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Do Low Prices for Sugar-Sweetened Beverages Increase Children's Weights?

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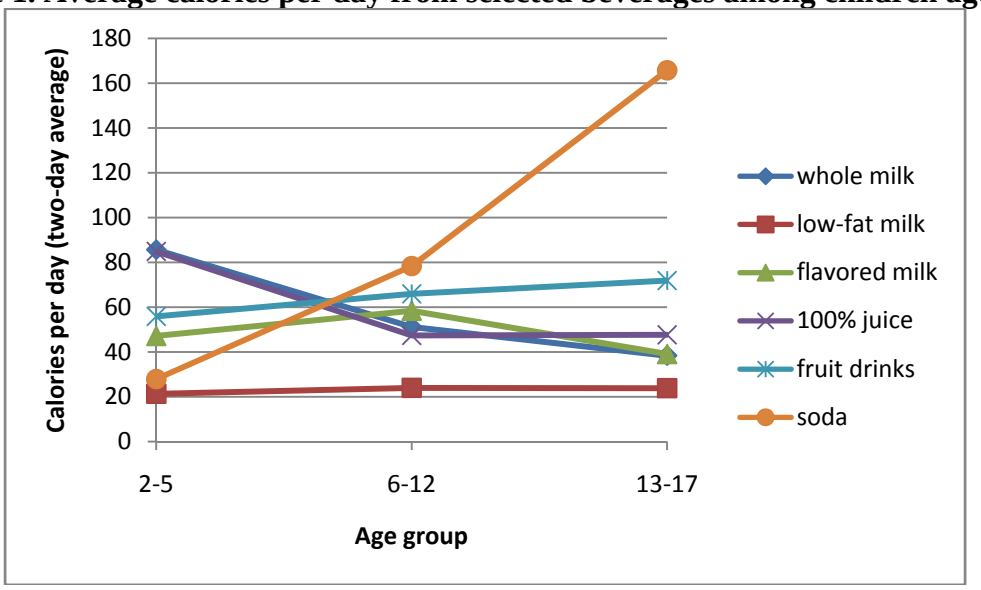
The views expressed are those of the authors and do not necessarily reflect the views of the Economic Research Service or the US Department of Agriculture.

Introduction

The escalating rate of childhood obesity in the U.S. heightens the need to identify modifiable factors contributing to this phenomenon. Consumption of sugar-sweetened beverages (SSBs) has been shown to be correlated with excess weight (Ludwig et al., 2001; James et al., 2004; Malik et al., 2006; Wang et al., 2008). School-age children consume more calories from sugar-sweetened beverages (soda, fruit drinks and flavored milk) than from any other type of beverage (Figure 1). Consequently, SSBs have become a popular target for policies aiming to reduce excess calorie intake, and ultimately to reduce excess weight gain.

Figure 1. Average calories per day from selected beverages among children age 2-17.



Source: Authors' tabulation from NHANES 2003-2006

Objective

To contribute to the literature investigating whether a tax on SSBs can help fight the obesity epidemic, we test whether prices of soda, fruit drinks and alternative beverages influence children's BMI measures.

Data

Child-level data are taken from the Early Childhood Longitudinal Study–Kindergarten Class (ECLS-K)—a national representative cohort of kindergarten students first surveyed in the 1998-1999 school year and followed when they were in 1st, 3rd, 5th, and 8th grade (2006-2007 school year). The ECLS-K contains students' demographics, parental characteristics and background, as well as information about household lifestyles. Children's height and weight were measured (as opposed to self-report) in all survey rounds.

Food and beverage prices are obtained from the Quarterly Food at Home Price Database (QFAHPD), which provides quarterly prices between 1998 and 2006 for 35 geographic market areas covering the contiguous United States.

