

# Sugar-Sweetened Beverages (SSB) Industry Partnerships: Social Commitment or Commercial Agenda, a panel data approach

Josep Bosch<sup>1</sup> and Eric Torres<sup>2</sup>

<sup>1</sup> Barcelona Graduate School of Economics, Barcelona, Spain  
`josep.bosch@barcelonagse.eu`

<sup>2</sup> Barcelona Graduate School of Economics, Barcelona, Spain  
`eric.torres@barcelonagse.eu`

**Abstract.** Obesity is a major health challenge. Physical inactivity and sugar-sweetened beverages (SSB) consumption emerge as two of its main causes. Our hypothesis is that the main SSB companies use their philanthropic activity, officially aimed to reduce obesity, to satisfy their own commercial agenda. The objective of this paper is to identify the effect of the partnerships of the major SSB companies with several organizations on both physical activity and SSB consumption among adolescents in the US. To do so we take advantage of the Coca-Cola Transparency list. We find that the intensity of the investments in non-research partnerships by Coca-Cola at a state level has a negative but not significant effect on adolescents' physical activity, but a significant positive effect on sugar-sweetened drinks' consumption (although the size is very small). This findings suggest that the partnership schemes of the SSB industry satisfy their marketing objectives, although they go against the public health interest.

**Keywords:** Coca-Cola, lobbying, partnerships, obesity, SSB industry, sugar-sweetened beverages, physical activity.

**Jel Classification:** I12, L66, M31.

## 1 Introduction

More than a half a billion people in the world suffer obesity. Its incidence is high enough to consider it as a global epidemic (Bhruosy et al, 2014), and fighting it is a major health challenge. The United States is not an exception: more than one third of American adults are obese, and around 17% of children (Ogden et al., 2014). Obesity increases the risk of many other chronic health conditions such as diabetes or coronary disease, and, if it is not controlled, it could even decrease the life expectancy of current US generations compared to their parents' one (Catenacci et al, 2009). Besides the social costs in terms of a lower life

quality, obesity is also an economic burden for the national healthcare systems (Tremmel et al., 2017)<sup>3</sup>.

The World Health Organization determines that the main causes of obesity are a poor diet, which includes high levels of sugar-sweetened beverages (SBB) consumption and implies a rise in the energy intake, physical inactivity, which generates a low energy expenditure, and the consumption of tobacco and alcohol (World Health Organization, 2010). There are several publications that stress the role of SSB-intensive diets on weight gain and other health conditions linked to it, such as diabetes or coronary diseases (Schulze et al., 2004, Johnson et al., 2007; Malik et al., 2010). In the same line, the current levels of added sugar consumption in children are large enough to increase their risk of a cardiovascular disease (Vos et al., 2017). Similar evidence has been found for diet soda, showing that a rise in diet soda consumption is associated with a long-run increase in abdominal obesity (Fowler et al., 2015). Moreover, it is a risk factor for diabetes, although the underlying mechanisms that explain the positive association between diet soda and diabetes are still not clear (Gardener et al., 2018).

To understand the magnitude of the effect of sugary-sweetened drinks on obesity, it is estimated that, for the period between 1977 and 2007, SSBs have contributed for at least one fifth of the weight increase in the US population (Woodward-Lopez et al., 2011). Then, reducing the SSB's consumption becomes a crucial factor for the battle against obesity.

Despite this apparent evidence there is still an open debate in the medical literature about the relation between sugar-sweetened beverages and obesity (Keller and Bucher Della Torre, 2015), although the methodological quality of the studies could influence the findings. Most of the studies with high quality ratings find a positive association between SSB consumption and obesity, specially among overweight children (Della Torre et al., 2016).

Related to the debate in the literature, it has been reported that big soda companies, such as Coca-Cola, have tried to influence the research on the impact of SSBs on obesity, providing financial support to projects that highlight the role physical activity as the principal determinant of obesity, and undermining the role of diet and soda consumption (Serodio et al., 2018). In addition, the funding

---

<sup>3</sup> Overweight in adults is defined by the World Health Organization as a body mass index (BMI) greater than or equal to 25, and obesity implies a BMI greater or equal to 30. For children between 5 and 19 years, overweight is a BMI greater than 1 standard deviation above the World Health Organization Child Growth Standards Median for each age, and obesity is a BMI greater than 2 standard deviations above.

of targeted research is only a part of a bigger partnerships' policy, which also includes philanthropic donations to non-research institutions and social programs. In the same line than the research financial support, and besides their apparent altruistic motivation, non-research partnerships also aim to shift the focus of the determinants of obesity away from SSB consumption (Aaron and Siegel, 2017).

