Economic perspectives on childhood obesity

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"Overweight and obesity may soon cause as much preventable disease and death as cigarette smoking. People tend to think of overweight and obesity as strictly a personal matter, but there is much that communities can and should do to address these problems." (Surgeon General David Satcher)[1]

Introduction and summary

Obesity rates in the United States have skyrocketed in the last 30 years. Among adults, obesity rates more than doubled from the early 1970s to the late 1990s. Over the same period, children's obesity rates nearly tripled. These alarming trends have received a great deal of attention in recent years. Researchers are anxious to understand the reasons underlying the trends, policymakers would like to implement programs to promote a healthier population, and the media reports virtually every glimmer of insight from research and every potential policy remedy.

In what follows, we have several goals. First, we discuss why trends in obesity, and childhood obesity in particular, are of interest from an economic perspective. One might think that weight is a private matter, the result of each individual deciding how much to eat and how much to exercise. We argue that this view ignores several ways in which individuals' weight may have ramifications beyond their own well-being—for example, if overweight individuals use more medical care and the cost is in part borne by society. Further, it ignores ways in which existing government policies may already influence individuals' weight. In particular, we argue that children's weight is an appropriate area for government intervention for all the reasons that the government acts to protect children's health more broadly, for example, by barring them from purchasing cigarettes and alcohol.

Next, we document changes in obesity over time in the United States for adults and children. The data that the Centers for Disease Control (CDC) use to track changes in obesity are called the National Health and Nutrition Examination Surveys (NHANES). Four of these surveys have been conducted in 1971–74, 1976–80, 1988–94, and 1999–2000. Interestingly, the distribution of body mass indexes (BMI),[2] the usual metric by which overweight and obesity are defined, was nearly identical in the first of these two surveys. The increase in obesity began between 1980 and 1988 and continued between 1994 and 1999. The timing of the increase discredits some of the easy answers about the underlying cause of the so-called epidemic in obesity—television and fast food, for example, were already available in 1980. The BMI distributions also show that not everyone seems to be affected by the epidemic. The median body mass index rose 9.2 percent and 4.5 percent for adults and children, respectively, between the first and last surveys. However, BMI at the 95th percentile rose 16.7 percent and 15.7 percent for adults and children, respectively.

Third, we discuss changes in children's lives over the last three decades that may be causally related to weight gain. In particular, we examine the increase in mothers working outside the home. It may be that mothers who work outside the home may not have time to prepare nutritious low-calorie meals and supervise their children's outdoor, calorie-expending play. We use National Longitudinal Survey of Youth (NLSY) data to examine whether mothers who work more hours per week, on average, or more weeks over their children's lives are more likely to have obese children. The data contain information on many socioeconomic

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characteristics of families and multiple observations over time on all of a mother's children. This allows us to control for many observable and unobservable differences between mothers who work and mothers who do not that might be correlated with children's weight. For example, we can examine whether siblings' obesity status differs depending on whether their mother worked more during one sibling's life than the other's. This holds constant all of the (fixed) family characteristics that might be correlated both with children's weight and mothers' labor supply.

We find that mothers who work more hours per week, on average, during their children's lives, are more likely to have overweight children. It is not working per se that matters, but working a lot of hours per week. This suggests that it is time constraints that may make it harder for working mothers to oversee their children's diet and exercise. Further, we find that this effect only holds for upper income families (the top quartile of the family income distribution). Although children in lower income families are more likely to have weight problems, it does not seem to hinge on how much their mothers work. We find that for upper income families, the increase in average hours worked by mothers between the mid-1970s and the mid-1990s can explain between 12 percent and 35 percent of the increase in obesity among children in these families. The increase in mothers' hours of work is important, but it does not explain the whole of the increase in childhood obesity.

Given that mothers work, and that these trends are likely to continue, are there potential policy levers that would help to improve children's health? We briefly examine changes in the school environment over the last decade for two reasons. First, increases in the availability of unhealthful foods in schools may be a contributor to the childhood obesity epidemic. This may be particularly important if working parents are more likely to rely on food available at school to feed their children. In addition, this is an area of active policymaking, with many school districts acting to curtail children's access to soda, for example. We suggest that the relationship between school finance policies, school food, and children's health is an important avenue for future research.

Economics of childhood obesity

Why is the increase in obesity, and childhood obesity in particular, an interesting question from the perspective of economics? There is a small, but growing literature on obesity in economics. Some of it addresses the underlying reasons for the increase in obesity and some examines the consequences of this increase. Cutler et al. (2002) and Lakdawalla and Philipson (2002), for example, both posit that technological change is at the root of increases in obesity.[3] To simplify things a great deal: Calories have become relatively cheaper and exercise has become relatively more expensive. Individuals have maximized their utility subject to this new budget constraint, and higher body mass indexes have been the result. As Cutler et al. (2002) point out, in the standard economic model, the resulting obesity is not necessarily viewed as a bad outcome. People make a choice and if they choose to eat more and exercise less in the face of the current environment, it must be because that makes them happier than eating less and exercising more. The implication of this simple economic analysis is that there is no reason to intervene with policies to reduce obesity, since it is merely the outcome of individuals pursuing their own self-interests.

Even if one finds the economic analysis above compelling and believes there is no role for policy intervention for adults, it is hard to support such a conclusion when it comes to children. The standard economic model requires well-informed individuals who are free to make their own choices. Children, in general, do not purchase their own food or determine what's for dinner. (If they do purchase their own food, it is generally because an adult has given them the money to do so.) To a large extent, they do not determine how they spend their time. As Eberstat (2003) puts it in her review of the issue, "If free-choosing adults were the only people implicated thus, we could perhaps rest philosophical here, content in the knowledge that the fat problem—again, like smoking—will ultimately right or at least ameliorate itself in the long run. The problem, however, as the latest round of headlines demonstrates, is that the casualty count goes beyond those with free choice. For there *is* something uniquely worrisome, both as a public health issue and as a social fact, in one important subset of that problem—namely, the cavalcade of new evidence about obese and overweight children."

Furthermore, there are reasons not to endorse the standard economic model's laissez-faire implications even when applied to adults. First, there may be externalities—costs borne by society that individuals do not take into account when making their decisions—through deteriorating health and its costs, associated with the increase in obesity. Second, as Cutler et al. explain, there may be "'internalities', or costs borne by individuals themselves because of their higher weights. These internalities exist in the presence of self-control or addiction problems—people would like to eat less than they do, but have difficulty limiting their consumption. They are similar to externalities because they result from individuals when they are consuming food not internalizing the impact on their future happiness."

Cutler et al. go on to argue (as well as to develop formal models of self-control) that individuals do not believe that their increase in obesity is the result of welfare-enhancing shifts in technology. In particular, people are willing to spend large amounts of money to try to lose weight; they report that the diet industry is estimated at between $30 billion and $50 billion per year. Similarly, they present survey evidence that desired BMI rises much more slowly than actual BMI, indicating that most overweight people would like to weigh less than they do.[4] Finally, as we discuss in the next section, median BMI has increased over time, but it has increased much more slowly than BMI at the 95th percentile of the distribution, or rates of obesity. This suggests that there are some people, be they people with poor self-control or with particular physiological characteristics that make it easier for them to gain weight, who are especially susceptible to obesity.

Externalities are an additional reason why economists, even if they think increases in BMI are solely the result of individuals pursuing their own best interests, might think that some form of policy intervention is warranted. If overweight and obese people consume more medical care, and if much of that medical care is paid for by society, then there is an externality associated with weight problems.[5] A recent Surgeon General's report details the deleterious health effects of excess weight.[6] For example, individuals with a BMI above 30 have a 50 percent to 100 percent increased risk of premature death from all causes compared with individuals with BMI in the "healthy range" from 20 to 25. By some estimates, 300,000 deaths a year may be attributable to obesity, making it the second leading cause of "preventable" deaths after smoking (which accounts for 400,000 deaths). Morbidity is also higher for obese people, and this morbidity is associated with increased direct and indirect costs. In 2000, the direct cost of obesity-related disease was estimated at $61 billion. Indirect costs were estimated at $56 billion. Direct costs are health care costs associated with physician visits and hospitalizations, for example. Indirect costs are the value of lost wages by those who cannot work due to sickness or disability and foregone earnings due to premature death. Further, overweight and obese individuals receive lower wages than those without weight problems. This may be because obesity-related illness reduces productivity or because of employer discrimination (Averett and Korenman, 1996; Cawley, 2000).[7]

The health care cost externalities are most likely to be generated from adult weight problems because obesity-related illness is most likely to take its toll on adults. However, there has been a stark increase in obesity-related health problems in children. Doctors report increases in type 2 (which used to be called "adult onset") diabetes in children, as well as high blood lipids, hypertension, sleep apnea, orthopedic problems, and early maturation.[8] Perhaps most importantly for long-term health care costs, children with weight problems are likely to become adults with weight problems.

