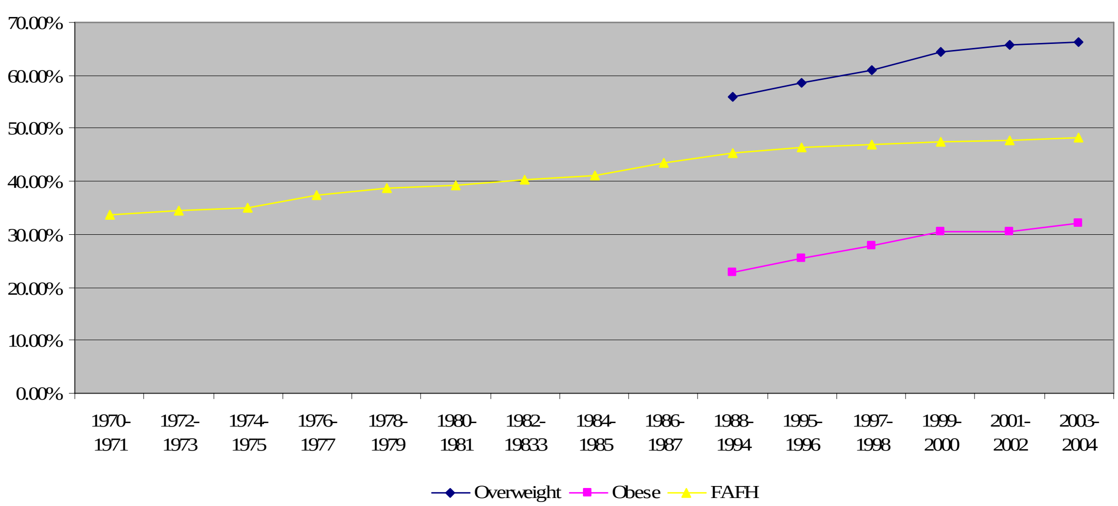
INTRODUCTION

Obesity is a rapidly growing threat reaching epidemic proportions worldwide. It is prevalent in both developing and developed countries and affects both adults and children alike. The United States (US), being in forefront of this issue, has overweight rates of 75.6% and 72.6% among males and females, respectively, and obesity rates of 36.5% and 41.8% among males and females, respectively. By 2010, more than 77% of US female population and more than 81% of US male population are projected to be overweight and obese [1]. Health consequences associated with obesity have been extensively researched and are generally associated with diabetes, cardiovascular diseases, cancers, gastrointestinal diseases, arthritis, depression and low self-esteem, to name a few[2], thereby raising premature death toll and decreasing life expectancy (Peeters et al, 2003; Pi-Sunyer, 1993, 2002). The various estimates of the economic cost of obesity reach up to one hundred billion U.S. dollars and comprise a sizable portion of public health expenditure (Wolf and Colditz, 1994, 1998).

While it is believed that genetic factors may predetermine the magnitude of metabolic complications associated with obesity (Cardon et al, 1994), environmental factors such as dietary behavior and lifestyle are largely blamed as the major driving forces behind the epidemic outburst of obesity since the 1970's (see Chou, Grossman, Saffer, 2004; Rashad, Grossman, Chou, 2005; Binkley, Eales, Jekanowski, 2000; Binkley, 2006; Boumtje, et al, 2005). The rationale is that while obesity has always been around, it reached epidemic proportions only during the last two to three decades, which is a relatively short period for genetic mutations to take place (Stunkard, Foch and Hrubec, 1986). This said, it should be mentioned here that the health and premature death risk distinction between environmental and biological factors is rather nebulous and is surrounded by controversy[3].

One factor that is largely held responsible for overweight and obesity serge since 1970s both in literature and in public eye, is the dietary intake and dietary quality, especially when eating out decisions are concerned (Binkley, 2006). This is mainly based on the concurrent raise in Food Away From Home (FAFH) share in total food expenditures and overweight and obesity rates[4]. Graph 1 below demonstrates the point[5].

Graph 1. Overweight, Obesity and FAFH Time Trend



Although there have been several studies of the associations of FAFH and overweight and obesity (Chou, Grossman, Saffer, 2004; Rashad, Grossman, Chou, 2005; Rashad, 2006), we believe that breaking this influence down by restaurant category – full or quick service, and/or by meal occasion, is bound to reveal further intricacies of the complex relationship between FAFH and overweight and obesity.

In this study our objective is to examine the effects of FAFH on obesity. Four models are estimated to reveal the effects of FAFH disaggregated at different levels on BMI: (i) FAFH consumption in general; (ii) FAFH disaggregated by restaurant category – Full Service (FS) and Quick Service (QS); (iii) FAFH disaggregated by meal occasion – Breakfast, Lunch, Dinner, and Snack; (iv) FAFH disaggregated by meal occasion and restaurant category – Breakfast at FS, Breakfast at QS, Lunch at FS, Lunch at QS, etc.