Then, the SSB industry is lobbying against the public interest to defend its own commercial interests. However, the possibility that this industry influence on the public debate through a partnership policy could affect the main causes of obesity has not been exploited yet. So, we investigate the impact of the SSB industry partnerships with different organizations to understand whether there is a causal link between this policy and both physical activity and SSB consumption. To do so, we take advantage of the Coca-Cola Transparency list to look at how the intensity of the investment in non-research partnerships by the Coca-Cola company across the US states affects their ratios of physical activity and soda consumption among adolescents. We take adolescents as the target population both for data availability issues and the evidence that it is a factor risk for the development of obesity and related diseases in adulthood (Biro and Wien, 2010).

Our hypothesis is that, rather than serving altruistic interests to fight the obesity epidemic, the Coca-Cola partnerships follow brand marketing interests. Therefore, they don't contribute to neither an improvement in physical activity levels nor a reduction in SSB consumption among American adolescents. We even guess it is the other way around for soda consumption, and a higher intensity of the partnership investment increases soda consumption, which in the long-run would foster obesity. Two complementary channels that could explain it are a potential capture of the funded institutions by the company and an improvement of the brand reputation. The potential effects of the partnerships on physical activity, and the underlying mechanisms, seem less clear. As far as we know this is the first work that investigates the impact of the SSB industry partnership schemes on physical activity and SSB consumption in the US at a state level.

The paper is structured as follows. In section 2 we review the main findings of the literature on the SSB industry partnerships and the determinants of soda consumption. Following it, in section 3 we introduce the Coca-Cola partnerships' case. Next, in section 4 we discuss our dataset and its potential limitations. In section 5 we discuss our model, including the endogeneity concern and the strategies to tackle it. In section 6 we analyze the results. The last section includes the conclusions, where we summarize the main findings and limitations of our work, as well as its potential policy implications.

## 2 Literature review

In 2015, an article published in *The New York Times* (O'Connor, 2015) opened the debate on the Coca-Cola hidden interests in its scientific philanthropic activity, accusing the company of financing the research projects that promote the idea that the role of sugar-sweetened drinks and the high levels of caloric intake are not main determinants of obesity. This article had a big diffusion around the world, and inspired researchers from a wide range of scientific disciplines to investigate deeper the research partnerships of the company. Since then, a growing literature has emerged in the last years that confirms the concerns of the 2015's journalistic piece.

An analysis of internal industry documents, to be more precise mails sent by the former Chief Health and Science officer of Coca-Cola to a few groups of academics on 9 July 2014, revealed that the company financed the Global Energy Balance Network (GEBN), a US-based nonprofit organization intended to study the causes of obesity, to fulfill the brand commercial interests (Barlow et al., 2018). The strategy of Coca-Cola was to use the GEBN to reorient the debate about the obesity towards the idea that physical inactivity is the main determinant of obesity, exonerating sugar-sweetened drinks from their decisive role. An analysis of research publications funded by Coca-Cola between 2010 and 2016 in Spain finds that most of them supported the idea that physical inactivity is the main cause of obesity (Rey-López and Gonzalez, 2018). Although the available data on research partnerships is scarce, in this paper the sample size is very small (only 20 observations), hence the results must be taken cautiously.

Another work uses network science and machine learning techniques on the Web of Science Core Collection database to prove that, in the 2016's Coca-Cola Transparency list<sup>4</sup>, the company fails to report most of its research donations (Serodio et al, 2018). In fact, the company acknowledged only 42 out of 513 research projects where it potentially partnered as a financial support. This suggests that the Coca-Cola Transparency list, due to its incompleteness, is not as transparent as one could think beforehand. They also identify several researchers funded by Coca-Cola who failed to declare it in their research papers. Furthermore, using a conservative criterion, the authors recreate the Coca-Cola Transparency list using the papers and projects misreported by the company. They find that, in line with other publications, most of the research supported by Coca-Cola undermines the impact of diet and SSBs consumption on obesity, fixing the attention on physical inactivity.

---

<sup>4</sup> Coca-Cola updates the transparency list regularly.

Extending the analysis to non-research partnerships, a study of the two main soda companies (Coca-Cola and PepsiCo) philanthropic expenditures and sponsorships to national health organizations for the period 2011-2015 in the US, found that these donations were used by the companies as a lobbying mechanism (Aaron and Siegel, 2017). In 97% of the cases, Coca-Cola and PepsiCo lobbied against public health interventions to decrease the levels of sugar-sweetened drinks' consumption, as for example SSB taxation, through the sponsored institutions.