Finally, economists may care about policy interventions to address obesity because the government already intervenes in people's lives in a myriad of ways that may have intentional or unintentional consequences for their weight. Public spending on transportation, parks, and safety, for example, may affect the amount of exercise people get. Farm subsidies may affect food prices. Beyond these broad brushstrokes, however, there are specific ways in which government policies may affect childhood obesity. The U.S. Department of Agriculture's Food Guide Pyramid provides the government's definition of a healthful diet.[9] This, in turn, affects the food that schools serve to children.

Similarly, education policies affect physical education requirements in schools. Finally, economic and social policies may have direct or indirect effects on parents' labor supply, which may, in turn, affect the amount of time they have to oversee their children's diet and exercise.

In this section we have briefly outlined why obesity, and childhood obesity in particular, is of interest from an economic perspective. In the next section, we give a brief overview of the literature on childhood obesity in a number of different disciplines. Then, we provide a detailed description of how obesity has increased over the past three decades.

Why has childhood obesity increased?

What determines whether someone weighs too much, too little, or just the right amount? Many researchers believe that genetics play a strong role in determining whether an individual has weight problems. Studies have found a correlation between parent and child obesity, although such a correlation may be due either to genetic or common environmental factors, because families share both (see Vuille and Mellbin, 1979; Dietz, 1991). Strong evidence for an important genetic component to weight comes from an influential study of identical twins (Stunkard et al., 1990). BMI for adult identical twins who had been reared apart was only slightly less than the correlation in BMI for those who had been reared together (0.70 versus 0.74). However, while there is compelling evidence that genes play an important role in determining who will be obese, large-scale genetic change is thought to happen too slowly to be the underlying cause of the observed increase in obesity in the United States over the last 30 years.

More likely, genetics determine whether one is susceptible to the disease of obesity, and environmental factors then determine whether the conditions are right for individuals to "catch" the disease.

At some basic physiological level, the determinants of weight gain are well understood. If one takes in more calories than one expends, then one gains weight. The question then, is what has upset the delicate balance between calorie expenditure and intake, such that more people are overweight and obese? Researchers have turned to environmental factors to explain the upswing in obesity.

Before we give an overview of this literature, however, it is worth noting that the balance between energy intake and expenditure is aptly described as "delicate." Cutler et al. (2002) give a nice illustration of the very small increase in calories needed to produce the increase in steady state weight observed in their data. For example, they observe a 12-pound increase in median weight for adult men between the 1971–74 and 1988–94 NHANES surveys. A mere 155 extra calories a day would produce this increase in weight, if there were no change in exercise. They point out that 150 calories a day is equivalent to a 12-ounce can of soda or three Oreo cookies. On the other hand, it requires about 1.5 miles per day of walking to burn 150 calories.[10] Thus, really quite subtle changes in people's environment that affect energy consumption or expenditure may produce significant weight gain and a correspondingly higher-steady state weight.

What changes in children's lives may have generated the observed increase in weight problems? Ebbeling et al. (2002) give a succinct overview of the current literature. In trying to understand the increase in childhood obesity, researchers have focused on both the physical activity and consumption sides of the equation. Television viewing is a perennial villain in this literature. And, indeed, there is evidence that children who engage in the least vigorous physical activity or the most television viewing tend to be the most overweight (Andersen et al., 1998). Television viewing is thought to affect weight through several insidious channels: first, obviously, children are typically sedentary while watching TV; second, eating is often a complementary activity to television viewing; and, third, while watching television children are exposed to many advertisements for foods that are thought to contribute disproportionately to weight problems. A number of studies have found that children watched about ten food commercials per hour of television (Kotz et al., 1994, Lewis and Hill, 1998, Taras and Gage, 1995) and that these advertisements affect the foods children choose to consume (Borzekowski and Robinson, 2001).

There are two problems with television as the smoking gun in the childhood obesity mystery. First, typically the studies documenting a link between weight problems and television viewing habits are cross-sectional. It is hard to say whether children who watched a lot of TV developed weight problems or whether children with such problems tended to watch a lot of TV—perhaps because physical activity is more difficult for them or because interacting with their peers is less pleasant. Second, as we see in the next section, there were large increases in the fraction of children with weight problems between the NHANES surveys in 1971–74 and 1988–94 and again between the NHANES surveys in 1988–94 and 1999–2001. Television was widely available by 1974, and even cable television was available by 1994, making it unlikely that the mere *availability* of television could be driving the trend.

Fast food consumption is the other leading suspect in the childhood obesity epidemic. As Ebbeling et al. (2002) note, fast food typically includes all of the things that nutritionists warn against: "saturated and trans fats, high glycemic index, high energy density, and increasingly, large portion size." They further note that a large fast food meal can contain about 2,200 calories, which at a burn rate of 85–100 calories per mile would require something near a full marathon to expend! There is evidence that fast food consumption and total energy consumption or bodyweight are positively correlated (French et al., 2001; French et al., 2000; Binkley et al., 2000).

It is also clear that fast food consumption has increased over time. Children had gone from eating 17 percent of their meals away from home in the late 1970s to eating 30 percent of their meals away from home by the mid- to late 1990s. Fast food had gone from contributing 2 percent of children's total calories to about 10 percent over the same period (Ebbeling et al., 2002; Lin et al., 2001). Similarly distressing from a nutritional standpoint, daily per capita soft drink consumption for children (11–18 years old) rose from 179 grams to 520 grams for boys and from 148 grams to 337 grams for girls between 1965 and 1996 (Cavadini et al., 2000).

While it is intuitively appealing to blame fast food for the increase in childhood obesity, fast food, like television, has been available for decades. The question then is, why have television viewing, fast food, and soda consumption by children increased over the last several decades? Before we examine the increase in maternal employment as a potential reason that children's energy consumption has increased and their energy expenditure has decreased, we document the trends in obesity in the United States below.

Changes in rates of obesity in the U.S.

Obesity rates and BMI distributions

Table 1 presents information on the changes over time in body mass index and prevalence of obesity in the United States by age and sex.[11] The data are from the National Health and Nutrition Examination Surveys (NHANES) I–IV and are weighted to be nationally representative.[12] Obesity for adults is defined as a body mass index greater than or equal to 30. For children, the CDC has recently released age- and sex-specific BMI cutoffs to define problem weights. The CDC used data from earlier health examination surveys, when obesity was not as prevalent, to create age-sex specific BMI distributions. Roughly, we are defining children as obese if their BMI is above the 95th percentile of the age-sex specific BMI distribution from the earlier period.[13] By definition then, about 5 percent of children, aged two to 19, are obese in the sample from the early 1970s.

Table 1 shows that BMI and obesity have increased over time for all age groups and for both sexes. The fraction obese is lower among children than among adults, but the overall rate has nearly tripled for children, while it has somewhat more than doubled for adults. Interestingly, although average BMI has increased over the roughly 30-year period, it has not increased as dramatically as the fraction of the population that is obese. This may be because a large fraction of the population was near the obesity threshold, then a small rightward shift of the entire distribution produced a large increase in the fraction of the population that is defined as obese. Alternatively, the distribution of BMI may be shifting in ways that are not captured by means—the shape of the distribution may be changing over time.

Figure 1, panels A and B (on p. 36) show the density function for body mass index for adults and children in all four surveys. The vertical line in each figure marks the 95th percentile of the 1971–74 log BMI distribution. First, notice that the distribution is more dispersed for adults than for children. This makes sense as the adults have had time to grow to their eventual heights and to put on weight. What is clear in both figures, however, is there is more weight in the right tail of the distribution with each successive survey. Interestingly, the distributions are remarkably similar for the 1971–74 and 1976–80 data. The right tail of the distribution begins to pull away in 1988–94. It then pulls farther away in the 1999–2000 data. Figure 2, panels A and B (on p. 37) only present the data from the beginning and ending periods, making it easier to see the dramatic change over time.