Background and Literature Review

As the obesity prevalence was gaining momentum during the last three decades, its overall importance as a major public health and economic problem made it imperative to understand this phenomenon and act upon it. This triggered an entire stream of multidisciplinary research on obesity and different aspects of it.

From the nutritionist point of view, overweight and obesity are caused by positive imbalance of energy intake and energy expenditure, constituting what is referred to in economic and medical literature as the energy equation. A number of studies have associated overweight and obesity with changes in lifestyle (Lakdawalla and Philipson, 2002; Philipson and Posner, 2003, Loureiro and Nayga, 2005; Martínez-González et al, 1999), and major technological breakthroughs (Cutler, Glaeser and Shapiro, 2003). Lakdawalla and Philipson establish that reduction in job strenuousness, induced by technological change, compounded by reduction in food prices, also due to technological change, account for as much as 40% of the recent weight growth. Technological change has also brought about significant reduction in time spent on household production process which increased women's labor force participation. While the number of employed adults in general grew by a factor of 1.83 from 1970 to 2003, the number of women workers grew by a factor of 2.51, increasing the portion of working women from just over a third of all employees in 1970 to just under a half in 2003[6]. This, reinforced by lower wage rates for overweight women, stimulated the demand for inexpensive convenience food (Cawley, 2004).

While it is true that energy intake and body fat levels control appetite, habits and desires can override metabolic needs. This has been established by both medical evidence and economic evidence of a positive effect of past consumption on current consumption (Cawley, 1999).

Chou, Grossman, and Saffer (2002) offer another explanation to rising obesity. They demonstrate large positive elasticities associated with per capita number of restaurants, which suggests urban sprawl association with obesity (also Lopez, 2004). Tobacco use has also been associated with obesity increase since smoking accelerates metabolism. Positive association between cigarette price and BMI was established by Chou, Grossman, and Saffer (2002, 2004), Mercer et al (2003), et al.

Conceptual Framework and Empirical Model

The conceptual framework of this study is based on household production theory (Becker, 1965). It postulates that people do not directly derive utility from goods purchased in the market place. Rather, they derive utility from the commodities they produce from market goods using their time as one of the inputs. The implication of this theory for our models is that we can postulate that consumers derive utility from meals prepared and consumed at home, foods obtained and consumed away from home, health condition, and active leisure. Obviously these commodities are themselves interrelated – diets are based on health conditions and vice versa (at least in the inter-temporal sense), and the time factor affects each and every argument in the function. Therefore, referring back to the energy equation, foods consumed both at home and away from home refer to the caloric intake, and active leisure and both market and non-market work refer to energy expenditure. Since time is a limited resource, the substitution between any of these activities is based on the relative market prices of those activities and other constraints. We are going to assume that people do not derive utility from overweight and obesity, in other words, there is no cultural or aesthetic value associated with obesity. Therefore, in the context of the above theory if people become overweight or obese, there should be something in their utility functions that offsets the disutility from being obese.

To formalize these interrelationships in the context of the above optimization, we model obesity by the following production function:

$$BMI = g(E_{INPUT}, E_{EXPENDITURE}, \mu),$$

which is simply the imbalance between the two sides of the energy equation: energy input, E_{INPUT}, and energy expenditure, $E_{EXPENDITURE}$.

Energy input is represented by foods consumed at home and away from home. Foods consumption is represented by number of foods consumed, not quantities of food consumed. In particular, FAFH consumption was captured by creating a ratio of number of FAFH to the number of all foods consumed during the survey period. This inconvenience deprives us of imposing any monotonicity assumptions on BMI function above and limits our inference to only distributional effects of foods between at home and away from home. Energy expenditure is represented by Exercise History variable only, again due to data limitations. We could use occupation variable (professional, white collar, blue collar, etc.) as a proxy for job strenuousness, but although our study is confined to adults defined as 20 years of age and over, we did not venture into making a strong and probably unjustified assumption that the respondents are actually household heads. The total set of food, exercise, and demographic variables, their descriptions and summary statistics are presented in the next section and are summarized in table 2.

Endogeneity Issues

Since we view obesity as an ”output” of some “production” process where energy intake, in the form of food choices, and energy expenditure, in the form of exercise behavior, are “inputs”, a natural question to ask is whether these “inputs” are truly choice variables. If they are endogenous, then the OLS estimators will be biased, and an IV estimation is suggested. A natural choice of instruments would seem to be prices for foods both at home and away from home. As proxies we employed the Consumer Price Indices for both food at home and away from home differentiated by four census regions and by months. To circumvent the difficulty of finding legitimate instruments, Lewbel's proposed technique of obtaining instruments was employed (Lewbel, 1997; Park and Davis, 2001). The technique helps constructing instruments from existing endogenous and continuous exogenous variables using their second and third moments. An excellent example of constructing instruments using Lewbel's technique is described in Park and Davis, 2001. If we let

$$BMI = \beta' \Delta + \gamma' \mathrm{E} + \varepsilon$$

where Δ denotes the set of demographic variables (with only AGE and PIR continuous) and E denotes energy intake (e.g. FAFH) and energy expenditure (e.g. Exercise History) variables, then

$$\begin{aligned} r_1 &= (BMI = \overline{BMI})(FAFH - \overline{FAFH}) \\ r_2 &= (BMI - \overline{BMI})(AGE - \overline{AGE}) \\ r_3 &= (BMI - \overline{BMI})(PIR - \overline{PIR}) \end{aligned}$$

are legitimate instruments for testing FAFH endogeneity (likewise for other disaggregate FAFH variables and their CPIs).

