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Association of a Community Campaign for Better Beverage Choices With Beverage Purchases From Supermarkets

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IMPORTANCE Data are needed to evaluate community interventions to reduce consumption of sugary drinks. Supermarket sales data can be used for this purpose.

OBJECTIVE To compare beverage sales in Howard County, Maryland (HC), with sales in comparison stores in a contiguous state before and during a 3-year campaign to reduce consumption of sugary beverages.

DESIGN, SETTING, AND PARTIPICANTS This observational experiment with a control group included 15 HC supermarkets and 17 comparison supermarkets. Weekly beverage sales data at baseline (January 1 to December 31, 2012) and from campaign years 1 to 3 (January 1, 2013, through December 31, 2015) were analyzed. A difference-in-differences (DID) regression compared the volume sales per product per week in the HC and comparison stores, controlling for mean product price, competitor's product price, product size, weekly local temperature, and manufacturer.

EXPOSURES The campaign message was to reduce consumption of all sugary drinks. Television advertising, digital marketing, direct mail, outdoor advertising, social media, and earned media during the 3-year period created 17 million impressions. Community partners successfully advocated for public policies to encourage healthy beverage consumption in schools, child care, health care, and government settings.

MAIN OUTCOMES AND MEASURES Sales were tracked of sugary drinks highlighted in the campaign, including regular soda, sports drinks, and fruit drinks. Sales of diet soda and 100% juice were also tracked. Sales data are expressed as mean fluid ounces sold per product, per store, per week.

RESULTS Regular soda sales in the 15 HC supermarkets decreased (−19.7%) from 2012 through 2015, whereas sales remained stable (0.8%) in the 17 comparison supermarkets (DID adjusted mean, −369 fl oz; 95% CI, −469 to −269 fl oz; $P < .01$). Fruit drink sales decreased (−15.3%) in HC stores and remained stable (−0.6%) in comparison stores (DID adjusted mean, −342 fl oz; 95% CI, −466 to −220 fl oz; $P < .001$). Sales of 100% juice decreased more in HC (−15.0%) than comparison (−2.1%) stores (DID mean, −576 fl oz; 95% CI, −776 to −375 fl oz; $P < .001$). Sales of sports drinks (−86.3 fl oz; 95% CI, −343.6 to 170.9 fl oz) and diet soda (−17.8 in HC stores vs −11.3 in comparison stores; DID adjusted mean, −78.9 fl oz; 95% CI, −182.1 to 24.4 fl oz) decreased in both communities, but the decreases were not significantly different between groups.

CONCLUSIONS AND RELEVANCE A locally designed, multicomponent campaign to reduce consumption of sugary drinks was associated with an accelerated decrease in sales of regular soda, fruit drinks, and 100% juice. This policy-focused campaign provides a road map for other communities to reduce consumption of sugary drinks.

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Editor's Note
Supplemental content

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The 2012 Institute of Medicine report on strategies to accelerate prevention of childhood obesity recommends that communities "adopt policies and implement practices to reduce overconsumption of sugar-sweetened beverages."[1(p166)] Sugary drinks, defined as any beverage containing added sugar or nutritive sweetener, warrant specific attention by public health departments and advocates owing to compelling evidence linking these products to obesity, type 2 diabetes, and cardiovascular risk.[2,3] Furthermore, as noted in the *Dietary Guidelines for Americans 2015-2020*,[4] calories from added sugars should make up less than 10% of total calories, reinforcing the importance of limiting calories from sugary drinks.

The momentum of local efforts to reduce consumption of sugary drinks has built steadily during the past decade. In 2010, the Centers for Disease Control and Prevention[5] published a guide of strategies that communities could use to reduce consumption of sugary drinks, emphasizing the role of policy and environmental changes to reduce access to sugary drinks and promote water. The Centers for Disease Control and Prevention guide also recommended working with medical care professionals to educate them about the harm associated with sugary drinks and screening patients for consumption. In response, dozens of community-level campaigns have been initiated to educate consumers and pass policies to limit access to sugary drinks in schools, child care centers, and government-owned properties; to place warning labels on packages; and to tax sugary beverages.[6]

Evidence of the effect of these campaigns conducted by local health departments and advocacy organizations is sparse. Boles and colleagues[7] evaluated a county-level mass media campaign about sugary drinks, and the findings suggest that the campaign increased awareness and intentions to change, but did not create measurable changes in consumption. New York City has taken several actions against sugary drinks since 2008, including a mass media campaign and several policy proposals (eg, an excise tax, exclusion from the Supplemental Nutrition Assistance Program, and a portion cap in food service establishments). Although the policies did not pass, each led to substantial earned media coverage of the issue, which may have assisted in educating the public. Encouragingly, self-reported consumption of sugary drinks by adults and youths in New York City decreased substantially from 2007 to 2013.[8] To our knowledge, no community-based campaign has documented its effects using objective measurements of beverage sales.