The increase in obesity in the United States is not simply a matter of everyone, no matter where they originally were in the BMI distribution, gaining a few extra pounds. The figures show that what has happened is that those people who were higher up in the BMI distribution gained more weight. Table 2 (on p. 38) makes this clear. Median BMI for adults went from 24.6 in the first period to 26.8 in the last. That is an 8.9 percent increase. However, BMI at the 95th percentile of each distribution increased from 33.9 to 39.6, a 16.8 percent increase. For children, something similar occurred. Median BMI increased from 17.7 to 18.5, a 4.5 percent increase. However, BMI at the 95th percentile increased from 26.1 to 30.2, a 15.7 percent increase. The difference in the increase in BMI between the median and the 95th percentile is even more dramatic for children.

What do the changes in the shape of the BMI distribution for adults and children tell us? First, the increases in obesity began between the 1976–80 and the 1988–94 survey periods, but the increases continued at a similar rate into the 1999–2000 period. Thus, researchers may want to focus on environmental factors that changed in people's lives between 1980 and 1988, for example. Second, whatever these environmental factors are, they seem to have a deleterious effect on a sizable fraction of the population, but not on the entire population. Thus, there appear to be people who are "at risk" of obesity, and these environmental factors provide the necessary conditions for their disease to flourish.

Relationship between BMI and age, and obesity and age

Before moving on to look more closely at changes in the environment facing children, we examine the relationships between BMI and age, and obesity and age. Table 1 shows that within each survey, BMI and obesity increase with age.[14] However, each of these surveys is cross-sectional. If the distribution of BMI were stable from period to period, one might reasonably be able to say that the BMI of six to 11 year olds in 1976–80 is a good prediction of what the BMI of two to five year olds in that period will be in a few years. However, because the BMI distribution changed so drastically after 1980, this is likely to be a very poor estimate.

Figure 3 (on p. 38) shows the relationship between age and BMI in each of the surveys. We created this figure by running an ordinary least squares regression with BMI on the left-hand side and a quartic in age on the right-hand side. We then predicted BMI from the resulting regression coefficients. The relationship between age and BMI is virtually identical for 1971–74 and 1976–80. In the two successive surveys, however, the relationship between age and BMI rotates up. This is important for thinking about what is likely to happen to weight problems as today's children age. Someone who was ten years old in 1980, for example, would be between 18 and 24 years old in 1988–94 and between 29 and 30 in 1999–2000. Thus, if we

TABLE 1

Average body mass index and fraction obese 1971–2000

	1971–74		1976–80		1988–94		1999–2000	
	BMI	Obese	BMI	Obese	BMI	Obese	BMI	Obese
Male								
Age 2–19	18.62 (3.86)	0.053 (0.224)	18.83 (3.84)	0.055 (0.229)	19.19 (4.55)	0.104 (0.305)	19.66 (4.91)	0.138 (0.345)
Age 2–5	15.96 (1.41)	0.047 (0.213)	15.87 (1.38)	0.045 (0.208)	16.06 (1.70)	0.060 (0.238)	16.21 (1.61)	0.103 (0.305)
Age 6–11	16.74 (2.61)	0.045 (0.208)	17.04 (2.83)	0.072 (0.259)	17.68 (3.30)	0.120 (0.325)	17.94 (3.37)	0.152 (0.359)
Age 12–19	21.14 (3.81)	0.061 (0.240)	21.16 (3.64)	0.048 (0.214)	22.12 (4.76)	0.115 (0.320)	22.82 (5.19)	0.144 (0.351)
Age 20–70	25.55 (4.07)	0.118 (0.322)	25.48 (3.94)	0.120 (0.325)	26.54 (4.61)	0.193 (0.395)	27.62 (5.31)	0.264 (0.441)
Age 20–55	25.53 (4.08)	0.118 (0.322)	25.38 (3.98)	0.116 (0.320)	26.33 (4.64)	0.178 (0.383)	27.43 (5.38)	0.250 (0.433)
Age 56+	25.59 (4.05)	0.118 (0.322)	25.86 (3.78)	0.135 (0.342)	27.47 (4.36)	0.261 (0.440)	28.41 (4.99)	0.319 (0.467)
Female								
Age 2–19	18.64 (4.11)	0.051 (0.221)	18.94 (4.15)	0.056 (0.023)	19.39 (4.73)	0.097 (0.296)	19.97 (5.30)	0.141 (0.348)
Age 2–5	15.66 (1.53)	0.050 (0.218)	15.69 (1.49)	0.052 (0.221)	16.08 (1.94)	0.085 (0.279)	16.05 (1.99)	0.110 (0.313)
Age 6–11	16.79 (2.66)	0.038 (0.191)	17.10 (3.16)	0.066 (0.249)	17.86 (3.70)	0.109 (0.312)	18.07 (3.85)	0.145 (0.353)
Age 12–19	21.23 (4.15)	0.061 (0.240)	21.33 (3.95)	0.051 (0.220)	22.42 (4.75)	0.093 (0.291)	23.39 (5.30)	0.153 (0.360)
Age 20–70	24.93 (5.32)	0.161 (0.367)	25.02 (5.40)	0.164 (0.370)	26.33 (6.12)	0.246 (0.431)	28.15 (6.76)	0.336 (0.472)
Age 20–55	24.54 (5.26)	0.142 (0.350)	24.63 (5.35)	0.148 (0.355)	25.97 (6.10)	0.231 (0.421)	27.87 (6.82)	0.314 (0.464)
Age 56+	26.30 (5.29)	0.226 (0.418)	26.39 (5.36)	0.218 (0.413)	27.77 (6.01)	0.308 (0.461)	29.39 (6.36)	0.432 (0.496)
Observations	19,004		18,380		24,654		7,697	

Notes: Standard deviations in parentheses. We use the term "obese" to refer to children with BMIs above an age-sex specific cutoff. This cutoff roughly corresponds to the 95th percentile of the age-sex specific BMI distribution in NHANES data from the 1960s and early 1970s. Children with BMIs above this cutoff are usually termed "overweight" in the medical literature, while "obese" is used for adults. We use "obese" for both groups. Adults are termed "obese" if their BMI is 30 or above. The data include 2–19 year olds for the children and 20–70 year olds for adults.
Source: Authors' calculations based on data from the National Health and Nutrition Examination Surveys.

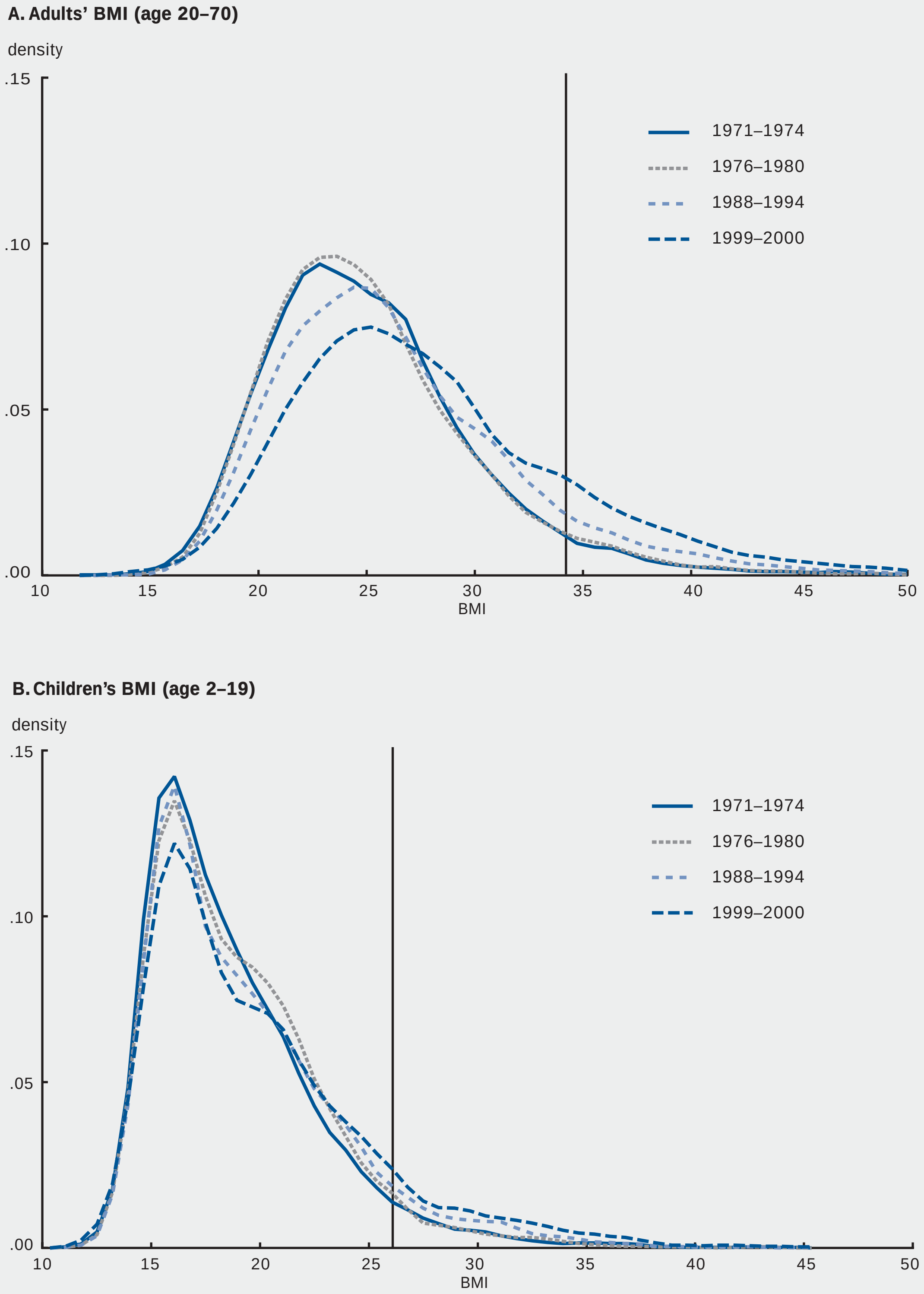
want to track the BMI-age profile for ten year olds in 1980, we would look at the BMI for, say, 21 year olds in NHANES III and 30 year olds in NHANES IV.[15] The resulting age-BMI profile for a ten year old in 1980 would be much steeper than those within a given survey.