Table 1. Descriptive statistics (N=8730)[1]

Variables	Mean/ Frequency	SD
Outcome variable		
Body Mass Index (BMI)	19.02	4.50
Individual and household control variables		
Age (months)	116.38	37.01
Female	0.49	50
Asian	3%	17
Black	17%	38
Hispanic	18%	39
Others	4%	21
Birth weight (ounces)	118.72	21.08
Child is less active than others	7%	25
Child is more active than others	44%	50
Contemporaneous Prices (dollars per 100g)		
Carbonated beverages	0.076	0.010
Fruit drinks	0.121	0.015
100% juices	0.171	0.023
Low fat milk (skim, 1% and 2%)	0.090	0.012
Whole milk	0.142	0.023
Whole fruits	0.239	0.044
Fresh and frozen dark green vegetables	0.291	0.036
Fresh and frozen starchy vegetables	0.194	0.027
Sweet snacks	0.880	0.085
Salty/savory snacks	0.737	0.073

[1] Number of observations is rounded to the nearest 10.

Methods

Reduced form regressions of the form:

$$BMI = f(Prices, X, Z)$$

are estimated via

1) OLS with robust standard errors and
2) with student-level fixed-effects

Both models are also estimated as log-log models (BMI and prices log-transformed).

We first use contemporaneous and then re-estimate all models when prices are lagged one year.

Table 2. Estimation Results, Contemporaneous Prices

BMI or ln(BMI)	**OLS**	**Fixed-effect**	**Log-log**	**Log-log fixed-effect**
Soda price	-0.162	-0.827	-0.011	-0.015
	(2.477)	(2.466)	(0.010)	(0.010)
Fruit drinks price	-0.371	-0.583	0.006	0.008
	(1.017)	(1.146)	(0.007)	(0.007)
100% juices price	-4.284***	-4.254***	-0.037***	-0.036***
	(0.880)	(1.128)	(0.008)	(0.009)
Low-fat milk price	0.660	-2.302	-0.001	-0.013
	(2.239)	(2.418)	(0.009)	(0.010)
Whole milk price	1.163	2.462**	0.004	0.009
	(0.922)	(1.113)	(0.006)	(0.007)
Whole fruits price	-2.589***	-3.175***	-0.012*	-0.010
	(0.861)	(0.944)	(0.006)	(0.007)
Dark green vegetables price	0.236	-0.164	-0.001	-0.007
	(0.607)	(0.635)	(0.008)	(0.008)
Starchy vegetables price	-1.657**	-1.567*	-0.018**	-0.013
	(0.844)	(0.880)	(0.008)	(0.009)
Sweet snacks price	-0.090	0.072	0.012	0.019
	(0.287)	(0.305)	(0.011)	(0.012)
Salty/savory snacks price	-0.958***	-1.017***	-0.043***	-0.043***
	(0.304)	(0.330)	(0.011)	(0.012)
Number of observations[1]	33600	33600	31410	31410
Number of student clusters[2]	8780	8780	8730	8730
R-squared (within)	0.663	0.664	0.716	0.717
R-squared (between)	0.165	0.113	0.225	0.175
R-squared (overall)	0.307	0.268	0.349	0.310

*** p<0.01, ** p<0.05, * p<0.1

[1,2] These numbers are rounded to the nearest 10.

Notes: Standard errors in parentheses and are adjusted using Huber-White covariance matrix estimate. Control variables include the child's age in months, birth weight, indicators for whether the child is female, Asian, Black, Hispanic, or other race/ethnicity, household's socioeconomic status (quintiles), parents' types, mother's weekly working hours, father's weekly working hours, whether the child is more or less active than other children, and survey round of data.

Results

When considering current prices, only the price of 100% juices and salty/savory snacks are statistically significant across all 4 regressions (Table 2). All else equal, a 10 cent increase in the price per 100 grams (about 3.2 ounces) of 100% juice leads to a decrease in BMI of 0.42 units while the same increase in the price of salty/savory snacks reduces BMI about 0.16 units.

The log-log models provide estimates of the price elasticity of BMI. A 10 percent increase in the price of 100% juices reduces BMI 0.37 percent, while the same change in the price of salty/savory snacks reduces BMI by 0.43 percent.