To test the relevance of instruments Godfrey/Hutton J statistic was calculated which has an asymptotic χ^2 distribution with *(p – k)* degrees of freedom, where *p* is instrument matrix column rank and *k* is the column rank of the explanatory variables. If J is significantly larger than the critical value the validity of instruments must be reconsidered. The test results show that at 1% level J statistic is less than the critical value for all four models. Likelihood Ratio test was performed as suggested by Shea, 1997; Godfrey, 1999; and following directions specified in Davis et al, 2002. The Likelihood Ratio test rejected the null hypothesis of no instrument relevance at 1% significance level. The results are given in table 1 below.

Table 1. Instrument Specification Test Results

Models	**Likelihood Ratio Test**	**Godfrey/Hutton J statistic**
Model 1	0.0458***	20.9526**
Model 2	0.10385***	22.0671**
Model 3	0.01541***	7.8015
Model 4	0.04086***	14.9343**

*, **, and *** indicate significance at 10%, 5%, and 1% or higher level, respectively.

Having established instrument validity, we performed Wu-Hausman test for endogeneity. To overcome the ambiguity associated with the nature of doing this test for a binary variable which Exercise History is, we adopted a safe strategy of developing two scenarios: estimating Exercise History with (i) probit, and (ii) OLS, estimate the main equation with both sets of residuals from first two estimations and treat variable as endogenous if the corresponding residuals are significant in both cases. Based on this decision rule, FAFH in Model 1, QS in Model 2, LFAFH in Model 3, and DQS in model 4 were recognized as endogenous. It should be mentioned though that the parameter estimates, their signs and significance stayed remarkably unchanged from one scenario to the other. GMM estimation is used for IV estimation of each model to take care of heteroskedasticity by implementing White's heteroskedasticity consistent covariance estimator.

Data

The data used for this research come from National Eating Trends (NET) provided by National Purchase Diary (NPD). NET is a database designed to track both individual consumers' and households' dietary behavior for food at home and away from home. The households were recruited from a national mail panel to participate in the survey. They were sent 14 daily diaries for recording dietary behavior information for each household member. The sample households are balanced to the total U.S. Census each quarter, using the March Current Population Survey (CPS) from the previous year. Data cover the time period from Feb. 24, 2003 to Feb. 29, 2004. The data consist of 417,989 observations (number of foods eaten) for 4792 individuals from 1982 households. It should be reemphasized here that reported number of foods eaten has no meaningful association with quantities consumed.

The initial dataset observation units were number of foods consumed by each individual during 14 consecutive survey days. Since we model food away from home for different meal occasions and restaurant category, we are interested in keeping only those observations/foods for which respondents were clear for what meal occasion a particular food was consumed and where it was obtained from. Then the food observations per individual were summed up and consequently individuals became observation units. Then individuals who had a higher (more than 20% of the time) incidence of not being able to assign the proper restaurant category were found unreliable and were eliminated from the sample. So were individuals who could not specify their Exercise History level.

Since this study concerns adult population only, we kept a sub-sample of only those of 20 years of age and above. After eliminating respondents with BMI below the 5th percentile and above the 99th percentile, we ended up with a sample size of 2,229 observation units/individuals.

Variables

Although this dataset gives us a unique chance to observe consumption behavior for a relatively long period – 14 days, it has its limitations. One such limitation is that the BMI is based on self-reported weight and height information. This is a shortcoming since self-reported BMI tend to be biased downward (Chou, Grossman and Saffer; Spencer, Appleby, Davey, and Key). We did not try to address this issue and correct the bias on the account of two factors. Firstly, we do not find it relevant to our analysis since we set to test if FAFH significantly changes BMI in the expected direction[7]. It should also be mentioned that the mean value of BMI of 27 is close to the national mean value of BMI of 28 by CDC estimates for 2002. Secondly, measurement errors in dependent variable are seldom a major problem (Greene, Econometric Analysis, p. 78), as long as the independent variables are not measured with errors, which we presume to be the case.

Government poverty guidelines for 2003 were used along with income variable to create Poverty Income Ratio (PIR) which takes into account household size and therefore is a better measure of per capita income than household income variable. It is calculated as

$$PIR = Income / Poverty\ Threshold,$$

where income is taken to be the midpoint of the range chosen by respondents. Squared values for PIR and age are added to the models to capture the nonlinearity of BMI response to changes in these variables. A complete list, description and summary statistics are presented in table 2.