We can draw a parallelism with the case of the tobacco industry. An analysis of internal documents of the tobacco industry showed how the companies planned to delay and prevent the adoption of laws aimed to regulate tobacco (Bero et al., 2003). In 1988, three US tobacco companies created The Center for Indoor Air Research (CIAR), which was intended to fund research projects on indoor air quality. A review of the projects financed by the CIAR suggests a bias towards the studies that divert the focus away from the environmental tobacco smoke as an indoor air pollutant (Barnes and Bero, 1996). Then, although food and tobacco companies have important differences, SSB industry takes similar lobbying actions to influence the research and policy agenda than the ones that the tobacco industry historically performed, with the final goal to defend their interests (Brownell and Warner, 2009; Fabbri et al., 2018). But, as their products are harmful for the population, these actions are against the public health interest.

In fact, the debate on whether the food industry should fund public health institutions is opened and goes beyond the scope of the present work. It involves multiple scientific disciplines, from medicine to economics, but also philosophy, as it has a strong ethical component (Aveyard et al., 2016). The main arguments in favor of food industry research funding are that it employs thousands of individuals and play a crucial role in the economy, so public health organizations should cooperate and consult them when debating policies to tackle the main health challenges. However, they stress that industry lobbies should not participate in the final decision processes. The main argument against their contribution is the misalignment of objectives, which implies the previously mentioned bias in the research and policy proposals to serve the industry marketing interests instead of the general interest.

Previous studies focusing on the regional distribution of sugar-sweetened drinks beverages consumption patterns have focused on the role of individual sociodemographic and behavior characteristics (Park et al., 2014). In this work, they use survey data from the 2011 Behavioral Risk Factor Surveillance System

for adult Americans, taking a sample of six states, and they run a multivariate logistic regression. They find that sociodemographic characteristics such as age, gender or household income increase odds of consuming one or more SSB per day. Another publication shows regional-driven variations of the odds of consuming at least one SSB per day for American adults (Park et al., 2015). This study is cross-sectional, dividing the country by census regions and using the 2010 National Health Interview Survey data. Again, they run a multivariate logit regression model. However, they don't infer the causes of the regional differences they find, although they make a guess and point beverage environments, marketing and advertising efforts by the industry and cultural norms as potential causes.

We also find studies on the impact of school-level soda policies on both soda availability and high school students SSBs consumption. Taking a nationally representative survey data of American high school students' health habits, and school policies data reported directly by the school administrators, there is evidence that school policies regarding soda affect its availability for students (Terry-McElrath et al., 2015). Nevertheless, school policies only decreased the consumption among a specific group, African American students, but not the overall adolescent population. It suggests that, when schools restrict the access to SSBs, high-school students find other ways to purchase and consume them.

The economic literature dealing with the sugar-sweetened drinks has focused on the role of soda taxation on sugar consumption. We find for instance case-studies of the soda tax impact in reducing regular soda consumption in California (Falbe et al., 2016) and Catalonia (Vall and Lopez-Casasnovas, 2018). They both take a diff-in-diff empirical strategy to show that the price increase of sugar-sweetened beverages due to taxation has a positive and significant effect in reducing their consumption, as its demand is not inelastic. However, Vall and Lopez-Casasnovas (2018) find that this decrease in regular soda consumption is partially compensated by an increase in diet soda intake. In the same direction, other works evidence that SSB taxation is not enough to overcome the obesity epidemic (Bes-Rastrollo et al., 2016).

A few works highlight the role of the economic environment in shifting individual preferences towards higher levels of obesity (Finkelstein et al., 2010). They argue that the developments in medicine to overcome the health complications derived from obesity have reduced the cost of being obese, which, together with the fact that unhealthier food is cheaper than the healthy alternatives, and that it is costlier to be physically active at work, has increased the individual preferences for unhealthy habits. Then, the economic environment provides in-

centives to individuals to choose a worse diet and a more inactive lifestyle, which in turn leads to an increase in SSB consumption and obesity rates. However, this literature has ignored the potential influence of the big firms of the industry on affecting individual choices through marketing campaigns and aligned research funding.

### 3 The Coca-Cola partnerships case

Coca-Cola is the main producer and distributor of sugar-sweetened beverages in many countries around the world. Besides its most famous product, Coca-Cola, the company owns other recognizable brands such as Fanta, Nestea, Aquarius and Powerade. It is probably the most representative firm of the SSB industry, as the other big corporation, PepsiCo, not only produces and distributes sugar-sweetened drinks, but also other food such as snacks.

In 2015, as a response to the New York times article that reported the bias in the scientific research funded by Coca-Cola<sup>5</sup>, the company published at its own website the so-called Coca-Cola Transparency list<sup>6</sup>. This list records the institutions with which the company has collaborated in form of financial supporter. Moreover, the list also includes the name of the programs where the funds were assigned, the money delivered to each of them, and the year the donation took place. They report the partnerships for the year 2010 onwards. It is important to state that the published partnerships only include research and programs funded by The Coca-Cola Company's US corporate headquarters, The Coca-Cola Foundation and Coca-Cola North America for programs conducted in the US (although for the research-oriented funds it also includes investigations of Canada-based institutions).

