An Economic Analysis of Adult Obesity: Results From the Behavioral Risk Factor Surveillance System

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Background

This paper focuses on economic forces that may alter the cost of nutritional and leisure time choices made by individuals. Specifically, it considers the effect of changes in relative prices, which are beyond the individual's control, on these choices. The principal hypothesis is that an increase in the prevalence of obesity is the result of several economic changes that have altered the lifestyle choices of Americans. One change is the increase in the value of time, particularly of women, reflected by the growth in their labor force participation rates and their hours of work. The reduction in their home time, due in part to the slow growth in income among certain groups, has been associated with an increase in the demand for convenience food. Another change is the rise in the real cost of cigarette smoking due to increases in the price of cigarettes, the diffusion of information about the harmful effects of smoking, and the enactment of State statutes that restrict smoking in public places and the workplace. This relative price change may have led to a reduction in smoking, which tends to increase weight. A final set of relative price changes involves the increasing availability of fast food, which reduces shopping and travel time and leads to changes in the relative cost of meals in fast-food and full-service restaurants and of meals prepared at home.

Methods and Findings

Data from repeated cross-sections from the Behavioral Risk Factor Surveillance System (BRFSS) for the years 1984 through 1999 were used. The BRFSS consists of annual telephone surveys of people 18 years and older conducted by State health departments in collaboration with the Centers for Disease Control and Prevention (CDC). Fifteen States participated in the first survey in 1984. The number of participating States grew to 33 in 1987, to 45 in 1990, and to all 51 States (including the District of Columbia) in 1996.

Self-reported data on height and weight were corrected for measurement error, using correction factors obtained by a statistical model relating actual weight and height data to reported weight and height data for people 18 years and older in the Third National Health and Nutrition Examination Survey (NHANES III) for eight demographic groups, defined by race/ethnicity and sex. The corrected measures were then used to compute the Body Mass Index (BMI) and obesity indicator (defined as BMI $\geq$ 30 kg/m^2).

To capture the influence of changes in relative prices, the authors merged State-level variables with the BRFSS data. The number of fast-food and full-service restaurants was taken from the 1982, 1987, 1992, and 1997 Census of Retail Trade (Bureau of the Census, 1986, 1989, 1994, 2000). For other years, these variables were obtained from interpolations and extrapolations of State-specific logarithmic time trends.

The full-service restaurant price pertains to the average cost of a meal in this type of restaurant and was taken from the same source as the number of full-service restaurants. The fast-food price and the food-at-home price were obtained from the ACCRA Cost of Living Index, published quarterly by the American Chamber of Commerce Researchers Association for 250 to 300 cities.

The price of cigarettes was taken from *The Tax Burden on Tobacco* (Orzechowski and Walker, 2002, formerly published by the Tobacco Institute). It includes both Federal and State excise taxes. The clean indoor air regulations (private, government, restaurant, and other) were obtained from the CDC website. Hours worked per week by employed workers, hourly wage rates of employed workers (usual weekly earnings divided by usual hours worked), and employment rates (ratios of employment to population) were obtained from the Current Population Survey (CPS) Merged Outgoing Rotation Groups Files (Bureau of Labor Statistics and Bureau of the Census, 2000) for 64 demographic groups, defined by sex, race (White non-Hispanic and other), marital status (married and other), age (25-44 and 45-64), and years of formal schooling completed (less than 12, 12, 13-15, and 16 and over). The models also included a set of variables identifying the States in order to control for unmeasured determinants of obesity that vary among States but do not vary over time.

Statistical models regressing BMI and the probability of being obese for people 18 and older on the set of variables outlined above show that age has an inverted U-shaped effect; that Black non-Hispanics and Hispanics have higher values of both outcomes than Whites; that males have higher BMI levels than females, but females are more likely to be obese; that married and widowed persons have higher levels of BMI and obesity prevalence than single (never-married) and divorced individuals; and that years of formal schooling completed and real household income have negative effects on BMI and the probability of being obese. At weighted sample means, the income elasticity of BMI is modest (-0.03; that is, a 1-percent increase in income leads to a 0.03-percent decrease in BMI). The income elasticity of the probability of being obese, -0.50, is more substantial. Also, the estimated effect of time shows a secular trend in rising obesity, even after controlling for the variables included in the models.

Per capita number of restaurants and the real price of cigarettes have positive and significant effects on BMI and probability of being obese. Similarly, the real fast-food restaurant price, the real food-at-home price, and the real full-service restaurant price have negative and significant effects, while the effects of the clean indoor air laws do not show a consistent pattern.

The authors also examine the contribution of changes in the composition of the population to the increase in mean BMI and obesity prevalence and find that race/ethnicity, schooling, marital status, and household income contribute little to an understanding in the behavior of obesity over time. Indeed, the last three variables predict reductions in obesity because schooling, real household income, and the divorced fraction of the population grew in the period at issue, while the married fraction of the population declined.

Without the effect of time, the increase in the per capita number of restaurants makes the largest contribution to trends in weight outcomes, accounting for 69 percent of the growth in BMI and 68 percent of the rise in the percentage of people who are obese. The real price of cigarettes ranks second, and the rising prevalence of clean indoor air laws has about the same impact as the reduction in the fast-food restaurant price.

Discussion

The authors emphasize two results: the correlation between the growing number of restaurants per capita and increasing overweight and the correlation between rising cigarette prices and overweight.

The large positive elasticities associated with the per capita number of restaurants—and the importance of trends in this variable in explaining the stability of obesity between 1960 and 1978 and the increase since 1978—suggest that fast-food and full-service restaurants may have played a role in the rise in obesity. At the same time, the authors point out that the growth in these restaurants, especially fast-food restaurants, is to a large extent a response to the increasing scarcity and value of household or nonmarket time.

However, the pooling of different data on food prices in restaurants across years to estimate simple models by least squares may be problematic. Increasing the sample sizes to around a million observations can easily lead to spurious statistical significance. Alternative techniques, such as those for analyzing "repeated cross sections" that often create "pseudo panels" are available.

The positive effect of cigarette price on weight points to an unintended consequence of the anti-smoking campaign, namely that State and Federal excise tax hikes and the settlement of State Medicaid lawsuits have not only caused the real price of cigarettes to rise substantially, but may also have contributed to the upward trend in obesity.

In contrast to this result, Bhargava (2003) estimated a dynamic random effects model for body weight from the Framingham Offspring dataset and found a small negative elasticity of approximately 0.01 of body weight with respect to the number of cigarettes smoked. The elasticity with respect to alcohol consumption was positive and approximately half the magnitude. The evolving patterns in smoking and drinking are apparently different among men and women in different socioeconomic groups.

Future research

The authors propose that a structural approach in which caloric intake, energy expenditure, and cigarette smoking are treated as endogenous determinants of weight be given high priority on an agenda for future research. They suggest repeating the analysis using data from the NHANES. The determinants of childhood obesity, with a focus on factors considered in the BRFSS study and on interactions between fast-food advertising on television and the amount of time spent watching TV, also merit further inquiry.

In addition, it was recommended that the authors consult the literature on nutrition education and interventions for less-educated groups for improving dietary intakes. For example, low-income families are more likely to eat fast foods that are typically energy-dense and inexpensive. While it is true that, with both parents working, mothers have less time for cooking, it is also true that children from low-income households are more likely to eat in fast-food restaurants. Thus, educating parents about children's nutritional requirements and monitoring the contents of food served in restaurants are likely to be helpful in reducing obesity prevalence—i.e., the societal work patterns need not change to stem the obesity epidemic.