Economic Caused and Consequences of Obesity

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Finkelstein, Eric A.; Ruhm, Christopher J.; and Kosa1, Katherine M. (2005). Economic Causes and Consequences of Obesity. *Annual Review of Public Health* Vol. 26: 239-57.

Abstract:

Obesity is not only a health but also an economic phenomenon. This chapter (*a*) examines underlying economic causes, such as technological advancements, behind the obesity epidemic; (*b*) describes economic consequences of obesity, including increasing obesity-related medical expenditures; and (*c*) discusses the role of government in combating the obesity epidemic. Because of the high costs of obesity, and the fact that the majority of these costs are financed by taxpayers, there is a clear motivation for government to try to reduce these costs. However, because obesity may result from poor information and addictive behavior and/or as a result of living in an increasingly obesogenic environment, interventions will need to be multifaceted to ensure the best chance of success.

Key Words: costs, expenditure, technology, wages, intervention

Article:

INTRODUCTION

As shown in Figure 1, the rapid rise in obesity rates began in the 1980s. Between 1960 and 1980, obesity prevalence rates in the United States increased less than 2 percentage points to 15% (23).[1] In the past 25 years, obesity rates have more than doubled. During the late 1980s and early 1990s, obesity prevalence climbed to 23% and reached 31% by 2000. Grade III obesity (BMI $\geq$ 40.0 kg/m^2) grew even more rapidly, rising from 1.3% in the late 1970s to 4.7% in 2000 (22, 23).

As the prevalence of obesity has increased, so too has the incidence of obesity-related diseases, including type 2 diabetes, cardiovascular disease, several types of cancer (endometrial, postmenopausal breast, kidney, and colon cancers), musculoskeletal disorders, sleep apnea, and gallbladder disease (19, 45, 75). As a result, obesity now accounts for approximately 400,000 deaths per year, second only to tobacco (44).

Obesity is not only a health but also an economic phenomenon. Several economic factors affect our food consumption and physical activity decisions, and ultimately our weight. The first section of this chapter provides a review of articles attempting to explain the underlying economic causes of the obesity epidemic. Without a better understanding of these causes, it is difficult to identify effective strategies that might help stem the rise in obesity rates. The second

***RTI International is a trade name of Research Triangle Institute.*

***1.** Adults are classified as obese if their body mass index (BMI) is >30 kg/m2 (48, 78). These prevalence rates are age-adjusted using the 2000 Census population.*

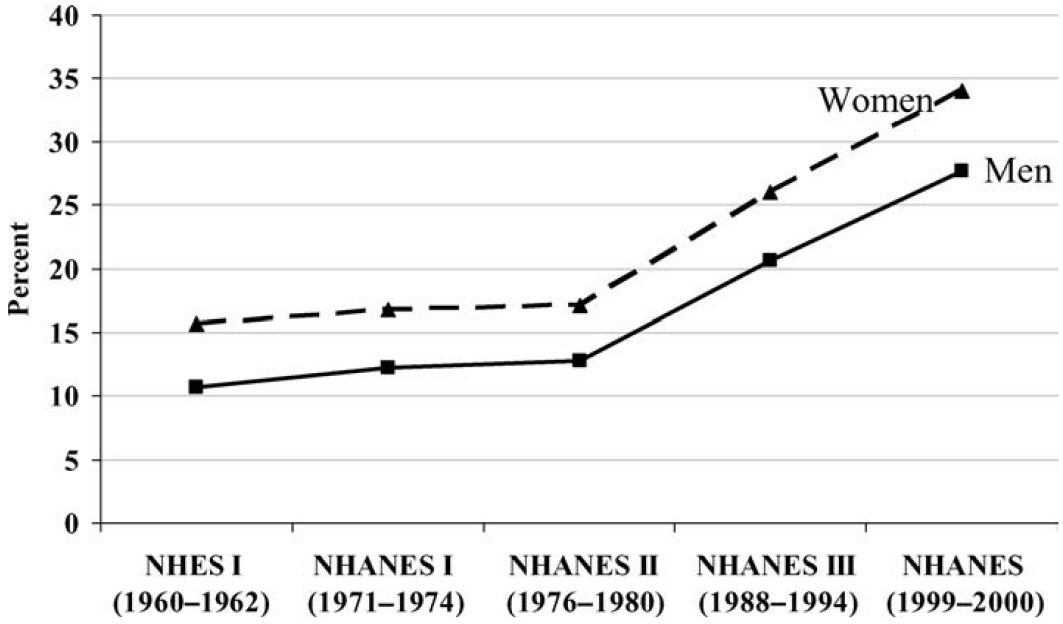

Figure 1 Adult obesity trends by gender, United States, 1960–2000 (Source: Reference 23). NHANES, National Health and Nutrition Examination Survey.

half of the review focuses on the economic consequences of obesity, including the increase in medical and other obesity-related expenditures and the relationship between obesity and wages. We conclude with a summary and discussion of the government's role in reducing obesity rates.

This review is meant to be selective rather than exhaustive. We conducted a systematic exploration of computerized scientific literature databases of economic (EconLit), medical (Medline), and agricultural (AGRICOLA) citations. Our search started with a list of key words established by the investigators. The key words included body weight terms (e.g., BMI, overweight, and obesity) and various economic indicators, including food prices, employment, income, direct medical costs, and productivity loss.

CAUSES OF OBESITY

Taking a historical perspective, obesity was a rare phenomena until the latter part of the twentieth century (11). Because the majority of the population was more likely to suffer from weight deficits, increased body weight was typically associated with improved health. This view changed when obesity rates skyrocketed during the past 25 years.