However, as the publication of the partner organizations required their permission, not all the partnerships are in the list. According to Coca-Cola, these anonymous partners received an aggregate amount of funding of 679,000 US dollars in the period 2010-2015. An extra limitation of the list is the fact that there are around twenty research studies that confirmed receiving Coca-Cola funding for the same period, but they don't appear on the Coca-Cola Transparency list (Serodio et al., 2018). More shocking is the fact that over 400 researchers declared being financed by Coca-Cola but were not acknowledged by the company, and then they are also out of the Transparency list.

---

<sup>5</sup> See section 2.

<sup>6</sup> <https://www.coca-colacompany.com/transparency/our-commitment-transparency> (Consulted on June 1, 2019).

Coca-Cola partnerships can be divided in two big groups. One group includes the research partnerships, and it is defined by the company as any funding provided to entities based in the US or Canada for research relating to dietary intake, nutrition, health or physical activity. These research partnerships are labeled as research in the type of program section of the Transparency list. The second group includes the non-research partnerships, defined as funding provided to entities based in the US for health and well-being programs, as well as communications activities conducted in the US. The non-research partnerships are labeled as partnership in the type of program section of the Transparency list.

On December 18 of 2018, in an article published on the company website<sup>7</sup>, Coca-Cola declared that the main goal of the partnerships program is to fight the obesity epidemic:

At The Coca-Cola Company, we've continued our journey to be a more helpful and effective partner in efforts to address the serious problem of obesity around the world. Over the past three years, we've listened and learned from the public health community, our customers, associates and our consumers to understand the most appropriate role we can play to support the fight against obesity in a way that is credible, transparent, and beneficial for everyone. We plan to continue this effort as we endeavor to meet the changing needs of our consumers and the communities we serve.

This statement might look contradictory, because in the previous section we have seen that most of the literature establish a causal link between SSBs consumption and weight gain, and then a first policy that Coca-Cola could undertake to fight obesity is to retire its products of the market. There is an apparent conflict between the brand commercial interests, that is, increase the number of consumers to rise the business volume and profits, and the official intention of the partnerships scheme. But if we consider that, as we have seen in the literature review, the company focus its research partnerships in funding projects that stress the role of physical inactivity on obesity and downplay the role of a bad diet, it looks that both objectives (profits maximization and eradicating obesity), from a marketing point of view, can coexist.

Following this idea, we propose the hypothesis that Coca-Cola non-research partnerships also follow commercial (instead of altruistic) interests, as it is the case for the research ones. Then, our guess is that an improvement of the Coca-Cola contribution to non-research partnerships in a given state would increase its levels of SSB consumption. We base this potential causal link in two potential

---

<sup>7</sup> <https://www.coca-colacompany.com/transparency> (Consulted on June 1, 2019).



mechanisms.

The first mechanism is lobbying. With the partnership agreement, the partner institution becomes partially dependent on the Coca-Cola financial resources. As more budget constrained is the partner, higher is the dependence. In the same way, a more generous contribution by Coca-Cola, both in absolute and relative terms, also implies higher degrees of dependence. Then, Coca-Cola can use the threat of retiring these funds to align the partner organization agenda with the own interests of the company, which would result in an increase in SSB consumption.

A paradigmatic example of these lobbying actions of Coca-Cola through the non-partnership schemes is the case of Save the Children (Aaron and Siegel, 2017). Among other interventions, Save the Children used to promote the introduction of soda taxes. Nevertheless, after receiving more than five million dollars in 2009 from both Coca-Cola and PepsiCo, the organization removed it from its policy agenda.

The second channel is marketing. The involvement of the company in financing organizations with a solid reputation and social programs could improve the brand reputation, as people would associate it with its philanthropic activities. Then, individuals would be less reluctant to consume Coca-Cola drinks, resulting in a higher SSB consumption.

The potential impact of Coca-Cola non-research partnerships on physical activity seems less evident. Our guess is that a higher intensity of partnership funding in a state would not increase physical activity levels. Instead of promoting the most efficient use of the resources to rise it, Coca-Cola would allocate its money to projects that may have larger public repercussion (or lobby to force the partners to do it), as a part of the brand's marketing strategy. However, in this case we have no solid arguments to think that physical activity would rather decrease.

