Weighty Factors in Children's Food and Beverage Consumption

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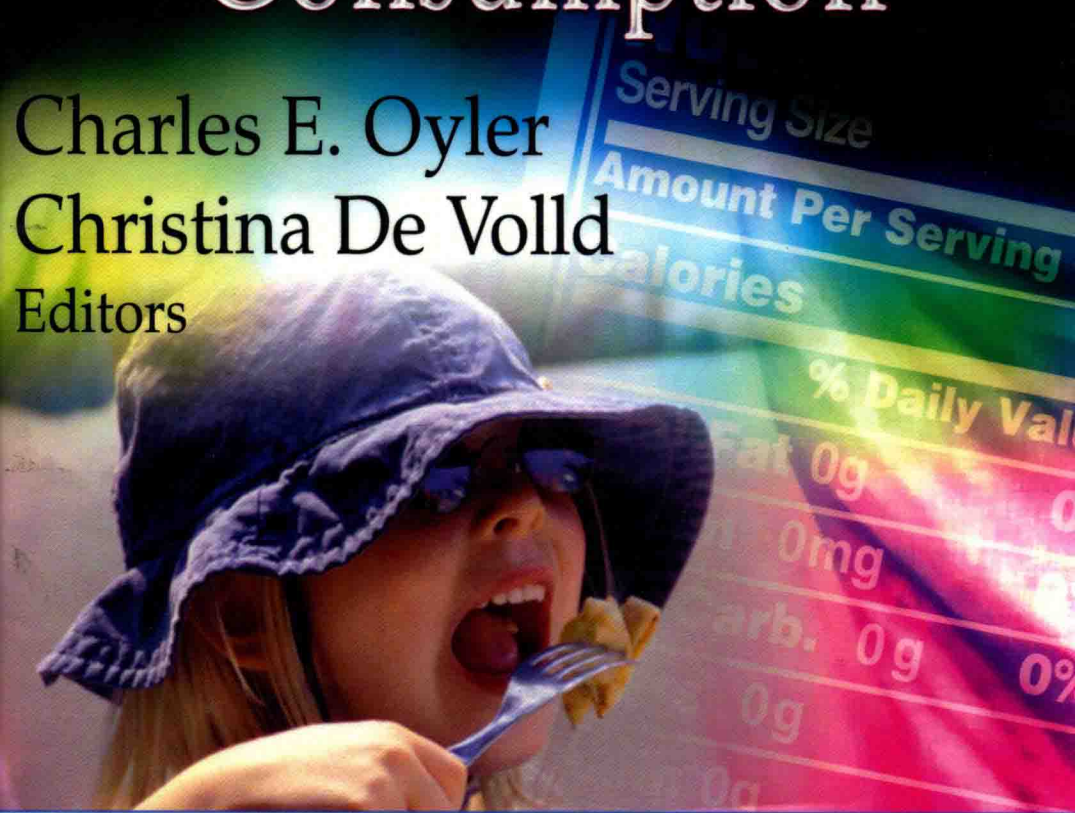
Editors



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CHARLES E. OYLER
AND
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PREFACE

The prevalence of childhood obesity has risen dramatically in the last several decades in the United States, and is currently considered to be epidemic. This book examines the many factors that play a role in this crisis including the effect of food and beverage prices on children's weights; how food away from home affects children's diet quality; the environments to which children are exposed in their daily lives (ie., schools, child care, communities) can influence the healthfulness of their diets; and the potential effects on taxing caloric sweetened beverages.

Chapter 1 – One factor that may be important in explaining rising childhood obesity is food prices. This report explores the effect of food prices on children's Body Mass Index (BMI) using data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) and the Quarterly Food-at-Home Price Database.

On average, higher prices for soda, 100 percent juices, starchy vegetables, and sweet snacks are associated with lower BMIs among children. In addition, lower prices for dark green vegetables and lowfat milk are associated with reduced BMI. The effect of subsidizing healthy food may be just as large as raising prices of less healthy foods.

