

Fast-Food Restaurant Advertising on Television and Its Influence on Childhood Obesity

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Abstract

Childhood obesity around the world, and particularly in the United States, is an escalating problem that is especially detrimental as its effects carry on into adulthood. In this paper we employ the 1979 Child-Young Adult National Longitudinal Survey of Youth and the 1997 National Longitudinal Survey of Youth to estimate the effects of fast-food restaurant advertising on children and adolescents being overweight. The advertising measure used is the number of hours of spot television fast-food restaurant advertising messages seen per week. Our results indicate that a ban on these advertisements would reduce the number of overweight children ages 3-11 in a fixed population by 18 percent and would reduce the number of overweight adolescents ages 12-18 by 14 percent. The elimination of the tax deductibility of this type of advertising would produce smaller declines of between 5 and 7 percent in these outcomes but would impose lower costs on children and adults who consume fast food in moderation because positive information about restaurants that supply this type of food would not be banned completely from television.

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I. INTRODUCTION

Childhood obesity around the world, and particularly in the United States, is an escalating problem that has received much attention of late. In less than thirty years, the prevalence of overweight children and adolescents in America has more than doubled. In the 1963-1970 period, 4 percent of children aged 6 to 11 years and 5 percent of adolescents aged 12 to 19 were defined as being overweight. The percentage of children who are overweight has more than tripled by 1999, reaching 13 percent. For adolescents, the incidence of overweight has nearly tripled in the same period, reaching 14 percent (Centers for Disease Control 2001).

Finding the causes of this dramatic increase in obesity among children and adolescents is an important input in designing prevention policies. On the simplest level, weight gain is caused by more energy intake than energy expenditure over a long period of time. The problem of energy imbalance is not purely due to genetics, since our genes have not changed substantially during the past two decades. Researchers have tended to focus on environmental factors such as the availability of highly palatable and calorie-dense fast food to promote high energy intake as well as the appeal of television, video games, and computers to discourage energy expenditure.

Children and adolescents are increasingly engaging in sedentary behavior, spending less time exercising outdoors and more time watching television and playing video games. The Third National Health and Nutrition Examination Survey (1988-1994) indicates that 20 percent of US children aged 8 to 16 participated in 2 or fewer bouts of vigorous activity per week, and more than 26 percent watched at least 4 hours of television per day and 67 percent watched at least 2 hours per day (Andersen et al. 1998).

Television viewing may contribute to childhood obesity both by reducing energy expenditure from displacement of physical activity and increasing energy intake from increased snacking during television viewing or as a result of exposure to food advertising.

How the commercial advertising of foods contributes to the epidemic of obesity among children and adolescents is still an ongoing debate. There is widespread speculation that the exposure to food advertising may contribute to unhealthy food choices and weight gain. Despite lacking evidence showing the direct linkage between television food advertising and childhood obesity, several industrialized countries such as Sweden, Norway, and Finland have banned commercial sponsorship of children's programs. Sweden also does not permit any television advertising targeting children under the age of twelve (Kaiser Family Foundation 2004). In the United States, most recently, companies such as Kraft Foods have decided to curb advertising aimed at children in an effort to encourage better eating habits (Mayer 2005). However, the Bush administration has argued that no one has proven that advertising causes obesity and did not take any action in regulating advertising directed at children, after the World Health Organization proposed that countries be urged to limit advertisements that encourage unhealthy diets, especially those directed at children.

The purpose of this paper is to explore the causal relationship between exposure to fast-food restaurant advertising on television and childhood obesity. We employ two individual-level data sets: the National Longitudinal Survey of Youth 1997 for adolescents aged 12 to 18 and the Child-Young Adult National Longitudinal Survey of Youth 1979 for children aged 3 to 11. The data for fast-food restaurant advertising on

television are appended to the individual-level data by designated market area and year. We employ several different specifications, and most results show a positive and statistically significant impact of fast-food restaurant advertising on television on body mass index and the probability of being overweight for children and adolescents.

II. BACKGROUND AND LITERATURE REVIEW

Obesity is measured by the body mass index (BMI), also termed Quetelet's index, and defined as weight in kilograms divided by height in meters squared. Persons 18 years of age and older with a BMI greater than or equal to 30 kg/m^2 are classified as obese. An overweight child or adolescent (the term obese is reserved for adults) is defined as one having a BMI at or above the 95th percentile based on age- and gender-specific growth charts for children and adolescents in the second and third National Health Examination Surveys (NHES II and NHES III), conducted between 1963 and 1965 and between 1966 and 1970, respectively, and from the first, second, and third National Health and Nutrition Examination Surveys (NHANES I, NHANES II, and NHANES III), conducted between 1971 and 1974, 1976 and 1980, and 1988 and 1994, respectively.¹

Trends in the mean body mass index of persons ages 3-11 (hereafter termed children) and the percentage overweight between 1963 and 2000 are presented in Table 1a. Similar data for persons aged 12-18 (hereafter termed adolescents or teenagers) are presented in Table 1b. These data come from heights and weights obtained from physical

¹ Prior to 2000, the growth charts excluded data from NHANES II and III. The 2000 revisions included children and adolescents in NHANES II and children under 6 in NHANES III to make the charts more nationally representative. There is little difference, however, between the two sets of charts, especially for children over the age of 1 (Kuczmarski et al. 2002). In particular, trends are not distorted by the use of examinations in different years to construct the growth charts.

examinations conducted in NHES II and III, in NHANES I, II, and III, and in 1999-2000 NHANES (NHANES 99).² Both tables show dramatic increases in the percentage of overweight children and teenagers between 1978 (the mid-year of NHANES II) and 2000. This percentage doubled for teenagers and almost tripled for children. For teenagers, the relatively flat trend prior to 1978 and the rapid increase since that year mirror the behavior of the trend in obesity for adults (Chou et al. 2004). For children, the picture is somewhat different. There appears to be an upward trend throughout the period, but the figures for 1963-65 pertain to children ages 6-11. As shown by Ogden et al. (2002), if the series on overweight is limited to this age range, there is no increase between 1964 (the mid-year of NHES II) and late 1972 (the mid-point of NHANES I, which began in May 1971 and ended in June 1974). This percentage rises between 1972 and 1978 for 6-11 year-olds, but it does not rise for 3-5 year-olds. In any case, data from the most recent NHANES survey suggest that the upward trend in the percentage of children and teenagers who are overweight between NHANES II and NHANES III continued through the year 2000.

Obesity puts children and adolescents at risk for a range of health problems and can affect cardiovascular health (hypercholesterolemia and dyslipidemia, hypertension), the endocrine system (hyperinsulinism, insulin resistance, impaired glucose tolerance, type II diabetes mellitus, menstrual irregularity), and mental health (depression, low self-esteem) (Krebs and Jacobson 2003). For example, the prevalence of type II diabetes in children, originally termed adult-onset diabetes, went from four percent in 1982 to 16 percent in 1994 (Squires 1998). Overweight children and adolescents are likely to grow

² For adolescents in the earliest period, NHES I, conducted between 1959 and 1962, is used for 18-year-olds.

into overweight adults. The probability of childhood obesity persisting into adulthood is estimated to increase from about 20 percent at 4 years of age to approximately 80 percent by adolescence (Krebs and Jacobson 2003). Some estimates suggest that the increasing prevalence of overweight and obesity accounts for approximately 300,000 deaths every year, next only to the preventable mortality associated with cigarette smoking (McGinnis and Foege 1993; Allison et al. 1999). In a more recent study, Flegal et al. (2005) report a smaller but still substantial figure of approximately 112,000 excess deaths in the year 2000. Aggregate medical spending for the United States that is attributed to obesity accounted for 9.1 percent of total annual medical expenditures in 1998, as high as \$78.5 billion (Finkelstein et al. 2003).