Howard County Unsweetened is a multiyear campaign designed to reduce consumption of sugary drinks through the promotion of policy, systems, and environmental changes. Howard County, Maryland (HC), has a population of approximately 300 000 people and is located between Washington, DC, and Baltimore, Maryland. The present study presents data on HC supermarket retail sales of beverages before (January 1 through December 31, 2012) and during the first 3 years of the campaign (January 1, 2013, through December 31, 2015).

Key Points

Question Are campaigns to decrease consumption of sugary drinks associated with decreases in beverage purchases from local supermarkets?

Findings This observational experiment with a control group measured supermarket beverage sales before and during a 3-year community campaign. Regular soda sales decreased by 19.7%, fruit drink sales decreased by 15.3%, and juice sales decreased by 15.0%, changes significantly larger than those observed in the control stores.

Meaning A community public health policy campaign targeting sugary drinks had a measurable effect on retail beverage sales.

Methods

Intervention

In 2012, the Horizon Foundation and several community partners planned a multicomponent campaign to reduce sugary drink consumption in HC. The official launch occurred in December 2012, and campaign activities have taken place since 2013. The initiative was designed to address all levels of the social ecological model.[9] **Table 1** details the many components of the campaign, which promoted change at the interpersonal, organizational, community, and policy levels.[10-22] Through extensive community outreach, a range of partners were engaged, including faith-based groups, businesses, the county school system, child care providers, local government agencies, pediatricians, and the health care system. The present analysis of sales data did not involve human subjects and was deemed exempt from institutional review board approval by the University of Connecticut.

Howard County Unsweetened targeted beverages that contained any type of added sugar and encouraged people to move away from sugary drinks and toward those lower in sugar and calories (defined as *better beverages*). The sugary drinks most frequently identified in campaign materials through pictures and words were regular soda, sports drinks, and fruit drinks. Sweetened flavored waters, sweetened teas, and sweet hot beverages (eg, flavored coffee drinks) were also included in some communications. The beverage most often promoted was water, including bottled, plain tap, and tap water flavored with pieces of whole fruit, vegetables, and herbs. Diet soda was not addressed explicitly by the campaign, although it was designated as a better choice in the Better Beverage Finder.[10] One hundred percent juice was also designated as a better beverage; however, materials included the caveat that portion size matters and provided age-appropriate limits.

During the 3-year period, the media campaign alone reached more than 576 000 nonunique county residents and created 17 million impressions through cable and broadcast television advertising, television advertising, digital marketing advertising, direct mail, outdoor and facility advertising, and social media. The campaign also benefited from significant additional earned media in response