Table 3. Estimation Results, Lagged Prices

BMI or ln(BMI)	**OLS**	**Fixed-effect**	**Log-log**	**Log-log fixed-effect**
Soda price	-8.331***	-10.390***	-0.024***	-0.030***
	(2.454)	(2.610)	(0.008)	(0.009)
Fruit drinks price	-2.838***	-3.188***	-0.017***	-0.019***
	(0.836)	(0.844)	(0.005)	(0.005)
Fruit juices price	-3.923***	-4.331***	-0.031***	-0.034***
	(1.003)	(1.236)	(0.008)	(0.009)
Low-fat milk price	3.572**	2.499*	0.013**	0.009
	(1.513)	(1.506)	(0.006)	(0.006)
Whole milk price	1.322	1.872*	0.002	0.005
	(0.913)	(0.976)	(0.005)	(0.006)
Whole fruits price	-0.474	-0.438	-0.010*	-0.01
	(0.465)	(0.496)	(0.006)	(0.006)
Dark green vegetables price	1.025**	1.006**	0.014**	0.014**
	(0.429)	(0.462)	(0.006)	(0.006)
Starchy vegetables price	-4.691***	-4.740***	-0.026***	-0.026***
	(1.037)	(1.134)	(0.008)	(0.009)
Sweet snacks price	0.031	0.052	-0.003	-0.001
	(0.146)	(0.145)	(0.006)	(0.006)
Salty/savory snacks price	-0.949***	-0.810***	-0.027***	-0.023***
	(0.274)	(0.285)	(0.009)	(0.009)
Number of observations[1]	31410	31410	31410	31410
Number of student clusters[2]	8730	8730	8730	8730
R-squared (within)	0.658	0.659	0.716	0.717
R-squared (between)	0.213	0.164	0.226	0.177
R-squared (overall)	0.322	0.283	0.349	0.311

*** p<0.01, ** p<0.05, * p<0.1

[1,2] These numbers are rounded to the nearest 10.

Notes: Standard errors in parentheses and are adjusted using Huber-White covariance matrix estimate. Control variables include the child's age in months, birth weight, indicators for whether the child is female, Asian, Black, Hispanic, or other race/ethnicity, household's socioeconomic status (quintiles), parents' types, mother's weekly working hours, father's weekly working hours, whether the child is more or less active than other children, and survey round of data.

The results with lagged prices indicate that lower prices for SSBs, fruit juices, and relatively high-calorie foods such as starchy vegetables (e.g. potatoes, corn) lead to higher BMIs among children. The fixed effects estimates show that a 10 cent increase in the price per 100 grams of soda leads to a 1 unit decrease in BMI. The effect of fruit drinks is smaller, a 10 cent increase in price reduces BMI 0.32 units. The effect of the price of starch vegetables is similar to that of fruit drinks and 100% juices.

There is some indication that decreases in the prices of healthier foods (e.g. milk, dark green vegetables) could reduce children's BMI, but the effects are relatively small (dark green vegetables) or not statistically significant across all four regressions (milk).

Implications

According to the CDC growth charts, boys between 6 and 14 years of age who are at the 50th percentile growth rate normally gain between 0.1 and 0.9 BMI units per year (CDC, 2005). Thus, a 10 percent decrease in the price per 100 grams of soda could account for about 10 percent of the BMI growth path for a 10-year-old boy who is at the 50th percentile of growth.

In general, our results are in line with previous findings in terms of positive relationship between prices of fruits and vegetables (Sturm and Datar 2005, 2008; Auld and Powell, 2008; Powell and Bao, 2009), and an inverse association between prices for sodas, fruit drinks, and sport drinks and children's weight (Smith et al., forthcoming).

A main contribution of our study is the finding that lagged prices for foods and drinks have more significant effects on children's BMI compared to contemporaneous prices. This indicates that policies that affect food prices such as taxing or subsidizing would take time to have an effect on children's weight. We only allowed prices to lag one year, but there may be effects from earlier periods as well. Further studies should take into account this lagged effects of prices on health outcomes.

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