Behavioral and environmental factors are large contributors to the obesity epidemic and also the most easily modifiable causes of obesity among children (Hill and Peters 1998; US Department of Health and Human Services 2001). Television viewing is suspected to be one potential contributor to childhood obesity through several possible avenues.³ First, television viewing time will displace time spent engaging in physical activity. The sedentary nature of watching television further encourages one to consume unhealthy foods. Moreover, being exposed to food advertisements on television, children and adolescents are more prone to developing unhealthy dietary habits that are likely to carry over into adulthood. Most studies using cross-sectional data have found a significant correlation between obesity prevalence and television viewing (Dietz and Gortmaker 1985; Gortmaker et al. 1996; Crespo et al. 2001; Andersen et al. 1998), but others have not (Robinson et al. 1993). The results based on a randomized controlled school-based trial aimed at reducing television viewing for school-aged children have

³ See Kaiser Family Foundation (2004) for a more detailed report on the role of media in childhood obesity.

provided strong evidence to support the role of limiting television time in the prevention of childhood obesity (Robinson 1999). Two longitudinal studies also found the persistent effect of television viewing on body fat over time (Hancox et al. 2004; Proctor et al. 2003). Hancox et al. (2004) have shown that television viewing during childhood and adolescence is associated with an increased likelihood of being overweight in early adulthood. Proctor et al. (2003) found that preschool children who watched the most television had the greatest possibility of becoming overweight adolescents.

In the period during which childhood obesity increased so drastically, there was also an increased amount of time spent watching television and an increased exposure to food advertising by children and adolescents. Around 1950, only two percent of households in the United States had television sets; by the early 1990s, 98 percent of households owned at least one, and over 60 percent had cable television (Huston 1992; Donnerstein et al. 1994). In the late 1970s, children viewed an average of about 20,000 commercials aired on television per year. The number increased to 30,000 per year in the late 1980s and more than 40,000 per year in the late 1990s (Kunkel 2001). Moreover, the majority of advertisements targeted at children are ones of food with minimum nutritional value: candy (32 percent of all children's ads), cereal (31 percent), and fast-food restaurants (9 percent) (Kunkel 2001). In 1997 US food manufacturers spent \$7 billion on product advertising. Money spent on fast-food restaurant advertising made up about 28 percent of advertising, up from only five percent in 1980 (Gallo 1999).

While most prior studies have confirmed correlations between television watching and obesity in children, few studies have looked at the effect that fast-food restaurant advertising on television per se might have on childhood obesity. Several studies

reviewed by the Kaiser Family Foundation (2004) indirectly pointed to the positive relationship between television advertising and caloric intake. For example, Giammattei et al. (2003) found that middle-school children who watched more television tended to consume more soft drinks, a possible consequence of exposure to food advertising on television. Borzekowski and Robinson (2001) have shown that even brief exposures to televised food commercials can influence preschool children's food preferences. Based on a randomized trial, children exposed to videotapes with embedded commercials were significantly more likely to choose the advertised items. However, two cross-sectional studies cited in Ashton (2004) supported the argument that there was no causal relationship between television advertising and childhood obesity. One study showed that childhood obesity rates were no different in Quebec, where food advertising aimed at children has been banned since 1980, from those rates in other Canadian provinces. The other showed that Sweden, where a similar advertising ban has existed for over a decade, did not have lower childhood obesity rates.

Among many potentially important contributors to a positive energy balance, fast-food restaurant advertising on television is the main focus of this study. Children are easily molded by what they see in television commercials. Studies indicate that the more children watch television, the more they specifically request the brand-name products that are advertised on television when at the grocery store.⁴ Consumer behavior in response to advertising could be explained using Becker and Murphy (1993), where a model in which a brand's advertising level interacts with consumption in the consumer's utility function is proposed. In this model, by treating advertising as a complementary good, consumers may simply derive more utility from consuming a more advertised good. As

⁴ See Kaiser Family Foundation (2004) for a reference.

an example, it may be that a child values the toys that go together with the commercial products, and advertising may then serve as an input that enables the consumer to derive more utility when the advertised product is consumed. Moreover, children – especially younger ones – may not be able to distinguish advertisements from regular programs and have little understanding of their persuasive intent. Using children’s favorite characters and linking products with concepts such as fun, happiness, and well-being, food advertisements can successfully entice children to consume their products.

Nevertheless, the effect of television advertising on childhood obesity is complex, dealing with the interplay between the characteristics of the children, the attitudes of their parents, and environmental settings. Our empirical study attempts to isolate the effect of fast-food restaurant advertising on television on obesity in children and adolescents.

III. DATA AND SAMPLE

The micro-level data set that we use for adolescents aged 12 to 18 is the National Longitudinal Survey of Youth 1997. The National Longitudinal Survey of Youth 1997 (hereafter NLSY97) is a nationally representative sample of the US population aged 12 to 16 years old as of December 31, 1996. The initial sample in 1997 consists of 8,984 respondents originated from 6,819 unique households. Two subsamples comprise the NLSY97 cohort. The first is a nationally-representative sample of 6,748 respondents born between 1980 and 1984. The second consists of 2,236 oversampled black and Hispanic respondents for that age group. The survey has collected extensive information about youth labor market behavior and educational experiences over time. Round 1 of the NLSY97, which took place in 1997, contains a parent questionnaire that generates

information about the youth's family background and history. Only 7,942 youth respondents, out of 8,984, have information available from a parent interview. The NLSY97 also contains information on time use including the amount of time spent in the prior week watching television from youth aged 12 to 14 in Round 1.⁵

We pool 3 rounds of NLSY97 for the analysis: 1997 (N=8,984), 1998 (N=8,386) and 1999 (N=8,209).⁶ Before any state-level or advertising data are appended to the NLSY97, the pooled sample size is 14,852 when observations with missing values are deleted. Note that a large percentage of observations are dropped due to the missing values on television watching time. This question is not asked of youth over the age of 14 in 1997 (Round 1), and it is not asked after that year. Therefore, we assume that the 1997 values also apply to 1998 and 1999.

We also use the matched mother-child data from the National Longitudinal Survey of Youth 1979 (hereafter NLSY79) for children aged 3 to 11. The NLSY79 is a nationally representative sample of 12,686 individuals, of whom 6,283 were women who were 14-22 years old when they were first surveyed in 1979. In 1986, biennial interviews of all children born to female respondents began, making up the Child and Young Adult File. We use three survey years of data, 1996, 1998, and 2000. The television watching variable is available in each of these years. We restrict both final samples to those individuals that have a body mass index not less than 11 kg/m² and not greater than 140kg/m².

Fast-food restaurant television advertising data are obtained from Competitive Media Reporting (CMR), the largest provider of advertising tracking services in the

⁵ Out of 8,984, only 5,419 youth respondents were between the ages of 12 and 14 in Round 1. Thus, 40% of our sample was dropped due to the missing values on television watching time.

⁶ We do not use the year 2000 for NLSY97 because our advertising data are from 1996 to 1999.

United States. This has exposure information and dollar expenditures for a wide array of fast-food restaurant chains in the United States from 1996 to 1999.⁷ Competitive Media Reporting was formed in 1992 by combining several advertising tracking and broadcast proof-of-performance companies. The exposure variable equals the annual number of seconds of fast-food restaurant messages aired on television. This variable is then divided by a factor of (60*60*52) or 187,200 to convert it into the weekly number of hours of fast-food restaurant advertising messages aired. The unit of observation for this variable is the DMA, or Designated Market Area, which is similar to a Metropolitan Statistical Area. The designated market area is a region composed of counties (and occasionally split counties) that defines a television market. Thus, the advertising data were appended to our individual records by DMA and year.⁸ Out of about 210 DMAs, the top 75 (in terms of TV households) are contained in the CMR database and used in our study. As a consequence, our final sample sizes, when the advertising data are appended, are 6,034 person-years for respondents aged 3 to 11 (NLSY79) and 7,069 person-years for respondents aged 12-18 (NLSY97).

Note that network television, syndicated television, and cable network television advertising are not included in our data because they have no local variation. National advertising effects cannot be obtained in the specifications that

⁷ The corporations we chose for this analysis that we believed best reflected the fast-food industry were: A&W Restaurants Inc, AFC Enterprises, Allied Domecq Plc, Arthur Treachers Inc, Carrols Corp, Chester Fried Chicken Restaurants, Chick-Fil-A Inc, Cici Enterprises Inc, Cke Restaurants Inc, Culver Franchising System Inc, Diageo Plc, Dominos Pizza Inc, Fatboys Franchise Systems Inc, Foodmaker Inc, Galardi Group, Hungry Howies Pizza & Subs Inc, Ich Corp, In-N-Out Burgers Inc, Inno-Pacific Holdings Inc, Krispy Kreme Doughnut Corp, Krystal Co, Leeann Chin, Little Caesars Enterprises Inc, Long John Silvers Inc, McDonalds Corp, Panda Express, Papa Ginos Inc, Papa Johns Intl Inc, Quality Dining Inc, Ranch 1, Rax Restaurants Inc, Showbiz Pizza Time Inc, Sizzler Intl Inc, Sonic Corp, Speedy Burgers Inc, TCBY Enterprises Inc, Triarc Cos Inc, Tricon Global Restaurants Inc, Wendys Intl Inc, Whataburger Inc, and White Castle System Inc.