Table 1. Campaign Components for Each Level of the Ecological Model

Campaign	Campaign Activities
Interpersonal Level[a]	
Better Beverage Finder[10]	This online tool, powered by national nutrition standards compiled by the Rudd Center, aims to help residents search for more than 300 beverage options with less sugar and calories. It provides the nutrition content of chosen beverages and where to purchase them in the county. The Better Beverage Finder had 159 641 page views through 2015.
Howard County Unsweetened Street Teams	The campaign hired professional marketers in 2013 and 2014 to set up and staff booths at neighborhood summer and fall events (eg, 4th of July fireworks), swimming pools, sporting events, etc, with the goal of educating residents about the Better Beverage Finder and collecting contact information from supporters. These marketers had 5200 active conversations with residents during both deployments and distributed more than 2400 samples of healthy drinks.
Organizational Level[b]	
Hopkins Medicine Healthy Beverage Initiative[11]	Howard County [Maryland] General Hospital, a member of Hopkins Medicine, launched an initiative in 2014 to make healthier drinks more widely available and affordable on the hospital campus. Only healthier drinks are provided at Johns Hopkins–sponsored meetings and events. Healthier drinks sold on site cost less per ounce and receive more prominent placement than sugary drinks. Sugary drinks that are available are sold in containers of 12 oz or less. Howard County General Hospital is the third largest private employer in Howard County and employs more than 1000 county residents. In 2015 alone, nearly 60 000 adult county residents were admitted to the hospital or visited its emergency department.
Healthy Play Campaign[12]	In 2015, a local soccer league launched a program to educate young players about proper nutrition and fitness and is working to develop, source, and test a healthy concession menu.
AAP Pediatric Obesity Collaborative[13]	The Maryland Chapter of the AAP launched a 9-mo, quality improvement, learning collaborative in 2015 to improve health care professionals' practice behaviors related to the prevention, diagnosis, and treatment of childhood obesity and related diseases. Thirteen practices and 40 health care professionals participated and met 8 of 9 quality measure goals by the end of the collaborative. Additional resources were developed to help support practice transformation and provide proper counseling on sugary drink consumption.
Better Choices Coalition[13,14]	In 2014, the campaign formed the Better Choices Coalition to work with community organizations, faith groups, and businesses to improve the food environment in those settings. Almost 50 local community organizations have agreed to improve the food and drink they offer at meetings, improve vending machine selections, and educate their members, clients, and visitors about the dangers of sugary drink consumption. A comprehensive toolkit offered to members includes social media posts, newsletter articles, posters, handouts, activities, and more.
Maryland Dental Action Coalition	The Maryland Dental Action Coalition and state and local dentist and dental hygienist groups have been developing best-practice guidelines related to counseling about consumption of sugary drinks. The project began with a survey that was sent to every licensed dentist and dental hygienist in the state (8846; completion rate, 15%). The survey queried oral health care professionals about their sugary drink counseling and other practice behaviors related to obesity and caries prevention. Once practice guidelines are developed, they will be vetted with state professional groups and adopted as best practices for oral health care practices and professionals.
Eat, Play, Grow in Head Start[15]	In 2015, the local Head Start programs adopted this 11-week curriculum based on a program created by the National Institutes of Health and Children's Museum of Manhattan. This curriculum teaches young children about healthy nutrition and physical activity and involves parents in classroom learning and take-home activities. Two hundred sixty-four Head Start students participated in weekly classroom activities, and 39 families attended additional monthly family-night sessions.
Healthy Child Care program	A local nonprofit, Healthy Howard, launched this program in 2013 to help child care facilities provide healthier drinks to children in their care, better support mothers who are breastfeeding, and reduce noneducational screen time. More than 70 child care facilities were certified as healthy child care facilities during a 2-y period.
Community Level[c]	
Joint data collection and priority setting	In 2012, 4 major community health institutions joined forces to field a biennial community health survey to serve as a joint strategic planning tool. As a result, these organizations have similar strategic planning goals, including helping to keep children and adults at a healthy weight.
Your Voice, Your Choice documentary contest	In 2014, the Horizon Foundation held a youth documentary contest related to sugary drinks and their effect in the community. Youth teams submitted 10 entries. About 200 youth and their families attended the red-carpet community celebration where the winning video was revealed and aired. Subsequently, the winning video received more than 80 000 views on social media.
Sugar Free Kids Maryland Coalition[16]	This coalition of 240 members formed to build on the work of Howard County Unsweetened and advance sugary drink policy statewide. Since its inception in 2014, the coalition's work appeared in state-wide print/online news, on the radio, or on television news more than 150 times, including 3 front-page appearances in the *Baltimore Sun*.
Community partnerships	The Horizon Foundation established partnerships with several key community groups (eg, PATH, HCPSS, AACR, and the LHIC) to serve as key hubs for improving the food and physical activity environment in the county. PATH members include 12 county faith institutions, the teachers' union, and other nonprofit affiliates. The AACR has 14 organizational members, and the LHIC has more than 40 organizational members.
Howard County Unsweetened media campaign[17]	Since 2013, the campaign has aired 30-s spots on cable television stations, run digital advertisements on a variety of internet sites, sent direct mail to county households, and used earned media strategies to educate the public about campaign activities. The cable and broadcast television spots had 1 067 582 impressions. The digital marketing advertisements (eg, banner, digital video) had 6 578 184 impressions. The campaign regularly posted information on several social media channels, including Facebook, Twitter, YouTube, and Pinterest. The social media campaign had 6 056 137 impressions. Direct mail led to 24 151 impressions. Outdoor and facility advertising (eg, mall and grocery store) led to 3 562 498 impressions. Together the media campaign generated more than 17 million impressions with a documented reach of more than 576 855 residents. Key targeted audiences (eg, parents with children younger than 18 y) likely viewed more campaign messages than the general population.
Joint Chamber of Commerce Study on Obesity[18]	Working with the local chamber of commerce, the Horizon Foundation commissioned a study to examine the fiscal effect of obesity on county businesses. Study results were the subject of a Chamber of Commerce luncheon that attracted more than 200 business and community leaders.
Policy Level[d]	
School Policy Wellness Policy Update[19-21]	Since 2013, the Foundation and its community partners have been working together with the HCPSS to improve the school food and nutrition environment and to update the school wellness policy to be more reflective of best practices. Using its Wellness School Assessment Tool policy scoring system, the Rudd Center determined that the new wellness policy ranked in the top third of the nation after modifications. As a result of the policy, student-accessible vending machines were removed from middle schools and all food and beverages offered or sold by the school system were required to meet Institute of Medicine nutrition standards. Nearly 55 000 students (prekindergarten to 12th grade) were enrolled in the HCPSS for the 2015-2016 school year. They and their families are directly affected by the wellness policy and choices made by the school system to promote good nutrition. In addition, about 500 residents were involved in the formation of the policy and efforts to get the Board of Education to ratify it.