Food variables are created by combining number of foods consumed in a location (home, QS, or FS) for a certain occasion (breakfast, lunch, dinner, snack), then each one is represented as a proportion of the whole, which is obviously the summation of all of them. Consequently we came up with eight variables: BFS, LFS, DFS, SFS, BQS, LQS, DQS, SQS. This is the most disaggregate level. Then we aggregated them up to get

(i) restaurant category variables:

$$FAFH = FS + QS$$

(ii) restaurant category variables:

$$FS = BFS + LFS + DFS + SFS$$

$$QS = BQS + LQS + DQS + SQS$$

(iii) meal occasion variables:

$$BFAFH = BFS + BQS$$

$$LFAFH = LFS + LQS$$

$$DFAFH = DFS + DQS$$

$$SFAFH = SFS + SQS$$

The flow chart in figure 1 describes this process visually.

Results

Table 3 contains GMM estimators, along with R^2, adjusted R^2 and sample size number. The signs of parameter estimates for demographic variables are consistent with expectations and are remarkably consistent in all four models. In Model 1 FAFH variable is positive and significant (p-value = 0.02) as expected. It indicates a more than 1.3 point increase in BMI, in average, per 10% increase in FAFH ratio.

In Model 2 both FS and QS have the expected signs and are both significant (with p-value = 0.0170 and 0.0085, respectively). A 10 % increase in either one will result in 0.3 and 1.02 point increase in BMI, respectively. These too, are large numbers considering that we are talking about food numbers rather than meal occasions here. As could be seen from the estimates QS contributes significantly more to BMI than FS true to findings in literature (Binkley, 2006) and public perception, possibly accounting for the larger part of the FAFH positive influence in Model 1.

The results in Model 3 indicate that Lunch has the most detrimental effect on BMI. The very large parameter estimate of 34.7369 indicates that an increase or decrease of the number of foods eaten away from home at lunch by 10% would have such a dramatic effect as making the average person obese or normal weight, respectively. This is a remarkable result, and might have huge policy implications.

The results in Model 4 do not seem to reveal any significant association. This might indicate that meal occasion and restaurant category effects are reinforced in aggregation and when having them at the most disaggregated level, the marginal effects are just not significant.

As expected, those who exercised regularly for four months or more have significantly lower BMIs than those who did not. BMI, as expected, increases with age at a decreasing rate as captured by the positive and negative significant coefficients of age and age-squared, respectively. All models indicate that Males tend to have higher BMI than Females, *ceteris paribus*. Surprisingly, employment is not statistically significant in all models. It would seem that employment would affect BMI through food decisions as far as income and time are concerned, and through energy expenditure decision as far as time is concerned. A possible explanation to this is that if Employment comes into the picture through these decisions, then a simultaneous set up of the problem would have captured this significance. Binkley et al. (2000) demonstrate that unemployment significantly lowers men's BMI, but not women's BMI.

Female Head education at either college or some college level does not affect BMI statistically differently than high school level education. Male Head education has the expected sign and does affect BMI differently if the male head has a college degree when making very general decisions like eating at home or away from home, but does make a difference when deciding where or for which meal occasion. Race and ethnicity do not seem to play a significant role in driving BMI, except that Black Non-Hispanics have significantly higher BMI compared to all other Hispanics (including Black Hispanic). Region is not statistically significant either.

Conclusion and Areas of Future Research

In this paper we have examined factors that were considered some of the forces behind the recent obesity surge in the US. We have established that indeed FAFH influences obesity. Our study went one step farther than any study known to us to establish a pattern of associations of FAFH disaggregated by service type and meal occasion and BMI. Our findings show that the public perception that fast food is one of the major contributors to BMI is justified. Sizably more so than FS restaurant food.

The analysis by meal occasion revealed that lunch is the single most detrimental food having an adverse effect on BMI. This in turn might indicate the QS being more responsible for obesity than FS as lunch in when people eat fast food most of the time. This is an important finding and is loaded with policy implications.

Finally, our results indicate that further disaggregation does not reveal any significant association. This is an interesting result by itself indicating possibly at the fact that certain attributes combined reveal a pattern which virtually disappears when not viewed in a certain setting.

Perception that Exercise makes a significant effect on obesity has been fully supported by all four models.

Interesting future research expansion of this topic is to incorporate more food information in the study, such as construction and use of a metric measuring “convenience” of foods consumed at home instead of treating the whole spectrum of foods consumed at home of uniform nutritional consistency and value. Another interesting expansion would be taking into account the “household” effects, since persons who belong to the same household are likely to share the same foods, therefore, producing clustering effects.

REFERENCES

Becker G. S. *A Theory of the Allocation of Time.* Economic Journal, 75 (September), 1965. pp. 493-517.