⁸ We append 1999 advertising data to 2000 NLSY79 data by DMA.

we employ since they contain dichotomous year indicators. Spot television advertising has local variation and is reported by year and by market area by CMR. That is the type of advertising that we consider.

An important conceptual issue that arises in measuring the impact of exposure to advertising on consumer behavior is whether the effect on any one consumer depends on the total number of minutes of advertising aired on television in the consumer's DMA or on the per capita number of minutes aired. This depends on whether advertising is treated as a public good. Public goods are non-excludable and non-rejectable. If street signs are public goods, then a billboard showing an ad, for example, can be viewed as a public good (or a public "bad" if over-provided). This is not as straightforward with advertisements on television, which could be excludable (unless everyone owns a television set) or rejectable (as one can turn the channel if one chooses to do so).

The advertising literature seems to be mixed with regard to using total exposure or this variable per capita.⁹ The most compelling justification for total exposure is that two consumers cannot eat the same apple, but two consumers can watch the same advertisement. The most compelling justification for the per capita specification is that there are more television stations in larger market areas. This lowers the probability that two consumers will see the same advertisement in a larger market even if they spend the same amount of time watching television. Because the first factor seems to us to be more important than the second (two consumers in the same market area certainly can view the same advertisement no matter how large the area), we emphasize results with total

⁹ For example, Saffer (1997), Tellis and Weissee (1995), and Tellis et al. (2000) use advertising only, while Saffer and Dave (2003) use exposure per capita.

exposure. In preliminary research, we found that results for per capita exposure were similar to those with total exposure.

To control for other factors that might affect caloric intake and caloric expenditure, we also include several state-level variables that are appended to the individual data by state and year. The number of fast-food restaurants and the number of full-service restaurants are taken from the *Census of Retail Trade*. Three food prices are also included: full-service restaurant price, fast-food restaurant price, and food at home price. The first price variable is taken from the same source as the number of restaurants, namely the *Census of Retail Trade*. The last two price variables are obtained from the American Chamber of Commerce Researchers Association (ACCRA). The price of cigarettes is taken from the *Tax Burden on Tobacco* (Orzechowski and Walker 2002). Clean indoor air laws are taken from the Centers for Disease Control and Prevention website (<http://www2.cdc.gov/nccdph/osh/state>). More detailed descriptions of the definitions and construction of these variables and their roles in equations for weight outcomes can be found in Chou et al. (2004).

IV. EMPIRICAL IMPLEMENTATION

We employ height and weight measures in NLSY79 and in NLSY97 to construct two dependent variables: body mass index (BMI) and an indicator that equals one if the child or adolescent is overweight. Given the large sample size, we fit linear probability models rather than logit or probit models when the overweight indicator is the outcome. Our most inclusive regression model is

$$Y_{ijt} = \gamma_0 + \gamma_1 \ln S_{ijt} + \gamma_2 \ln T_{ijt} + \beta_1 X_{ijt} + \beta_2 M_{ijt} + \beta_3 Z_{ijt} + \mu_j + v_t + \varepsilon_{ijt}. \quad (1)$$

In this equation, the dependent variable (Y_{ijt}) is the weight outcome (BMI or overweight) for person i in DMA j surveyed in year t . The regressors are the natural logarithm of number of hours of spot television fast-food restaurant advertising messages seen per week ($\ln S_{ijt}$); natural logarithm of the number of hours per week spent watching television ($\ln T_{ijt}$); a vector of demographic variables for children or adolescents, including age, race, and gender (X_{ijt}); a vector of variables containing mother's employment status, household income, a dummy for missing income, and dummy variables indicating whether the mother is overweight (BMI of 25 kg/m^2 or greater) or obese (M_{ijt}); a vector of state-specific variables including the per capita number of fast-food restaurants, the per capita number of full-service restaurants, the real cigarette price, dichotomous indicators for clean indoor air laws, the real full-service restaurant price, the real food at home price, and the real fast-food restaurant price (Z_{ijt}); and vectors indicating DMA (μ_j) and year (v_t). The disturbance term is ε_{ijt} .

Whether the mother is overweight or obese helps to partially capture the genetic component that determines a child's body mass index. The effect of food advertising on children and adolescents also depends on the resources allocated by parents for food consumption by the family, to parental response to their children's food purchase requests, and to parental control of their food consumption. We include family income and mother's employment status to control for parental influence on children's and adolescents' food consumption.¹⁰ Anderson et al. (2003) focus on children and find that maternal employment has an effect on obesity in children.

¹⁰ We do not account for the potential endogeneity of mother's employment status in our regressions, as that is not the main focus of this paper. See Anderson et al. (2003) for an analysis of the impact of mother's employment status on childhood obesity while accounting for potential endogeneity.

Our main variable of interest is the number of hours of spot television fast-food restaurant advertising messages seen per week (S_{ijt}). We compute this as

$$S_{ijt} = p_{ijt}A_{jt}, \quad (2)$$

where A_{jt} is the number of hours of messages aired per week and p_{ijt} is the probability that a given child or adolescent saw one hour of advertising. In turn, this probability is estimated as

$$p_{ijt} = T_{ijt}/168 \quad (3)$$

where T_{ijt} is the number of hours per week that the child or adolescent watches television and 168 equals the total number of hours in a week. This assumes that the ratio of hours of advertising seen to hours of advertising aired is equal to the ratio of hours of television seen to hours available for all activities including sleep.

An advantage of the specification given by equation (1) is that it allows the amount of time spent watching television to have an effect on weight outcomes that is independent of the number of minutes of fast-food restaurant advertising messages seen. Both S_{ijt} and T_{ijt} are entered in natural logarithms for several reasons. First, both variables are positively skewed. By employing natural logarithms, we mitigate the influence of outliers in determining regression coefficients. In addition, we allow the marginal effect of each variable on BMI or obesity to be nonlinear and to diminish as the variable increases. Preliminary analyses revealed evidence in support of this type of nonlinearity.

Finally, given the definition of S_{ijt} in equations (2) and (3), equation (1) can be rewritten as

$$Y_{ijt} = \gamma_0 - \gamma_1 \ln 168 + \gamma_1 \ln A_{jt} + (\gamma_1 + \gamma_2) \ln T_{ijt} + \beta_1 X_{ijt} + \beta_2 M_{ijt} + \beta_3 Z_{ijt} + \mu_j + v_t + \varepsilon_{ijt}. \quad (4)$$

At first glance, $\alpha \equiv \gamma_1 + \gamma_2$ should exceed γ_1 since that coefficient and γ_2 are positive. Both S_{ijt} and T_{ijt} are, however, measured with error in the equations that generate equation (4). The amount of time that children spend watching television is based on estimates reported by their mothers in NLSY79, except that this information is obtained directly from 10 and 11 year olds. In NLSY97, the information is reported by adolescents and is available only in the first year of the panel. Clearly, our estimate of the probability that a given child saw a certain message is subject to error.

Given the issues just raised, we begin by estimating equation (4) and testing the hypothesis that α equals γ_1 . This is useful because it may be unrealistic to try to obtain separate estimates of γ_1 and γ_2 . Moreover, both television viewing time and advertising may be endogenous. More overweight children may be more sedentary and thus watch more television, and advertising may be determined simultaneously with consumption in fast-food restaurants. We lack instruments to treat both variables as endogenous but can explore one in which $\ln T_{ijt}$ is omitted from equation (1). That is equivalent to constraining the coefficient of $\ln A_{jt}$ to equal the coefficient of $\ln T_{ijt}$

By including DMA or area effects, we control for time-invariant unmeasured factors that are correlated with television advertising and weight outcomes. For example, fast-food restaurants may choose to place more advertisements in areas where residents have a higher than average taste for caloric foods, and hence a larger percentage of the population is overweight. Since the children of overweight parents are more likely to be overweight than the children of normal-weight parents, advertising effects are biased if area effects are omitted.

Although an individual fixed effects model controls for DMA fixed effects if individuals do not move, we estimate a DMA fixed effects model for several reasons. First, as explained above, the amount of time spent watching television in the NLSY97 is available only in the first year of the panel and cannot be used as a regressor with individual fixed effects. Second, the key unobservables governing area-level advertising decisions are characteristics pertaining to the population of the area. Since an individual picked at random in an area with a strong taste for dining in fast-food restaurants is likely to share the tastes of the area, the area indicator reflects that factor.