(continued)

Table 1. Campaign Components for Each Level of the Ecological Model (continued)

Maryland Healthy Eating and Physical Activity in Childcare Act	In 2014, Sugar Free Kids Maryland successfully advocated for the passage of this state law that requires facilities to only serve drinks with no added sweetener (ie, water, plain low-fat or nonfat milk, or small amounts of 100% fruit juice) to children in their care, to better support mothers who are breastfeeding, and to reduce noneducational screen time. Many of these standards are based on the successful Healthy Child Care program. More than 10 000 Howard County children are annually cared for in a licensed child care facility (ie, those subject to this state law).
Healthy Food and Beverage Options on County Property[22-25]	The Foundation and its community partners have been working to make healthier food and drinks more widely available, accessible, and noticeable on county property and in county programs since Howard County Unsweetened began. Four distinct policy campaigns related to this process have occurred. The most recent policy campaign in the summer of 2015 resulted in the enactment of a county ordinance. As a result, 75% of the food and drinks offered in county-operated food and beverage vending machines and all packaged food and drinks offered as part of youth-oriented programs must meet national nutrition standards. Once fully implemented, this law will affect 2800 county employees, 1500 children in county child care programs, and nearly 3 million visitors to the county library system. News coverage about the county's healthy vending policy debate appeared in statewide or local print/online news, on the radio, or on television news more than 60 times since the inception of the first campaign. Nearly 1500 residents directly participated in these policy efforts in some way.

Abbreviations: AACR, African American Community Roundtable; AAP, American Academy of Pediatrics; HCPSS, Howard County public school system; LHIC, Local Health Improvement Coalition; PATH, People Acting Together in Howard.

[a] Designed to facilitate individual behavior change by influencing a person's social network (eg, family, friends, classmates) and changing social norms.

[b] Designed to facilitate individual behavior change through changes to organizational systems and policies.

[c] Designed to facilitate individual behavior change through leveraging community resources and participation.

[d] Designed to facilitate individual behavior change through changes to laws, policies, and budgets.

to the public discourse surrounding the proposed policy changes. In this context, earned media is the free publicity gained through publication of online and print news stories. Successful policy changes during the study period included a state-wide policy removing sugary drinks from child care facilities, a local school wellness policy that required healthier food and drinks to be served during the school day and in vending machines, and a healthy vending policy for all county government property. Residents of HC were also exposed to media coverage of Maryland statewide campaigns to remove the sales tax from bottled water and a bill to require a healthy default beverage in children's meals in restaurants.

Evaluating the Campaign With Supermarket Sales Data

IRI is a commercial company that analyzes scanner data for the consumer packaged goods industry. One IRI service includes conducting quantitative studies to measure the effect of specific advertising campaigns on subsequent sales. We hired IRI to perform the same type of advertising analysis to determine whether Howard County Unsweetened was associated with a measurable change in sales of sugary drinks.

We requested data for all 17 full-service chain supermarkets in the county, but 2 retailers would not release data, leaving a sample of 15 HC stores. We purchased scanner data for the top-selling brands from the 3 largest beverage companies (Coca-Cola Co, PepsiCo, and Dr Pepper Snapple Group) in the regular soda (13 brands), sports drink (2 brands), and diet soda (7 brands) categories. We also purchased data for the brands with the highest sales in the 100% juice (4 brands) and fruit drink (6 brands) categories. The sports drinks and fruit drinks in the study were all regular (ie, not diet) varieties that contain added sugar. Owing to data use restrictions, the names of the specific brands included cannot be reported. The data set included weekly sales information (dollar sales, volume sales in fluid ounces, and unit sales) for each individual UPC code. In the analyses, each brand is considered a single product and the volumes are combined across different sized packages (eg, 2-L bottles, 12-fl oz cans [to convert fluid ounces to milliliters, multiply by 30]) to calculate total fluid ounces sold per product, per week, within each supermarket.