Figure 4 presents similar information, although now the fraction obese is on the left-hand axis. In 1980, roughly 5 percent of ten year olds were obese. Looking only at data from 1976–80, we would predict that when those ten year olds become 21 year olds, between 5 percent and 10 percent of them would be obese. In actuality, when that cohort of ten year olds gets to be 21 in 1991 and 29 in 1999, over 10 percent and over 20 percent of them, respectively, are obese.

The age-BMI and age-obesity profiles highlight two important facts. First, the rate at which body mass index and obesity increase with age has increased. If this pattern continues, we can expect that when today's children become adults, they will have even more severe weight problems than today's adults. Second, obesity is a chronic disease that has its roots in childhood. Thus, addressing the disease in childhood may be the best prescription for reducing its toll.

FIGURE 1

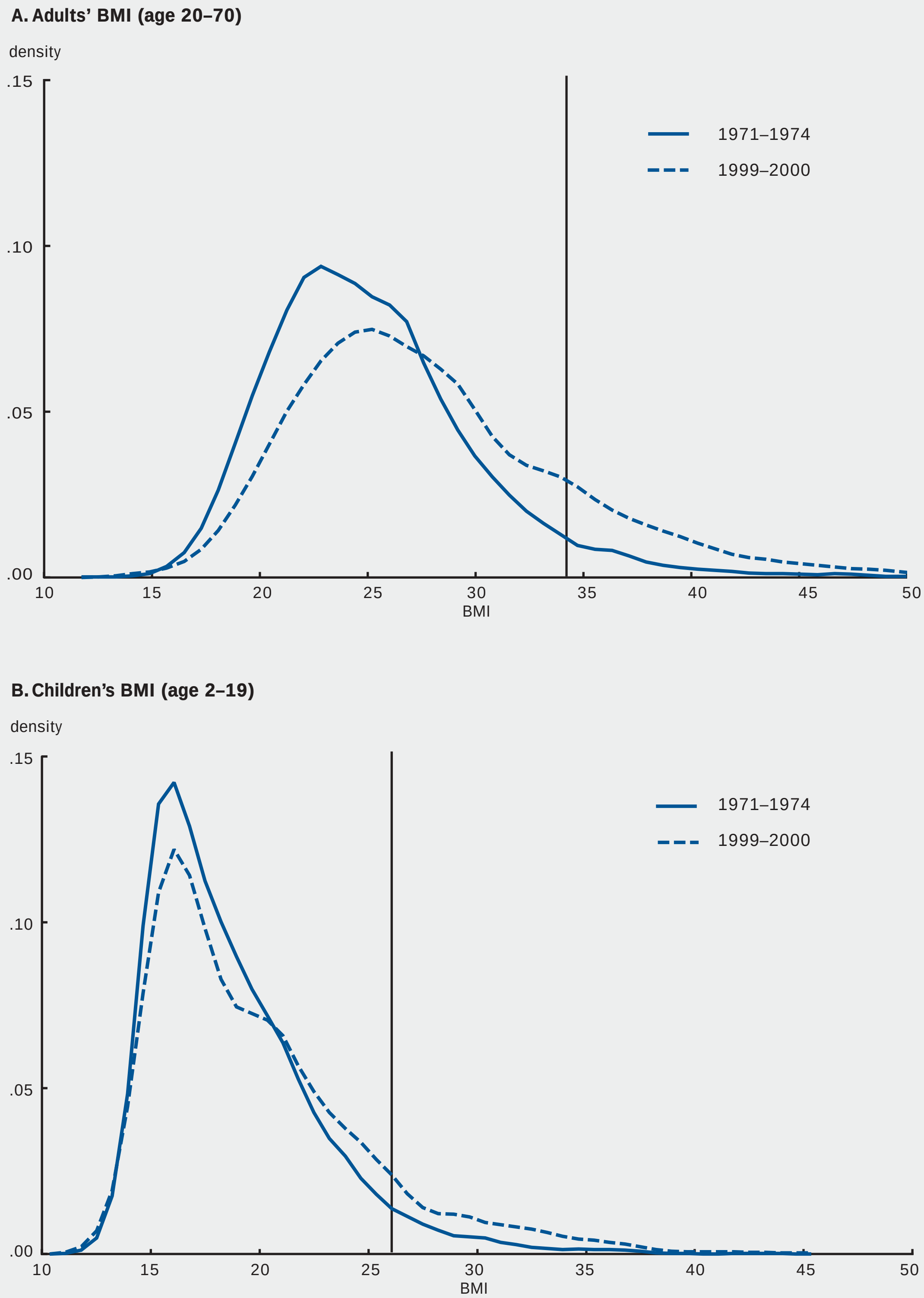
BMI distribution



Note: Vertical line marks the 95th percentile of the 1971–74 distribution.
Source: Authors' calculations using NHANES data.

FIGURE 2

BMI distribution: 1971–74 and 1999–2000



Note: Vertical line marks the 95th percentile of the 1971–74 distribution.
Source: Authors' calculations using NHANES data.

TABLE 2

BMI at the median and 95th percentile of the distribution

	Adults (age 20–70)		Children (age 2–19)	
	Median BMI	95th percentile	Median BMI	95th percentile
NHANES I: 1971–74	24.58	33.94	17.69	26.10
NHANES II: 1976–80	24.50	34.38	18.04	26.11
NHANES III: 1988–94	25.46	36.96	18.16	28.26
NHANES IV: 1999–2000	26.83	39.60	18.49	30.20

Source: Authors' calculations based on data from *National Health and Nutrition Examination Surveys* (NHANES).