Chapter 2 – Based on two days of dietary data and panel data methods, this study includes estimates of how each child's consumption of food away from home, food from school (which includes all foods available for purchase at schools, not only those offered as part of USDA reimbursable meals), and caloric sweetened beverages affects that child's diet quality and calorie consumption. Compared with meals and snacks prepared at home, food prepared away from home increases caloric intake of children, especially older children. Each food-away-from-home meal adds 108 more calories to daily

total intake among children ages 13-18 than a snack or meal from home; all food from school is estimated to add 145 more calories. Both food away from home and all food from school also lower the daily diet quality of older children (as measured by the 2005 Healthy Eating Index). Among younger children, who are more likely than older children to eat a USDA school meal and face a more healthful school food environment, the effect of food from school on caloric intake and diet quality does not differ significantly from that of food from home.

Chapter 3 – The current childhood obesity epidemic is the result of many factors and may not be resolved by any single action. Rather, resolution of the childhood obesity epidemic will require concerted action across many sectors and settings such as child care facilities, communities, and schools. The 2011 Children's Food Environment State Indicator Report highlights selected behaviors, environments, and policies that affect childhood obesity through support of healthy eating. These indicators represent opportunities for action.

Chapter 4 – The link between high U.S. obesity rates and the overconsumption of added sugars, largely from sodas and fruit drinks, has prompted public calls for a tax on caloric sweetened beverages. Faced with such a tax, consumers may reduce consumption of these sweetened beverages and substitute nontaxed beverages, such as bottled water, juice, and milk. This study estimated that a tax-induced 20-percent price increase on caloric sweetened beverages could cause an average reduction of 37 calories per day, or 3.8 pounds of body weight over a year, for adults and an average of 43 calories per day, or 4.5 pounds over a year, for children. Given these reductions in calorie consumption, results show an estimated decline in adult overweight prevalence (66.9 to 62.4 percent) and obesity prevalence (33.4 to 30.4 percent), as well as the child at-risk-for-overweight prevalence (32.3 to 27.0 percent) and the overweight prevalence (16.6 to 13.7 percent). Actual impacts would depend on many factors, including how the tax is reflected in consumer prices and the competitive strategies of beverage manufacturers and food retailers.

CONTENTS

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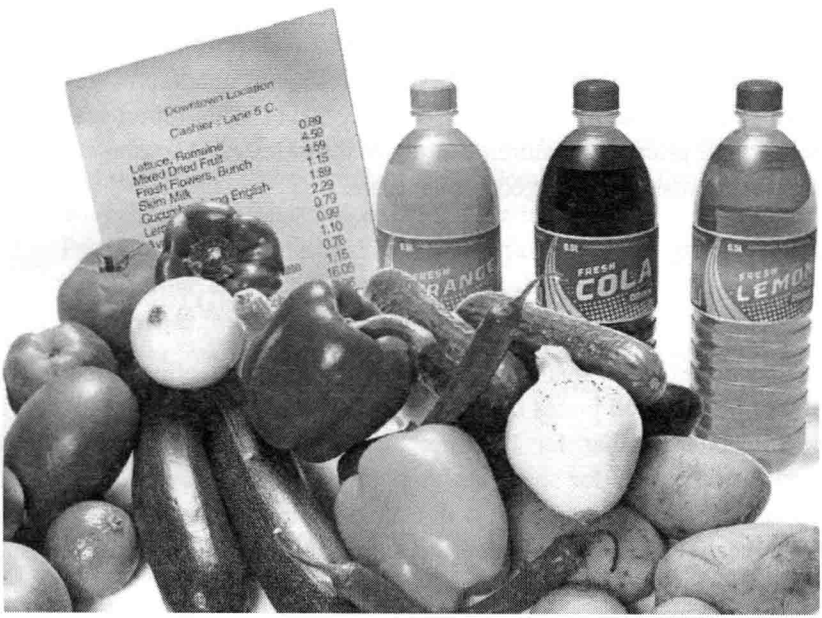
Chapter 1

THE EFFECT OF FOOD AND BEVERAGE PRICES ON CHILDREN'S WEIGHTS*

Minh Wendt and Jessica E. Todd



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* This is an edited, reformatted and augmented version of United States Department of Agriculture, Economic Research Report No. 118, dated June 2011.