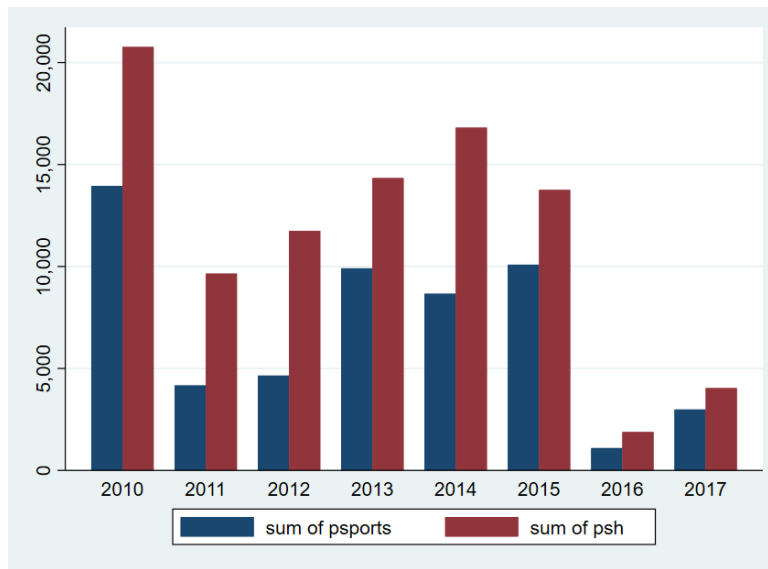
## 4 Data

In this section we describe the data we will use to test our hypothesis. As noted before, we take advantage of the Coca-Cola Transparency list, and we extract the information relative to the non-research partnerships of Coca-Cola to build our panel from it. By the time we consulted it, the list covered partnerships from January 1 of 2010 to June of 2018, so we have excluded the partnerships of 2018 from the final sample, because they did not cover the full year. From 2010 to

2017, Coca-Cola records 1311 partnerships with institutions of all kinds.

In the previous section we mentioned Coca-Cola partnerships can be divided in two groups: research and non-research partnerships. Paying attention to the non-research ones, we have classified the data in seven subgroups, according to the purpose of the project to which the expenditure of the partnership was directed. The groups are: sports, health, education, nutrition, recreation, immigration support and others (for the ones which did not fit with any of the previous groups). We focus our attention on the partnerships financing sports and health projects, as they are directly linked to lifestyle habits that may affect our outcomes of interest (physical activity and SSB consumption). At the same time, these two groups of partnerships are the biggest ones, having together 816 observations out of 1311.

Fig. 1: Annual expenditure by category (thousands of USD)

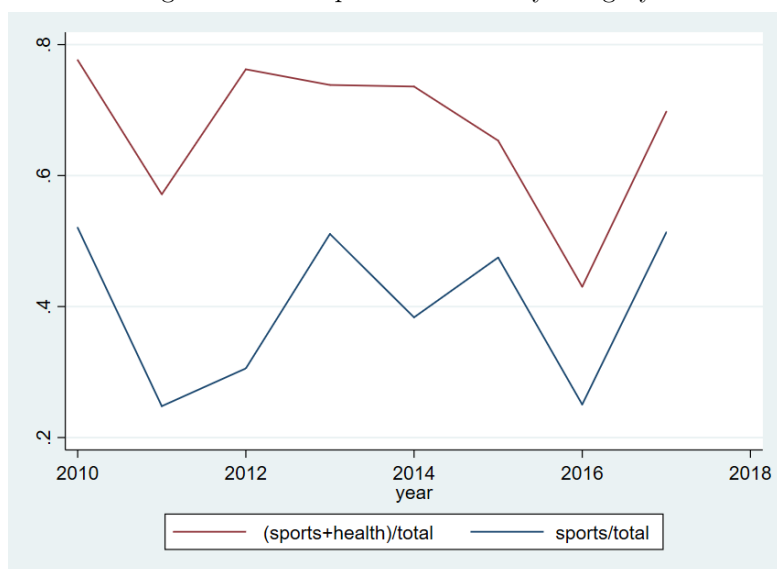


In figure 1 we plot the yearly evolution of the aggregate amount spent by Coca-Cola in both sports (blue bars) and sport+health (red bars) partnerships, in thousands US Dollars. As we can see, in 2016, the number of both sport and sport+health partnerships, probably as a result of the diffusion of The New York Times article (O'Connor, 2015), diminished considerably. This decrease could be explained both by the possibility that several of the partner institutions financed by Coca-Cola didn't give their permission to be included in the list to preserve their reputation, or they even decided not to partner with Coca-Cola anymore,

and by a potential drop in the willingness of the company to reveal all the information about the entities to which it finances.

Figure 2 shows the ratio of the expenditure in sports (blue line) and sport+health (blue line) partnerships on the total amount of partnerships. We see how, after the publication of The New York Times article, both groups (sports and sports+health) decreased their relative weight in the total amount of partnership expenditure. However, while Figure 1 shows a very slow recovery of the expenditure in these categories in absolute levels for the year 2017, we see that, in relative terms, the recovery was much stronger.