A closer look at home and school

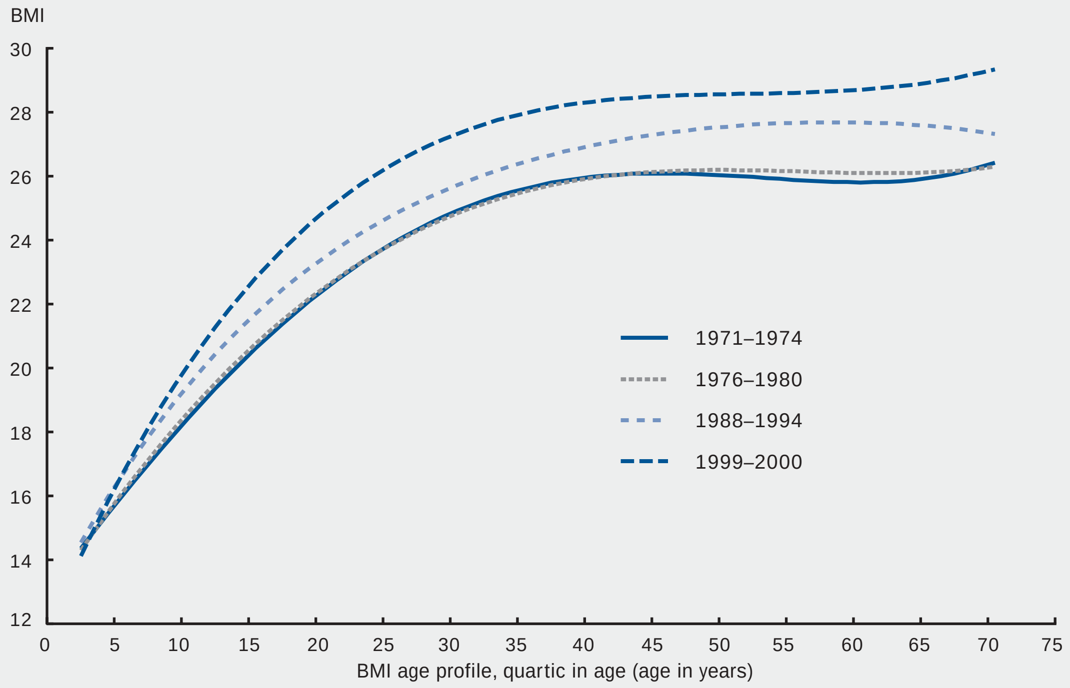
As detailed in the sections above, children's fast food and soda consumption and television watching have increased, while at the same time more active physical activity has decreased. While these may be the particular activities that have disrupted the delicate balance between energy intake and expenditure, the studies cited above tell us little about why that balance has changed in recent years. In this section, we look more closely at the two places that children spend the bulk of their time: home and school. Have these environments changed in ways that are likely to increase children's consumption of food with poor nutritional quality? Are these changes likely to increase children's passive, rather than active, leisure activities?[16] We concentrate on changes in women's labor supply and then supplement this analysis with information on changes in the school environment.

Changes in mothers' labor supply

Popular opinion routinely draws a direct link between mothers working and poor health and social

FIGURE 3

BMI age profile



Source: Authors' calculations using NHANES data.

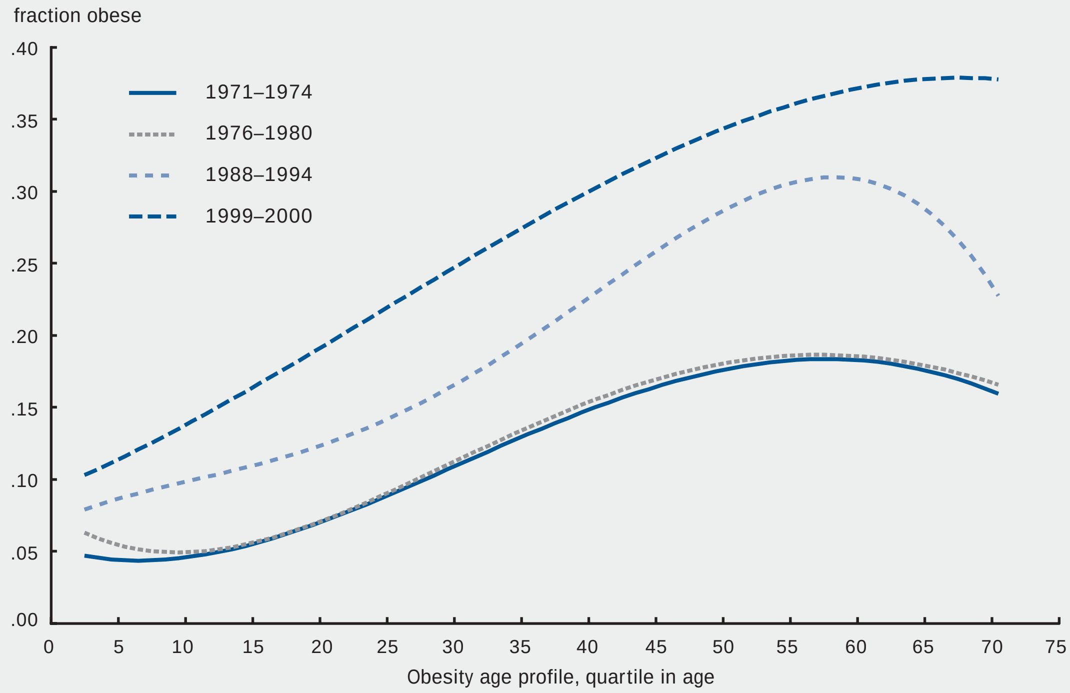
outcomes for children. Typical comments express concern about the effects of child care, for instance warning that "parents who casually warehouse their kids could use a healthy dose of anxiety" (Feder, 1999). According to the *Washington Post*, "two-thirds of the people surveyed said that although it may be necessary for a mother to work, it would be better for her family if she could stay home and care for the house and children" (Grimsley and Melton, 1998). Popular news reports on the topic of overweight and obese children are similarly peppered with comments from health practitioners who either implicitly or explicitly attribute changes in children's diet and exercise to the increased likelihood that both parents work outside the home. For example, a 1999 *Boston Herald* article cited a pediatric nutrition specialist who "noted in particular that dual-career couples are spending less time monitoring their latchkey children, who consequently snack after school, using their often liberal allowances on candy, ice cream, or soda pop" (Mashberg, 1999). Popular nutrition author Dr. Andrew Weil in an interview on CNN attributed the increased reliance on prepared and processed foods to the fact that "typically, people say they don't have time to cook." The interviewer attributed this time constraint to the prevalence of dual-career families (Weil, 2002).

At first blush, those who believe the increase in mothers working has contributed to changes in children's diet and exercise have a compelling story, because there certainly have been dramatic changes in mothers' labor supply that coincide with the rise in childhood obesity. Meyer and Rosenbaum (2001) report that in 1967 about 48 percent of married mothers worked in the previous year.[17] By 1996, that number had increased to 75 percent. Single mothers have always been more likely to work than married mothers. For single mothers, the figures are 74 percent worked in the previous year in 1967 and 82 percent worked in the previous year in 1996. Although single mothers did not increase their likelihood of working as much as married mothers, there was an increase in the fraction of women who were single mothers over the time period (from 4 percent to 13 percent). Clearly, children are much more likely to have a mother who works outside the home than they were 30 years ago.

There are several potential mechanisms through which children's eating patterns and levels of physical activity may be affected by having parents who work outside the home. Child care providers may be more likely than parents to offer children food that is highly caloric and of poor nutritional value, perhaps because

FIGURE 4

Obesity age profile



Source: Authors' calculations using NHANES data.

they are more concerned with placating their wards than with their long-term health. Further, parents who work outside the home may serve more high-calorie prepared or fast foods because of time constraints. Additionally, unsupervised children may make poor nutritional choices when preparing their own after-school snacks. Similarly, unsupervised children may spend a great deal of time indoors, perhaps due to their parents' safety concerns, watching television or playing video games rather than engaging in more active outdoor pursuits. Finally, a number of recent studies show a negative correlation between breast feeding and obesity in children (Gillman et al., 2001; von Kries et al., 1999). Thus far, the literature does not distinguish whether this is due to permanent physiological effects unique to human breast milk or due to psychological effects from the act of breast feeding.[18] Whatever the precise mechanism, it seems likely that women who work when their children are very young may be less likely to breast feed, or at least less likely to breast feed as often as women who spend all their time with their infants.

Alternatively, the increase in working mothers may have no adverse effect on childhood weight problems. Any correlation between working mothers and childhood obesity may be spurious if mothers who work are those who would be less attentive to their children's nutrition and exercise in any case. There may even be a negative impact of maternal work on children's probability of being obese if households where the mother works have more money with which to purchase more healthful meals. Even if working mothers lead to more obese children, increases in maternal work may be a small component of the myriad of environmental changes affecting children's health. The United States might have faced the current epidemic in childhood weight problems, even if women's labor force activity had not increased.