At the most basic level, the cause of increased body weight is well understood: Individuals gain weight when calories consumed exceed those expended. Why this imbalance changed so abruptly in the early 1980s and continues today remains an open question. Shifts in economic factors that substantially pre- or postdate the rise in obesity rates are unlikely to explain a large portion of the trend; however, identifying economic factors that changed around the time that obesity prevalence markedly increased may help identify underlying causes of the epidemic. A complicating factor, as pointed out by Hill et al. (37), is that the rise in obesity rates could be explained by as little as an average net increase of 50–100 calories per day, which is less than half the calories in a 16-ounce carbonated beverage.

Reductions in Energy Expenditure

Philipson (53) and Lakdawalla & Philipson (40) argued that technological change is responsible for the obesity epidemic largely because of its effect of reducing energy expenditure in the workplace. Advancements in workplace technology may have been responsible for a portion of the increase in obesity in the 1980s, but the majority of the shift away from manual employment predated this time period.

Consider employment in goods-producing (versus service-providing) industries as an approximation of the strenuousness of market work. The fraction of wage and salary workers employed in goods-producing industries fell from 27% in 1980 to 19% in 2000 (12); however, this decline represents the continuation of a longer-term trend: 35% of jobs were in goods-producing industries in 1960. This gradual decline in manual labor began well before the rapid rise in obesity rates and suggests that other factors are more likely to be responsible for the rise in obesity. This evidence is not intended to be comprehensive, since goods- producing jobs have also become more sedentary over time. However, this too is likely to represent a longer trend, with little reason to suspect that sharp changes have occurred since the late 1970s. Even when expanded to include labor-saving devices in the home, the same story can be told. For example, the portion of homes with washing machines and dishwashers rose from 55% to 77% and from 7% to 43%, respectively, between 1960 and 1979, but only slightly further to 79% and 54%, respectively, by 2001 (72, 73).

More generally, the available evidence, although prone to considerable error, suggests that reductions in calorie expenditures are unlikely to explain the majority of the rise in obesity observed during the last quarter-century. For example, using data from time use diaries presented by Robinson & Godbey (58), Cutler et al. (13) reported that energy expenditure fell substantially from 1.69 to 1.57 kcal/min/kg between 1965 and 1975 but has remained fairly constant since that time.

Moreover, Robinson & Godbey (58) provided evidence that leisure-time activities have become more active. For instance, the time individuals spent in "active" sports, outdoor recreation, or walking/hiking/exercise rose from 7 to 24 min per day between 1965 and 1995. Similarly, survey data indicate the percentage of adults who engage in light-to-moderate physical activity rose from 22% to 30%, and the percentage who participate in vigorous activities rose from 12% to 14% between 1985 and 1998 (47).[2] Conversely, the fraction of adults who engage in no leisure-time physical activity declined from 31% in 1988 to 25% in 2002 (9). Finally, the rapid rise in obesity rates among children and adolescents, who are presumably less affected by labor-saving technology, suggests that other factors are responsible for the obesity epidemic.

Increases in Energy Intake

Table 1 summarizes the results of five studies examining trends in energy intake. These data suggest that the number of calories consumed has risen markedly during the same time period as

2. *Individuals are defined as engaging in light-to-moderate physical activity if the activities last for at least 30 min on 5 or more days per week and cause light sweating or slightto-moderate increases in heart rate. Vigorous activities require heavy sweating or large increases in heart rate for at least 20 min on 3 or more days per week.*

the increase in obesity, and that the growth in energy intake is of sufficient magnitude to explain the rise in body weight. For instance, Putnum et al. (54) showed that, after remaining roughly constant between 1910 and 1985, caloric intake rose by roughly 12% (300 calories per day) between 1985 and 2000, mainly because of increased consumption of grains, added fats, and added sugars. The Centers for Disease Control and Prevention (CDC) (10) indicated that caloric consumption remained essentially unchanged between 1971–1974 and 1976–1980 but increased 7.3% (179 calories per day) for men and 23.3% (355 calories per day) for women between 1976–1980 and 1999–2000 (10). Nielsen & Popkin (49) did not show any change in energy consumption from 1977–1978 through 1989– 1991 but found an 11% (190 kcal per day) increase from 1989–1991 to 1994– 1996.

Much of the rise in energy intake is related to increased consumption of carbohydrates. In 1976–1980, adult men and women aged 20–74 years consumed daily 1039 and 700 kcal of carbohydrates, respectively. In 1999–2000, these numbers increased to 1283 and 969 kcal (10). Beverages, particularly fruit and soft drinks, are also responsible for a surprising number of calories. In 1997, the average American consumed 53 gallons of soft drinks and 17 gallons of fruit juices or drinks, a 51% and 40% increase since 1980 (55).[3] During the 1988–1994 period, 20%–24% of the calories consumed by children came from beverages of all types and, among 12- to 19-year-olds, 8% came from soft drinks, and 4% came from fruit juices and drinks (70).[4]

The increase in energy intake has been accompanied by changes in eating patterns; snacking has become more prevalent over time. Cutler et al. (13) found that higher snack calories are responsible for the entire rise in energy intake among females between 1977–1978 and 1994–1996 and for 90% of the increase among males. Nielsen & Popkin (49) showed that 76% of the growth in calories between these two periods resulted from increased snacking. Related studies highlight the increases in the prevalence of snacking, number of snacks per day, and energy density of snacks for children and young adults (38, 80). There is some variation across studies in the trends in calories consumed per snack. Jahns et al. (38) found that this has remained relatively constant for 2- to 18-year-olds, whereas Zizza et al. (78) indicated a 26% increase over the past two decades for adults between the ages of 19 and 29 years.

Causes of Increased Consumption

Economists' first law of demand implies that a decrease in the price of food will cause consumption to increase (43). Moreover, if the price of calorie-dense, prepackaged, and/or prepared foods (e.g., fast food) falls faster than for less calorie- dense foods (e.g., vegetables), then individuals will shift their consumption toward these cheaper alternatives.

Consumer price index (CPI) data indicate that food prices rose 3.4% per year from 1980 to 2000, which is slower than the 3.8% average rise in the inflation rate over the same period (12).

