Preliminary Draft: Please do not cite or quote

Adult Eating Behaviors and Weight Status: A Time Use Analysis

Charlene M. Kalenkoski
Ohio University
Department of Economics
Bentley Annex 351
Athens, OH 45701
Phone: (740) 593-2022
Fax: (740) 593-0181
kalenkos@ohio.edu

Leslie S. Stratton
Virginia Commonwealth University
Department of Economics
301 W. Main St. PO Box 844000
Richmond, VA 23284-4000
Phone: (804) 828-7141
Fax: (804) 828-9103
lsstratt@vcu.edu

Abstract

The Centers for Disease Control and Prevention have declared that there is an obesity epidemic in the United States. Much research has been conducted linking personal, family, economic, and even environmental factors to weight and particularly to body mass index (BMI). However, one's education and family situation are not of themselves directly linked to BMI. Rather it is one's eating habits and other behaviors such as sleeping and physical activity that are more appropriately recognized as the risk factors. We use 24-hour time-diary data from the 2006 American Time Use Survey (ATUS), including the Eating and Health module, to examine the relations between such behaviors and adults' weight status in hopes of shedding further light on the behavioral aspects underlying this epidemic. Continuous regressions, logit models, ordered logit models, and multinomial logit models are estimated separately by gender to determine the associations with BMI, overweight status, and obesity status. In general, the results are robust across functional form and indicate that behaviors, even those observed during a single 24-hour window, are significant determinants of weight status, though not at the expense of demographic factors. More specifically, men who eat at restaurants and men and women who spend more time in sedentary activities have significantly higher BMI, while women who spend more time in higher-energy activities have significantly lower BMI.

The authors would like to thank Yi He for research assistance.

Adult Eating Behaviors and Weight Status: A Time Use Analysis

Charlene M. Kalenkoski
Ohio University

Leslie S. Stratton
Virginia Commonwealth University

Introduction

The Centers for Disease Control and Prevention has declared that there is an obesity epidemic in the United States. A stated national health objective is to reduce the fraction of obese adults, but all indications are that obesity is becoming more, not less, prevalent. There is a substantial literature associating demographic, familial, economic, and environmental factors with weight outcomes. Such factors as education level and income do not, however, directly influence weight. Rather, they influence weight indirectly via their associations with food choice, eating behavior, and activity level. We use data from the 2006 American Time Use Survey (ATUS) and the Eating and Health module that accompanies it to identify respondents' day-to-day activities and eating patterns. We then examine the extent to which expanding the set of typical factors to include data on behaviors helps explain obesity.

Loosely speaking, an individual is said to be overweight if s/he weighs more than is considered healthy for a person of similar height. The most common definitions of 'overweight' and 'obese' are based on Body Mass Index (BMI). BMI is calculated for adults as one's weight in kilograms divided by the square of one's height in meters. If this number is between 25 and 30, an adult is considered overweight; if this number is 30 or over, an adult is considered obese. Although BMI is not an ideal measure of body fat, it is easier and less expensive to calculate than more direct measures based on skin-fold thickness and waist circumference, waist-to-hip circumference ratios, or such hi-tech approaches as ultrasound or magnetic resonance imaging.

Male athletes, in particular, are likely to be misidentified as overweight using BMI as a measure. However, in general, BMI is correlated with body fat and it remains the conventional measure.

Being overweight or obese has substantial negative health implications. The Centers for Disease Control and Prevention (CDC) reports that the risk of coronary heart disease, type 2 diabetes, several cancers, high blood pressure, stroke, liver and gallbladder disease, sleep and respiratory problems, osteoarthritis, and gynecological problems are all higher for overweight persons (CDC, 2008). Estimates of the cost of medical treatments attributable to excessive weight range from $51.5 to $78.5 billion dollars for the year 1998 alone (CDC, 2008), and these are only the direct costs. Indirect costs such as lost productivity due to higher absentee rates and early death are likely to be substantially larger. Furthermore, obesity is on the rise. The fraction of obese Americans aged 20-74 stood at 32.9% in 2003-4. This figure contrasts sharply with data from 1990 when the Behavioral Risk Factor Surveillance System found that in 10 states less than 10% of the population was obese and in no states was obesity a problem for over 15% of the population (CDC, 2008). Thus, the economic consequences of being overweight are substantial and rising. Any behaviors associated with being overweight are risky ones worth examining. Furthermore, behaviors are of particular importance because, unlike race or gender, behaviors can be changed, potentially by policy interventions.

Literature

The literature addressing BMI and obesity is extensive. Providing demographic evidence, Rashad (2006) shows that married men have higher BMIs than unmarried men, Baum (2007) and Baum and Ruhm (2007) show that weight rises with age and varies with individuals' race and ethnicity, and Burke and Heiland (2008) show different rates of obesity for black and white women but not black and white men. Education has generally been found to be negatively related to obesity (Rashad 2006; Nayga 2001; Tsou and Liu 2006), while the effect of income varies by gender. Rashad (2006) reports that income is positively associated with BMI for men and negatively associated with BMI for women. None of these factors is itself a direct cause of obesity but may instead reflect a genetic association or a common lifestyle choice.

Environmental factors have also been linked to obesity. Both Chou et al (2004) and Rashad (2006) find that increased availability of inexpensive restaurants, falling food prices, and increased cigarette taxes are associated with increased obesity. Miljkovic et al. (2008) find that past, current, and future prices of addictive and non-addictive foods affect weight status. Dunn (2008) finds a significant relation between the density of fast food restaurants and obesity in a county. Similarly, Mandal and Chern (2007) report that state-level per capita sales at restaurants are associated positively with obesity. They also find that greater income inequality and higher unemployment rates are associated with a higher probability of obesity. Performing a state-level analysis, Cai et al. (2008) find that food-away-from-home expenditures are positively related to obesity rates and that food-at-home expenditures are negatively related to these rates. Other researchers (Cohen-Cole and Fletcher, 2008) have observed peer effects, though there is some concern that these may represent unobserved locality-specific factors instead. Indeed, Ackerson et al. (2008) find that neighborhood wealth is associated with increased levels of overweight and decreased levels of underweight.

Nevertheless, factors such as the presence of fast food restaurants and obese neighbors do not directly cause weight gain. Instead, these environmental data likely serve as proxies for such information as where and what individuals eat. Some empirical evidence does link behavioral factors to obesity. Boumtje et al. (2005), Rashad (2006), and Zhang et al. (2008) focus on caloric intake and physical activity. Gomez et al. (2007) and Mendoza et al. (2007) find evidence suggesting that television viewing is positively related to obesity. Schoenborn and Adams (2008) find that sleeping is negatively related to obesity. Other reports suggest that skipping breakfast may cause individuals to overeat later in the day (Schlundt et al. 1992; Timlin et al. 2008).