The last factor is important because the area fixed effects model is more efficient than the individual fixed effects model. This is true because the former model involves the estimation of far fewer parameters. Indeed, preliminary results revealed similar point estimates of advertising coefficients but larger standard errors in individual fixed effects models compared to area fixed effects models.¹¹ We do account for the panel nature of the data and for the measurement of at least one component of the advertising variable at the area level by clustering by DMAs in obtaining standard errors of regression coefficients. This allows the disturbance term (ε_{ijt}) to be correlated for the same person over time and to be correlated among different persons in the same DMA both at a moment in time and over time.

Means and standard deviations for the NLSY79 and NLSY97 data sets are reported in Tables 2a and 2b. These means and the regressions in the next section employ the NLSY sampling weights. In NLSY79, heights and weights are obtained from measurements taken by interviewers for approximately 75 percent of the sample. The

¹¹ This comparison could only be done for NLSY79 because we could not estimate individual fixed effects models for NLSY97, as explained above.

remainder of the height and weight data are reported by mothers. All of our regression models for this sample include a dichotomous indicator that equals one if BMI and overweight are based on mother reports since they are more likely to result in errors in BMI and in the classification of overweight status. In NLSY97, heights and weights are reported by adolescents.

The average BMIs are 17.62 kg/m² and 22.10 kg/m² for children aged 3-11 and adolescents aged 12-18, respectively. Moreover, 15.8 percent of the children (NLSY79) and 10.3 percent of the adolescents (NLSY97) are overweight. All of these figures except for the last one are comparable to those from NHANES99 in Tables 1a and 1b. To be specific, adolescents are 40 percent more likely to be overweight in NHANES99 than in NLS97. Almost all of this difference results because adolescent girls are twice as likely to be overweight in NHANES99 than in NLSY97. Undoubtedly, this reflects a reluctance by adolescent girls to report their true weight.

Inclusion of a gender indicator in NLSY97 regressions controls for the source of response error just described. Of course, one cannot decompose the gross difference in overweight status between adolescent males and females or the difference net of other regressors into a component due to response error and a component due to other factors. But as long as response error is uncorrelated with variables other than gender, regression coefficients of these variables are unbiased, although their standard errors are inflated. Hence, the t-ratios on which tests of significance are based are conservative lower-bound estimates.

If reporting errors result in a constant percentage reduction in BMI, all slope coefficients involving this outcome, including those associated with fast-food advertising,

are understated. When the probability of being overweight is the outcome, the bias is less obvious even if, as we hypothesize, overweight girls are more likely to be found in areas with relatively large amounts of fast-food advertising on television. That depends on the distribution of girls around the overweight cutoff among areas and the degree to which response error in percentage terms is correlated with true weight. If too few girls are classified as overweight in areas with relatively large amounts of advertising, the associated coefficients are conservative lower-bound estimates. Note that all percentage changes in BMI and in the number of overweight children and adolescents computed from regression results in Sections V and VI employ NHANES99 means. If slope coefficients are unbiased, this corrects for the upward bias in the absolute value of the impact of a change advertising on the percentage change in the number of overweight adolescents that would result if NLSY97 means were employed in the computations.

V. RESULTS

Table 3 presents results in which body mass index is the dependent variable for children aged 3-11 (upper panel) and for adolescents aged 12-18 (lower panel). Table 4 contains similar results in which the probability of being overweight is the dependent variable. Regressions are also run separately by gender because the results of Chow tests (not shown) indicate significant differences between male and female slope coefficients in most specifications.¹² Pooled regressions are presented for completeness, for the interest of the reader, because they are based on more observations than the gender-specific regressions, and because of the response errors associated with weight outcomes of adolescent girls discussed in the previous section. Moreover, the policy initiatives that

¹² These tests allow the intercept to vary by gender.

we consider in the next section are not gender-specific. In almost all cases, the advertising coefficient in a given regression is a simple average of the corresponding gender-specific coefficients. Hence, the pooled coefficient can be used to evaluate the impact of the policy at issue.

In all specifications, individual characteristics, as well as DMA and year fixed effects, are included. In specification 1 in each table, we include both the natural logarithm of television watching time ($\ln T$) and the natural logarithm of fast-food restaurant advertising messages aired on television ($\ln A$) as explanatory variables. We find a positive and significant relationship between television viewing time and BMI or overweight, except when the probability that adolescent females are overweight is the outcome.¹³ All twelve coefficients of advertising messages aired are positive, but only two of the six coefficients are significant when BMI is the outcome. Five of the six coefficients are, however, significant when overweight is the outcome. As is the case for television viewing time, the exception pertains to adolescent girls.

In each of the twelve specification 1 regressions in Tables 3 and 4, we test the hypothesis that the coefficient of the log of TV time is equal to the coefficient of the log of messages aired. In each case, we accept the hypothesis that the two coefficients are the same. Therefore, we estimate a second model (specification 2 in each table) in which the log of TV time is omitted. As pointed out in Section III, this is equivalent to constraining the coefficient of the log of TV time to equal the coefficient of the log of messages aired. In this specification, all twelve coefficients are positive and significant.

¹³ We evaluate the significance of advertising coefficients with one-tailed tests since the alternative hypothesis is that these coefficients are positive.

To gauge the magnitudes of the effects at issue, we focus on the regressions in Table 4 in which the probability of being overweight is the dependent variable. This outcome is a negative correlate of health, while BMI is a positive correlated for children and adolescents who are below their ideal weight. Moreover, the coefficients of the log of messages seen are smaller than the coefficients of the log of messages aired in Table 4, while the reverse holds in Table 3. Hence the ones in specification 2 of Table 4 may be viewed as conservative lower-bound estimates.

We employ an increase in the number of messages seen equal to its coefficient of variation in the actual variable rather than in its natural logarithm. On average children and youths view approximately half an hour per week of fast-food advertising messages. Since the coefficient of variation of this variable is approximately equal to one in each regression, our computations reveal the impacts of an increase in exposure to this type of advertising of half an hour per week.¹⁴

For boys aged 3-11, increasing exposure to fast-food advertising by half an hour per week will increase the probability of being overweight by 2.2 percentage points. This translates to a 15 percent increase in the number of overweight boys in a fixed population.¹⁵ The corresponding figures for girls aged 3-11 are 1.6 percentage point increase and a 12 percent increase in the number of overweight girls in a fixed population.

¹⁴ To be specific, we compute the percentage point increase in the percentage of children or adolescents overweight as $100\gamma_1 \ln(1 + \frac{\Delta S}{\bar{S}})$, where γ_1 is regression the coefficient of $\ln S$, \bar{S} is the mean of S and

$\Delta S / \bar{S}$ is set equal to the coefficient of variation. Note that the antilog of the mean of the log of S is the geometric mean and is measured in the same units as S --namely, hours per week. But the antilog of the standard deviation of $\ln S$ is a not measured in hours per week. Bland and Altman (1996) indicate that calculation of the standard deviation of a variable after it has been transformed to natural logarithms requires taking the difference between each log observation and the log of the geometric mean. Since the difference between the log of two numbers is the log of their ratio, it is a dimensionless pure number. For that reason and because a half an hour per week increase in messages seen is a meaningful magnitude to consider, we base our computations on arithmetic means and the corresponding standard deviations.

¹⁵ We use the means from the NHANES99 data set to compute the percentage change.

For adolescent boys and girls aged 12-18, we obtain an increase of 2.5 percentage points (17 percent) for boys and an increase of 0.6 percentage points (4 percent) for girls. The larger effects for males relative to females, especially in the adolescent sample, may reflect a greater concern by females about their weight. They may also reflect in part underreporting of weight by adolescent females.

To account for the possible endogeneity of the advertising exposure variable, we fit instrumental variables (IV) models in which the price of advertising (measured in dollars per seconds of messages aired) and the number of households with a television in the DMA serve as instruments.¹⁶ In conducting the instrumental variable regressions, we employ specification 2 where the endogenous variable is exposure to fast-food restaurant advertising (messages seen). Personal characteristics, DMA and year fixed effects, and state variables are all included in the model. The first stage results reveal that the instruments behave in the expected fashion. An increase in the price of an advertisement significantly reduces fast-food restaurant advertising exposure on television, and an increase in the number of households with television sets significantly increases exposure.