Binkley J. K., Eales J., Jekanowski M. *The Relation Between Dietary Change and Risiong US Obesity.* International Journal of Obesity (2000) 24, pp. 1032-1039.

Binkley J. K. *The Effect of Demographic, Economic, and Nutrition Factors on the Frequency of Food Away From Home.* The Journal of Consumer Affairs., Vol. 40, No. 2, 2006, pp. 372-391.

Boumtje P. I., Huang C. L., Lee J. Y., Lin B. H. *Dietary Habits, Demographics, and the Development of Overweight and Obesity Among Children in the US.* Food Policy 30(2005), pp. 115-128.

Bryant H.L., Bessler D.A., Haigh M.S. *Disproving Causal Relations Using Observational Data.* January 2005.

Cardon L.R., Carmelli D., Fabritz R.R., Reed T. *Genetic And Environmental Correlations Between Obesity and Body Fat Distribution in Adult Male Twins.* Human Biology, 66(3), pp. 465-79, June 1994.

Cawley J. *The Impact of Obesity on Wages.* The Journal of Human Resources, 39.2(2004), pp. 451-474.

Cawley J., Burkhauser R. *Beyond BMI: the Value of More Accurate Measures of Fatness and Obesity in Social Science Research.* NBER Working Paper 12291.

Chou S-Y, Grossman M, Saffer H. *An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System*. NBER, 2002.

Chou S-Y, Grossman M, Saffer H. *An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System*. Journal of Health Economics, 23 (2004), pp. 565-587.

Cutler D. M., Glaeser E. L., Shapiro J. M. *Why Have Americans Become More Obese?* The Journal of Economic Perspectives, Summer 2003, 17, 3, p.93.

Davis G.C., Kim S-Y. *Measuring Instrumental Relevance in the Single Endogenous Regressor – Multiple Instrument Case: A Simplifying Procedure.* Economics Letters, Vol.74, 2002.

Godfrey L.G. *Instrument Relevance in Multivariate Linear Models.* The Review of Economics and Statistics, 1999.

Godfrey L.G., Hutton J.P., *Discriminating Between Errors-in-Variables/Simultaneity and Missprcification in Linear Regression Models.* Economics Letters, 44 (1994), pp. 359-364.

Greene W.H. Econometric Analysis. 2002.

Lakdawalla D., Philipson T. *The Growth of Obesity and Technological Change: A Theoretical and Empirical Examination.* NBER, Working Paper 8946, May 2002.

Lopez R. *Urban Sprawl and Risk for Being Overweight or Obese*. American Journal of Public Health. Vol 94, No. 9, pp. 1574-1579, September 2004.

Loureiro M. L., Nayga R. M. Jr. *International Dimensions OF Obesity AND Overweight Related Problems: An Economics Perspective*. American Journal of Agricultural Economics, Volume 87, Number 5, November 2005, pp. 1147-1153(7).

Martínez-González M Á, Martínez J A, Hu F B, Gibney M J, Kearney J. *Physical Inactivity, Sedentary Lifestyle and Obesity in the European Union*. Volume 23, Number 11, Pages 1192-1201, November 1999.

Mascarinec G., Takata Y., Pagano I., et al, "Trends and Dietary Determinants of Overweight and Obesity in a Multiethnic Population", Obesity, Vol. 14 No 4, April 2006.

Mercer S. L., Green L.W., Rosenthal A.C., Husten C.G., Khan L.K., Dietz H.W., *Possible Lessons From the Tobacco Experience for Obesity Control*. The American Journal of Clinical Nutrition, 77(4), 2003.

Park J., Davis G. C. *The Theory and Econometrics of Health Information in Cross-Sectional Nutrient Demand Analysis*. American Journal of Agricultural Economics, Vol. 83 Page 840 - November 2001.

Peeters A., Barendregt J., Willekens F., Mackenbach J., Mamun A.A., Bonneux L. *Obesity in Adulthood and Its Consequences for Life Expectancy: A Life-Table Analysis.* Annals of Internal Medicine, Volume 138, Issue 1, pp. 24-32, January 2003.

Philipson T.J., Posner R.A. *The Long-Run Growth in Obesity as a Function of Technological Change.* John M. Olin Law & Economics Working Paper No. 78.

Pi-Sunyer F.X. *The Obesity Epidemic: Pathophysiology and Consequences of Obesity.* Obesity Research, Vol. 10 Suppl. 2, December 2002.

Pi-Sunyer F.X. *Medical Hazards of Obesity.* Annals of Internal Medicine, Volume 119, Issue 7 Part 2, pp. 655-660, October 1993.

Rashad I. *Structural Estimation of Caloric Intake, Exercise, Smoking, and Obesity.* NBER Working Paper No. W11957, January 2006.

Rashad I., Grossman M., Chou S-Y. *Fast-Food Restaurant Advertising on Television and It's Influence on Childhood Obesity*. National Bureau of Economic Research, Working Paper 11879, 2005.