ABSTRACT

One factor that may be important in explaining rising childhood obesity is food prices. This report explores the effect of food prices on children's Body Mass Index (BMI) using data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) and the Quarterly Food-at-Home Price Database.

On average, higher prices for soda, 100 percent juices, starchy vegetables, and sweet snacks are associated with lower BMIs among children. In addition, lower prices for dark green vegetables and lowfat milk are associated with reduced BMI. The effect of subsidizing healthy food may be just as large as raising prices of less healthy foods.

SUMMARY

The rate of overweight among children has tripled over the past 30 years. First Lady Michelle Obama's *Let's Move* campaign highlights the growing public interest in finding ways to reverse this trend. One factor that may be important in shaping children's dietary intake and weight is food prices. Previous research has shown that there is substantial geographic variation the relative price of healthy foods (Todd et al., 2011). This report estimates the effect of food prices on children's Body Mass Index (BMI) using variation in food prices across time and geographic areas.

WHAT DID THE STUDY FIND?

Food prices have small but statistically significant effects on children's BMI, but not all food prices have the same effect. While the magnitude of the price effects is similar for healthier and less healthy foods, the direction differs. Lower prices for some healthier foods, such as lowfat milk and dark green vegetables, are associated with decreases in children's BMI. In contrast, lower prices for soda, 100 percent juices, starchy vegetables, and sweet snacks are associated with increases in children's BMI.

These results show that the effect of subsidizing healthy food may be just as large as raising prices of less healthy foods. Specifically:

- A 10-percent price decrease for lowfat milk in the previous quarter is associated with a decrease in BMI of approximately 0.35 percent, or about 0.07 BMI units average for an 8- to 9-year-old.
- A 10-percent drop in the price of dark green vegetables (e.g., spinach and broccoli) in the previous quarter is associated with a reduction in BMI of 0.28 percent.
- A decrease in the price of sweet snacks during the previous quarter is associated with an increase in BMI of 0.27 percent.

Not surprisingly, there is sometimes a delay between when prices change and when measurable changes occur in children's BMI.

- A 10-percent price increase for carbonated beverages 1 year prior is associated with a decrease of 0.42 percent in the average child's BMI. The same price increase for 100 percent juices or starchy vegetables (e.g., potatoes and corn) is associated with a decrease in BMI of 0.3 percent 1 year later.

In addition to the effects varying over time, the effects of prices vary by other characteristics.

- Soda prices have a greater effect on children in households with income below 200 percent of the Federal poverty line, as compared with children in households with higher income.
- Prices for healthy foods such as lowfat milk and green vegetables have larger effects on higher BMI children than on children of average weight.
- Prices for less healthy food groups such as carbonated beverages, fruit drinks, and starchy vegetables have larger effects on BMI for children of average weight.

How Was the Study Conducted?

Panel data on children's BMI, demographic, and household characteristics from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 were linked to average retail food prices from the Quarterly Food-atHome Price Database. BMI was regressed on lagged prices (one-quarter and 1-year lags) using fixed-effects regressions to control for unobserved factors that are

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likely correlated with BMI. Alternative specifications included price changes over the previous quarter and previous year. Regressions were conducted on the full sample and also separately for boys and girls. Quantile regressions were used to explore whether heavier children have different responses to food prices than thinner children.

INTRODUCTION

The prevalence of childhood overweight has risen dramatically in the last several decades in the United States, and is currently considered to be epidemic (U.S. Department of Health and Human Services, 2007; Institute of Medicine, 2008). According to the Centers of Disease Control and Prevention (CDC), overweight rates of U.S. children and adolescents age 6-11 have more than tripled in the last 3 decades, from 6.5 percent in the 1970s to 19.6 percent in 2007-08 (Ogden and Carroll, 2010).[1] Moreover, the extent to which children's body mass index (BMI) exceeds the overweight threshold is also increasing (Flegal and Troiano, 2000; Jolliffe, 2004).