3. *Consumption of fruit drinks was not reported in 1980. The percentage increase in fruit juices and drinks was therefore calculated by assuming that the ratio of fruit juices to drinks consumed was the same in 1980 as in 1987, the first year in which fruit drink consumption was identified. This probably overstates the consumption of fruit drinks in the earlier year, implying that the trend growth for the entire category is likely to be underestimated.*

4. *For children aged 2–5 years and 6–11 years, 27% and 4%, respectively, of calories came from soft drinks and 8% and 5%, respectively, came from fruit juice/drinks.*

TABLE 1 Trends in energy intake

Study	Data[a]	Results
Centers for Disease Control and Prevention (2004) (10)	NHANES: 1971–1974, 1976–1980, 1988–1994, 1999–2000	Daily energy intake of males and females aged 20–74 years increased from 2439 kcals and 1522 kcals in 1976–1980 to 2618 and 1877, respectively, in 1999–2000. The increase is due primarily to a rise in the intake of carbohydrates, which accounted for 42.6% and 46.0% of the total calories consumed in 1976–1980 for men and women, respectively, and 49.0% and 51.6%, respectively, in 1999–2000.
Cutler et al. (2003) (13)	CSFII: 1977–1978, 1994–1996	Daily energy intake for males and females increased from 2080 kcals and 1515 kcals in 1977–1978 to 2347 kcals and 1658 kcals in 1994–1996, respectively.
Nielsen & Popkin (2003) (49)	NFCS: 1977–1978; CSFII: 1989–1991 and 1994–1996	Daily energy intake for persons aged 2 years and older increased from 1795 kcals in 1989–91 to 1985 kcals in 1994–1996.
Putnum et al. (2002) (55)	USFSS: 1985–2000	Average daily energy intake rose 12% (approximately 300 kcal) between 1985 and 2000. Grains, added fats, and added sugars accounted for 46%, 24%, and 23%, respectively, of the increase.
Troiano et al. (2000) (70)	NHANES: 1971–1974, 1976–1980, 1988–1994 (12 to 19 year olds)	Daily energy intake of males and females aged 12–19 years increased from 2789 kcals and 1751 kcals in 1976–1980 to 2864 kcals and 1975 kcals in 1988–1994, respectively.

[a]Abbreviations: CSFII: Continuing Survey of Food Intake by Individuals;
NHANES: National Health and Nutrition Examination Survey;
NFCS: Nationwide Food Consumption Surveys;
USFSS: U.S. Food Supply Series.

Although this difference may not seem large, it implies that the relative price of food fell 14% over this time period. Interestingly, from 1960 through 1980, when the prevalence of obesity did not change, food prices actually rose slightly faster than the overall inflation rate (5.5% versus 5.3% per year). Moreover, the relative prices of calorie-dense foods and beverages (i.e., those made from added sugars and fats) decreased since the early 1980s, compared with less energy-dense foods, like fruits and vegetables. Between 1985 and 2000, the price of fresh fruits and vegetables, fish, and dairy products increased by 118%, 77%, and 56%, respectively, whereas sugar and sweets, fats and oils, and carbonated beverages (54) increased at lower rates—46%, 35%, and 20%, respectively (55). These trends in relative prices are consistent with rapid increases in the consumption of products made with added sugars and fats (15). As a result, Cutler et al. (13) hypothesized that the rise in caloric intake and obesity primarily resulted from changes in food production technology that reduced the price of mass-produced, calorie-dense foods. In addition, evidence from a randomized experiment conducted by Devitt & Mattes (14) suggested that among subjects given equal-sized meals (measured by weight), those receiving foods with the highest energy densities consume more calories because they do not materially change the amount of food eaten.

Reductions in the relative price of energy-dense foods and an increased prevalence of marginal cost pricing (i.e., "supersizing") have resulted not only in an increase in food consumption between meals, but also in an increase in the amount of food consumed at each meal (i.e., larger portion sizes). Young & Nestle (79) provided evidence that serving sizes of virtually all food eaten away from home have increased over time. Nielsen & Popkin (49) found similar growth in portion sizes for the majority of foods examined, with the largest increases seen for French fries and sweetened beverages. Serving sizes, which began to increase in the 1970s, continued to increase in the 1980s and 1990s at the same time that obesity rates rose. In fact, classic cook books, such as *Joy of Cooking*, now specify fewer servings from the same recipes than did older editions, which suggests that portion sizes have also increased for meals eaten at home. Moreover, serving sizes are also larger in the United States than in Europe.

In addition to affecting the strenuousness of most activities and reducing the relative price of food, technological advancements have also resulted in an increase in real wages for those in many occupations. For example, between 1982 and 2002, the average hourly wage of workers in private nonagricultural industries rose by approximately 5% (12). Several studies (29–33) influenced by Becker's seminal work (5) have shown that changes in wage rates affect both employment and "household production."

A rise in wages will presumably result in more hours worked, which could lead to an increase in the consumption of restaurant and prepackaged foods, and ultimately increased weight. Lakdawalla & Phillipson (40) used data from the National Longitudinal Survey of Youth (NLSY) to test the relationship between wages and weight. They found no statistically significant effects of wages on men's weight but find that higher wages are associated with lower weight for women. As discussed in the following section, however, the direction of causality in the relationship between wages and weight remains an open question.

Although not addressed in the Lakdawalla & Phillipson (40) analysis, higher wage opportunities for women have also led to a dramatic increase in female labor force participation, which may have independently increased obesity rates. From 1970 to 1990, the typical two-income family

increased annual market work by 600 hours (6). This trend may partly explain why the consumption of food away from home increased from 18% to 32% of total calories between 1977–1978 and 1994– 1996 and from 32% to 38% of food expenditures between 1980 and 2000 (17,35).[5] Foods eaten away from home, particularly fast food, are associated with high levels of fat and calorie intake. In 1995, 27% of meals included away-from-home foods, and 34% of calories came from these foods (25).