The IV test results suggest that the messages seen variable is not endogenous. All the Durbin-Wu-Hausman tests are not rejected, regardless of the sample. To verify the validity of our instruments, we also conduct overidentification tests (Hansen's J statistics) and F tests of the significance of the set of instruments in the first stage. None of the Hansen's J statistics is rejected at the 5 percent level. This implies that the null

¹⁶ The use of lagged values for the advertising variable in an attempt to get around the possible endogeneity problem is not an attractive strategy, as it has been shown that advertising effects depreciate rapidly (Boyd and Seldon 1990). The shape of the response function is believed to be concave-downward, so that exposure to a given advertising message has diminishing effects, or conveys less and less information with each additional exposure (Simon and Arndt 1980).

hypothesis--that the instruments are uncorrelated with the error terms--is confirmed. The F statistics resulting from the test of the two instruments as a set range from 15 to 76, suggesting that the instrumental variable estimates are not biased because the instruments are weakly correlated with the endogenous explanatory variables (Bound et al. 1995; Staiger and Stock 1997). Given these results, we relegate them to an appendix available on request.

In Tables 5 and 6, we examine the sensitivity of our results to alternative specifications. BMI is the dependent variable in Table 5, while the probability of being overweight is the dependent variable in Table 6. The first specification in each table is identical to specification 2 in Table 3 or 4. The second specification omits DMA fixed effects and state variables. The third specification adds DMA fixed effects, while the fourth adds state variables and linear DMA-specific trends. In general, the coefficients of the log of messages seen are very stable across these alternative specifications. One might be concerned if the effects became smaller as more location-specific variables were included because that might be evidence of omitted-variables bias. In fact, that is not the case. Hence, the estimates in Tables 5 and 6 strengthen our confidence in those emphasized in Tables 3 and 4.

Finally, regression results for other explanatory variables are reported in Table A1 (for children aged 3-11) and Table A2 (for adolescents aged 12-18) in the Appendix. For children aged 3-11 (Table A1), BMI increases with age, but the probability of being overweight is negatively associated with age. Hispanic boys and black girls are associated with higher body mass indexes and higher probabilities of being overweight. Boys are also more likely to be overweight. Higher family income significantly reduces

a child's body mass index and the probability of being overweight, regardless of gender. A wealthy family is more capable of choosing a healthy diet by staying away from calorie-rich but relatively cheap fast food. Yet they are also more able to consume at "upscale" restaurants where food is rich in calories as well. Our results suggest that the first factor dominates the second one. Mother's weight status is a strong predictor of a child's body mass index and the probability of being overweight, revealing a powerful genetic component. Mother's employment status has no impact on these outcomes.

For adolescents aged 12-18 (Table A2), being a black teenage female is strongly associated with having a higher body mass index and a higher probability of being overweight. Family income is associated with a lower body mass index and the probability of being overweight. Again, a mother's overweight or obese status is strongly associated with the body mass index and the probability of being overweight, but a mother's employment status is not significantly associated with these outcomes.

Most state variables are not statistically significant in the regressions. We summarize some interesting findings with regard to those state variables. First, a higher cigarette price leads to a higher probability of being overweight for teenage females (Table A2, the last column). This finding is consistent with several streams of literature: The price elasticity of cigarettes for youth is large and smoking cessation usually results in weight gain. Moreover, teenage girls are more sensitive to their body weight and are more likely to control weight by smoking (Cawley et al. 2004). Second, higher fast-food prices will lead to lower body mass indexes for adolescents. Fast food is rich in calories and its consumption may further adversely affect diet quality such as by reducing daily servings of fruit and vegetables (Bowman et al. 2004; French et al. 2000). Higher fast-

food prices may reduce its consumption and decrease the body mass index. Third, the number of fast-food restaurants is positively associated with a child's BMI and the probability of being overweight.

VI. DISCUSSION

The investigation of the causal relationship between fast-food restaurant advertising and body weight among children and adolescents is important when forming policies to cope with the obesity epidemic. Overall, our results show a strong positive effect of exposure to fast-food restaurant advertising on the probability that children and adolescents are overweight

Our results could be used to estimate the impact of a fast-food restaurant advertising ban on television on childhood obesity. A complete advertising ban on television would reduce the number of overweight children aged 3-11 in a fixed population by 18 percent.¹⁷ The decline for boys is approximately 4 percentage points larger than that for girls. The impact of this policy for adolescents aged 12-18 amounts to a smaller decline of 14 percent. Here the effect is much more pronounced for males than for females; the difference is approximately 18 percentage points.

These computations underestimate the impact of a complete advertising ban on television because they are based on local or spot television advertising and ignore advertising associated with network, syndicated, and cable television advertising because

¹⁷ Calculations use specification 2 in Table 4 and means for the percentage overweight from NHANES 99. The number of advertising messages seen is assumed to fall from its age- and gender-specific mean to zero. Since we employ the log of messages seen in the regressions, we compute the marginal effect of S at the mean (γ_1 / \bar{S}) and then multiply this effect by \bar{S} . Of course, that is equivalent to computing the effect of a ban as γ_1 . This is an underestimate since the effect of S on the probability of being overweight rises as S falls. In our view this source of bias is less relevant than those discussed in the text.

they have local variation. On the other hand, they could overestimate the impact of an advertising ban because we ignore advertising in other media (i.e. radio, magazines, outdoor, newspaper). If advertising were equally effective in all media and total advertising remained the same, there would be no impact. If advertising in other media were less effective, especially since we are dealing with youth, and/or the increase was less than the reduction in television advertising, the number of overweight children would fall but by less than our estimates predict. If advertising in all media were banned, the media substitution would be eliminated, and our estimate would be a lower bound. However, such a ban might be difficult to legislate and would not exclude other types of marketing, such as sports and cultural events sponsorships, consumer novelties, and the internet.

Another policy option is to eliminate food advertising as ordinary business expenses that reduce taxable corporate income. Since the corporate income tax rate is 35 percent, elimination of the tax deductibility of food advertising costs is equivalent to increasing the price of advertising by about 54 percent. Based on our results, the elimination of tax deductibility of food advertising would reduce fast-food restaurant messages seen on television by 40 percent and 33 percent for children and adolescents, respectively. As a result, elimination of tax deductibility would reduce the number of overweight children and adolescents by 7 percent and 5 percent, respectively.¹⁸

¹⁸ These computations employ specification 2 in Table 4 and the reduced-form advertising price coefficients for each age group from the first-stage of our IV models. To be specific, let γ_1 be the coefficient of the log of messages seen in the overweight regression, let β be the coefficient of price in the log messages seen regression, let p be the mean price of a message seen, and let t be the corporate tax rate. Then the reduction in the percentage overweight due to the elimination of the tax deductibility of advertising is $100\gamma_1\beta p t / (1 - t)$.

Clearly, we have not provided enough information to fully evaluate the two policies just discussed. Indeed, we have not addressed the larger issue of whether the government should intervene in the food purchase decisions of its citizens. Obesity carries a high personal cost. But does it carry a high enough social cost to make it a concern of public policy? The answer is no if consumers are fully informed, and if the obese bear all the consequences of their actions. The answer is yes if consumers do not have full information or something that reasonably approximates it, or if third parties like Medicare, Medicaid, private health insurance companies, and ultimately the non-obese end up bearing significant amounts of the costs.

In the case of children, one justification for government intervention is that society as a whole may reap substantial current and future production and consumption benefits from improvements in children's health. The deep government involvement in children's lives reflects these potential benefits. Through its sponsorship of school programs, school lunches, and recreational facilities, the government can more easily and immediately affect the choices of children than adults. The case is strengthened because overweight children are extremely likely to become obese adults and because children are less likely to have information about the consequences of their actions or to heavily discount these consequences.

Of course, one would still need to consider the degree of government involvement that is merited and the costs of alternative policies. Relative to positive efforts such as subsidies to programs that encourage children to exercise, advertising bans or increases in the price of advertising impose welfare costs on children and adults who consume fast food in moderation. Additional welfare costs arise because consumers are denied positive

information conveyed by advertising. Not surprisingly, an advertising ban not accompanied by media substitution produces larger reductions in the number of overweight children and adolescents than the elimination of the tax deductibility of advertising. But the welfare costs of the former policy are likely to be much larger than those of the latter. Moreover, implementation of both policies raises the difficult issue of distinguishing between fast-food and full-service restaurants and between fast food and other types of food. Hence, more research is required to evaluate the effectiveness of these policies and others. Our study should be viewed as one of many inputs in this process.