However, these studies of the relations between behaviors and obesity typically collect their behavioral information from questionnaires asking respondents 'how much time they usually spend in an activity' or 'if they engage in an activity'. Such data generally overstate time spent in activities (Robinson, 1985) and may in fact be biased as individuals report what they *should* be doing rather than what they actually do, particularly if they know the researchers are concerned about health issues. In this paper, however, we utilize more accurate and detailed time-diary data that provide information on all activities performed by an individual during a 24-hour period. Thus we are able to analyze a greater number of behaviors simultaneously than have previous researchers in the field. We examine the extent to which expanding the set of typical factors used to explain overweight and obesity improves our understanding of these conditions.

Data

The data used for this analysis come from the 2006 American Time Use Survey (ATUS) and the associated Eating and Health (EH) module provided by the U.S. Bureau of Labor Statistics. Subjects for the ATUS are drawn from households in their last month of participation in the Current Population Survey (CPS). Specifically, one person aged 15 or over from each household is randomly selected to participate and asked to describe their primary activities during the preceding 24-hour period. Specially coded time diaries including information on the duration of each activity, where it takes place, and who else is present are constructed from these responses.

The CPS and ATUS provide a wide array of demographic and economic information on gender, race, ethnicity, state of residence, age, education, household income, and family composition. State of residence is used to merge in environmental variables such as the fraction of overweight and obese individuals in the state (National Center for Chronic Disease Prevention & Health Promotion, 2008) and the number of limited service restaurants per thousand residents (U.S. Census Bureau, 2002). Both the ATUS and the EH module provide the behavioral data for our analysis. While the ATUS provides information on activities listed as primary activities in the time-diary, individuals sometimes multitask and this information is not recorded by the ATUS. In particular, for our purposes, individuals often eat while doing something else. The EH Module was designed to collect this information. Respondents to this special module are asked to provide information on all eating and drinking (excluding water) occurring outside of primary eating time. It is also through this module that the weight and height information necessary to calculate each respondent's BMI is collected.

Our final sample consists of 9,722 respondents: 4,273 men and 5,449 women. The ATUS survey covers 12,943 respondents but only 11,888 complete the EH Module, providing information on height, weight, and secondary eating and drinking activities. We further restrict the sample to those aged 20 and over as children's weight status is measured on a different scale. This reduces the sample size to 10,346. The final sample is obtained by requiring that respondents complete at least 23 hours of the time diary so that missing information is not a serious problem.

These data have several shortcomings. First, BMI is constructed from self-reported measures of height and weight. It is well known that individuals tend to exaggerate their height and understate their weight. Thus, self-reports tend to yield lowball estimates of BMI. One approach sometimes used to address this concern is to employ data from the National Health and Nutrition Examination Survey, which contains both clinical and self-reported measures of height and weight, to model the relation between clinical and self-reported values. This model is then used to predict measured values in the research sample and these predicted values are employed in lieu of the reported values to generate a 'corrected' measure of BMI (Pinkston and Stewart, 2008). Baum and Ruhm (2007), however, report no significant difference in estimates obtained using these 'corrected' measures versus the reported measures so we follow them in using the reported measures.

Second, we have time use data for only one 24-hour period. This single day may not be representative of an individual's time use. To partially address this concern, we include controls for type of day (weekend, holiday) and for season. We also include a dummy variable (Sick) to identify individuals who spent four or more hours on health-related activities or over twenty hours of health-related or sleep activities during the 24-hour period.[1]

Finally, we acknowledge that current BMI is more a function of past than current behavior. However as present and past behavior are likely to be highly correlated, and because of the nature of the data available to us, we utilize current behavior to "explain" current BMI.

Our primary contribution to the literature on BMI is our use of observed behavioral measures that are newly available with the release of the EH Module to the ATUS or are more accurate than existing measures due to their collection via a time diary. We include behaviors from two different categories of time use: eating and physical activity.

---

[1] Because such activity could be the result of weight issues, we chose not to exclude such persons from the sample.

We use several variables to capture eating behaviors. First, we include measures of total time spent eating and drinking when eating and drinking is reported as a primary activity, total time spent eating when eating is reported as a secondary activity, and the number of episodes during which the respondent reported eating. It is not entirely clear what impact to expect from these measures. More time spent eating may mean more calories consumed, which would lead to a higher BMI, all else equal. More time spent eating, however, may mean eating at a slower pace, which would lead to a lower BMI (Sasaki et al., 2003). Holding constant time spent eating while increasing the number of times the respondent reports eating may be indicative of grazing which some diet plans suggest increases metabolism and is thus better for weight loss (http://yourtotalhealth.ivillage.com/diet-fitness/grazing-weight-loss.html). Hamermesh (2008) finds that BMI is negatively associated with the number of primary meals but not significantly associated with the time spent eating, further suggesting that that controlling for time and meals separately is reasonable. Second, we include a measure of the time spent eating while watching television and time spent sleeping, as well as an indicator variable for those with nonstandard work hours[2]. There is some evidence that people consume more calories while watching TV than they would in a different environment (Gomez et al, 2007). There is other evidence that those who get less sleep may be more prone to obesity (Schoenborn and Adams, 2008) and nonstandard work schedules may also contribute to unusual eating patterns (Polivka, 2008). Third, we include dummy variables to identify respondents who eat breakfast and those who eat a meal shortly before bed. The breakfast variable takes a value of one for those who report eating or drinking something other than water within two hours of waking up. The variable identifying late-night eaters takes a value of one for those who report eating as a primary activity

[2] This variable takes a value of one if the respondent reports working between 9 PM and 4 AM and zero otherwise.

within two hours of going to bed.[3] Schlundt et al (1992) and Timlin et al (2008) reported evidence that skipping breakfast may cause individuals to overeat later in the day and so may be associated with overweight. Eating before bed may reflect eating more calories than are needed in the course of a day, although evidence found for rhesus monkeys suggests that the time of day one eats does not affect weight status (Oregon Health and Science University, 2006). Fourth, we include dummy variables to identify respondents who eat at a restaurant and elsewhere away from home or work during the diary day and a measure of the number of meals the respondent eats alone. Large restaurant portions are often identified as a problem related to obesity (CDC, 2006). WebMD (2009) suggests that one of the ways to lose weight and maintain a healthy weight is through portion control. Having substantial social engagements may have a positive effect on weight if they require much exposure to food. On the other hand, Costa-Font and Gil (2004) find evidence that social interactions might encourage behaviors that mitigate the likelihood of overweight and obesity.

We also include several variables to capture physical activity. First, we include a measure of time spent in physical activities – measured as time spent in self-reported sports, exercise, or recreation. Second, we recognize that calories are expended during all sorts of activities, not just in explicit physical exercise. Thus, time spent gardening or vacuuming may burn as many calories as time spent doing some exercises at the gym. In order to construct a more time inclusive measure of caloric expenditure, we link metabolic equivalents or MET codes to each time use activity according to the method suggested by Tudor-Locke et al (2008).