Fig. 2: Annual expenditure ratio by category



After classifying the non-research partnerships by groups we investigated where the money was invested, identifying in which state each program had been executed. For the programs that don't reveal the place where they took place, we have assigned as a state the place where the headquarters of the recipient institution are located. We have also considered that there are institutions that run programs in other states, besides the headquarters location, so we have tracked the year and the date to try to identify the place of execution. In a similar line, for the partnerships associated to projects with an execution period longer than a year, we have assumed that the spending was equally distributed across years.

The data on physical activity and soda consumption<sup>8</sup> for adolescents is obtained from the CDC database (Centers for Disease Control and Prevention of the United States of America). Additionally CDC provides information about the proportion of secondary schools that allowed students to purchase soda pop or fruit drinks from one or more vending machines, or at the school store, canteen, or snack bar. Data on income per capita, GDP per capita and the educational level of the population has been extracted from the website of the Census Bureau of the United States. We also take the yearly average temperature per state, which has been extracted from the NOAA website (National Oceanic and Atmospheric Administration).

All this information has been compiled and we have subsequently built a panel with the 51 states of the USA for the period between 2010 and 2017. The years included in the sample are just eight due to the restriction in the available information on Coca-Cola partnerships.

A potential limitation of our dataset is that Coca-Cola is hiding information on the research projects it finances, making the transparency list not as transparent as we might think (Serodio et al., 2018). It could also be the case for the non-research partnerships. This would lead us to a measurement error. However, the motivation for this lack of transparency is more likely to benefit the marketing interests of the company. It would imply a potential attenuation bias, which is not problematic as it would go against our hypothesis shifting the coefficients towards zero.

In table 1 we report the descriptive statistics for our set of variables. In the case of money spent on partnerships in the last 3 rows, we observe the presence of zeros as minimum values, which means that for some states in some years Coca-Cola did not invest any money in this type of non-research partnerships. We have taken this detail into account when transforming the variables into logarithms<sup>9</sup>. Another thing to mention is that the panel was unbalanced, with missing information for some certain observations, with missing values for some individuals in certain periods. The missing values have been imputed by a linear

---

<sup>8</sup> There is no available data on sugar-sweetened beverage consumption, so we approximate it using soda consumption. In fact, the difference between soda and SSBs is minimal, and sometimes both words are used to refer to the same group of drinks. The Department of Health of the State of Rhode Island defines that the only difference is that sports, sweetened tea and energy drinks are included as SSBs, but not as soda: <http://www.health.ri.gov/healthrisks/sugarsweetenedbeverages> (Accessed on June 1, 2019).

<sup>9</sup> In order to avoid negative values when computing the  $\log(0)$ , we take the logarithm of one plus the value of the variable partnership:  $\log(1 + x)$ .

Table 1: Descriptive statistics

VARIABLES	N	mean	sd	min	max
GDP (per capita)	408	53,070	19,998	33,158	181,747
Income	408	40,673	6,900	28,636	67,850
Soda consumption (% adolescents by state)	408	21.91	6.755	10	40.90
Education (% secondary at least)	408	88.51	3.288	79.60	95.80
Temperature C °	408	53.35	9.026	24.30	78.70
Physical activity (% adolescents by state)	408	25.17	3.144	13.40	38.50
Policy (% schools allow drinks by state)	408	23.36	12.69	2.673	56.10
Populations (thousands)	408	6,221	7,012	564.5	39,399
Sport partnerships (USD thousands by state)	408	136.1	566.7	0	7,356
Health partnerships (USD thousands by state)	408	91.84	367.3	0	3,612
Sport+health partnerships (USD thousands by state)	408	227.9	742.6	0	7,366

regression using an OLS estimation. The complete set of variables is described below:

- **Log (GDP per capita)**: logarithm of the Gross domestic product per capita by state.
- **Log (Income)**: Personal disposable income per capita by state in constant 2012 US Dollars.
- **Soda consumption**: Percentage of adolescents (from 9th to 12th grade) of a certain state who consume at least one sugar-sweetened drink per day.
- **Education**: percentage of the population with complete high school or a higher level of education achievement by state.
- **Temperature C°**: average annual temperature by state.
- **Physical activity**: Percentage of adolescents (from 9th to 12th grade) of a certain state who practice one or more hours of moderate and/or vigorous physical activity per day.
- **Population**: population by state.
- **School policy**: proportion of schools in the state that allow the purchase of sugar-sweetened drinks.
- **Sport partnerships**: Amount of money invested by Coca-Cola in partnerships associated with programs aimed to foster physical activity in each state.
- **Health partnerships**: Amount of money invested by Coca-Cola in partnerships associated with the prevention of diseases and donations to hospitals for health campaigns in each State.
- **Sport + Health partnerships**: Represents the sum of the two previous items.