The method IRI used to test advertising campaigns is the Matched Market Test.[26] The Matched Market Test measures sales for the target (ie, advertised) brand and the other brands in the category for 52 weeks before the campaign begins (eTable 1 in the Supplement includes materials for marketing term definitions). Sales are assessed in stores located where the advertising campaign is planned (the test market) and a set of control stores in another location that have been identified as the best match during the previous 52 weeks for sales of the target brand and category (the control market). To identify the control market, IRI considers qualitative and quantitative factors and avoids markets where other tests have recently occurred that may affect sales. The details of the statistics used in the matching protocol are proprietary, but the concepts are described in the marketing literature.[26]

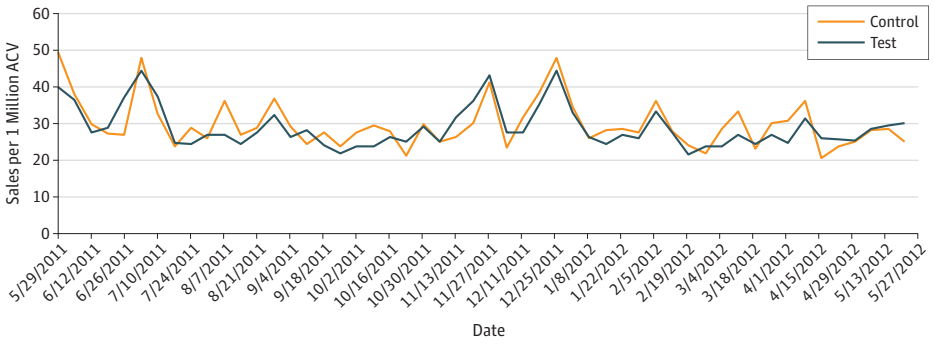
To identify the best-matched control stores, IRI examined beverage sales for each category of interest during the 52 weeks from May 29, 2011, to May 20, 2012, in HC supermarkets. These data were compared with a sample of 326 supermarkets that included the same HC chains and were in the same region of the country. From that pool, IRI identified a set of 17 stores in southeastern Pennsylvania that provided the best match. The HC stores were from 6 large supermarket chains, and all of the final sample in the contiguous state were drawn from 4 of those chains.

Because the stores vary in size and the control stores were bigger than the HC stores, the matching protocol controlled for store size using a metric termed *all-commodity volume*, which is the total amount of sales in US dollars across all products in a supermarket. The sales in US dollars for a specific category are converted into a value that reflects the sales as a proportion of $1 million all-commodity volume. **Figure 1** illustrates the match between HC (test market) and comparison (control market) stores at baseline for regular soft drink volume sales per $1 million all-commodity volume. The similar level and pattern of sales during the 52 weeks indicate that the HC and comparison stores are a good match.

Statistical Analysis

We compared the changes over time in volume sales of each beverage category for HC and comparison stores using differ-

Figure 1. Comparison of Store Groups in Sales of Regular Soda



This graph was produced by IRI MarketAdvantage to demonstrate the close match between Howard County, Maryland (HC) and comparison stores in sales of regular soda. The total sales of regular soda per 1 million all-commodity volume (ACV) of total supermarket sales in the HC stores (test) and comparison stores (control) for the 52 weeks ending on May 20, 2012, are given.

ence-in-differences (DID) regression. We used STATA software (version 14; StataCorp) to conduct the analyses. The DID design diminishes confounding factors that could affect measured shifts in sales between the 2 groups of stores. Because weather may influence beverage sales, the model controls for weekly temperature data for store location obtained from the National Oceanic and Atmospheric Administration. Product price and the competing product prices are important predictors of sales, so these variables are included in the model. By comparing changes over time, we account for broader trends in beverage sales that influence both groups. We expressed each outcome variable as fluid ounces sold (per product, per store, per week). The DID regression model is as follows:

$$y_{ijt} = X_{ijt}\alpha + \beta_1 D + \beta_2 T_2 + \beta_3 T_3 + \beta_4 T_4 + \beta_5 DT_2 + \beta_6 DT_3 + \beta_7 DT_4 + \varepsilon,$$

where y_{ijt} is the volume sale of product i in store j in week t and X_{ijt} is a vector of control variables, including product mean price in week t, the mean price of all of the competitors in that beverage category in week t, the product size, local current temperature in week t, and manufacturer's individual dummies. D is a county dummy that equals 1 for HC and 0 for comparison stores; T_2, T_3, and T_4 are dummies for 2013, 2014, and 2015, respectively; DT_2, DT_3, and DT_4 are interactions of county and year for 2013, 2014, and 2015, respectively; ε is the error term; and β_5, β_6, and β_7 measure the campaign effects in 2013, 2014, and 2015, respectively, compared with the 2012 baseline. A t test was used for difference in difference analysis, with statistical significance considered as $P < .05$.

Comparing the Supermarket Neighborhoods

Although the comparison stores were selected based on sales of sugary drinks, additional information about HC stores and the communities where the comparison stores were located were drawn from the US Census Bureau 2015 and the American Community Survey 1-year estimates from 2012, 2013, 2014, and 2015.[27] The address of each supermarket was used to identify the closest high school, and the demographic data from each high school were obtained by school district and each state's Department of Education web sites.[28,29] The high school profiles included race, ethnicity, and the percentage of students who qualify for free or reduced-price federal meals. Students who live in households with incomes under 130% of the poverty level qualify for free meals, and households under 185% of the poverty level qualify for reduced-price meals.