Chou et al. (10a) linked the rise in body weight to the increase in the availability of fast-food and full-service restaurants, which they interpret as a reduction in time costs that occur in response to an increase in the value of household time.[6] Similarly, Anderson et al. (2) and Ruhm (62) provided evidence that increases in maternal employment may account for some of the rise in childhood obesity and suggest that children of working mothers eat home-cooked meals less frequently. One caveat, however, is that the number of women in the labor force increased well before the rise in obesity began.[7]

Investigators have posited many other factors as at least partly responsible for the rise in obesity rates. These factors may have independent effects or interact with the economic factors discussed above. For example, urban sprawl has been correlated with obesity (18). Although urban sprawl began prior to the obesity epidemic and has changed fairly gradually over time, an increase in sprawl likely acts to attenuate the effects of the economic factors detailed above.

Television has also received a great deal of attention for its role in promoting a sedentary lifestyle. However, there is some evidence that the largest growth in viewing hours occurred during the early 1960s and mid-1970s, when color televisions first became widely available at relatively low prices. For example, time diary evidence summarized by Cutler et al. (13) indicated that daily television viewing increased 21% (from 158 to 191 min) between 1965 and 1975 but just 11% from 1975 to 1995 (to 212 min). Although Nielsen data suggested much higher levels of television viewing during this time period (48a), it is unlikely that television viewing alone is responsible for the obesity epidemic. In fact, total screen time, including time spent in front of computers, video games, and other media devices, all of which increased dramatically since the 1980s, may better explain the rise in obesity rates than television viewing alone. However, only television viewing has been shown to increase snacking, portion sizes, the percentage of calories from fat, and calories (25), and these effects are likely to be more pronounced when calorie-dense foods are cheaper and more widely available. Moreover, since children are exposed to —10 food commercials per hour of viewing, most for fast foods, soft drinks, sweets, and sugar-sweetened cereals (16), television may increase demand for these products more than computer or video game use.

CONSEQUENCES OF OBESITY

The rapid rise in body weight has been associated with a commensurate increase in

5. *Nielsen et al. (50) showed that the dramatic increases in food consumption away from home occurred fairly uniformly across age groups rather than being concentrated among the young as is often believed.*

6. *Ruhm (61, 63) showed that obesity becomes more prevalent during macroeconomic upturns, in part because higher time costs lead to reductions in health-preserving activities such as exercise.*

7. *The fraction of females aged 16 years and over who were employed rose from 36% in 1960 to 48% in 1980 and to 58% in 2000 (12).*

obesity-related medical treatments and expenditures. Between 1988 and 1994, there was an 88% increase in the number of physician office visits resulting from obesity (77). Two papers, Quesenberry et al. (56) and Thompson et al. (68), presented statistics detailing obesity-attributable utilization and cost differences for specific medical services.

Compared with individuals of normal weight (20 kg/m^2 ≤BMI ≤24.9 kg/m^2), Quesenberry et al. (56) estimated that individuals who are moderately obese (30 kg/m^2≤BMI ≤34.9 kg/m^2) and severely obese (BMI≥ 35 kg/m^2) have 14% and 25% more physician visits, respectively. Thompson et al. (68) found that obese adults (BMI ≥ 30 kg/m^2) have 38% more visits to primary care physicians. Quesenberry et al. (56) reported that moderately and severely obese individuals have 34% and 74%, respectively, more inpatient days than those of normal weight, and Thompson et al. (68) reported that obese individuals average 48% more inpatient days per year. They also reported that individuals with a BMI greater than 30 kg/m^2 had 1.84 times the annual number of pharmacy dispenses, including 6 times the number of dispenses for diabetes medication and 3.4 times the number of dispenses for cardiovascular medications (68).

Annual Medical Costs

Two recent nationally representative studies compare the annual obesity-attributable medical costs for obese and normal-weight individuals; the findings are nearly identical. Sturm (66) used nationally representative data from the 1997– 1998 Healthcare for Communities survey and found that obese adults aged 18–65 years incur annual medical expenditures that are 36% higher than expenditures of normal-weight individuals. Similarly, Finkelstein et al. (20) used data from the 1998 Medical Expenditure Panel Survey (MEPS) linked to the National Health Interview Survey (NHIS) and found that the average increase in annual medical expenditures associated with obesity is 37.4% ($732) and ranges between 26.1% ($125) for out-of-pocket expenses, 36.8% ($1486) for Medicare recipients, and 39.1% ($864) for Medicaid recipients.

Several studies (67, 76, 77) that combined prevalence and cost data to produce aggregate obesity cost estimates revealed similar results. Early studies rely mostly on epidemiologic methods. Using this approach, Thompson et al. (67) found that total spending attributable to obesity accounts for approximately 5% of health insurance expenditures among businesses with employer-provided health insurance. Wolf & Colditz (76, 77) published several papers that suggest aggregate costs of obesity range from 5.5% to 7.0% of annual medical expenditures. In two papers that use an econometric approach to quantify costs of obesity, Finkelstein et al. (20, 21) produced cost estimates ranging from 5.3% to 5.7% of annual medical expenditures. These papers provide evidence that the aggregate annual obesity-attributable medical costs in the United States are between 5% and 7% of annual health care expenditures.

These two papers were the first to show the percentage of obesity costs financed by taxpayers (20, 21). Because many obese individuals will inevitably be covered by Medicare, and because the Medicaid population has a 50% higher prevalence of obesity, the government finances roughly half the total annual medical costs attributable to obesity. As a result, the average taxpayer spends approximately $175 per year to finance obesity-related medical expenditures among Medicare and Medicaid recipients (20, 21).