In Anderson et al. (2003), we examine whether there is a causal link between the likelihood that a child has weight problems and mothers' labor supply.[19] Here, we summarize some of the results from that research. Table 3 shows that, at least on the surface, mothers who work more hours have children who are more likely to be obese. These data are from the *National Longitudinal Survey of Youth* (NSLY) data for children age three to 11. We define mothers' work behavior over the child's entire lifetime (see Anderson et al., 2003 for details), because it may take time for children to gain or lose weight, so contemporaneous measures of mothers' work behavior may not capture the effects of their working. Table 3 shows that 9.4 percent of children whose mothers never worked are obese, but that number rises to 10.1 percent for children whose mothers work part time (less than 35 hours per week), and to 12.9 percent for children whose mothers work full time (greater than 35 hours per week). Table 3 also shows that obesity decreases as we move up the family income distribution (although not monotonically).[20] By income group, mothers' work only seems to have an adverse effect on obesity for higher income families.

The obvious question is whether the results in table 3 reflect a causal impact of mothers' work on children's weight outcomes, or whether mothers who work are simply different from mothers who do not work. In table 4, we address this question in several ways. First, we use probit models that estimate the outcome (obesity) as a function of the family's, mother's, and child's characteristics.[21] Here, we control for a long list of observable characteristics that may differ across children and their mothers and may be correlated with both labor supply and children's weight. For example, we include dummy variables for race and ethnicity. African American and Hispanic children are more likely to be overweight than non-Hispanic white children. If their mothers also have fewer employment prospects, then we might find a spurious negative correlation between mothers' work and children's obesity. We also control for mothers' education. Again, better educated mothers may have more information about how to promote their children's health and may have better employment prospects. We control for whether children's mothers are themselves overweight or obese, since this may have a direct impact on children's weight and may affect women's labor market outcomes.[22] We control for a number of other socioeconomic differences that may affect both children's weight and mothers' employment.[23] The table reports the estimated effect of average hours worked per week if working, measured over the child's lifetime and, separately, the number of weeks worked since the child was born.[24] This allows the effect of working per se to differ from the intensity of work. As table 4 shows, there is no effect of number of weeks worked. However, for upper income families, a mother working more hours per week has a positive and significant effect on the probability that her child will be obese. An increase of ten hours of work per week leads to a 1.3 percent increase in these upper income children's probability of having an unhealthy weight.[25]

The next three panels of the table use different statistical techniques to control for unobservable heterogeneity across either mothers or children that might cause a spurious correlation between mothers' work and children's weight problems. For example, if mothers who work are those who would otherwise have been less attentive to their children's nutrition or exercise, then the results in the first panel may not reflect a causal impact of maternal work on children's health. Each

TABLE 3

Percent obese, children age 3–11 in the NLSY, by maternal employment and socioeconomic status

	All	Mother never worked	Mother worked < 35 hours / week since birth	Mother worked ≥ 35 hours / week since birth
All	10.6	9.4	10.1	12.9
By quartile of family income (since child's birth)				
First quartile	12.4	13.3	11.4	13.0
Second quartile	11.1	8.5	11.0	11.5
Third quartile	11.7	12.1	11.0	12.2
Fourth quartile	8.5	3.2	7.3	10.6

Notes: Hours per week relate to weeks in which some work occurred. Family income is the average of family income for each year since the child's birth. Sampling weights are used to provide nationally representative estimates.

of these techniques exploits the fact that the NLSY contains information on all of a mother's children and multiple observations on each child. We use these multiple observations to "difference out" any fixed unobservable differences about the mother, the family, or, alternatively, about the child that may be driving the result in the first panel. For individual "long" differences, we subtract the first observation we have on each child from the last observation for each child.[26] This examines whether children whose mothers work more hours per week or more weeks in the intervening years are more likely to gain enough weight to become obese. This will hold constant any fixed unobservable characteristics about the family, the mother, or the child.

Another strategy is to use sibling differences to address the unobserved heterogeneity. Here, we subtract the observations for a pair of siblings, either at a given time or at a given age, to examine whether the sibling for whom the mother spent more time working over his/or her lifetime is more likely to have an unhealthy weight than the sibling for whom the mother worked less. This will control for unobservable, fixed characteristics of the mother or the family that may have spuriously caused us to find a link between maternal employment and children's weight. Each of these techniques has strengths and weaknesses. See Anderson et al. (2003) for a detailed discussion of the merits of each of these approaches.

The main thing to note here is that the estimates we get from each of these techniques strengthen the conclusion that there is a causal impact of mothers' average hours worked per week on children's obesity for families in the top quartile of the family income distribution. The "long differences" and the sibling differences "at the same time" imply that a ten-hour per week increase in work leads to between a 3.5 percent and 3.8 percent increase in the likelihood that a child is obese. The sibling difference "at the same age" is not statistically significant, but the estimated impact is slightly larger than for the probit.[27]

How big are these effects? To put the magnitude of our findings in context, we consider the extent to which the effect of mothers' work can explain the increased fraction of children who are obese over the past few decades. First, note that weight problems have increased across all income, race, and education groups. Since maternal work is only related to childhood obesity among relatively advantaged families, and because even when we control for a large number of variables we can only explain around 6 percent of the variation in childhood obesity, there are clearly other factors besides working mothers contributing to this epidemic. Here, we examine how much of the increase in the fraction of children who are obese can be explained by increases in mothers' average hours per week for families in the top quartile of the family income distribution. This analysis is necessarily inexact because we must use several different datasets that cover slightly different periods and use somewhat different data definitions. It is only for illustrative purposes.

For this exercise, we used data from the March 1976 and March 1995 *Current Population Survey* to estimate the increase in hours worked per week over the past calendar year for women 16 years or older, who had children under 18 living at home, in families with incomes in the top quartile of the income distribution. We also use data from the 1971–75 and the 1988–94 NHANES to estimate the change in the percentage of these children who are obese.[28] Table 5 shows the change in the fraction of children who are obese and the change in average hours worked per week for women with children in the home over the

TABLE 4

Impact of maternal employment on whether child is obese by quartile of family income

	First quartile (1)	Second quartile (2)	Third quartile (3)	Fourth quartile (4)
Percent overweight in sample	12.4	11.1	11.7	8.5
Probit (marginal probabilities)				
Average hours per week if working since child's birth (units of 10)	0.001 (0.005)	0.003 (0.004)	0.004 (0.006)	0.013 (0.005)
Number of weeks worked since child's birth (units of 52)	–0.001 (0.005)	0.001 (0.004)	–0.005 (0.004)	0.001 (0.003)
Number of observations	4,161	4,165	4,161	4,163
Individual long differences				
Average hours per week if working since child's birth (units of 10)	0.001 (0.010)	–0.001 (0.011)	0.025 (0.014)	0.035 (0.017)
Number of weeks worked since child's birth (units of 52)	0.001 (0.011)	–0.017 (0.009)	–0.008 (0.009)	–0.0004 (0.007)
Number of observations	1,040	1,040	1,040	1,039
Sibling differences—same time				
Average hours per week if working since child's birth (units of 10)	–0.011 (0.011)	–0.013 (0.013)	–0.004 (0.011)	0.038 (0.013)
Number of weeks worked since child's birth (units of 52)	0.021 (0.020)	0.005 (0.013)	–0.020 (0.011)	0.003 (0.008)
Number of observations	1,980	1,980	1,980	1,979
Sibling differences—same age				
Average hours per week if working since child's birth (units of 10)	0.012 (0.010)	0.001 (0.013)	0.002 (0.013)	0.014 (0.011)
Number of weeks worked since child's birth (units of 52)	0.012 (0.018)	0.009 (0.010)	0.010 (0.013)	–0.003 (0.010)
Number of observations	1,118	1,118	1,118	1,117

Notes: Estimates represent derivatives; robust standard errors in parentheses. The dependent variables in these models are based on a binary variable equal to 1 if the child's BMI is above the 95th percentile (of a particular BMI distribution) for his/her age and sex. In the probit model, this variable is used directly. In the remaining models, the dependent variable is the relevant difference in this variable measured for the same person at different times (individual long differences) or across siblings (sibling differences). The probit model includes whether the mother is black, non-Hispanic, or Hispanic, mother's highest grade completed, mother's AFQT score, whether the child is first born, the number of children, whether the child was breast fed, whether mother is overweight or obese, average family income since the child's birth, the percent of the child's life the mother was married, child's birth weight, both the child's and mother's age in years, dummy variables for the year of the survey, controls for education levels of the mother's parents, dummy variables indicating whether mother's parents were present when she was 14, a dummy variable indicating whether the child is female, and dummy variables indicating the mother reported the child's height and weight. The long differences include all of these controls, except those that do not vary for an individual over time (for example, mother's ethnicity, breast fed). The sibling differences "at the same time" include all of these controls except those that do not vary between siblings at the same point in time (for example, mothers' education). The sibling differences "at the same age" include all of these controls except those that do not vary between siblings (for example, mother's race). All estimates are weighted using the child's sampling weight. The standard errors are robust, clustered on mother's identification code as there are multiple observations in each household over time.

relevant period. Average hours worked per week increased from 20.1 in 1975 to 27.2 in 1994 for women in the top quartile of family income. The results from our analysis above predict that this change (7.1) in average hours per week will lead to an increase in the probability of a child being obese of between 0.9 and 2.7 percentage points.[29] In 1976, the probability that a child in a top-income-quartile household was obese was 2.1 percent. By 1994, this had risen to 9.9 percent. Thus, the probability that a child from one of these families was obese increased by 7.8 percentage points. Based on these calculations, the increase in average hours worked by mothers in high-income families can account for between 11.8 percent and 34.6 percent of the increase in the probability that children in these families are obese.