## 5 Methodology

### 5.1 Model

In this section we explore the potential causal relation between the intensity of the non-research partnerships’ investment of The Coca-Cola Company at a state level and two dependent variables of interest: physical activity and soda consumption, both in American adolescents. We consider two dependent variables as a proxy for future obesity, as the data scarcity does not allow us to investigate the impact of Coca-Cola partnerships in the long-run. That’s why we investigate the impact of the partnership scheme of Coca-Cola on two of the main determinants of obesity, physical activity and soda consumption. In doing so, we capture the short-run impact of these non-research partnerships on increasing the risk for the American adolescents of being obese in the future.

Since we are working on a panel dataset, we build a fixed effects model in order account for both the state characteristics that don’t change across time (for example cultural norms), and the ones that are constant across states but change over time. We first regress physical activity in the adolescent population on the Coca-Cola expenditure in sports partnerships:

$$pact_{it} = \beta_0 + \beta_1 \ln(sport\_partn_{it}) + \beta_2 X_{it} + \eta_i + \gamma_t + \epsilon_{it} \quad (1)$$

Where the dependent variable  $pact_{it}$  is the percentage of adolescents who practice physical activity on a daily basis in the state “i” at the year “t”. Our main explanatory variable,  $\ln(sport\_partn_{it})$ , is the logarithm of the amount of money spent by Coca-cola in partnerships aimed to promote physical activity, in the state “i” at the year “t”.  $X$  is a vector of covariates, including sociodemographic and weather controls.  $\eta_i$  accounts for the state fixed effects,  $\gamma_t$  for time fixed effects and  $\epsilon_{it}$  is the error term.

In the next equation of our model we change the outcome variable, using the proportion of adolescents who consume at least one soda drink per day in the state “i” at the year “t”, instead of physical activity. In is labeled as  $sdcons_{it}$  in the equation 2. At the same time, we use a new explanatory variable: the logarithm of Coca-Cola spending in partnerships aimed to promote physical activity and health campaigns:  $\ln(sport.health\_partn_{it})$ . The equation looks as follows:

$$sdcons_{it} = \beta_0 + \beta_1 \ln(sport.health\_partn_{it}) + \beta_2 X_{it} + \eta_i + \gamma_t + \epsilon_{it} \quad (2)$$

Where  $X$  is a vector of covariates, including sociodemographic and weather

controls, as in the equation 1, but also an additional school soda policies control. Again,  $\eta_i$  represents the state fixed effects,  $\gamma_t$  the time fixed effects and  $\epsilon_{it}$  the error term.

## 5.2 Endogeneity

The specification in equation 2 has a potential problem of omitted variable bias. This concern is fundamented by two facts. First, the consumption of sugar drinks in the past could influence soda consumption in the present, as it could have an addictive component. At the same time, the geographical non-research partnerships allocation decision of Coca-Cola could be correlated with the past intensity of soda consumption, as the company would be more interested in defending its position and commercial interests in the states where it has larger business volumes.

Then, we would bias upwards the estimated impact of the amount spent in non-research sports and health partnerships by Coca-Cola on adolescents' soda consumption. If that is the case, the assumption of strict exogeneity does not hold, because the independent variable includes lagged values of the dependent variable (Arellano, 2003). This means that static panel data models, which rely on strict exogeneity, would provide biased estimates.

## 5.3 GMM approach

Our strategy to deal with the endogeneity concern is to use a dynamic panel data approach. It enables us to relax the strict exogeneity assumption, and then account for the autoregressive component (Arellano, 2003). We propose the following equation:

$$sdcons_{it} = \beta_1 sdcons_{it-1} + \beta_2 \ln(sport.health\_partn_{it}) + \beta_3 X_{it} + \eta_i + \gamma_t + \epsilon_{it} \quad (3)$$

Where we add the lagged value of the dependent variable to the model of the equation 2 (section 5.1). To tackle the exogeneity issue, Arellano and Bond (Arellano and Bond, 1991) propose an estimator based on the generalized method of moments (GMM). The Arellano and Bond estimator, also known as difference GMM, instruments the one-year lagged value of the dependent variable using other lagged values of the same variable, and the differences of all the variables of the model. It eliminates the state and time fixed effects by using first differences, and instruments all the potential endogenous variables that may remain

in the model by using their lagged values and differences, solving then the endogeneity problem.