Lifetime Medical Costs

Policy makers have used the high annual cost of obesity as a justification for governmental intervention (74). Although annual health care costs among the obese are higher, investigators have suggested that lifetime costs may be lower because obese individuals have shorter life expectancies (24, 65). Three papers address lifetime medical costs of obesity and find no "savings" (1, 27, 69). In the only paper to quantify aggregate costs, Allison et al. (1) reported that 4.3% of lifetime costs are attributable to obesity, compared with an annual estimate between 5.6% and 7.0% (20, 21, 76, 77).

Nonmedical Expenditures

The increase in medical expenditures is not the only cost associated with obesity. Although results vary considerably, many studies have shown that obese individuals, especially women, are more likely to be absent from work than are their normal-weight coworkers (7, 41, 46, 67, 71). After controlling for confounders, Tucker & Friedman (71) reported obese employees (percent body fat ≥25% and 30% for men and women, respectively) are 1.74 and 1.61 times more likely to experience high (7 or more absenses due to illness per 6 months) and moderate (3–6 more absenses due to illness per 6 months) levels of absenteeism, respectively, than were their lean counterparts (percent body fat ≤ 15% and 20% for men and women, respectively). Thompson et al. (67) estimated obesity-attributable absenteeism cost employers $2.4 billion in 1998 ($2.95 billion in 2003 dollars). In addition to medical expenditures and absenteeism, Wolf & Colditz (77) estimated that obesity (in aggregate) resulted in 239 million restricted activity days and 89.5 million bed days in 1995.

Occupational Choice and Wages

Some evidence exists that obese individuals' occupations, primarily women's, differ from those of normal-weight individuals. Pagan & Davila (52) reported that obese women work mostly in relatively low-paying occupations and are largely excluded from high-paying managerial/ professional and technical occupations. Haskins & Ransford (36), using data from one employer in the aerospace industry, reported that 65% of normal-weight women are in managerial/professional positions compared with only 39% of overweight women (defined as 10% or more over the upper limit of ideal body weight range). Sarlio-Lahteenkorva et al. (64) found that obese women are 2.5 times more likely to report long-term unemployment and have higher rates of poverty. Even for those in similar occupations, obese individuals may earn less than their normal-weight counterparts do.

Eight studies (3, 4, 8, 28, 42, 43, 52, 57) have used nationally representative data from the NLSY to quantify the effect of obesity on wages. Although most studies found a negative correlation between women's wages and weight (3, 8, 43, 52, 57), they were unable to determine whether lower wages result from higher weight or vice versa. Gortmaker et al. (28) attempted to solve this problem by focusing on the effects of weight in adolescence on wages seven years later. They found that women who are overweight (BMI > 95th percentile for age and sex) in adolescence have 22% ($6710) lower annual household incomes than do women of normal weight.

The effect of weight on women's wages may differ by race. Averett & Korenman (4) reported that white obese (BMI ≥ 30 kg/m^2) women earn 17% less than do white women of normal weight (19 kg/m^2 < BMI < 25 kg/m^2). Cawley (8) reported that an increase in weight of two

standard deviations (roughly 65 pounds) is associated with a 7% decrease in wages of white women. Neither of the studies found a significant effect of weight on wages of black women.

There is less compelling evidence of a negative relationship between earnings and weight for men; three studies (43, 52, 57) found no relationship, and one study (42) found a positive relationship. When Averett & Korenman (3) examined the effect of obesity in 1981 on the wages of men in 1988, they found a statistically significant negative relationship; however, the effect becomes insignificant when differences for social class and family background are controlled. Gortmaker et al. (28) reported that men overweight (BMI > 95th percentile for age and sex) in adolescence have 9% ($2876) lower annual household incomes seven years later than do men of normal weight. The results from these studies for both males and females are summarized in Table 2.

CONCLUSION

The published evidence, although not conclusive, suggests that technology may be primarily responsible for the obesity epidemic. Technological advancements have allowed us to be increasingly productive at work and at home while expending fewer calories and have also reduced food prices, especially prices for energy- dense foods. These changes directly increase net calories and may interact with other factors (e.g., television, the built environment) to further promote weight gain.

The obesity epidemic has deleterious economic consequences. Obesity is responsible for between 5% and 7% of the total annual medical expenditures in the United States or $75 billion per year (20). Updated to 2003 dollars, the 2001 U.S. Surgeon General's report on obesity stated that annual indirect costs of obesity total $64 billion (74), which suggests that the total (direct and indirect) costs of obesity may now be as high as $139 billion per year.

The published literature reveals a negative correlation between wages and weight, primarily among white women; however, two questions need to be answered. First, do lower wages result in weight gain, or does excess weight lead to lower wages? Second, are earnings lower because of discrimination, as suggested (3, 4, 28, 36, 43, 52, 57), or productivity differences?[8]

Given the changes in our environment that have occurred over the past 30 years, it has become increasingly more difficult for individuals to maintain a healthy weight. It is not surprising, therefore, that the prevalence of obesity has increased. Many people who could have maintained a healthy weight in decades past find it too difficult to do so today. Even with full information about the benefits of physical activity, the nutrient content of food, and the health consequences of obesity, some fraction of the population will optimally choose to engage in a lifestyle that leads to weight gain because the costs (in terms of time, money, and opportunity costs) of not doing so are just too high. Because much of the monetary costs of obesity are financed by taxpayers, the physical activity and food consumption decisions of these individuals are not optimal from a broader societal perspective, implying a role for government in attempting to

8. *Results in the Occupational Choice and Wages section indicate that obese women miss more days from work, raising the possibility that lower wages are not caused by discrimination, which presumably would also affect men and nonwhite women, but that employers are paying lower wages to compensate for increased absenteeism or other factors resulting from obesity.*