Childhood overweight is linked to a number of medical problems such as type II diabetes, high blood pressure, sleep apnea, and breathing problems; obese children are also more likely to become obese adults than are children of normal weight (U.S. DHHS, 2007; Steinberger et al., 2001; Must and Strauss, 1999; Whitaker et al., 1997). For children and adolescents age 6 to 17, overweight-related hospital costs increased more than threefold from $35 million per year during 1979-81 to $127 million during 1997-99 (Wang and Dietz, 2002).[2] As overweight and obese children become adults, their weight-related morbidities will lead to even greater economic costs. Medical costs of obesity in the United States were estimated to be as high as $147 billion in 2008, up from $78.5 billion in 1998 (Finkelstein et al., 2009).

First Lady Michelle Obama's *Let's Move* campaign highlights the growing national interest in identifying ways to reverse this trend. Recognizing that obesity is the result of many interrelated factors, the campaign encourages families, schools, and communities to improve dietary intake and increase energy expenditure among children.

One factor that may be important in shaping children's dietary intake is food prices. Previous research has show that there is substantial geographic variation in both the absolute price of foods (Todd and Leibtag, 2010) as well as the relative price of healthy foods (Todd et al., 2011). Economic literature on consumer behavior has shown that consumers change their purchases in

response to prices changes. Previous research has shown that own-price elasticities (the percentage change in purchases of a good from a 1-percent change in its price) of foods and beverages are relatively large, ranging from 0.27 to 0.81, with food away from home, soft drinks, juice, and meat being most responsive to price changes (Andreyeva et al., 2010).

Recent studies have investigated the relationship between prices of certain food groups—such as meat, fruits/vegetables, and fast food—and childhood obesity. The consensus thus far is that higher prices for fast food and lower prices for fruits and vegetables are associated with lower children's weights (Auld and Powell, 2009; Powell and Bao, 2009; Sturm and Datar, 2008, 2005). However, while these studies examined the effect of market-level food prices, they did not study the effect of beverage prices.

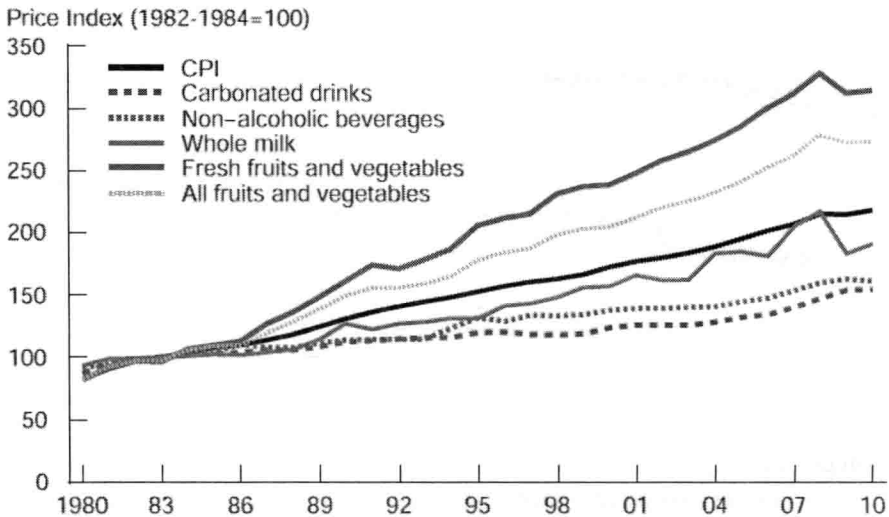
This study's main innovation is to estimate the impact of food prices on childhood obesity by directly linking a unique database of food prices, the Quarterly Food-at-Home-Price Database (QFAHPD), with clinically measured body mass of children. The average retail prices for five beverage types, two types of vegetables, and sweet snack foods are linked to a longitudinal database tracking children's height and weight from kindergarten through eighth grade. The QFAHPD allows the comparison of food and beverage prices over time within and across geographic areas, enabling us to identify the effect of food prices on children's weight status.