Rashad I., Grossman M., Chou S.Y. *The Super Size of America An Economic Estimation of Body Mass Index and Obesity in Adults*. National Bureau of Economic Research, Working Paper 11584, August 2005.

Shea J. *Instrument relevance in Multivariate Linear Models: A Simple Measure.* Review of Economics and Statistics, Vol. 79, No. 2, 1997. pp. 348-352.

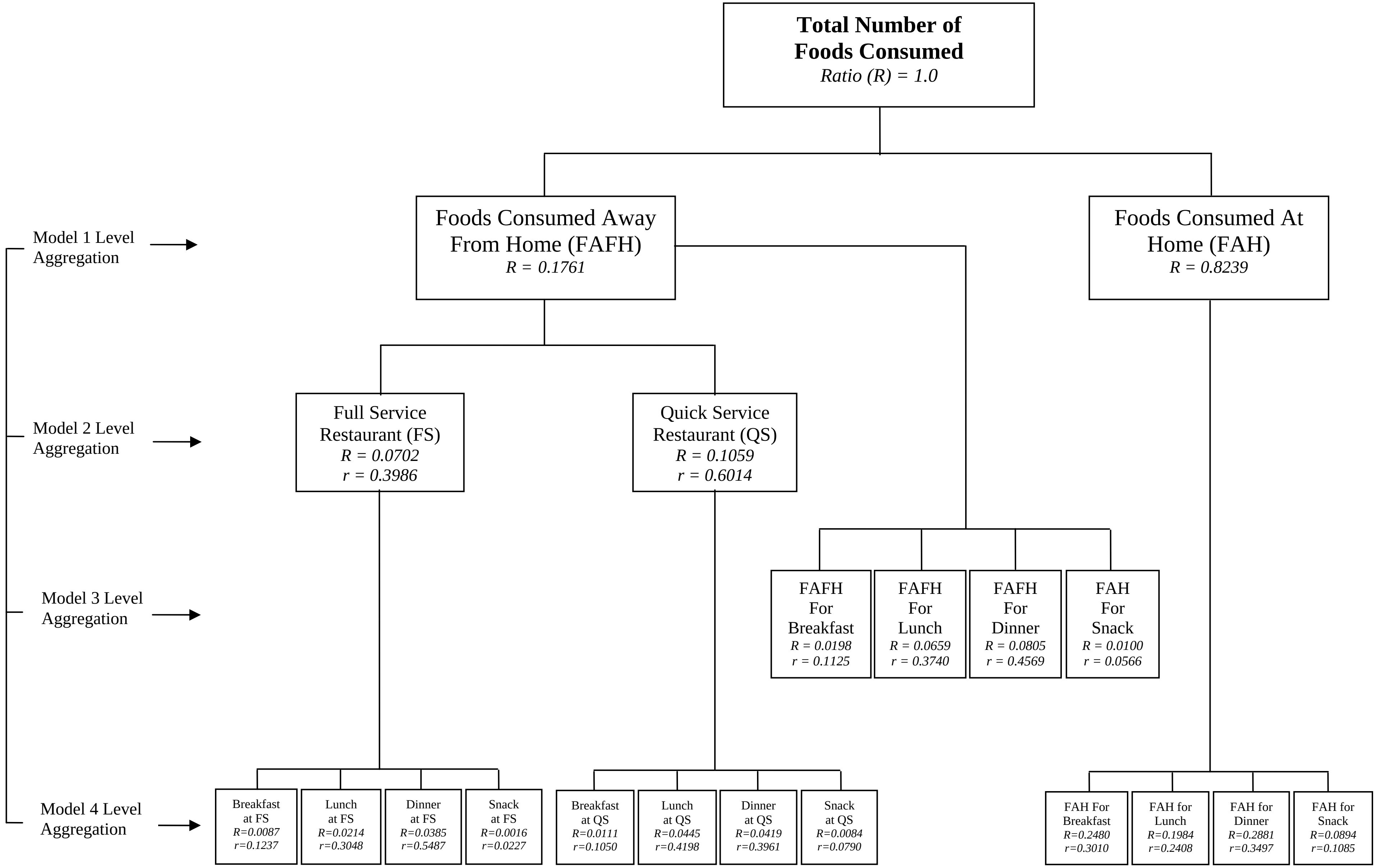
Spencer E. A., Appleby P. N., Davey G. K., Key T. J. *Validity of self-reported height and weight in 4808 EPIC-Oxford participants.* Public Health Nutrition 5(4), 2002, pp. 561-565.

Stunkard A.J., Foch T.T. and Hrubec Z.. *A Twin Study of Human Obesity*. The Journal of American Medical Association, Vol 256, No.1, July 4, 1986.

Wolf A.M., Colditz G.A.. *The Cost of Obesity: the US Perspective*. Pharmacoeconomics, 5(Suppl 1) Page 34-7, 1994.

Wolf A.M., Colditz G.A.. *Current Estimates of the Economic Cost of Obesity in the United States.* Obesity Research, 6, Page 97-106, March 1998.