TABLE 2 Findings on the effect of body weight on earnings for males and females

		Findings	
Study	**Obesity measure**	**Males**	**Females**
Register & Williams (1990) (57)	Obesity (relative weight ≥ 20% above the standard)	No effect	Obese females earn 12% less than nonobese females.
Gortmaker et al. (1993) (28)	Overweight (BMI ≥ 95th percentile for age and sex)	Men overweight in adolescence have 9% lower annual household incomes 7 years later.	Women overweight in adolescence have 22% lower annual household incomes 7 years later.
Loh (1993) (42)	Obesity (relative weight ≥ 20% above the standard)	Men who weigh 10% more than their ideal weight earn 1.4% more.	No effect
Averett & Korenman (1996) (3)	Overweight (BMI is 25–29 kg/m^2) and Obesity (BMI ≥ 30 kg/m^2)	Obese males in 1981 earned 8% less in 1988 in the cross-sectional specifications. In the sibling-differenced specifications, the wage effect on weight is insignificant.	Obese females earn 10% less and overweight females earn 5% less than normal-weight women in the cross-sectional specifications. In the sibling-differenced specifications, the wage effect of weight is insignificant.
Pagan & Davila (1997) (52)	Continuous BMI	No effect	A one point increase in BMI is associated with a decrease in wages ranging from 0.1% in the precision production/craft/repair operators occupation to 1.5% in the technical and assemblers/inspectors/machine occupations.

Averett & Korenman (1999) (4)	Overweight (BMI is 25–29 kg/m^2) and Obesity (BMI $\geq$ 30 kg/m^2)	Not in the sample	White obese women earn 17% less than white women of recommended weight. The effect of weight is insignificant for black women.
Cawley (2000) (8)	Continuous BMI or weight in pounds controlled for height in inches	Not in the sample	An increase in weight of two standard deviations (roughly 65 pounds) is associated with a 7% decrease in wages for white women. No effect of weight is found for Hispanic or black women.
Mitra (2001) (43)	Continuous weight in pounds controlled for height in inches	No effect	A one-pound increase in weight is associated with a 2% decrease in wages of women in professional and managerial occupations. A one-pound increase in weight is associated with a 1% decrease in wages of women with below-average mathematical skills. No effect of weight on wages is found among women with above-average mathematical skills.

reduce obesity. It should be acknowledged, however, that for many individuals information-based interventions or other interventions that do not affect the costs or benefits of physical activity and food consumption decisions are unlikely to be effective. For some individuals, additional incentives may be needed to encourage them to lose weight.

An emerging class of economic models emphasizes how suboptimal outcomes will be obtained by individuals with self-control problems, either because of genetics or other factors (34, 39, 51). These individuals would like to make different choices but are not able to do so.[9] Given self-control problems associated with food consumption (59, 60), many individuals consume more food than they would like. This notion receives support from the existence of the more than $40 billion-per-year diet industry currently serving nearly 55 million Americans who attempt to lose weight each year (26). The trend toward larger portion sizes, perhaps due to falling food prices, only serves to exacerbate this problem. Similar to those who optimally choose to be overweight, for individuals with self-control problems, provision of additional information is also unlikely to be effective because these individuals are unable to take advantage of their newfound knowledge. Moreover, for those with self-control problems, analogous to those addicted to smoking, changes in costs and benefits of behaviors related to weight may also be ineffective. However, other strategies, such as limiting portion sizes, may be desirable.

This discussion suggests that information-based strategies to combat obesity will have a limited impact. Some subset of the population, even with this information, will still choose a lifestyle that leads to excess weight gain. Those with self-control problems are also unlikely to benefit from the information. For the remainder of the population, these strategies may be effective. Individuals require accurate information to make decisions. Thus, policies such as nutrition labeling laws that increase access to information may allow individuals to make better food consumption choices. Those who are unaware of the consequences of obesity may also benefit from public health education efforts, although the number of individuals who will benefit and the cost-effectiveness of such types of interventions remain largely unexplored. Regardless, this discussion reveals that interventions will need to be multifaceted to have the best chance of success. Given current trends, a concerted effort by individuals, employers, and the government will be needed to prevent obesity rates and related expenditures from rising in the foreseeable future.

ACKNOWLEDGMENT
The authors gratefully acknowledge Olga Khavjou of RTI for her research assistance on this chapter.

LITERATURE CITED
1. Allison DB, Zannolli R, Narayan KM. 1999. The direct health care costs of obesity in the United States. Am. J. Public Health 89(8):1194–99
2. Anderson PM, Butcher KF, Levine PB. 2003. Maternal employment and overweight children. J. Health Econ. 22(3): 477–504

9. *For example, Gruber & Koszegi (34) considered tobacco policies with time-inconsistent preferences and Cutler et al. (13) briefly considered the effects of self-control problems on policies related to obesity.*