We estimate models that test whether prices of carbonated beverages, fruit drinks, 100 percent juices, lowfat milk, whole and 2% milk, starchy vegetables (e.g., corn and potatoes), dark green vegetables (e.g., spinach and broccoli), and sweet snacks affect BMI among a cohort of U.S. children as they age from 5 to 14 years old. We selected these food groups because, with the exception of dark green vegetables, they represent a substantial portion of daily calorie intake among children and adolescents. Nielsen and Popkin (2004) show that soft drinks, fruit drinks, milk, fruit juice, and other beverages comprised 22.4 percent of daily calorie intake for children 2-18 years old in 1999-2001. Almost half of these beverage calories (10.3 percent) were from soft drinks and fruit drinks. Reedy and Krebs-Smith (2010) show that grain-based desserts (e.g., cakes and cookies) comprised 7.2 percent of average daily caloric intake among children age 2-18 in 2005-06. We include prices for dark green vegetables because they are nutrient-dense and low-calorie alternatives to starchy vegetables.

FOOD AND BEVERAGE PRICES AND CONSUMPTION AMONG U.S. CHILDREN AND ADOLESCENTS

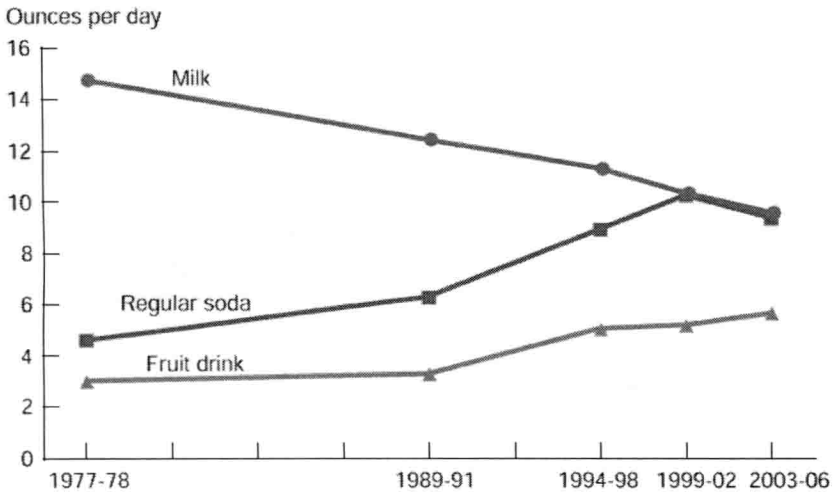
The price index for carbonated drinks has been below both the consumer price index (CPI) and the indexes for all non-alcoholic beverages and whole milk over the last 25 years or so (fig. 1). That is, the real prices for carbonated drinks are actually declining over time. In contrast, the price index for all fruits and vegetables,[3] particularly fresh, is increasing faster than the CPI.[4]

At the same time, consumption of carbonated sweetened beverages (CSBs) and fruit drinks has increased among U.S. children and adolescents, while consumption of milk has declined. Mean intake of CSBs more than doubled, from 5 fluid ounces per day in 1977-78 to 12 fluid ounces in 1994-98 (fig. 2). Per capita daily caloric contribution from CSBs and 100 percent fruit juices increased from 242 kcal per day in 1988-94 to 270 kcal per day in 1999-2004. The largest increase—of about 20 percent—occurred among children age 6 to 11 years (Wang et al., 2008).



Notes: Prices for each group are annual average prices for all urban consumers. All fruits and vegetables include fresh, canned, and frozen. Base period 1982-84=100.
Source: Bureau of Labor Statistics, http://data.bls.gov/pdq/querytool.jsp?survey=cu.

Figure 1. Price indexes for selected foods and beverages, 1980-2010.



Source: Smith et al., 2010. Data are from 1977-78, NFCS (Nationwide Food Consumption Survey), USDA; 1989-91 and 1994-98 CSFII (Continuing Survey of Food Intakes by Individuals), USDA; 1999-2006 NHANES (National Health and Nutrition Examination Survey).

Figure 2. Soda, fruit drink, and milk consumption trend for children age 2-19, 1977-78 to 2003-06.

The combination of lower real prices and increased consumption lead many to argue that prices have a strong influence on consumption. However, this is ultimately an empirical question, as the full price effect depends on how much intake responds to price and how much weight changes in response to changes in caloric intake (Chow and Hall, 2008). We estimate the (reduced form) relationship between price and weight outcomes based on a traditional household economic framework.