---

[3] While we give precedence to overnight sleep spells in determining the time each respondent "wakes up" and the time each respondent "goes to bed", we also try to recognize the longest spell of sleep activity (discounting as much as possible brief interruptions such as those to visit the bathroom, to see to a child, or to answer a phone). However there are some respondents for whom it is not possible to identify a waking or sleeping time and these respondents are identified with separate dummy variables.

According to this method, energy expenditure for time spent at work is based on reported occupation. Time spent traveling is coded based on the 'where' codes to distinguish between walking and driving. Remaining activity codes are linked with a specific MET code. This coding is far from perfect and Tudor-Locke et al (2008) provide an excellent critique, but it is currently the best measure available for linking caloric expenditure and time diary data. Furthermore, we follow their suggestion and rather than constructing a continuous measure of average daily MET, we identify the number of minutes spent in sedentary or light activity (MET codes 1-2.9), the number of minutes spent in moderate activity (MET codes 3-6), and the number of minutes spent in high energy activity (MET codes above 6).[4] This rougher breakdown should make an allowance for substantial reporting and linking errors.

Sample statistics for the weight variables and the behavioral variables are reported separately by gender and weight status in Table 1. Sample statistics for the demographic, familial, and environmental variables are reported in Table 2. In each case these figures are weighted to more accurately reflect population averages.

Overall, as reported in other national statistics, a substantial fraction of the population is overweight or obese. Fifty-five percent of women and 73% of men have a BMI of 25 or above. Within these samples, 45% of women and 40% of men are obese (have a BMI of at least 30). The total sample weighted average BMI is 27.4.

The behavioral measures indicate some significant differences by weight, but also by gender. Thus, those with lower BMI spend more time eating as a primary activity and eat more meals than those who are overweight, but this differential is only significant for women. Men with lower BMI sleep significantly more, while women with lower BMI sleep less but not

[4] As some activities were not identified and a few have no MET code, these values will not sum to 1440 minutes and a measure of minutes missing MET codes is included in the empirical analysis.

significantly so. Women with lower BMI are significantly more likely to work nonstandard hours, more likely to eat breakfast, and more likely to eat shortly before going to bed. Men with higher BMI are significantly more likely to have eaten in a restaurant, while women with higher BMI are significantly less likely to have eaten elsewhere. Men with lower BMI eat significantly more meals alone. Women with low BMI spend more time in physical activity and less time in low MET activities. Both men and women with lower BMI scores spend more time in activities with relatively high MET values.

The other explanatory variables also exhibit differences. All respondents of Asian descent are significantly less likely to be overweight, and BMI appears to increase with age and be negatively related to education for everyone. However, women of Hispanic and African American descent are more likely to be overweight than other women and household income and children have effects that differ by gender. Married and cohabiting men tend to be less overweight, but there is no such difference for women. Interestingly, residence in a city is associated with decreased BMI for both men and women, while region of residence has no consistent pattern by gender. More limited service restaurants per capita is actually associated with lower BMI, though living in a state with a heavier population is associated with a higher BMI. The advantage of multivariate analysis is that all these factors can be accounted for simultaneously.

Research Methodology

Our goal is to determine the degree to which controlling for behaviors contributes to our understanding of weight. Clearly, current weight is in part a function of the genetics that underlie each individual's metabolic rate as well as the lifetime accumulation of caloric intake, behavior, and physical activity. Caloric intake, behavior, and physical activity are influenced by cultural, socioeconomic, and environmental factors. While we do not have information here on caloric intake, we do have information on current behaviors and physical activity, and we use this information to proxy for past behavior and physical activity. These measures will be imperfect even as measures of current actions because our observation period is limited to a single 24-hour period, so we expect demographic, familial, economic, and environmental factors will still be significant. However, it is of some interest to see how valuable is information on current behavior in predicting weight outcomes and what behaviors have the greatest associations. Such an analysis can help further educate the public regarding weight control.

Estimation proceeds in two stages. First, we model weight (Y) as depending upon demographic, familial, economic, and environmental factors (X):

$$(1)\ Y = \alpha_1 + \beta_1 X + \mu_1$$

where the subscript refers to the equation. Next we add controls for various eating behaviors (E) and other uses of time (B):

$$(2)\ Y = \alpha_2 + \beta_2 X + \gamma_2 E + \delta_2 B + \mu_2.$$

These models are estimated separately by gender in recognition of the fact that other researchers have found significant differences by gender.

We experiment with several alternative measures of weight (Y) in our analysis and adjust the specification used accordingly. First, we measure weight status using BMI itself. As BMI is a continuous measure, we use Ordinary Least Squares (OLS) for this analysis. Next, as we are particularly concerned with individuals' overweight and obesity status, we construct an indicator variable for whether an individual is overweight or obese and use a logit specification to estimate the resulting binary choice model. Finally, we measure weight status as a categorical outcome variable distinguishing between normal weight and below, overweight, and obese outcomes. Both an ordered logit and a multinomial logit specification are estimated and the results compared.

Results

Coefficient estimates from the demographic, familial, economic, and environmental factors (X) for both specifications (1) and (2) are reported in Tables 3 and 4 for men and women respectively for each of the four models or functional forms discussed above. In general, there appears to be little substantive difference between the coefficient estimates from specifications (1) and (2). Controlling for behaviors does not appear to substantially alter the association between demographic, familial, economic, and environmental factors and weight.

Cross-model comparisons indicate these associations are quite robust to alternative specifications of the dependent variable. Factors that are significant at the 5 or 1% level in one specification are typically significant in most specifications. Thus, Asian men are less likely and Hispanic and African American women are more likely to be overweight (ceteris paribus) than white, non-Hispanics no matter how weight is measured. Weight increases at a decreasing rate with age for both men and women and is generally lower for those with a college degree or more. Higher income (>$75K) is associated with lower weight status for women, while income ranging from $40K to $150K is associated with higher weight status for men. The presence of children age 0-1 is associated with higher weight status for women, likely because of the influence of pregnancy, else children of any age have little association with weight status. Holidays appear to be marginally significantly associated with higher weight status for all respondents, and regional differences are pronounced for women.

Cases in which the association between a factor and weight status appears to be modestly different across specifications are limited and primarily highlight differences between overweight and obese status. Such nonlinear effects are revealed primarily by examining the coefficient estimates from the multinomial logit specification in which the factors distinguishing between overweight and normal weight status (identified in the fourth set of estimates) are allowed to differ from those distinguishing between obese and normal weight status (identified in the fifth and final set of estimates). The OLS specification treats BMI as a linear variable, the simple logit distinguishes only between normal and higher than normal weight status (treating overweight and obese respondents identically), and the ordered logit treats obesity as an extreme version of overweight. Only the multinomial logit allows the factors associated with obesity to differ from the factors associated with overweight status. A joint test of the significance of the demographic, familial, economic, and environmental factors in distinguishing between overweight and obese status indicates that there are significant differences at the 1% level for all respondents in both specification (1) and specification (2).