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Table 1a

Trends in Body Mass Index and the Percentage Overweight,
Persons 3 to 11 Years of Age^a

Survey	Period			<i>Males only</i>		<i>Females only</i>	
		BMI ^b	Overweight ^c	BMI ^b	Overweight ^c	BMI ^b	Overweight ^c
NHES II	1963-1965	16.63	4.24	16.57	4.00	16.68	4.50
NHANES I	1971-1974	16.44	5.33	16.46	5.74	16.42	4.92
NHANES II	1976-1980	16.64	7.33	16.64	7.22	16.64	7.44
NHANES III	1988-1994	17.15	10.59	17.09	10.25	17.22	10.95
NHANES 99	1999-2000	17.37	14.26	17.38	14.74	17.36	13.76

^aThe surveys are as follows: National Health Examination Survey II (NHES II), National Health and Nutrition Examination Survey I (NHANES I), National Health and Nutrition Examination Survey II (NHANES II), National Health and Nutrition Examination Survey III (NHANES III), and National Health and Nutrition Examination Survey 1999-2000 (NHANES 99). NHES II pertains to children 6-11 years of age. Survey weights are employed in all computations.

^bWeight in kilograms divided by height in meters squared. Actual weights and heights are used in calculations.

^cPercentage with BMI equal to or greater than the 95th percentile based on Centers for Disease Control and Prevention growth charts. See <http://www.cdc.gov/growthcharts>.

Table 1b

Trends in Body Mass Index and the Percentage Overweight,
Persons 12 to 18 Years of Age^a

Survey	Period			<i>Males only</i>		<i>Females only</i>	
		BMI ^b	Overweight ^c	BMI ^b	Overweight ^c	BMI ^b	Overweight ^c
NHES I,III	1959-1962, 1966-1970	20.61	4.45	20.47	4.50	20.76	4.40
NHANES I	1971-1974	20.97	6.82	20.81	6.83	21.13	6.82
NHANES II	1976-1980	21.03	5.63	20.92	5.39	21.16	5.89
NHANES III	1988-1994	22.11	10.62	21.95	11.48	22.28	9.72
NHANES 99	1999-2000	22.82	14.75	22.52	15.03	23.13	14.45

^aThe surveys are as follows: National Health Examination Survey I and III (NHES I,III), National Health and Nutrition Examination Survey I (NHANES I), National Health and Nutrition Examination Survey II (NHANES II), National Health and Nutrition Examination Survey III (NHANES III), and National Health and Nutrition Examination Survey 1999-2000 (NHANES 99). NHES I was used for adolescents aged 18, while NHES III was used for those between the ages of 12 and 17. Survey weights are employed in all computations.

^bWeight in kilograms divided by height in meters squared. Actual weights and heights are used in calculations.

^cPercentage with BMI equal to or greater than the 95th percentile based on Centers for Disease Control and Prevention growth charts. See <http://www.cdc.gov/growthcharts>.

Table 2a
Definitions, and Standard Deviations of Dependent Variables

Variable	Definition	Mean (Standard Deviation)					
		Ages 3-11 (NLSY79)			Ages 12-18 (NLSY97)		
		Whole	Male	Female	Whole	Male	Female
Body mass index	Weight in kilograms divided by height in meters squared	17.62 (4.67)	17.70 (4.51)	17.53 (4.84)	22.10 (4.44)	22.54 (4.58)	21.65 (4.24)
Overweight	Dichotomous variable that equals 1 if the body mass index is equal to or greater than the 95 th percentile	0.158 (0.365)	0.176 (0.381)	0.140 (0.347)	0.103 (0.304)	0.135 (0.342)	0.070 (0.255)
Sample size	Person-year	6034	3087	2947	7069	3665	3404

Table 2b
Definitions, Means, and Standard Deviations of Explanatory Variables

Variable	Definition	Mean (Standard Deviation)	
		Ages 3-11 (NLSY79)	Ages 12-18 (NLSY97)
Ln (TV Time)	Time spent by child watching television (in hours per week) in logs	2.966 (0.788)	2.650 (0.805)
Ln (Messages aired)	Hours of fast-food restaurant advertising messages aired per week in respondent's Designated Market Area in logs	1.194 (0.361)	1.269 (0.383)
Ln (Messages seen)	Hours of fast-food restaurant advertising messages seen per week in respondent's Designated Market Area in logs (see text for more details)	-0.964 (0.861)	-1.205 (0.911)
Age	Age of respondent	7.259 (2.532)	14.769 (1.400)
Hispanic	Dichotomous variable that equals 1 if respondent is Hispanic	0.060 (0.237)	0.111 (0.315)
Black non-Hispanic	Dichotomous variable that equals 1 if respondent is black but not Hispanic	0.123 (0.329)	0.155 (0.362)
Other race	Dichotomous variable if respondent's race is other than white, black, or Hispanic	---	0.012 (0.111)
Male	Dichotomous variable that equals 1 if respondent is male	0.513 (0.500)	0.511 (0.500)
Family income	Real household income in tens of thousands of 1982-84 dollars	7.062 (10.180)	5.474 (4.193)
Income missing	Dichotomous variable that equals 1 if family income is missing	0.034 (0.180)	0.132 (0.339)
Weight reported by mother	Dichotomous variable that equals 1 if weight is reported by mother	0.282 (0.450)	---
Height reported by mother	Dichotomous variable that equals 1 if height is reported by mother	0.232 (0.422)	---
Mother overweight	Dichotomous variable that equals 1 if mother's body mass index is equal to or greater than 25 kg/m ²	0.482 (0.500)	0.493 (0.500)
Mother obese	Dichotomous variable that equals 1 if mother's body mass index is equal to or greater than 30 kg/m ²	0.218 (0.413)	0.209 (0.407)
Mother employed	Dichotomous variable that equals 1 if mother is employed	0.693 (0.461)	0.708 (0.455)
Yr98	Dichotomous variable that equals 1 if year=1998	0.341 (0.474)	0.333 (0.471)
Yr99	Dichotomous variable that equals 1 if year=1999	---	0.343 (0.475)
Yr00	Dichotomous variable that equals 1 if year=2000	0.293 (0.455)	---

Variable	Definition	Mean (Standard Deviation)	
		Ages 3-11 (NLSY79)	Ages 12-18 (NLSY97)
Fast-food restaurants	Number of fast-food restaurants per 10,000 persons in respondent's state of residence	7.116 (0.564)	7.226 (0.491)
Full-service restaurants	Number of full-service restaurants per 10,000 persons in respondent's state of residence	7.144 (0.925)	7.232 (1.000)
Cigarette price	Real cigarette price in respondent's state of residence in 1982-1984 dollars	2.486 (0.532)	2.523 (0.495)
Government	Dichotomous variable that equals 1 if smoking is prohibited in government workplaces in respondent's state of residence	0.882 (0.323)	0.863 (0.344)
Private	Dichotomous variable that equals 1 if smoking is prohibited in private workplaces in respondent's state of residence	0.550 (0.498)	0.452 (0.498)
Restaurant	Dichotomous variable that equals 1 if smoking is prohibited in restaurants in respondent's state of residence	0.680 (0.466)	0.654 (0.476)
Other	Dichotomous variable that equals 1 if smoking is prohibited in other public places in respondent's state of residence	0.923 (0.266)	0.923 (0.267)
Full-service restaurant price	Real full-service restaurant meal price in respondent's state of residence in 1982-1984 dollars	8.991 (1.867)	9.258 (1.975)
Fast-food restaurant price	Real fast-food restaurant meal price in respondent's state of residence in 1982-1984 dollars	4.529 (0.266)	4.558 (0.250)
Food at home price	Real food at home price in respondent's state of residence in 1982-1984 dollars	2.011 (0.230)	2.025 (0.266)
Sample size (person-year)		6034	7069

Table 3
Regression Results.
Dependent variable: Body Mass Index ^a

	Ages 3-11 (NLSY79)					
	Specification 1			Specification 2		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages aired)	0.232 (0.763)	0.066 (0.155)	0.544 (1.175)	---	---	---
Ln (TV time)	0.278*** (3.118)	0.283** (2.211)	0.285*** (2.386)	---	---	---
Ln (Messages seen)	---	---	---	0.276*** (3.211)	0.272** (2.169)	0.297*** (2.493)
T-test on equality of coeff. ^b	0.885	0.617	0.576	---	---	---
R-squared	0.146	0.174	0.156	0.146	0.174	0.156
Sample size	6034	3087	2947	6034	3087	2947

	Ages 12-18 (NLSY97)					
	Specification 1			Specification 2		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages aired)	0.266* (1.630)	0.381* (1.365)	0.117 (0.557)	---	---	---
Ln (TV time)	0.474*** (4.479)	0.556*** (4.049)	0.380*** (3.274)	---	---	---
Ln (Messages seen)	---	---	---	0.463*** (4.721)	0.547*** (4.280)	0.367*** (3.367)
T-test on equality of coeff. ^b	0.346	0.606	0.298	---	---	---
R-squared	0.193	0.191	0.236	0.193	0.191	0.236
Sample	7069	3665	3404	7069	3665	3404

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses.