Results

Demographic Variables

The 17 comparison stores are spread over 7 counties in Pennsylvania; thus, the data from these counties were combined for comparison with the HC stores (eTable 2 in the Supplement). In 2012, HC had a population of 299 430 and a median income of $108 844, and 95.1% of residents had at least a high school diploma. In contrast, in 2012 the comparison counties were somewhat bigger (population 350 637 people), had a substantially lower median income ($53 713), and had a lower rate of residents with at least a high school diploma (86.2%). Examination of the high school demographic data revealed a more complex picture (eTable 3 in the Supplement). Although the mean income in HC was quite high, substantial household income differences existed across neighborhoods. Among the 10 high schools that surround the HC stores, the rate of students who qualified for free or reduced meals ranged from 4.0% to 40.0%, with a mean of 23.4%. In the comparison high schools, the rates ranged from 13.0% to 54.0%, with a mean of 27.7%. These data suggested that a considerable number of students in both communities lived in households with incomes below 185% of the poverty line.

The racial/ethnic profile of the 2 sets of communities also differed. The HC schools were substantially more racially and ethnically diverse, with a mean of 37.5% white, 28.2% black, 16.0% Asian, and 11.7% Hispanic students. The schools around the comparison stores had a mean of 74.0% white, 7.1% black, 4.4% Asian, and 13.0% Hispanic students. In sum, HC residents were wealthier, more educated, and more racially and ethnically diverse than the residents near the comparison stores.

Sales of Sugary Drinks

eTable 4 in the Supplement presents the summary statistics for the data that were used in the regression model. **Table 2** reports the adjusted mean values and percentage of change

Table 2. Adjusted Means of Volume Sold in Supermarkets From 2012 Through 2015

Beverage (No. of Brands)	HC Stores: Volume Sold, fl oz per Product per Store per Week				Change From 2012 to 2015, %	Comparison Stores: Volume Sold, fl oz per Product per Store per Week				Change From 2012 to 2015, %
	2012 (Baseline)	2013	2014	2015		2012 (Baseline)	2013	2014	2015	
Regular soda (n = 13)	2148	1784	1717	1725	−19.7	2193	2123	2162	2211	0.8
Sports drinks (n = 2)	3924	3406	3063	2938	−25.1	4891	5087	4513	4503	−7.9
Fruit drinks (n = 6)	2004	1928	1655	1696	−15.3	2315	2882	2315	2301	−0.6
Diet soda (n = 7)[a]	2325	2056	1899	1911	−17.8	2463	2338	2216	2184	−11.3
100% fruit juice (n = 4)[a]	2991	2996	2689	2544	−15.0	3204	3389	3241	3135	−2.1

Abbreviation: HC, Howard County.

SI conversion factor: To convert fluid ounces to milliliters, multiply by 30.

[a] Indicates nontargeted product.

Table 3. Estimated DID Volume Sales of Targeted and Nontargeted Beverage Categories

Product	Net DID (95% CI) in Volume Sales, fl oz per Product per Store per Week[a]		
	2012 to 2013	2012 to 2014	2012 to 2015
Regular soda	−255.3 (−355.7 to −154.9)[b]	−368.7 (−468.4 to −269.0)[b]	−369.0 (−469.1 to −268.9)[b]
Sport drink	−336.9 (−595.2 to −78.5)[c]	−130.5 (−388.4 to 127.3)	−86.3 (−343.6 to 170.9)
Fruit drink	−606.6 (−726.7 to −486.4)[b]	−222.0 (−340.2 to −103.8)[b]	−343.2 (−466.4 to −220.0)[b]
Diet soda[d]	−100.1 (−202.8 to 2.5)	−142.9 (−245.0 to −40.8)[c]	−78.9 (−182.1 to 24.4)
100% juice[d]	−437.1 (−637.0 to −237.3)[b]	−620.5 (−821.0 to −420.1)[b]	−575.6 (−776.4 to −374.8)[b]

Abbreviation: DID, difference-in-differences.

SI conversion factor: To convert fluid ounces to milliliters, multiply by 30.