The fact that it is only for relatively well-off families that mothers' labor supply affects children's weight is somewhat perplexing. Our results are consistent with a story in which mothers who are working a lot of hours, as the higher income mothers are more likely to be doing, are too time constrained to shop for and cook fresh vegetables and other healthy foods or to supervise their children's vigorous outdoor activities.

We speculate that lower income mothers may be too time constrained for such activities whether or not they work outside the home. Consider, for example, a well-off family that lives near a nice park. If the mother is home, she takes her children there regularly. If she is working full time, on the other hand, she does not. A lower income mother, who may live far away from such a park, may not have time to take her children there, whether or not she is working outside the home.

Changes in the school environment

The increase in single-parent and dual-career families represents an important change in how children are raised in the United States. While the increase in mothers working seems to be important for children's obesity outcomes in some families, it does not explain the increase in childhood obesity overall. We must look at other changes in children's lives to better understand the increase in childhood obesity. In addition to changes in the home environment, school environments have changed in ways that may have adverse consequences for children's weight. By some estimates, over 50 percent of children in the United States get breakfast or lunch from a school meal program and over 10 percent get both (Dwyer, 1995). Thus, there is a great deal of scope for children's diet to be influenced by the food they have access to in schools. There is evidence that the food that schools serve matters for what children consume. For example, Whitaker et al. (1993) demonstrate that making more low-fat foods available to children in school lunches reduces the amount of fat they consume.

In addition to school meals, however, children may have access to a wide variety of snack foods and drinks through vending machines, school stores, fundraisers, and the like. Research suggests that this access has an impact on children's diet. Cullen et al. (2000) find that fifth grade students in one Texas school district who had access to a school snack bar ate significantly fewer fruits and vegetables than did the fourth graders in the same district who did not have this access.

In table 6, we use the School Health Policies and Programs Study (SHPPS)[30] data, collected by the Centers for Disease Control in 1994 and 2000, to examine changes in children's access at school to snack foods and soda. These data form a nationally representative sample of (public and private) schools in the United States. In 1994, only junior and senior high schools were sampled, but the 2000 data include elementary schools. By 2000, 27 percent of elementary schools gave children access to vending machines from which they could buy various types of snacks and drinks. Sixteen percent of elementary schools had a contract with a brand name fast food provider. For middle schools, 67 percent had vending machines and 25 percent had a fast food contract, while for high schools, 96 percent had vending machines and 26 percent had a fast food contract. In most cases, these represent statistically significant increases in the access to such foods from 1994. Wechsler et al. (2001), in a thorough analysis of the SHPPS 2000 data, show that typically the foods and beverages that children have access to through vending machines and fast food contracts are of low nutritional quality.

There has been a great deal of controversy over the types of foods available to children in schools. Perhaps the most contentious issue is whether schools should be able to contract with food and beverage companies for their own financial gain. Table 6 shows that a substantial fraction of schools have contracts with soda producers, for example. Among elementary, middle, and high schools, 37 percent, 52 percent, and 64 percent, respectively, had struck deals with soda companies such that they would receive a percentage of the sales. Contracts between soda companies and schools are more common the higher the grade level of the school. At the high school level, 73 percent of schools had a "pouring rights" contract—typically an agreement to sell one brand of soda exclusively. In about 40 percent of the high schools, the school had a specific incentive-based contract with a soda company.

TABLE 5

Percent obese in NHANES I and NHANES III and mothers' work hours, March 1976 and March 1995 CPS, by family income

	Rates of obesity		Average work hours / week	
	NHANES I (1971–75)	NHANES III (1988–94)	March 1976 CPS	March 1995 CPS
All	4.5	10.3	17.9	23.9
First income quartile	5.7	14.9	15.3	17.2
Second quartile	4.2	9.6	17.4	24.6
Third quartile	5.6	8.8	18.6	26.5
Fourth quartile	2.1	9.9	20.1	27.2

Note: Income quartiles are created based on categorical measures of family income in the preceding calendar year.

Forty-six percent of high schools allowed some form of soda company advertisements to children either on school grounds, at school events, or on school buses.

Many educators and parents believe that these contracts between schools and beverage companies create an unhealthy and confusing environment for children—in nutrition classes children are taught one way to eat, but in the hallways and cafeterias quite another type of food is being promoted. This has been an active arena for policymaking, with those leading the charge making explicit claims about schools' role in either spreading or containing the epidemic of childhood obesity. Last year the Oakland school district banned junk food sales in schools, and the Los Angeles school district is banning the sale of soft drinks during school hours, beginning in 2004 (Fried and Nestle, 2002). Additionally, several state legislatures have begun debating statewide bans on soft drinks and/or snack foods in schools (Hellmich, 2003). It is clear, though, that schools see proceeds from vending contracts as a good way to increase their budgets, as the money involved is not insubstantial. For example, one high school in Beltsville, MD, made $72,439 in the 1999–2000 school year through a contract with a soft drink company and another $26,227 through a contract with a snack vending company. The almost $100,000 obtained was used for a variety of activities, including instructional uses such as computers and wiring, as well as extracurricular uses such as the yearbook, clubs, and field trips (Nakamura, 2001). District level contracts can be even more lucrative—one Colorado Springs district, for example, negotiated a ten-year beverage contract for $11.1 million (DD Marketing, 2003).

Conclusion

Battle and Brownell (1996) wrote "it is difficult to envision an environment more effective than ours for producing … obesity." This begs the question of how we can change the environment in ways that promote better health, particularly for children.

In this article, we have documented that, indeed, increases in obesity have been alarming. These increases are particularly worrisome in children for several reasons. Although the level of obesity is still

TABLE 6

Fraction of schools with vending machine, brand-name fast food access, and soda company contracts

	Elementary schools		Middle schools		High schools	
	1994	2000	1994	2000	1994	2000
Vending machines	NA	0.27 (0.443) [277]	0.61 (0.489) [311]	0.67 (0.473) [272]	0.88 (0.324) [291]	0.96* (0.205) [274]
Brand name fast food	NA	0.16 (0.365) [282]	0.13 (0.337) [289]	0.25* (0.433) [277]	0.19 (0.391) [281]	0.26* (0.438) [281]
School gets % of soda sales	NA	0.37 (0.483) [272]	NA	0.52 (0.501) [262]	NA	0.64 (0.480) [264]
Exclusive pouring rights contract	NA	0.42 (0.494) [275]	NA	0.58 (0.494) [265]	NA	0.73 (0.446) [268]
School gets incentives from soda company	NA	0.09 (0.289) [269]	NA	0.21 (0.411) [245]	NA	0.39 (0.488) [250]
Soda company can advertise at school[a]	NA NA	0.13 (0.336) [277]	NA	0.29 (0.456) [272]	NA	0.46 (0.499) [274]

*Denotes that the 2000 value is significantly different from the 1994 value at the 5 percent (or lower) level of significance.
[a] Includes, for example, advertisements allowed in school buildings, on school grounds, outside, in a stadium, or on school buses.
Notes: Standard deviations in parentheses; number of observations in brackets. The data include public and private schools. NA means that the data were not collected for that variable at that grade level or in that year.
Source: Authors' calculations based on data from the School Health Policies and Programs Study Data, 1994 and 2000 (weighted with school weights).

lower among children than among adults, the rate of increase is larger. A recent article in the *Journal of the American Medical Association* reports that obese children have dismally low quality of life scores (Schwimmer et al., 2003). Obesity has adverse long-term and short-term consequences for health that have a direct effect on the individual and may have an additional effect on society through health care and other costs.