3. Averett S, Korenman S. 1996. The economic reality of the beauty myth. J. Hum. Resour. 31(2):304–30
4. Averett S, Korenman S. 1999. Black- white differences in social and economic consequences of obesity. Int. J. Obes. 23: 166–73
5. Becker G. 1965. A theory of the allocation of time. Econ. J. 75:493–517
6. Bluestone B, Rose S. 1997. Overworked and underemployed: unraveling an economic enigma. Am. Prospect. 8(31):58– 69
7. Burton WN, Chen CY, Schultz AB, Edington DW. 1998. The economic costs associated with body mass index in a workplace. J. Occup. Environ. Med. 40(9): 786–92
8. Cawley J. 2000. Body weightand women's labor market outcome. Work. Pap. No. 7841, National Bur. Econ. Res., Cambridge, MA
9. Cent. Dis. Control Prev. 2004. Prevalence of no leisure-time physical activity—35 states and the District of Columbia, 198 8– 2002. Morb. Mortal. Wkly. Rep. 53(4):82– 86
10. Cent. Dis. Control Prev. 2004. Trends in the intake of energy and macronutrients— United States, 1971–2000. Morb. Mortal. Wkly. Rep. 53(4):80–82
10a. Chou S-Y, Grossman M, Saffer H. 2004. An economic analysis of adult obesity: results from the Behavioral Risk Factor Surveillance System. J. Health Econ. 23(3):565–87
11. Costa DL, Steckel RH. 1997. Long-term trends in U.S. health, welfare, and economic growth. In Health and Welfare During Industrializaton, ed. RH Steckel, R Floud, pp. 47–89. Chicago: Univ. Chicago Press, NBER Project Rep. Ser.
12. Counc. Econ. Advis. 2004. Economic Report of the President, 2004. Washington, DC: U.S. Gov. Print. Off.
13. Cutler DM, Glaeser EL, Shapiro JM. 2003. Why have Americans become more obese? J. Econ. Perspect. 17(3):93–118
14. Devitt AA, Mattes RD. 2004. Effects of food unit size and energy density on intake in humans. Appetite 42(2):213–20
15. Drewnowski A, Specter SE. 2004. Poverty and obesity: the role of energy density and costs. Am. J. Clin. Nutr. 791:6–16
16. Ebbeling CB, Pawlak DB, Ludwig DS. 2002. Childhood obesity: public-health crisis, common sense cure. Lancet 360 (9331):473–82
17. Econ. Res. Serv. 2004. Food CPI, Prices, and Expenditures (Table 7), Economic Research Service Briefing Room. http:// www.ers.usda.gov/Briefing/CPIFoodAnd Expenditures/Data/table7.htm
18. Ewing R, Schmid T, Killingsworth R, Zlot A, Raudenbush S. 2003. Relationship between urban sprawl and physical activity, obesity, and morbidity. Am. J. Health Pro- mot. 18(1):47–57
19. Field A, Coakley EH, Must A, Spadano JL, Laud N, et al. 2001. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. Arch. Intern. Med. 161(13):1581–86
20. Finkelstein EA, Fiebelkorn IC, Wang G. 2003. National medical spending attributable to overweight and obesity: how much, and who's paying? Health Aff. Suppl. W3-219–26
21. Finkelstein EA, Fiebelkorn IC, Wang G. 2004. State-level estimates of annual medical expenditures attributable to obesity. Obes. Res. 12:18–24
22. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. 1998. Overweight and obesity in the United States: prevalence and trends, 1960–1994. Int. J. Obes. 22(1):39– 47
23. Flegal KM, Carroll MD, Ogden CL, Johnson CL. 2002. Prevalence and trends in obesity among U.S. adults, 1999–2000. JAMA 288(14):1723–27

24. Fontaine KR, Redden DT, Wang C, West- fall AO, Allison DB. 2003. Years of life lost due to obesity. JAMA 289(2):187–93
25. French SA, Story M, Jeffery RW. 2001. Environmental influences on eating and physical activity. Annu. Rev. Public Health 22:309–35
26. Goodstein E. 2004. 10 Secrets of the Weight-Loss Industry. http://www.bankrate. com/brm/news/advice/20040113al.asp
27. Gorsky R, Pamuk E, Williamson D, Shaffer P, Koplan J. 1996. The 25-year health care costs of women who remain overweight after 40 years of age. Am. J. Prev. Med. 12:388–94
28. Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz W. 1993. Social and economic consequences of overweight in adolescence and young adulthood. N. Eng. J. Med. 329(14):1008–12
29. Gronau R. 1973. The intrafamily allocation of time: the value of the housewives' time. Am. Econ. Rev. 63(4):634–51
30. Gronau R. 1977. Leisure, home production, and work: the theory of the allocation of time revisited. J. Polit. Econ. 85(6):1099–124
31. Gronau R. 1980. Home production—a forgotten industry. Rev. Econ. Stat. 62(3): 408–16
32. Gronau R. 1997. The theory of home production: the past ten years. J. Labor Econ. 15(2):197–205
33. Grossman M. 2000. The human capital model. In Handbook of Health Economics, ed. J Culyer, JP Newhouse, pp. 347–408. New York: Elsevier
34. Gruber J, Koszegi B. 2001. Is addiction rational? Theory and evidence. Q. J. Econ. 116(4):1261–303
35. Guthrie JF, Lin BH, Frazao E. 2002. Role of food prepared away from home in the American diet, 1977–78 versus 1994–96: changes and consequences. J. Nutr. Educ. Behav. 34(3):140–50
36. Haskins K, Ransford HE. 1999. The relationship between weight and career payoffs among women. Sociol. Forum 14(2): 295–318
37. Hill JO, Wyatt HR, Reed GW, Peters JC. 2003. Obesity and the environment: Where do we go from here? Science 299(5608):853–55
38. Jahns L, Siega-Riz AM, Popkin BM. 2001. The increasing prevalence of snacking among U.S. children from 1977 to 1996. J. Pediatr. 138(4):493–98
39. Laibson D. 1997. Golden eggs and hyperbolic discounting. Q. J. Econ. 112(2):443– 77
40. Lakdawalla D, Philipson T. 2002. The growth of obesity and technological change: a theoretical and empirical examination. Natl. Bur. Econ. Res. Work. Pap. No. 8946, Cambridge, MA
41. Leigh JP. 1991. Employee and job attributes as predictors of absenteeism in a national sample of workers: the importance of health and dangerous working conditions. Soc. Sci. Med. 33:127–37
42. Loh ES. 1993. The economic effect of physical appearance. Soc. Sci. Q. 74(2): 420–37
42a. Mankiw NG. 1998. The market forces of supply and demand. In Principles of Microeconomics, 4:61–87. Orlando, FL: Harcourt Brace. 64 pp.
43. Mitra A. 2001. Effects of physical attributes on the wages of males and females. Appl. Econ. Lett. 8:731–35
44. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. 2000. Actual causes of death in the United States. JAMA 291:1238– 45
45. Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. 1999. The disease burden associated with overweight and obesity. JAMA 282(16):1523–29