Figure 1



R is the proportion of total number of foods consumed. *r* is the proportion of foods consumed in corresponding subgroups.

Table 2 Variables Used in the Analysis and Summary Statistics

Variable	Description	Mean	Standard Deviation	Minimum	Maximum
Bmi	Body Mass Index	26.96	5.45	15.50	48.70
FAFH	Proportion of foods obtained from either Full or Quick service restaurants for all meal occasions	0.18	0.17	0	1
FS	Proportion of foods obtained from Full service restaurants for all meal occasions	0.07	0.10	0	0.80
QS	Proportion of foods obtained from Quick service restaurants for all meal occasions	0.11	0.12	0	1
BFAFH	Proportion of foods obtained from either Full or Quick service restaurants for Breakfast	0.02	0.05	0	0.65
LFAFH	Proportion of foods obtained from either Full or Quick service restaurants for Lunch	0.07	0.09	0	0.80
DFAFH	Proportion of foods obtained from either Full or Quick service restaurants for Dinner	0.08	0.10	0	0.70
SFAFH	Proportion of foods obtained from either Full or Quick service restaurants for Snack	0.01	0.02	0	0.24
BFS	Proportion of foods obtained from Full service restaurants for Breakfast	0.01	0.03	0	0.33
LFS	Proportion of foods obtained from Full service restaurants for Lunch	0.02	0.05	0	0.80
DFS	Proportion of foods obtained from Full service restaurants for Dinner	0.04	0.07	0	0.70
SFS	Proportion of foods obtained from Full service restaurants for Snack	0.001	0.01	0	0.18
BQS	Proportion of foods obtained from Quick service restaurants for Breakfast	0.01	0.04	0	0.56
LQS	Proportion of foods obtained from Quick service restaurants for Lunch	0.04	0.07	0	0.60
DQS	Proportion of foods obtained from Quick service restaurants for Dinner	0.04	0.07	0	0.64
SQS	Proportion of foods obtained from Quick service restaurants for Snack	0.01	0.02	0	0.20

Table 2 – Contd. Variables Used in the Analysis and Summary Statistics

Variable	Description	Mean	Standard Deviation	Minimum	Maximum
ExerciseHist	Equals 1 if the respondent exercised for more than 4 months	0.77	0.42	0	1
Age	Age in years	49.68	15.84	20	92
PIR	Poverty income ratio	4.12	3.16	0.15	23.95
Male	Equals 1 if the respondent is male	0.42	0.49	0	1
FemaleHeadEmloyed	Equals 1 if the respondent’s family female head works part- or full-time	0.57	0.49	0	1
MaleHeadEmloyed	Equals 1 if the respondent’s family male head works part- or full-time	0.80	0.40	0	1
MaleEduCollege	Equals 1 if the respondent’s family male head has college education	0.35	0.48	0	1
MaleEduSomeCollege	Equals 1 if the respondent’s family male head has some college education	0.21	0.41	0	1
FemaleEduCollege	Equals 1 if the respondent’s family female head has college education	0.38	0.49	0	1
FemaleEduSomeCollege	Equals 1 if the respondent’s family female head has some college education	0.26	0.44	0	1
Married	Equals 1 if the respondent is married	0.74	0.44	0	1
WhiteNonHisp	Equals 1 if the respondent is White and is not Hispanic	0.82	0.39	0	1
BlackNonHisp	Equals 1 if the respondent is Black and is not Hispanic	0.08	0.28	0	1
OtherNonHisp	Equals 1 if the respondent is not White or Black and is not Hispanic	0.03	0.17	0	1
Northeast	Equals 1 if the respondent resides in Northeast	0.19	0.40	0	1
Midwest	Equals 1 if the respondent resides in Midwest	0.24	0.43	0	1
South	Equals 1 if the respondent resides in South	0.35	0.48	0	1