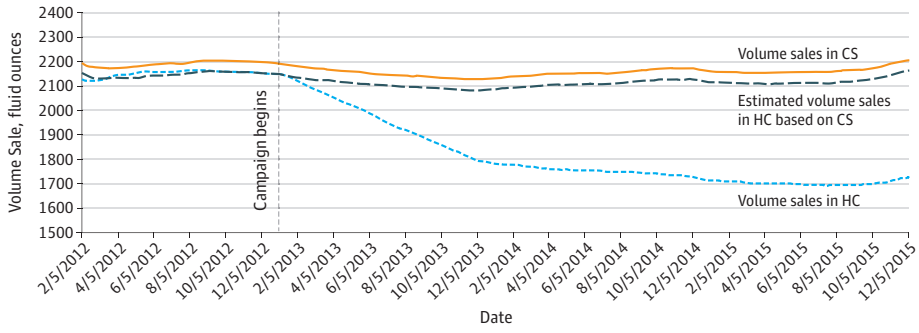
[a] Indicates the difference in Howard County stores (follow-up value minus baseline) minus the difference in comparison stores (follow-up value minus baseline).

[b] $P < .001$.

[c] $P < .05$.

[d] Indicates nontargeted product.

Figure 2. Moving Mean of Adjusted Weekly Volume Sales



The moving mean sales of regular soda for stores in Howard County, Maryland (HC), and comparison stores (CS) and the estimated volume sales for HC are shown. The estimated sales represent the expected HC sales without exposure to the campaign. The HC estimated sales were calculated by adjusting the intercept of the volume sales in comparison stores. To convert fluid ounces to milliliters, multiply by 30.

fluid ounces sold (per product per store per week) for each beverage category during the 4 years of the study for HC and comparison stores. **Table 3** presents the DID analysis by beverage category.

For regular soda, the adjusted mean sales in HC stores decreased (−19.7%) from 2012 to 2015, while sales of the same 13 regular soda products remained stable (0.8%) in the comparison stores, leading to a net significant difference of volume sales per product per store per week ($P < .001$). For the 2 brands of sports drinks, sales decreased steadily during the 3 study years in HC stores (−25.1%), while the pattern for sports drink sales in the comparison stores rose and fell, resulting in a final decrease (−7.9%). The change in the comparison stores for sports drinks sales was not significantly different than that in the HC stores ($P = .51$). Sales of the 6 brands of fruit drinks decreased in HC stores (−15.3%), with the largest drop from years 1 to 2 of the campaign. Fruit drink sales in the comparison stores increased and then decreased again to baseline levels and stayed steady through 2015 (−0.6%). The difference between HC and comparison stores was significant for fruit drinks ($P < .001$).

Sales of Nonsugary Drinks

Diet soda was not targeted in the campaign and was included as a better beverage choice in campaign materials. However, sales of diet soda for the 7 brands assessed decreased in HC

(−17.8%) and comparison (−11.3%) stores, although the final difference between the communities was not statistically significant (P = .13). Similarly, although 100% juice was not targeted in the campaign, sales of the 4 leading brands decreased in HC stores (−15.0%), while they remained stable in comparison stores (−2.1%). At the end of the 3 years, the drop in 100% juice sales was significantly greater in HC than comparison stores (P < .001).

Adjusted Weekly Volume Sales

To visualize the campaign effect, we graphed adjusted weekly volume sales for all products. The data for regular soda sales are illustrated in **Figure 2**, which presents adjusted weekly volume sales of regular soda from 2012 through 2015 for HC and comparison stores. The weekly data are smoothed using a 48-week moving mean. The dashed line represents the estimated volume sales in HC stores; these are the sales that would have been expected in HC without exposure to the campaign. The estimated sales in HC stores were calculated by adjusting the intercept of the volume sales in comparison stores. eFigures 1 through 4 in the Supplement contain graphs of the moving means of the adjusted weekly volume sales for the other beverage categories (sports drinks, fruit drinks, diet soda, and 100% juice).

Discussion

A county-level campaign targeting sugary drinks with interpersonal, organizational, community, and policy interventions was associated with a nearly 20% reduction during the 3 study years in regular soda sales of the top-selling 13 brands at supermarkets. This decrease was significantly different from the flat sales observed in the comparison stores and greater than the small decrease in national sales reported in 2013 (−3.0%) and 2014 (−0.9%).[30] This study is the first, to our knowledge, to use retail beverage sales data and identify a set of matched comparison stores a priori to rigorously evaluate community-based policy, systems, and environmental interventions. These findings support the hypothesis that community-based interventions aimed at changing attitudes and access to sugary drinks through policies can meaningfully influence purchasing behavior at the supermarket.

Diet soda sales also declined in the present study in HC and comparison stores, which is consistent with national trends. The fact that diet soda sales did not increase in HC stores suggests that people do not necessarily switch to diet soda when they stop drinking regular soda. Highlighting health concerns about regular soda may also trigger concerns about the artificial sweetener in diet soda. Previous research on parental attitudes about sugary drinks suggests that although parents are concerned about sugar in their children's drinks, they are even more concerned about artificial sweeteners.[31] Therefore, the public health messaging in this community to think about what children are drinking may have also deterred purchases of diet soda.