APPLYING THE HOUSEHOLD ECONOMIC FRAMEWORK

The household production function (Becker, 1965) has been widely used in economics to study determinants of children's health in the United States (Variyam et al., 1999; Senauer and Garcia, 1991). In this framework, households combine time, human capital (knowledge and skills), and purchased goods to produce outcomes—such as health of a child—to maximize the overall household's utility. The market goods purchased by households (e.g., foods) derive their values by supplying characteristics (e.g., nutrients)

necessary for the production of the outcome (e.g., body weight), in addition to other benefits such as taste and socialization while eating. In this model, when the price of a particular type of food increases, households reduce their consumption of that food in order to equate price with the benefit enjoyed from the last unit purchased (marginal utility).[5] Since weight is determined by net energy intake, we assume that children's body weight is determined by food intake as well as other factors (X) that would affect activity, such as household income and parents' education.

$$BMI = f(food, X) \quad (1)$$

Food intake is, in turn, determined by food prices, income, and demographic factors that affect preferences (Z).

$$Food = g(food\ prices, income, Z) \quad (2)$$

Since we do not directly observe the amount of food consumed by individuals, we can substitute equation 2 into equation 1 and obtain a (reduced-form) equation for children's BMI.

$$BMI = k(food\ prices, income, Z, X) \quad (3)$$

Thus, we can think of a child's weight or BMI as determined by food prices, income, and other factors, such as personal characteristics. Equation 3 allows us to estimate the effect of food prices on BMI, recognizing that the effect is transmitted through the effect that prices have on food intake.

DATA AND VARIABLES

Individual and Household Data

Individual and household data are from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K). The ECLS-K is a nationally representative sample of kindergarten students who were in kindergarten during the 1998-99 school year. Children are observed in kindergarten as well as during 1st, 3rd, 5th, and 8th grade. The five rounds of data used in this study correspond to the 1998-99, 1999-2000, 2001-02, 2003-04, and 2006-07 school years.[6]

The ECLS-K includes detailed household information, students' demographics, parents' background and characteristics, as well as classroom and school environment. An advantage of this survey is that, unlike other child-level data that rely on self-reported measurements, children's height and weight were measured by survey staff and collected during all survey rounds. Some children are lost from the sample mainly because they changed schools or their families moved outside of the survey's primary sampling units. Approximately 50 percent of "movers" were randomly selected to be followed by ECLS-K. Therefore, most of the children lost for followup were those randomly selected and would be unlikely to bias the results. For more details on sample attrition, including nonresponse and change in eligibility status over time, see Tourangeau et al. (2009).

Food Price Data

Food prices are from the ERS Quarterly Food–at–Home Price Database (QFAHPD).[7] The QFAHPD was constructed from Nielsen Homescan data, in which households report their food-at-home purchases from all store types, including grocery stores, convenience stores, mass merchandisers, club stores, and supercenters. Average quarterly prices are provided for 52 narrowly defined food groups, such as carbonated soda, fruit drinks, and vegetables grouped by type (dark green, starchy, orange) and processing method (fresh, frozen, or canned). These prices were estimated as the weighted average of household-level quarterly prices for each food group, where the household-level prices are the mean price paid by each household for foods within each food group weighted by purchase frequency, not expenditure share within the food group (see Todd et al., 2010, for more details on the construction of the QFAHPD).

The QFAHPD includes prices for market areas covering the contiguous United States. There are 26 metropolitan markets, which are either single metro areas—such as Philadelphia, Baltimore, and Los Angeles—or a group of metro areas, such as Metro Ohio, which includes Cincinnati, Cleveland, and Columbus. Between 1998 and 2001, areas in the lower 48 States not included in these 26 metro markets are grouped into 4 nonmetro regions; between 2002 and 2006, they are grouped into 9 census divisions (see fig. A1). Although these prices are constructed from household-level purchase data, and therefore are affected by market-level demand, they allow for identification of price effects because they are averages for large geographic areas. This means that

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