46. Narbro K, Jonsson E, Larsson B, Waaler J, Wedel H, Sjostrom L. 1996. Economic consequences of sick-leave and early retirement in obese Swedish women. Int. J. Obes. Relat. Metab. Disord. 20:895–903
47. Natl. Cent. Health Stat. 2001. Healthy People 2000 Final Review. Hyattsville, MD: Public Health Serv.
48. Natl. Heart Lung Blood Inst. 1998. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Bethesda, MD: Natl. Inst. Health
48a. Nielsen Media Res. 2004. Average Daily Viewing: 1949–2003. http://www.nielsenmedia.com
49. Nielsen SJ, Popkin BM. 2003. Patterns and trends in food portion sizes, 1977– 1998. JAMA 289(4):450–53
50. Nielsen SJ, Siega-Riz AM, Popkin BM. 2002. Trends in energy intake in the U.S. between 1977 and 1996: similar shifts seen across age groups. Obes. Res. 10(5):370–78
51. O'Donohue T, Rabin M. 1999. Doing it now or later. Am. Econ. Rev. 89(1):103– 24
52. Pagan JA, Davila A. 1997. Obesity, occupational attainment, and earnings. Soc. Sci. Q. 78(3):756–70
53. Philipson T. 2001. The world-wide growth in obesity: an economic research agenda. Health Econ. 10(1):1–7
54. Putnum JJ, Allshouse JE. 1999. Food Consumption, Prices, and Expenditures, 1970–97. Econ. Res. Serv., USDA, Stat. Bull. No. 965. Washington, DC
55. Putnum JJ, Allshouse JE, Kantor LS. 2002. U.S. per capita food supply trends: more calories, refined carbohydrates, and fats. Food Rev. 25(3):2–15
56. Quesenberry CP Jr, Caan B, Jacobson A. 1998. Obesity, health services use, and health care costs among members of a health maintenance organization. Arch. Intern. Med. 158(5):466–72
57. Register CA, Williams DR. 1990. Wage effects of obesity among young workers. Soc. Sci. Q. 71(1):130–41
58. Robinson JP, Godbey G. 1997. Time for Life: The Surprising Ways Americans Use Their Time. University Park: Penn. State Univ. Press
59. Rolls BJ, Morris EL, Roe LS. 2002. Portion size of food affects energy intake in normal-weight and overweight men and women. Am. J. Clin. Nutr. 76(6):1207– 13
60. Rolls BJ, Roe LS, Kral TVE, Meengs JS, Wall DE. 2004. Increasing portion size of a packaged snack increases energy intake in men and women. Appetite 42(1):63– 69
61. Ruhm CJ. 2000. Are recessions good for your health? Q. J. Econ. 115(2):617–50
62. Ruhm CJ. 2003. Maternal employment and adolescent development. Work. Pap. w10691, Univ. N.C., Greensboro
63. Ruhm CJ. 2005. Healthy living in hard times. J. Health Econ. In press
64. Sarlio-Lahteenkorva S, Lahelma E. 1999. The association of body mass index with social and economic disadvantage in women and men. Int. J. Epidemiol. 28(3):445–49
65. Stevens J, Cai J, Pamuk ER, Williamson DF, Thun MJ, Wood JL. 1998. The effect of age on the association between body- mass index and mortality. N. Engl. J. Med. 338(1):1–7
66. Sturm R. 2002. The effects of obesity, smoking, and drinking on medical problems and costs. Obesity outranks bothsmoking and drinking in its deleterious effects on health and health costs. Health Aff. 21:245–53
67. Thompson D, Edelsberg J, Kinsey KL, Oster G. 1998. Estimated economic costs of obesity to U.S. business. Am. J. Health Promot. 13(2):120–27

68. Thompson D, Brown JB, Nichols GA, Elmer PJ, Oster G. 2001. Body mass index and future healthcare costs: a retrospective cohort study. Obes. Res. 9(3):210–18
69. Thompson D, Edelsberg J, Colditz GA, Bird AP, Oster G. 1999. Lifetime health and economic consequences of obesity. Arch. Intern. Med. 159(18):2177–83
70. Trioiano RP, Briefel RR, Carroll MD, Bialostosky K. 2000. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination survey. Am. J. Clin. Nutr. 72(Suppl. 5):1343– 53
71. Tucker LA, Friedman GM. 1998. Obesity and absenteeism: an epidemiologic study of 10,825 employed adults. Am. J. Health Promot. 12(3):202–7
72. US Census Bur. 1982. Statistical Abstract of the United States: 1982–83. Washington, DC: US Census Bur. 103rd ed.
73. US Census Bur. 2003. Statistical Abstract of the United States: 2003. Washington, DC: US Census Bur. 123rd ed.
74. US Dep. Health Hum. Serv. 2001. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity. Rockville, MD: US Dep. Health Hum. Serv., Public Health Serv., Off. Surg. Gen.
75. Visscher T, Seidell J. 2001. The public health impact of obesity. Annu. Rev. Public Health 22:355–75
76. Wolf AM, Colditz GA. 1994. The cost of obesity: the US perspective. Pharmacoeconomics 5(Suppl. 1):34–37
77. Wolf AM, Colditz GA. 1998. Current estimates of the economic cost of obesity in the United States. Obes. Res. 6(2):97– 106
78. World Health Organ. 1997. Obesity: preventing and managing the global epidemic. Rep. WHO Consult. Obesity. World Health Organ., Geneva, Switz.
79. Young LR, Nestle M. 2002. The contribution of expanding portion sizes to the US obesity epidemic. Am. J. Public Health 97(2):246–49
80. Zizza C, Siega-Riz AM, Popkin BM. 2001. Significant increase in young adults' snacking between 1977–1978 and 1994–1996 represents a cause for concern! Prev. Med. 32(4):303–10