*** Significant at the 1% level (one tailed test). ** Significant at the 5% level (one tailed test).

* Significant at the 10% level (one tailed test). Regressions are clustered by DMA. All coefficients are adjusted for individual characteristics, state variables, DMA fixed effects and year fixed effects.

Individual variables include age, black non-Hispanic, Hispanic, other race (NLSY97 only), male, family income, missing income dummy, mother overweight, mother obese, mother employed, and dummies for weight and height reported by mothers (as opposed to actual measurements – NLSY79 only). State variables include the per capita number of fast-food restaurants, per capita number of full-service restaurants, real cigarette price, dummies for clean indoor air laws, real full-service restaurant price, real food at home price, and real fast-food restaurant price.

^b The null hypothesis is the coefficient of log(messages aired) is equal to the coefficient of log(TV time).

Table 4
Regression Results.
Dependent variable: Overweight ^a

	Ages 3-11 (NLSY79)					
	Specification 1			Specification 2		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages aired)	0.052** (2.302)	0.058* (1.565)	0.049* (1.545)	---	---	---
Ln (TV time)	0.025*** (3.319)	0.030*** (2.560)	0.021** (2.111)	---	---	---
Ln (Messages seen)	---	---	---	0.026*** (3.670)	0.032*** (2.729)	0.023** (2.314)
T-test on equality of coeff. ^b	0.260	0.464	0.412	---	---	---
R-squared	0.088	0.102	0.102	0.088	0.102	0.102
Sample size	6034	3087	2947	6034	3087	2947

	Ages 12-18 (NLSY97)					
	Specification 1			Specification 2		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages aired)	0.021** (1.967)	0.028** (1.846)	0.014 (0.822)	---	---	---
Ln (TV time)	0.021*** (3.071)	0.036*** (3.414)	0.009 (1.224)	---	---	---
Ln (Messages seen)	---	---	---	0.021*** (3.316)	0.036*** (3.555)	0.009* (1.383)
T-test on equality of coeff. ^b	0.961	0.650	0.805	---	---	---
R-squared	0.100	0.108	0.127	0.100	0.108	0.127
Sample size	7069	3665	3404	7069	3665	3404

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses.

*** Significant at the 1% level (one tailed test). ** Significant at the 5% level (one tailed test).

* Significant at the 10% level (one tailed test). Regressions are clustered by DMA. All coefficients are adjusted for individual characteristics, state variables, DMA fixed effects and year fixed effects.

Individual variables include age, black non-Hispanic, Hispanic, other race (NLSY97 only), male, family income, missing income dummy, mother overweight, mother obese, mother employed, and dummies for weight and height reported by mothers (as opposed to actual measurements – NLSY79 only). State variables include the per capita number of fast-food restaurants, per capita number of full-service restaurants, real cigarette price, dummies for clean indoor air laws, real full-service restaurant price, real food at home price, and real fast-food restaurant price.

^b The null hypothesis is the coefficient of log(messages aired) is equal to the coefficient of log(TV time).

Table 5
Alternative Specifications.
Dependent variable: Body Mass Index ^a

Ages 3-11 (NLSY79)												
	Specification 1			Specification 2			Specification 3			Specification 4		
	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.276*** (3.211)	0.272** (2.169)	0.297*** (2.493)	0.238*** (2.815)	0.291** (2.331)	0.186** (1.930)	0.282*** (3.335)	0.291** (2.373)	0.302*** (2.523)	0.297*** (3.343)	0.309** (2.271)	0.312*** (2.844)
DMA fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
State variables	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
DMA-specific trends	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
R-squared	0.146	0.174	0.156	0.111	0.121	0.106	0.141	0.168	0.147	0.164	0.198	0.200
Sample size	6034	3087	2947	6194	3171	3023	6194	3171	3023	6034	3087	2947

Ages 12-18 (NLSY97)												
	Specification 1			Specification 2			Specification 3			Specification 4		
	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.463*** (4.721)	0.547*** (4.280)	0.367*** (3.367)	0.429*** (4.760)	0.546*** (4.345)	0.298*** (3.013)	0.444*** (4.768)	0.516*** (4.156)	0.355*** (3.385)	0.475*** (4.540)	0.557*** (4.083)	0.377*** (3.338)
DMA fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
State variables	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
DMA-specific trends	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
R-squared	0.193	0.191	0.236	0.160	0.138	0.189	0.190	0.186	0.235	0.200	0.206	0.246
Sample size	7069	3665	3404	7387	3812	3575	7387	3812	3575	7069	3665	3404

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses. *** Significant at the 1% level (one tailed test). ** Significant at the 5% level (one tailed test). * Significant at the 10% level (one tailed test). Regressions are clustered by DMA. All coefficients are adjusted for individual characteristics and year fixed effects. Individual variables include age, black non-Hispanic, Hispanic, other race (NLSY97 only), male, family income, missing income dummy, mother overweight, mother obese, mother employed, and dummies for weight and height reported by mothers (as opposed to actual measurements – NLSY79 only). State variables include the per capita number of fast-food restaurants, per capita number of full-service restaurants, real cigarette price, dummies for clean indoor air laws, real full-service restaurant price, real food at home price, and real fast-food restaurant price.

Table 6
Alternative Specifications.
Dependent variable: Overweight ^a

Ages 3-11 (NLSY79)												
	Specification 1			Specification 2			Specification 3			Specification 4		
	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.026*** (3.670)	0.032*** (2.729)	0.023** (2.314)	0.018** (2.327)	0.026** (2.299)	0.01 (1.049)	0.023*** (3.378)	0.030*** (2.732)	0.019** (1.825)	0.027*** (3.711)	0.032*** (2.578)	0.026*** (2.458)
DMA fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
State variables	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
DMA-specific trends	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
R-squared	0.088	0.102	0.102	0.05	0.045	0.056	0.085	0.100	0.096	0.100	0.124	0.124
Sample size	6034	3087	2947	6194	3171	3023	6194	3171	3023	6034	3087	2947

Ages 12-18 (NLSY97)												
	Specification 1			Specification 2			Specification 3			Specification 4		
	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.021*** (3.316)	0.036*** (3.555)	0.009* (1.383)	0.020*** (3.538)	0.031*** (3.061)	0.009** (1.736)	0.021*** (3.330)	0.034*** (3.348)	0.010** (1.670)	0.022*** (3.179)	0.036*** (3.402)	0.009* (1.297)
DMA fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
State variables	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
DMA-specific trends	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
R-squared	0.100	0.108	0.127	0.078	0.069	0.086	0.096	0.107	0.121	0.105	0.117	0.142
Sample size	7069	3665	3404	7387	3812	3575	7387	3812	3575	7069	3665	3404

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses. *** Significant at the 1% level (one tailed test). ** Significant at the 5% level (one tailed test). * Significant at the 10% level (one tailed test). Regressions are clustered by DMA. All coefficients are adjusted for individual characteristics and year fixed effects. Individual variables include age, black non-Hispanic, Hispanic, other race (NLSY97 only), male, family income, missing income dummy, mother overweight, mother obese, mother employed, and dummies for weight and height reported by mothers (as opposed to actual measurements – NLSY79 only). State variables include the per capita number of fast-food restaurants, per capita number of full-service restaurants, real cigarette price, dummies for clean indoor air laws, real full-service restaurant price, real food at home price, and real fast-food restaurant price.