Focusing on these multinomial logit results, there are some differences in the factors influencing overweight versus obese status. Being of Hispanic ethnicity or African American race is for men significantly positively associated with BMI, but is more highly associated with obese status than with overweight status. Men who have completed some college conversely are less likely to be overweight than high school dropouts, but not less likely to be obese than to be overweight. Men in very high income (> $150K) households have an even more disparate outcome. They are significantly more likely to be overweight than to be normal weight, but are not significantly more likely to be obese as compared to normal weight. Similarly the association between overweight peers and a respondent's weight is significant only for overweight status not for obese status for men. For women there are still more differences by weight status. Asian women have lower BMI values, primarily because they are less likely to be obese, not because they are less likely to be overweight. There are similar differences for women with a post graduate degree and for women in high income (> $75K) households. Conversely, women of other races and women with infants are more likely to be obese but not more likely to be overweight. The fraction of obese persons in the state also appears to have a greater influence on obese rather than overweight outcomes for women and region is a more significant variable for obesity than it is for overweight status. In general, these nonlinear findings by weight status suggest that a multinomial logit specification may be a better fit than an ordered logit when using limited dependent variable models with more than two outcomes, but further analysis is warranted.

Gender differences in the demographic, familial, economic, and environmental factors associated with weight are substantial. Children have little association with men's weight, but infants matter substantially for women. Region of residence plays a greater role for women than for men and, while women in the West have higher BMI than women elsewhere, men in the West have lower BMI than elsewhere. Education has a similar effect by gender, but household income does not. Holding education constant, women living in higher income households have fewer weight problems while men living in higher income households have greater weight problems. Also of note is the fact that goodness-of-fit measures indicate that substantially more of the variation in weight status is explained for women than is explained for men.

The final row of Tables 3 and 4 provides information on the value added by the behavioral variables included in specification (2). In all but one case, these variables (E and B) are found to be jointly significant at the 1% level. Only in the case of the simple logit specification for men is the p-value above 1%, and then it is still significant at the 10% level. While adding the behavioral variables does not substantially diminish the role of demographic, familial, economic, or environmental variables in the analysis, it does significantly improve the fit of the model.

Tables 5 and 6 present the coefficient estimates for the behavioral variables for each of the four functional forms of these weight models for men and women respectively. As before the results are quite similar across all functional forms but differ substantially by gender. Secondary eating time is significantly negatively associated with weight status for men, meaning that men who spend more time eating as a secondary activity tend to weigh less – unless they report watching TV as their primary activity in which case there is a generally positive association with weight status. There is no such significant association between secondary eating time and weight status for women, and for neither men nor women is time spent eating as a primary activity significantly associated with weight status. The number of meals eaten during the day has a weak negative association with weight status for men and a weak positive association with weight status for women, but these associations are not generally statistically significant. Men who report more time sleeping, all else equal, report having a lower body weight as has been suggested in the literature, but for women the association is reversed. Women who report more time sleeping, all else equal, have higher body weight. Having a nonstandard work schedule does not appear to be associated with weight status and eating breakfast is weakly associated with lower weight status only for women. Eating within two hours of going to bed is associated with lower weight status for women, but not men. Eating in a restaurant or elsewhere is associated with higher weight status, significantly so for men. Eating more meals alone tends to be associated with lower weight status, particularly for women.

The non-eating activity measures incorporated here are highly correlated with weight status, especially for women. More time spent in sedentary activities, controlling for time spent in sleep, significantly increases weight status for both men and women. Time spent in sleep, controlling for total time spent in sedentary activities, is positively associated with weight for women but negatively associated with weight for men. Time spent in high energy activities, as measured by a high MET value or by time spent in physical exercise, has no significant association with men's weight status, but is significantly negatively associated with women's weight status. Interestingly, variables intended to control for energy expenditure on the job using MET values specific to the respondent's occupation and time spent working in a usual week were insignificant for all respondents (results not shown). Overall, the measures capturing activity level and, for men, eating out in a restaurant are the behaviors most statistically significantly associated with weight status.

Conclusion

The goal of this paper was to examine the extent to which demographic controls in a weight production function actually proxy for eating and other behaviors. Our hope was that including behavioral factors in addition to the usual demographic controls in such a production function would act to reduce the contribution of these demographic, familial, economic, and environmental factors in explaining individuals' weight. Our results, however, indicate that including measures of behavioral factors does little to alter the estimated impact of the demographic factors. Even so, we find that individuals' behaviors are significantly associated with weight status. This finding adds to our knowledge of the determinants of weight status and provides support for certain policy interventions designed to adjust these behaviors.

Not surprisingly, physical activity is found to be an important determinant of weight status. Increased time spent in sedentary activities is associated with significantly increased BMI for all persons and increased time spent doing high energy activities is associated with decreased BMI for women. Evaluated at the sample mean values for continuous variables and zero values for the dummy variables, we find that these significant associations are also substantial ones. An additional hour spent in non-sleep sedentary activities (less than one-third of a standard deviation for men, less than one-half of a standard deviation for women) increases predicted BMI for men (women) by 0.14 (0.12), increases the probability of being overweight or obese by 0.5% (1.1%) (logit results), and increases the probability of being obese by 0.9% (0.9%) (multinomial logit results). An additional 14 minutes of high energy activities that are not classified as physical exercise (one standard deviation of time spent in high MET activities) reduces predicted BMI for women by 0.2, reduces the probability of being overweight or obese by 2.2% (logit results), and reduces the probability of being obese by 1.2% (multinomial logit results). If these 14 minutes also constitute physical exercise (less than one-half a standard deviation), predicted BMI for women would fall by 0.3, the probability of being overweight or obese would fall by 3.1%, and the probability of being obese would fall by almost 3%. These are substantial differences associated with small changes in behavior and suggest that continued efforts to encourage more physical exercise would help curb the obesity epidemic.

For men, the association between overweight and restaurant meals is also highly significant and substantial. Eating out at a restaurant is associated with a 0.6 higher BMI, a 7.2% higher probability of being overweight or obese (logit), and a 1.5% higher probability of being overweight and a 6.0% higher probability of being obese (multinomial logit). As twenty-three percent of men reported eating at a restaurant during the diary day, such behavior is not unusual.

By contrast, the environmental variable included to capture fast food restaurant density (specifically the number of limited service restaurants per capita in the state) was found to be significantly associated with BMI only in OLS models and then only at the 10% level. While other research has observed a positive association between obesity and fast food restaurant sales or density, these results provide more direct evidence that it is the act of going out to eat not simply the availability of the restaurants that drives weight gain. Policy directives in the form of tax incentives and/or educational campaigns might be designed to influence this behavior.