The significant decrease in 100% juice sales was somewhat surprising because the campaign did not directly target juice. However, campaign materials featured messages that cautioned residents about appropriate portion sizes of 100% juice. Raising awareness about the danger of consuming added sugar in beverages may have led to concern about consuming the naturally occurring sugar in 100% juice.

Limitations and Strengths

This study has limitations. First, the study only included sales data from supermarkets. Sugary drinks can be purchased from restaurants and other retail outlets, such as drug stores; convenience stores; and mass merchandisers, such as Walmart.[32] To address the question of the proportion of sugary drink purchases that occur at the supermarket, we contacted the University of North Carolina Global Food Research Program. They analyzed Nielsen Homescan data and found that the proportion of sales of sugary drinks from chain grocery stores in 2012, 2013, and 2014 was 50.7%, 52.4%, and 50.2%, respectively, in the Baltimore market and 61.9%, 60.0%, and 62.8%, respectively, in the Philadelphia, Pennsylvania, market (Shu Wen Ng, PhD, electronic communication, November 2, 2016). These data suggest that supermarkets remain the largest single source of sugary drinks in the areas closest to the stores in our study, and more importantly, the proportion of sales in supermarkets remained consistent during the study period.

A second limitation concerns the unanswered questions of how demographic characteristics predict responsiveness to campaigns of this type. We do not know which groups of HC residents were most responsive to the campaign. Furthermore, the HC community and those surrounding the comparison stores differed on a few demographic points. Howard County has a wealthier, more diverse, and more educated population, and these characteristics may be associated with a greater receptiveness to the messages in the campaign. This challenge is endemic to observational studies because such communities are often the vanguard of policies that promote public health. In light of this, the findings in the present study may represent the best-case scenario for the effectiveness of a campaign. Future research can compare these findings with those of other locations, where concerted efforts are taking place to decrease sugary drink consumption. The recent passage of sugary drink taxes in Philadelphia; Boulder, Colorado; and several cities in California will provide interesting opportunities to examine sales of sugary drinks in a range of communities.

Third, these data do not tell us what people are drinking instead of the brands included in the study. The beverage industry is transforming quickly, and new products are introduced each year. We focused on the best-selling major brands within each category to ensure we could measure the same products each year. However, HC consumers may have shifted to beverages from small companies that are marketed as healthy alternatives, such as organic sodas or low-sugar iced teas. Future work should follow the sales of these smaller brands in the HC and comparison stores to determine whether consumers are shifting to other products and, in turn, how sugar intake from beverages has changed. Finally, as with most multicomponent interventions, determining which

individual components may have been more or less responsible for the observed effects is difficult.

This study also has important strengths. First, the study applied rigorous methods, including a comparison group with a nearly identical pattern of beverage sales before the start of the intervention. Second, although most studies rely on dietary self-report to assess sugary drink consumption, this study is the first, to our knowledge, to use retail sales data to assess the impact of a complex, community-wide sugary drink campaign. Third, the study has long-term outcome data. Because sales were tracked for 4 years, evidence suggests that the changes observed during the first year were sustained over time. Furthermore, the demographic data and supermarket share data in both communities remained consistent during the 4 years, ruling out the concern that the findings are due to demographic shifts in population or purchasing behavior.

Our study has important implications for community advocates and funders. These data suggest that local, community-based efforts to reduce consumption of sugary drinks are a worthwhile investment of time and funds. In addition, conducting rigorous analyses of community interventions using quasi-experimental designs is feasible, and further work of this type will enable public health advocates to identify the most cost-efficient policies to pursue. Future research in demographically diverse communities can also assess whether greater changes occur disproportionately among higher socioeconomic groups, with important implications for health equity.[33]

These study results should not dissuade policy makers from adopting additional policies to amplify decreases in consumption of sugary drinks. A recent study from Berkeley, California, suggests that sugary drink consumption decreased by 21% after the enactment of an excise tax.[34] Other policies that warrant consideration include the addition of warning labels on sugary drinks[35,36] and a requirement that restaurants offer healthy default beverages with children's meals.[37] Future work should address the power of exposure to media coverage of a controversial sugary drink policy campaign, because that may constitute an intervention that educates the community and focuses attention on the harm associated with sugary drinks.

Conclusions

This study provides the strongest evidence to date that a community-based campaign can produce meaningful changes in retail sales of soda and other beverages. This study highlights the importance of local organizations and government working together to create strong policies to promote consumption of healthy drinks in our communities.

ARTICLE INFORMATION

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Study concept and design: Schwartz, Schneider, Harris, Highsmith Vernick.
Acquisition, analysis, or interpretation of data: Schwartz, Schneider, Choi, Li, Harris, Andreyeva, Hyary, Appel.
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