Table A1
Complete Regression Results for Children Aged 3-11 (Specification 2 of Tables 3 and 4)^a

	Dep. Variable: Body Mass Index			Dep. Variable: Overweight		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.276*** (3.211)	0.272** (2.169)	0.297** (2.493)	0.026*** (3.670)	0.032*** (2.729)	0.023** (2.314)
Age	0.433*** (14.592)	0.477*** (10.443)	0.399*** (11.863)	-0.006*** (2.646)	-0.003 (0.998)	-0.009*** (3.096)
Hispanic	0.610*** (2.674)	0.818*** (2.888)	0.483 (1.414)	0.068*** (2.658)	0.078** (2.156)	0.061 (1.661)
Black non-Hispanic	0.557*** (2.788)	0.286 (0.948)	0.853** (2.186)	0.048*** (2.647)	0.020 (0.929)	0.079*** (2.709)
Male	0.058 (0.348)	---	---	0.035*** (3.152)	---	---
Family income	-0.009** (2.166)	-0.008 (1.589)	-0.011* (1.794)	-0.001*** (4.026)	-0.001*** (2.894)	-0.001** (2.152)
Income missing	-0.508 (1.345)	-0.655* (1.690)	-0.266 (0.466)	-0.032 (0.887)	-0.032 (0.777)	-0.028 (0.606)
Mother overweight	0.420* (1.683)	0.655 (1.587)	0.147 (0.544)	0.028* (1.803)	0.046* (1.991)	0.014 (0.526)
Mother obese	0.959*** (2.933)	0.651 (1.545)	1.313*** (3.154)	0.074*** (4.049)	0.072*** (2.714)	0.077*** (3.049)
Mother employed	0.663*** (3.898)	0.638*** (2.710)	0.687*** (2.649)	0.054*** (3.343)	0.051** (2.511)	0.051** (2.415)
Fast-food restaurants	0.867*** (4.075)	0.607** (2.261)	1.145*** (3.640)	0.063*** (3.363)	0.057** (2.325)	0.071** (2.491)
Full-service restaurants	-0.082 (0.476)	-0.213 (0.969)	0.034 (0.128)	0.015 (1.098)	0.009 (0.433)	0.022 (1.216)
Cigarette price	0.734 (1.414)	1.108 (1.520)	0.416 (0.811)	0.055** (2.121)	0.056 (1.375)	0.049 (1.312)
Government	-0.037 (0.110)	-0.297 (0.716)	0.255 (0.535)	-0.034* (1.925)	-0.025 (0.786)	-0.041** (2.004)
Private	-1.010 (1.357)	-1.105 (1.073)	-0.857 (0.898)	-0.006 (0.125)	-0.013 (0.181)	-0.032 (0.423)
Restaurant	0.694 (0.765)	0.895 (0.865)	0.544 (0.342)	0.108** (2.203)	0.054 (0.680)	0.144** (2.060)
Other	-0.352 (0.656)	-0.236 (0.294)	-0.609 (0.795)	-0.039 (1.082)	-0.042 (0.677)	-0.013 (0.238)
Full-service restaurant price	0.046 (0.077)	-0.027 (0.037)	0.246 (0.317)	0.051 (1.584)	0.024 (0.479)	0.073* (1.760)
Fast-food restaurant price	-0.557 (0.937)	0.073 (0.099)	-1.203 (1.409)	0.001 (0.044)	0.092* (1.708)	-0.094** (2.409)
Food at home price	0.125 (0.634)	-0.101 (0.343)	0.400 (1.394)	0.009 (0.695)	0.000 (0.013)	0.024* (1.831)
R-squared	0.146	0.174	0.156	0.088	0.102	0.102
Sample size	6034	3087	2947	6034	3087	2947

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses. Regressions are clustered by DMA. Regressions also include year and DMA fixed effects, and dummies for weight and height reported by mothers (as opposed to actual measurement). Intercepts are not shown. *** Significant at the 1% level (two tailed test). ** Significant at the 5% level (two tailed test). * Significant at the 10% level (two tailed test).

Table A2
Complete Regression Results for Children Aged 12-18 (Specification 2 of Tables 3 and 4)^a

	Dep. Variable: Body Mass Index			Dep. Variable: Overweight		
	Whole	Male	Female	Whole	Male	Female
Ln (Messages seen)	0.463 ^{***} (4.721)	0.547 ^{***} (4.280)	0.367 ^{***} (3.367)	0.021 ^{***} (3.316)	0.036 ^{***} (3.555)	0.009 (1.383)
Age	0.619 ^{***} (6.520)	0.542 ^{***} (3.774)	0.688 ^{***} (6.970)	-0.003 (0.482)	-0.007 (0.758)	0.001 (0.198)
Hispanic	0.632 [*] (1.714)	0.787 (1.534)	0.725 [*] (1.722)	0.035 (1.448)	0.064 [*] (1.826)	0.016 (0.611)
Black non-Hispanic	1.016 ^{***} (3.422)	0.296 (0.660)	2.029 ^{***} (4.813)	0.046 ^{**} (2.278)	0.021 (0.629)	0.086 ^{***} (3.255)
Other race	0.557 (1.236)	1.899 (1.619)	0.108 (0.213)	0.042 (0.934)	0.125 (1.143)	0.000 (0.030)
Male	0.740 ^{***} (4.712)	---	---	0.059 ^{***} (5.147)	---	---
Family income	-0.038 ^{**} (2.094)	-0.027 (1.131)	-0.039 (1.622)	-0.002 (1.483)	-0.001 (0.545)	-0.003 ^{**} (2.203)
Income missing	-0.688 ^{***} (3.025)	-0.760 ^{**} (2.392)	-0.458 (1.468)	-0.043 ^{***} (3.030)	-0.059 ^{**} (2.548)	-0.017 (1.150)
Mother overweight	1.004 ^{***} (5.521)	1.272 ^{**} (4.831)	0.680 ^{***} (2.955)	0.042 ^{***} (3.379)	0.056 ^{***} (2.687)	0.019 (1.663)
Mother obese	1.896 ^{***} (6.236)	1.375 ^{***} (2.869)	2.333 ^{***} (6.057)	0.123 ^{***} (5.715)	0.111 ^{***} (3.389)	0.134 ^{***} (4.119)
Mother employed	0.199 (0.897)	0.134 (0.420)	0.265 (1.075)	0.017 (1.337)	0.016 (0.832)	0.017 (1.271)
Fast-food restaurants	0.374 (1.357)	-0.054 (0.123)	0.487 ^{**} (2.025)	0.003 (0.211)	-0.004 (0.144)	0.002 (0.150)
Full-service restaurants	0.141 (0.707)	0.008 (0.037)	0.310 (1.658)	0.029 (1.248)	0.027 (1.190)	0.030 (1.344)
Cigarette price	0.590 (0.878)	0.199 (0.216)	1.541 ^{**} (2.072)	0.100 ^{**} (2.370)	0.087 (1.476)	0.116 ^{**} (2.411)
Government	1.652 (0.629)	1.556 (0.522)	2.741 ^{***} (4.156)	0.107 (0.433)	0.105 (0.371)	-0.04 (0.747)
Private	-0.402 (0.837)	-0.937 [*] (1.753)	0.285 (0.623)	-0.077 (1.377)	-0.095 ^{**} (2.011)	-0.053 (0.922)
Restaurant	0.879 (1.104)	1.416 (1.214)	-0.552 (0.843)	0.032 (0.411)	-0.01 (0.098)	0.05 (0.826)
Other	0.084 (0.159)	-0.433 (0.365)	0.826 [*] (1.695)	-0.011 (0.226)	0.019 (0.216)	-0.012 (0.339)
Full-service restaurant price	-0.154 (1.480)	-0.052 (0.456)	-0.314 ^{***} (2.907)	-0.019 [*] (1.682)	-0.023 ^{**} (2.007)	-0.019 [*] (1.690)
Fast-food restaurant price	-1.334 ^{**} (2.018)	-1.048 (1.100)	-1.545 ^{***} (3.078)	-0.013 (0.310)	0.004 (0.075)	-0.026 (0.605)
Food at home price	-2.154 ^{***} (2.718)	-1.868 ^{**} (2.050)	-4.349 ^{***} (2.680)	-0.164 [*] (1.796)	-0.207 ^{**} (2.325)	-0.104 (0.758)
R-squared	0.193	0.191	0.236	0.100	0.108	0.127
Sample size	7069	3665	3404	7069	3665	3404

^a All regressions are weighted by NLSY sampling weights. T-ratios are reported in parentheses. Regressions are clustered by DMA. Regressions also include year and DMA fixed effects. Intercepts are not shown. ***

Significant at the 1% level (two tailed test). ** Significant at the 5% level (two tailed test). * Significant at the 10% level (two tailed test).