Overall, we have documented that eating behaviors and other uses of time, even those observed within a short twenty-four hour time window, are significantly associated with obesity and hence potentially with a wide range of health problems. As these 'risky' behaviors may reflect habitual patterns, they may have a cumulative effect on weight and health over a lifetime. Further analysis of this possibility may help explain the strong association between age and weight status. It may be that the best way to address the obesity epidemic in the long run is to increase education and establish healthy habits among the young.

Table 1

Sample Statistics for Weight and Behavioral Variables

By Gender and Weight Status

	Men			Women		
	BMI < 25	BMI >= 25		BMI < 25	BMI >= 25	
Variable	Mean	Mean		Mean	Mean	
BMI	22.60	29.83		22.03	30.84	
% Overweight	0.00	1.00		0.00	1.00	
% Obese	0.00	0.40		0.00	0.45	
Primary Eating Time	70.06	69.70		68.45	66.08	*
Secondary Eating Time	17.70	16.24		16.47	15.41	
Number of Meals	2.80	2.75		2.91	2.80	***
Time Eating while Watching TV	4.73	4.31		3.29	3.44	
Time Sleeping	512.82	501.66	**	513.77	519.54	
Odd Work Schedule	0.12	0.11		0.07	0.05	***
Ate Breakfast	0.57	0.57		0.60	0.56	***
Ate Late Meal	0.20	0.19		0.18	0.15	***
Ate in Restaurant	0.19	0.24	***	0.20	0.19	
Ate Elsewhere	0.21	0.23		0.28	0.24	***
Number of Meals eaten Alone	1.02	0.91	***	0.95	0.92	
Time spent in Physical Activity	20.86	19.04		14.59	7.82	***
Time Low MET	1310.40	1314.98		1347.55	1360.88	***
Time High MET	5.51	3.55	**	3.48	1.21	***

All time is reported in minutes.
Asterisks indicate significant differences between normal and overweight populations at the 1% (***), 5% (**), and 10% (*) level.

Table 2

Sample Statistics for Demographic, Familial, and Environmental Variables

By Gender and Weight Status

	Men			Women		
	BMI < 25	BMI >= 25		BMI < 25	BMI >= 25	
Variable	Mean	Mean		Mean	Mean	
Hispanic	0.08	0.09		0.06	0.09	***
African American	0.10	0.11		0.08	0.18	***
Asian	0.06	0.02	***	0.05	0.02	***
Other Race	0.03	0.02		0.02	0.02	
Age	44.83	46.76	***	45.39	50.12	***
High School Degree	0.33	0.34		0.27	0.35	***
Some College	0.18	0.17		0.18	0.19	
Associate Degree	0.06	0.10	***	0.09	0.11	***
Bachelor Degree	0.19	0.18		0.24	0.14	***
Post Graduate Study	0.15	0.10	***	0.12	0.08	***
Missing HH Income	0.15	0.13	**	0.16	0.14	*
Household Income $15-40K	0.26	0.23	**	0.21	0.28	***
Household Income $40-75K	0.21	0.28	***	0.24	0.26	
Household Income $75-150K	0.20	0.24	***	0.24	0.16	***
Household Income >$150K	0.08	0.05	***	0.07	0.03	***
Married	0.56	0.65	***	0.57	0.58	
Cohabiting	0.04	0.05	***	0.03	0.02	
Lives Alone	0.17	0.14	**	0.16	0.18	*
# of Children age 0-1	0.08	0.06		0.08	0.06	*
# of Children age 2-3	0.07	0.07		0.09	0.06	***
# of Children age 4-6	0.09	0.10		0.12	0.10	***
# of Children age 7-11	0.15	0.18		0.19	0.18	
# of Children age 12-17	0.16	0.22	***	0.22	0.23	
Metro Residence	0.84	0.80	***	0.82	0.79	***
Northeast	0.22	0.20		0.19	0.16	***
Midwest	0.21	0.26	***	0.26	0.26	
South	0.34	0.36		0.35	0.39	***
% overweight in State	36.44	36.52	**	36.48	36.48	
% obese in State	26.23	26.51	***	26.34	26.65	***
# of Limited Service Restaurants *1000 per Capita in State	0.80	0.79	*	0.79	0.79	***
Holiday	0.01	0.02	**	0.02	0.02	**
Weekend	0.28	0.29		0.29	0.28	
Spring	0.28	0.25	*	0.26	0.25	
Summer	0.23	0.25		0.23	0.25	
Fall	0.25	0.25		0.24	0.26	**
Sample Size	1143	3130		2393	3056	

Dummy variables identifying missing values for MET time, breakfast, late meals, and metropolitan residence as well as sick respondents are also included in the multivariate analysis.

Table 3

Coefficient Estimates for Demographic, Familial, Economic, and Environmental Factors