We have presented evidence on changes in the home environment, specifically the increase in mothers' labor supply, that may have an impact on childhood obesity. We have evidence that for relatively well-off families, when mothers work more hours per week (on average, over children's lives), children are more likely to have weight problems. Since the increase in mothers working cannot explain all of the increase in childhood obesity, we have also highlighted changes in the school environment that may contribute to children's unhealthy weight. We have shown that children have access to a great deal of poor-nutritional-quality foods at school and that schools may have a financial incentive to encourage children to eat foods that are not very good for them.

There are several important avenues for potential research that would help in the design of better policies to improve children's health. The policy debate about the impact of maternal employment on children's health has focused on whether mothers should work. Mothers work because of a complex set of economic incentives, a trend that will likely continue, and mothers undoubtedly have their children's long term well-being in mind when they decide that their income is needed to help support their families. Thus, a more fruitful policy discussion should ask, "Given that mothers work, what policies will promote children's health?" The answer to that question depends on precisely what is going on in the home when mothers work a lot of hours. Are children eating poorer quality convenience foods because mothers are too time-constrained to shop and cook? What role do fathers play in the nutritional lives of their children? Is children's diet linked to child care quality? If the problem is mainly on the calorie consumption end, better nutritional information for mothers *and* fathers *and* other caregivers may help. Similarly, policies to promote better child care may help as well. On the other hand, the problem may be on the energy expenditure side of the equation. Formal after-school child care or informal "latchkey" arrangements may not provide children with safe places for physical activity. Understanding how children spend their time and how policies can promote their opportunities for vigorous physical exercise are critical.

Given the fact that many children have either a single working parent or two working parents, the school environment may be particularly important. For example, schools may need to focus more on exercise if children have few opportunities for physical activity once they leave the school grounds. Similarly, children may be consuming a large fraction of their calories for the day at school. Changing the school nutritional environment has become a hot-button issue for policymakers at many levels of government. However, this is a place where policy is way out in front of research. There is a good initial case for believing that schools are swelling their coffers by selling foods that also swell their students, but such a direct link has not been established. It may be that children so crave snack foods and soft drinks that they would just go to a local convenience store to buy them if they could not get them at school. Banning such foods from campuses may just encourage children to leave school grounds, which puts them at greater risk from traffic and enticements to truancy. If children are just going to buy food that is bad for them anyway, society might prefer the proceeds go back to cash strapped schools.

In sum, children's lives are governed, to a large extent, by their parents and by schools. Economic and social conditions and policies over the last three decades may have interacted with both these realms in ways that have promoted an increase in childhood obesity. A more detailed understanding of how children's lives have changed and how these changes affect their intake and output of energy will help in the design of more effective public policy to curb the epidemic in obesity.

NOTES

[1]U.S. Department of Health and Human Services, 2001, "Overweight and obesity threaten U.S. health gains," HHS News, available at www.hhs.gov/news, December 13.

[2]Body mass index is weight in kilograms divided by height in meters squared.

[3]Although they disagree on whether technological change has most affected the intake or output of energy.

[4]Cutler et al.'s calculations from the Behavioral Risk Factor Surveillance Survey.

[5]Cutler et al. (2002) believe the externalities associated with obesity exist, but are likely to be small. They make the analogy to the debate around the health care cost externalities associated with cigarette smoking (Gruber, 2001). Smokers are sicker than non-smokers and use more medical care during their lives. But their lives are shorter, so they may use fewer resources in old age. The

debate about whether smoking saves or costs money once these two effects are taken into account is unsettled. These questions have received less scholarly attention in the area of obesity.

[6]U.S. Department of Health and Human Services, Public Health Service (2001). See pages 8–10 for health risks and economic consequences of excess weight.

[7]Possibly some unobserved characteristic causes both obesity and poor labor market outcomes. See cited papers for a discussion of the issues.

[8]See Ebbeling et al. (2002) for more details about the health consequences of childhood obesity.

[9]There is a great deal of debate in the field of nutrition about what actually constitutes a healthful diet. See, for example, Willett (2001) for an easy-to-understand criticism of the government-endorsed food pyramid.

[10]Note that these are averages. Basal metabolism rates vary across individuals. See Cutler et al. (2002) for more details on these calculations.

[11]The sample is limited to those aged two to 70, inclusive. We dropped individuals with BMI greater than 50. This is well above the 99th percentile in all years and eliminates only 516 individuals over all years.

[12]NHANES I was collected from 1971 to 1974. NHANES II was collected from 1976–80. NHANES III was collected from 1988 to 1994. The NHANES IV data are from 1999–2000. BMI data are from the examination portion of the data collection process and are weighted accordingly. The weighting variables for each year are: I, PSU65; II, examined final weight; III, WTPFHX6; and IV, WTMEC2YR. See respective codebooks for further details.

[13]See www.cdc.gov/growthcharts/ for general information and www.cdc.gov/nchs/data/nhanes/growthcharts/bmiage.txt for specific BMI percentiles. The nomenclature in the health research can be a bit confusing. Health researchers typically label children with BMIs above the 85th percentile of the earlier age-specific BMI distribution as "at risk of overweight," and children with BMIs above the 95th percentile as "overweight." Adults, on the other hand, are termed overweight with BMIs between 25 and 30 and "obese" with BMIs above 30. For ease of exposition, we use the adult terminology and describe children above the upper end BMI cutoff as "obese."

[14]Medical researchers describe an "adiposity rebound." Body fat is normally at a minimum at five to six years old and then begins to increase into adulthood (Whitaker et al., 1993).

[15]This type of comparison is often termed a "synthetic cohort analysis." The analysis is more inexact here than usual because the surveys were conducted over a number of years at irregular intervals. One could narrow the dates by using information on the phase of the survey, but the analysis here is only for illustration.

[16]See Critser (2003), "Who Let the Calories In?," chapter 3, for a compelling story about how changes in home and school environments have affected children's weight.

[17]These calculations are from *March Current Population Surveys*, for women age 19–44. See Meyer and Rosenbaum (2001) for details.

[18]There may also be unobservable differences between mothers and/or children who breast feed and those who do not that may be correlated with children's later health status.

[19]Note that we only examine the role of women's work outside the home because the National Longitudinal Survey of Youth only gives us information on the children of women in the survey, not children of men in the survey.

[20]Average family income is defined over each child's lifetime. See Anderson et al. (2003) for details.

[21]The estimates presented in the second and third lines of the table are marginal probabilities calculated from the probit coefficients.

[22]In a sense, including measures of mothers' weight may be "overcontrolling" for the home environment. If working mothers are time constrained and are more likely to rely on calorie-rich prepared and fast foods, then we would expect everyone in the family to be more likely to be overweight when the mother works.

[23]See Anderson et al. (2003) for a more detailed discussion of the control variables. We include whether the child was first born, the number of children in the family, average family income since the child's birth, the percentage of the child's life that his or her mother was married, mother's AFQT score, the child's birth weight, both the child's and the mother's age in years, dummy variables for the year of the survey, controls for education levels of the mothers' parents, dummy variables indicating whether the mothers' parents were present when she was 14, whether the child was breast-fed, whether the child is female, and whether the mother reported the child's height and weight or whether they were measured directly. See Anderson et al. (2003), table 2, for estimates of the effect of these characteristics.

[24]This captures a child's lifetime "exposure" to mother's work, which is important because it may take time to gain or lose weight.

[25]These results are marginal probabilities calculated from the probit coefficients. Average hours worked per week is measured in units of ten, so the estimate given here can be interpreted to mean that a ten-hour increase leads to a 1.3 percent increase in the probability that a child is obese.

[26]We call these estimate "long" differences because they are the difference between the first and the last time we observe the child. In other words, they represent the difference over the longest period available in the data.

[27]As we discuss in Anderson et al. (2003), it is not surprising that this estimate is not statistically significant. Because of the way the sibling pairs are formed, there are fewer observations than with the sibling differences "at the same time," and the information on weeks worked is averaged over fewer years and so is likely more prone to measurement error.

[28]We describe the CPS, NHANES I, and NHANES III data sources in the data appendix in Anderson et al. (2003).

[29]The estimated impact ranges between 0.013 and 0.038. Since average hours per week are in units of ten, we first multiply the coefficient by ten. Then, we multiply this by the change in average hours per week.

[30]The full SHPPS includes data at the state, district, school, and classroom levels.

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