Table 3. Parameter Estimates and Standard Errors of the Regressions

Variables	Model 1	Model 2	Model 3	Model 4
Intercept	19.4954***	19.9880***	18.2913***	20.9982***
	(12.66)	(14.62)	(10.81)	(16.38)
Age	0.2938***	0.3027***	0.3317***	0.2682***
	(6.81)	(7.16)	(6.93)	(6.04)
Age_sq	-0.0025***	-0.0026***	-0.0029***	-0.0023***
	(-6.03)	(-6.51)	(-6.31)	(-5.32)
Male	0.4998**	0.5810***	0.4529*	0.6765***
	(2.01)	(2.71)	(1.76)	(3.15)
ExerciseHist	-1.5242***	-1.5212***	-1.5076***	-1.5397***
	(-4.63)	(-4.74)	(-4.31)	(-4.73)
PIR	-0.5215***	-0.3854***	-0.4621***	-0.3858***
	(-3.36)	(-3.42)	(-3.67)	(-3.38)
PIR_SQ	0.0194***	0.0167***	0.0179***	0.0183***
	(2.62)	(2.60)	(2.63)	(2.80)
FemaleHeadEmloyed	-0.2528	-0.1732	-0.1503	-0.1474
	(-0.86)	(-0.63)	(-0.51)	(-0.54)
MaleHeadEmloyed	0.1385	0.0404	0.2838	0.0318
	(0.35)	(0.11)	(0.67)	(0.09)
MaleEduCollege	-0.6169	-0.8808**	-0.8266**	-0.8468**
	(-1.45)	(-2.57)	(-2.23)	(-2.43)
MaleEduSomeCollege	-0.6896*	-0.8416**	-0.7451*	-0.6703*
	(-1.72)	(-2.27)	(-1.79)	(-1.77)
FemaleEduCollege	-0.2989	-0.2770	-0.0769	-0.3446
	(-0.90)	(-0.87)	(-0.21)	(-1.06)
FemaleEduSomeCollege	-0.5225	-0.3622	-0.4717	-0.3252
	(-1.52)	(-1.15)	(-1.31)	(-1.01)
Married	0.5873*	0.6123*	0.7970**	0.5646
	(1.68)	(1.84)	(2.14)	(1.64)
WhiteNonHisp	0.2369	0.1673	0.3804	0.0675
	(0.50)	(0.37)	(0.76)	(0.15)
BlackNonHisp	2.0117***	1.8272***	2.6468***	1.6477**
	(3.08)	(2.92)	(3.45)	(2.44)
OtherNonHisp	-1.0367	-0.9684	-0.7157	-0.8182
	(-1.27)	(-1.25)	(-0.80)	(-1.04)
Northeast	-0.4354	-0.4144	-0.1133	-0.3839
	(-1.19)	(-1.20)	(-0.28)	(-1.11)
Midwest	-0.4998	-0.4823	-0.6233*	-0.4689
	(-1.42)	(-1.43)	(-1.65)	(-1.36)
South	-0.0644	-0.0301	-0.2014	-0.0301
	(-0.20)	(-0.10)	(-0.56)	(-0.10)

*, **, and *** indicate significance at 10%, 5%, and 1% or higher level, respectively.

Table 3 - Contd. Parameter Estimates and Standard Errors of the Regressions

Variables	Model 1	Model 2	Model 3	Model 4
FAFH	13.1529** (2.33)			
FS		2.9288** (2.39)		
QS		10.2117*** (2.63)		
BFAFH			-4.4164 (-1.00)	
LFAFH			34.7369*** (2.73)	
DFAFH			-0.9172 (-0.40)	
SFAFH			-16.5562** (-2.38)	
BFS				0.8608 (0.20)
LFS				3.6710* (1.70)
DFS				3.6362* (1.85)
SFS				-18.1634 (-1.56)
BQS				-2.2506 (-0.46)
LQS				2.4358 (1.06)
DQS				21.5181* (1.95)
SQS				-6.0756 (-0.93)
N	2229	2229	2229	2229
R-Square	0.0108	0.0714	-0.1202	0.0481
Adj R-Sq	0.0018	0.0626	-0.1319	0.0364

*, **, and *** indicate significance at 10%, 5%, and 1% or higher level, respectively.

Endnotes

[1] World Health Organization, comparison of countries by BMI (for ages over 15), using WHO Estimates for certain available risk factors and other indicators, 2005.

[2] Ibid.

[3] It should also be mentioned that this paper does not seek to establish causal relationship between obesity and environmental or biological factors affecting it. The singularly interesting and the ultimate question would, of course, be what are the causes of obesity? Although Economics is full of such causal hypotheses, they rarely are tested mainly due to the absence of longitudinal observational data on BMI, hereditary factors, dietary behavior and lifestyle and other related demographics, as well as due to lack of causal inference methods (Bryant et al, 2005).

[4] The internationally adopted standards for overweight and obesity are based on Body Mass Index (BMI), which is a metric defined as the ratio of weight in kilograms and height in meters squared. By these standards overweight is denoted by BMI $\geq$25 kg/m^2 and obesity is denoted by BMI $\geq$ 30 kg/m^2.

[5] FAFH time trend data are obtained from Economic Research Services, USDA briefings at http:/www.ers.usda.gov/briefings/CPIFoodAndExpenditures/. The values in the graph are the averages of the two corresponding years. The overweight and obesity data for age 20 years and over are obtained from “Prevalence of Overweight and Obesity Among Adults: United States, 2003-2004”, National Center for Health Statistics, Centers for Disease Control. The values for overweight and obese for periods 1995-1996 and 1997-1998 were interpolated due to data unavailability.

[6] Employment, Hours, and Earnings from the Current Employment Statistics survey (National), U.S. Department of Labor, Bureau of Labor Statistics.

[7] We assume that increase or decrease in FAFH affects all BMI levels alike. Such linear approach might be farfetched, but since the opposite is not established in the literature as far as we are aware, we leave it at that.