Men

	OLS		Logit		Ordered Logit		Multinomial Logit			
Specification:	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dependent Variable:	BMI		1 if BMI ≥ 25		1 if 25 ≤ BMI < 30,	2 if BMI ≥ 30	25 ≤ BMI < 30 vs. BMI < 25		BMI ≥ 30 vs. BMI < 25	
Variables										
Hispanic	0.804 **	0.903 **	0.262	0.301	0.198	0.235	0.214	0.243	0.346 **	0.407 **
African American	0.748 **	0.676 *	0.161	0.185	0.212	0.225 *	0.062	0.101	0.301 **	0.299 **
Asian	-1.919 ***	-1.893 **	-1.089 ***	-1.064 ***	-0.992 ***	-0.980 ***	-0.989 ***	-0.953 ***	-1.292 ***	-1.299 ***
Other Race	-0.689	-0.733	-0.061	-0.070	0.143	0.113	-0.278	-0.282	0.201	0.171
Age	0.254 ***	0.268 ***	0.086 ***	0.096 ***	0.089 ***	0.095 ***	0.059 ***	0.070 ***	0.131 ***	0.140 ***
Age Squared	-0.002 ***	-0.003 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***
High School Grad	-0.579	-0.598	-0.339 **	-0.367 **	-0.201	-0.218	-0.363 **	-0.402 ***	-0.303 *	-0.318 **
Some College	-0.104	-0.168	-0.290	-0.350 *	-0.067	-0.099	-0.409 **	-0.483 ***	-0.123	-0.161
Assoc. Degree	-0.071	-0.186	-0.001	-0.057	-0.069	-0.116	0.024	-0.035	-0.037	-0.095
Bach. Degree	-1.072 ***	-1.211 ***	-0.420 **	-0.510 **	-0.349 **	-0.414 ***	-0.342 **	-0.437 ***	-0.564 ***	-0.654 ***
Post Graduate Study	-1.593 ***	-1.706 ***	-0.934 ***	-1.014 ***	-0.710 ***	-0.758 ***	-0.865 ***	-0.958 ***	-1.043 ***	-1.103 ***
Household Income $15-40K	0.287	0.318	0.066	0.054	0.043	0.051	0.073	0.048	0.053	0.048
Household Income $40-75K	1.009 **	1.022 **	0.553 ***	0.530 ***	0.312 *	0.305 *	0.589 ***	0.557 ***	0.501 ***	0.479 ***
Household Income $75-150K	0.697	0.654	0.598 ***	0.563 ***	0.269	0.247	0.689 ***	0.645 ***	0.454 **	0.421 **
Household Income >$150K	-0.542	-0.629	0.223	0.149	-0.149	-0.211	0.466 **	0.392 *	-0.305	-0.386
Married	0.544	0.570	0.279 *	0.260	0.240 *	0.243 *	0.261 **	0.226 *	0.309 **	0.312 **
Cohabiting	0.594	0.625	0.786 **	0.729 **	0.317	0.300	0.935 ***	0.862 ***	0.513 **	0.476 *
Lives Alone	-0.205	-0.279	0.050	0.035	-0.020	-0.046	0.120	0.118	-0.066	-0.105
Number of Children age 0-1	-0.070	0.042	-0.114	-0.076	-0.112	-0.079	-0.073	-0.046	-0.182	-0.125
Number of Children age 2-3	0.002	0.102	0.041	0.072	0.073	0.096	0.008	0.034	0.096	0.145
Number of Children age 4-6	-0.070	0.016	0.074	0.079	0.031	0.053	0.075	0.063	0.076	0.107
Number of Children age 7-11	-0.158	-0.144	-0.017	-0.017	-0.029	-0.029	0.006	0.004	-0.057	-0.051
Number of Children age 12-17	-0.096	-0.048	0.021	0.036	-0.040	-0.024	0.060	0.073	-0.041	-0.017
Metro Residence	-0.472	-0.577 *	-0.164	-0.183	-0.153	-0.182 *	-0.120	-0.125	-0.225 *	-0.273 **
Holiday	1.453 *	1.530 **	0.732	0.779	0.416	0.476 *	0.753 **	0.772 **	0.721 *	0.810 **
Northeast	0.708 **	0.688 **	0.030	0.034	0.126	0.127	-0.072	-0.063	0.192	0.200
Midwest	0.733 **	0.767 **	0.172	0.169	0.194	0.197	0.085	0.077	0.314 *	0.328 *
South	0.475	0.428	-0.017	-0.028	0.078	0.047	-0.107	-0.100	0.119	0.089
% Overweight in State	0.008	0.032	0.109 **	0.116 **	0.036	0.051	0.139 ***	0.138 ***	0.065	0.078
% Obese in State	0.071	0.065	0.040	0.039	0.028	0.028	0.039 *	0.038	0.042	0.040
# of Limited Service Restaurants*1000 per Capita	2.909 *	3.015 *	0.188	0.268	0.461	0.514	-0.236	-0.155	0.852	0.907
(McFadden's) R-Squared	0.0669	0.0847	0.0521	0.0613	0.0291	0.0359	0.0411	0.0520		
P-value of Behavioral Variables		0.0000		0.0759		0.0074		0.0013		

Also included in these specifications are dummy variables to identify missing breakfast and missing late dinner values, missing metro residence, missing income, sick persons, missing MET activity, season, weekends, and constant terms.

Asterisks indicate statistical significance using 2-sided tests: *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4

Coefficient Estimates for Demographic, Familial, Economic, and Environmental Factors

Women

	OLS		Logit		Ordered Logit		Multinomial Logit			
Specification:	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Dependent Variable:	BMI		1 if BMI ≥ 25		1 if 25 ≤ BMI < 30, 2 if BMI ≥ 30		25 ≤ BMI < 30 vs. BMI < 25		BMI ≥ 30 vs. BMI < 25	
Variables										
Hispanic	1.090 **	1.039 **	0.523 ***	0.528 ***	0.469 ***	0.475 ***	0.480 ***	0.488 ***	0.572 ***	0.576 ***
African American	3.050 ***	2.985 ***	1.051 ***	1.033 ***	0.880 ***	0.864 ***	0.947 ***	0.925 ***	1.162 ***	1.142 ***
Asian	-1.643 ***	-1.666 ***	-0.219	-0.204	-0.379	-0.370	0.105	0.116	-1.140 *	-1.111 *
Other Race	1.675 **	1.601 **	0.412	0.396	0.535 **	0.510 *	0.074	0.058	0.730 **	0.706 **
Age	0.377 ***	0.396 ***	0.102 ***	0.109 ***	0.103 ***	0.112 ***	0.076 ***	0.079 ***	0.140 ***	0.151 ***
Age Squared	-0.003 ***	-0.004 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***
High School Grad	-0.333	-0.372	0.043	0.029	-0.044	-0.054	0.158	0.145	-0.087	-0.106
Some College	-0.280	-0.412	0.059	0.017	-0.019	-0.057	0.133	0.102	-0.008	-0.070
Assoc. Degree	-0.766	-0.859 *	0.121	0.097	-0.003	-0.021	0.253	0.239	-0.027	-0.069
Bach. Degree	-1.567 ***	-1.600 ***	-0.458 ***	-0.464 ***	-0.495 ***	-0.503 ***	-0.317 *	-0.309 *	-0.620 ***	-0.648 ***
Post Graduate Study	-1.758 ***	-1.760 ***	-0.418 **	-0.412 **	-0.493 ***	-0.487 ***	-0.206	-0.194	-0.719 ***	-0.722 ***
Household Income $15-40K	-0.535	-0.475	-0.005	-0.005	-0.058	-0.045	0.060	0.048	-0.076	-0.056
Household Income $40-75K	-0.702	-0.641	-0.131	-0.140	-0.154	-0.146	-0.060	-0.083	-0.206	-0.193
Household Income $75-150K	-2.239 ***	-2.181 ***	-0.537 ***	-0.533 ***	-0.583 ***	-0.569 ***	-0.287	-0.291	-0.887 ***	-0.871 ***
Household Income >$150K	-3.267 ***	-3.279 ***	-0.892 ***	-0.914 ***	-1.061 ***	-1.068 ***	-0.386	-0.420 *	-2.091 ***	-2.079 ***
Married	0.419	0.345	0.239 **	0.207 *	0.194 *	0.163	0.227 *	0.194	0.261 *	0.234
Cohabiting	-0.154	-0.189	0.074	0.059	0.008	-0.014	0.123	0.099	0.031	0.026
Lives Alone	0.201	0.526	0.049	0.141	0.071	0.152	0.009	0.082	0.109	0.221
Number of Children age 0-1	0.956 **	0.950 **	0.252 *	0.257 **	0.323 **	0.337 **	0.108	0.107	0.425 **	0.440 ***
Number of Children age 2-3	-0.463	-0.574 *	-0.148	-0.164	-0.172	-0.201 *	-0.064	-0.064	-0.260	-0.299 *
Number of Children age 4-6	-0.372	-0.367	-0.073	-0.077	-0.083	-0.076	-0.051	-0.061	-0.106	-0.094
Number of Children age 7-11	-0.123	-0.104	-0.015	-0.014	0.023	0.028	-0.047	-0.051	0.023	0.033
Number of Children age 12-17	-0.359 **	-0.348 **	-0.057	-0.065	-0.073	-0.076	-0.015	-0.030	-0.113	-0.108
Metro Residence	-0.103	-0.120	-0.042	-0.056	-0.035	-0.046	-0.058	-0.072	-0.021	-0.041
Holiday	1.102	0.917	0.516 *	0.472	0.421 *	0.366	0.513 *	0.487	0.513	0.452
Northeast	-0.829 **	-0.784 **	-0.274 **	-0.271 *	-0.310 **	-0.305 **	-0.195	-0.195	-0.391 **	-0.381 **
Midwest	-0.917 **	-0.963 **	-0.220	-0.220	-0.269 **	-0.285 **	-0.121	-0.110	-0.363 **	-0.378 **
South	-1.245 ***	-1.279 ***	-0.278 *	-0.276 *	-0.333 **	-0.340 **	-0.167	-0.154	-0.439 **	-0.456 **
% Overweight in State	0.104	0.127	0.029	0.036	0.023	0.028	0.036	0.041	0.021	0.032
% Obese in State	0.154 ***	0.156 ***	0.034	0.032	0.043 **	0.041 **	0.015	0.011	0.061 **	0.061 **
# of Limited Service Restaurants*1000 per Capita	-0.601	-0.264	-0.570	-0.491	-0.558	-0.512	-0.507	-0.432	-0.695	-0.606
(McFadden's) R-Squared	0.1219	0.1371	0.0759	0.0849	0.0535	0.0608	0.0631	0.0723		
P-value of Behavioral Variables		0.0000		0.0022		0.0001		0.0052		
% correctly predicted			63.7%	64.5%	47.2%	48.3%	48.2%	49.2%		

Also included in these specifications are dummy variables to identify missing breakfast and missing late dinner values, missing metro residence, missing income, sick persons, missing MET activity, season, weekends, and constant terms.

Asterisks indicate statistical significance using 2-sided tests: *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5

Behavioral Coefficient Estimates for Men

	OLS		Logit		Ordered Logit		Multinomial Logit			
Dependent Variable:	BMI		1 if BMI ≥ 25		1 if 25 ≤ BMI < 30, 2 if BMI ≥ 30		25 ≤ BMI < 30, vs. BMI < 25		BMI ≥ 30 vs. BMI < 25	
Variable:										
Primary Eating Time	0.000		-0.001		-0.001		-0.001		-0.001	
Secondary Eating Time	-0.004	***	-0.001		-0.001	**	0.000		-0.003	**
Number of Meals	-0.160		-0.028		-0.044		-0.003		-0.059	
Time Eating while Watching TV	0.012	**	0.001		0.003		-0.002		0.005	***
Time Sleeping	-0.002	**	-0.001	*	-0.001	**	0.000		-0.001	***
Nonstandard Work Schedule	-0.030		-0.063		-0.038		-0.075		-0.049	
Ate Breakfast	-0.104		0.029		-0.015		0.058		-0.019	
Ate Late Meal	-0.029		-0.041		0.063		-0.123		0.079	
Ate in Restaurant	0.599	**	0.407	***	0.326	***	0.355	***	0.502	***
Ate Elsewhere	0.318		0.198		0.166	*	0.173	*	0.247	**
Number of Meals eaten Alone	0.021		-0.061		-0.019		-0.084	*	-0.023	
Time spent in Physical Activity	0.001		0.000		0.000		0.000		0.000	
Time Low MET	0.002	***	0.001	*	0.001	***	0.000		0.001	***
Time High MET	-0.006		-0.003		-0.002		-0.003		-0.003	

Also included in these specifications are all the variables named in Table 3.
Asterisks indicate statistical significance using 2-sided tests: *** at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6
Behavioral Coefficient Estimates for Women

	OLS		Logit		Ordered Logit		Multinomial Logit			
Dependent Variable:	BMI		1 if BMI ≥ 25		1 if 25 ≤ BMI < 30, 2 if BMI ≥ 30		25 ≤ BMI < 30 vs. BMI < 25		BMI ≥ 30 vs. BMI < 25	
Variable:										
Primary Eating Time	-0.002		0.000		-0.001		0.000		-0.001	
Secondary Eating Time	-0.003		0.000		0.000		0.001		-0.001	
Number of Meals	0.280	**	0.042		0.064		0.002		0.098	
Time Eating while Watching TV	-0.001		-0.001		0.000		-0.002		0.000	
Time Sleeping	0.003	**	0.000		0.001	*	0.000		0.001	*
Nonstandard Work Schedule	0.681		-0.059		0.040		-0.200		0.116	
Ate Breakfast	-0.507	**	-0.080		-0.115		-0.029		-0.145	
Ate Late Meal	-0.537	*	-0.190	*	-0.197	*	-0.134		-0.273	*
Ate in Restaurant	0.414		0.128		0.133		0.096		0.176	
Ate Elsewhere	0.176		-0.017		0.043		-0.084		0.073	
Number of Meals eaten Alone	-0.308	**	-0.100	**	-0.086	**	-0.092	*	-0.107	*
Time spent in Physical Activity	-0.008	***	-0.003	**	-0.003	***	-0.001		-0.006	***
Time Low MET	0.002	**	0.001	**	0.001	**	0.001	*	0.001	**
Time High MET	-0.015	**	-0.007	*	-0.007	**	-0.006		-0.006	

Also included in these specifications are all the variables named in Table 4.
Asterisks indicate statistical significance using 2-sided tests: *** at the 1% level, ** at the 5% level, and * at the 10% level.

References

Ackerson, Leland K.; Ichiro Kawachi; Elizabeth M. Barbeau; and S.V. Subramanian (2008). "Geography of Underweight and Overweight among Women in India: A Multilevel Analysis of 3204 Neighborhoods in 26 States," *Economics and Human Biology* 6: 264-280.

Baum, Charles L. (2007). "The Effects of Race, Ethnicity, and Age on Obesity," *Journal of Population Economics* 20(3): 687-705.

Baum, Charles L. and Christopher J. Ruhm (2007). "Age, Socioeconomic Status, and Obesity Growth," *NBER Working Paper* No. 13289.

Boumtje, Pierre I.; Chung L. Huang; Jonq-Ying Lee; and Biing-Hwan Lin (2005). "Dietary Habits, Demographics, and the Development of Overweight and Obesity Among Children in the United States," *Food Policy* 30: 115-128.

Burke, Mary A. and Frank Heiland (2008). "Race, Obesity, and the Puzzle of Gender Specificity," *Federal Reserve Bank of Boston Working Paper* No. 08-8.

Cai, Yongxia; Pedro A. Alviola, IV; Rodolfo M. Nayga, Jr.; and Ximing Wu (2008). "The Effect of Food-Away-from-Home and Food-at-Home Expenditures on Obesity Rates: A State-Level Analysis," *Journal of Agricultural and Applied Economics* 40(2): 507-521.

Centers for Disease Control and Prevention (2006). "Do Increased Portion Sizes Affect How Much We Eat?" *Research to Practice Series*, No. 2.

Centers for Disease Control and Prevention (2008). "Overweight and Obesity." http://www.cdc.gov/nccdphp/dnpa/obesity/index.htm. Accessed 5/7/08.

Chou, Shin-Yi; Michael Grossman; and Henry Saffer (2004). "An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System," *Journal of Health Economics* 23: 565-587.

Cohen-Cole, Ethan and Jason M. Fletcher (2008). "Is Obesity Contagious? Social Networks versus Environmental Factors in the Obesity Epidemic," *Journal of Health Economics*.

Costa-Font, Joan and Joan Gil (2004). "Social Interactions and the Contemporaneous Determinants of Individuals' Weight," *Applied Economics* 36: 2253-2263.

Dunn, Richard A. (2008). "Obesity and the Availability of Fast-food: an instrumental variables approach." Available at SSRN: http://ssrn.com/abstract=989363.

Gomez, Luis F.; Diana C. Parra; Felipe Lobelo; Belen Samper; Jose Moreno; Enrique Jacoby; Diego I. Lucumi; Sandra Matsudo; and Catalina Borda (2007). "Television Viewing and Its Association with Overweight in Columbian Children: Results from the 2005 National

Nutrition Survey: A Cross Sectional Study," *International Journal of Behavioral Nutrition and Physical Activity* 4(41).

Hamermesh, Daniel S. (2008). "Grazing and Making Fat: Determinants and Effects." Mimeo.

Mandal, Bidisha and Wen S. Chern (2007). "A Multilevel Approach to Model Obesity and Overweight in the United States." Available at SSRN: http://ssrn.com/abstract=989227.

Mendoza, Jason A.; Fred J. Zimmerman; and Dimitri A. Christakis (2007). "Television Viewing, Computer Use, Obesity, and Adiposity in US Preschool Children," *International Journal of Behavioral Nutrition and Physical Activity* 4(44).

Miljkovic, Dragan; William Nganje; Helene de Chastenet (2008). "Economic Factors Affecting the Increase in Obesity in the United States: Differential Response to Price," *Food Policy* 33: 48-60.

National Center for for Chronic Disease Prevention & Health Promotion (2008). Behavioral Risk Factor Surveillance System, Prevalence and Trends Data. http://apps.nccd.cdc.gov/brfss/list.asp?cat=OB&yr=2007&qkey=4409&state=All. Accessed 9/5/08.

Nayga, Jr., Rodolfo M. (2001). "Effect of Schooling on Obesity: Is Health Knowledge a Moderating Factor?" *Education Economics* 9(2): 129-137.

Oregon Health and Science University (2006, February 2). "Scientists Dispel Late-Night Eating/Weight Gain Myth," *Science Daily*. Retrieved February 10, 2009 from http://www.sciencedaily.com/releases/2006/02/060202080832.htm.

Pinhey, Thomas K., Donald H. Rubinstein, and Richard S. Colfax (1997). "Overweight and Happiness: The Reflected Self-Appraisal Hypothesis Reconsidered," Social Science Quarterly 78(3): 747-755.

Polivka, Anne (2008). "Day, Evening, and Night Workers: A Comparison of What They Do in Their Nonwork Hours and with Whom They Interact," in <u>How Do We Spend Our Time? Evidence from the American Time Use Survey</u>. Jean Kimmel, ed. W.E. Upjohn Institute for Employment Research, Kalamazoo, MI: 141-175.

Pinkston, Josh and Jay Stewart. "Time Use and Obesity." Paper presented in November 2008 at the Southern Economic Association meetings in Washington, D.C.

Rashad, Inas (2006). "Structural Estimation of Caloric Intake, Exercise, Smoking, and Obesity," *The Quarterly Review of Economics and Finance* 46: 268-283.

Robinson, John P. (1985). "The Validity and Reliability of Diaries versus Alternative Time Use Measures." In F.T. Juster and F.P. Stafford, eds. *Time, Goods, and Well-Being*. Ann Arbor, Michigan: Survey Research Center, Institute for Social Research, University of

Michigan: 33-62.

Sasaki, S.; A. Katagiri; T. Tsuji; T. Shimoda; and K. Amano (2003). "Self-reported Rate of Eating Correlates with Body Mass Index in 18-y-old Japanese Women," *International Journal of Obesity* 27: 1405-1410.

Schlundt, David G.; James O. Hill; Tracy Sbrocco; Jamie Pope-Cordle; and Teresa Sharp (1992). "The Role of Breakfast in the Treatment of Obesity: A Randomized Clinical Trial," *American Journal of Clinical Nutrition* 55: 645-651.

Schoenborn, Charlotte A. and Patricia F. Adams (2008). "Sleep Duration as a Correlate of Smoking, Alcohol Use, Leisure-Time Physical Inactivity, and Obesity Among Adults: United States, 2004-2006." http://www.cdc.gov/nchs/products/pubs/pubd/hestats/sleep04-06/sleep04-06.htm. Accessed 5/8/08.

Timlin, Maureen T.; Mark A. Pereira; Mary Story; and Dianne Neumark-Sztainer (2008). "Breakfast Eating and Weight Change in a 5-Year Prospective Analysis of Adolescents: Project EAT (Eating Among Teens)," *Pediatrics* 121(3): e638-e645.

Tsou, Meng-Wen and Jin-Tan Liu (2006). "Obesity, Schooling and Health Knowledge: An Empirical Study of Taiwanese women," *Education Economics* 14(1): 89-106.

Tudor-Locke, Catrine, Tracy L. (2008). Washington, Barbara E. Ainsworth, and Richard P. Troiano. "Linking the American Time Use Survey (ATUS) and the Compendium of Physical Activities: Methods and Rationale." *Journal of Physical Activity and Health*.

U.S. Census Bureau (2002). 2002 Economic Census. http://www.census.gov/econ/census02/data/industry/E7222.HTM#T4. Accessed 2/9/09.

WebMD (2009). http://www.webmd.com/diet/control-portion-size. Accessed February 10, 2009.

Zhang, Xiaoyong; Hans Dagevos; Yuna He; Ivo van der Lans; and Fengying Zhai (2008). "Consumption and Corpulence in China: A Consumer Segmentation Study Based on the Food Perspective," *Food Policy* 33: 37-47.