We also report the results for the system GMM estimator (Arellano and Bover, 1995), which uses additional orthogonality conditions. The use of additional moment conditions makes the estimator more efficient than the difference GMM. Our specification for the system GMM model is the following, adding a vector of predetermined (or endogenous) variables, "W", to the previous specification in equation 3:

$$sdcons_{it} = \beta_1 sdcons_{it-1} + \beta_2 \ln(sport.health\_partn_{it}) + \beta_3 X_{it} + \beta_4 W_{it} + \eta_i + \gamma_t + \epsilon_{it} \quad (4)$$

Running the models, we have considered as a strictly endogenous variable the one-year lagged value of soda consumption, and as predetermined the GDP per capita, disposable income and education, and as a exogenous variables the average annual temperature level per state and the school policy (percentage of schools in the state that allow the purchase of SSBs).

Even though the GMM estimators were designed to work with samples of labor and industries with a large number of individuals, they can also be applied for small samples, as is the case of the present work (Soto, 2009)<sup>10</sup>.

## 6 Results

In the following pages we report the results of our models. Table 2 shows the estimations for the equation 1. This is, the regression of physical activity of adolescents, measured by the percentage of adolescents of the given state who practice at least one hour of physical activity per day, on the logarithm of the amount of money spent by Coca-Cola in sports partnerships. In the first specification we report the fixed-effects estimator without any control. In the second one, we report it controlling for the GDP per capita and disposable income per capita of the state. In the third specification we add two additional controls to the fixed-effects model: education level and average temperature. Although the most complete specification gives as a negative (but very small) effect of the sports partnerships on adolescent physical activity, we can see that the coefficients for all three specifications are not statistically significant. In addition, we

<sup>10</sup> Using other estimators obtained with Montecarlo simulations, the author proves that the System GMM estimates are very precise in terms of sample bias when the sample is small and it is not at the individual or industry level but at the country or state level.



report an OLS estimation, which also finds a slightly negative but not significant effect.

Table 2: FE/OLS for physical activity (adolescents)

Physical activity (adolescents)	(1) FE	(2) FE	(3) FE	(4) OLS
Log (partnership sports)	-0.0044 (0.0241)	0.0013 (0.0230)	-0.0012 (0.0224)	-0.0066 (0.0243)
Log (GDP per capita)		-1.3510 (4.2550)	-0.4830 (4.4090)	-4.9660*** (1.0530)
Log (income)		11.1800 (8.4510)	9.6000 (8.7960)	1.5620 (1.6650)
Education (% secondary at least)			0.1660 (0.1020)	-0.0681 (0.0542)
Temperature C °			0.1390* (0.0733)	-0.0591*** (0.0196)
Observations	408	408	408	408
R-squared	0.167	0.190	0.216	0.134
Number of states	51	51	51	51
State F.E.s	yes	yes	yes	no
Time F.E.s	yes	yes	yes	no
Controls	no	yes	yes	yes

Robust standard errors in parentheses

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

Table 3 shows the same model and specifications than table 1, but replacing adolescent physical activity for adult physical inactivity (measured as a percentage of adults in the state that practice less than one hour of physical activity per day) as a dependent variable. We do it to have more information about the relation between the Coca-Cola sports partnerships and physical activity ratios. We obtain the physical inactivity data from The state of Obesity, a collaborative project of the Trust for America's Health and the Robert Wood Johnson Foundation. The OLS estimation suggests that a higher intensity of partnership investment in a state would result in a reduction of the physical inactivity ratio (and then an increase in physical activity), although the effect is not statistically significant. This result would support the idea that the partnerships actually contribute to fight the causes of obesity. However, the fixed-effect models suggest the opposite: a higher investment in partnerships implies a higher proportion of physically inactive adults. In this case, the coefficient is statistically significant, although its size is very small.<sup>11</sup>

<sup>11</sup> Our independent variable is the logarithm of the amount spent by Coca-Cola in sports partnership, and our dependent variable is the percentage of adults in the state that practice less than one hour of physical activity per day. Then, a one

Table 3: FE/OLS estimations for physical inactivity (adults)

Physical inactivity (adults)	(1) FE	(2) FE	(3) FE	(4) FE	(5) OLS
Log (partnership sports+health)	0.0290 (0.0213)	0.0348 (0.0214)	0.0347 (0.0212)	0.0375* (0.0212)	-0.0411 (0.0378)
Log (GDP per capita)		-6.0140** (2.4960)	-6.0390** (2.9870)	-7.7840*** (2.8870)	-4.2060*** (1.0150)
Log (income)		13.550*** (4.4480)	13.5000*** (4.3680)	15.0100*** (4.4640)	1.5210 (1.9690)
Education (% secondary at least)			0.0160 (0.0895)	0.0570 (0.0940)	-0.3980*** (0.0829)
Temperature C °				-0.2080*** (0.0745)	0.1050*** (0.0256)
Observations	408	408	408	408	408
R-squared	0.568	0.581	0.581	0.591	0.313
Number of states	51	51	51	51	51
State F.E.s	yes	yes	yes	yes	no
Year F.E.s	yes	yes	yes	yes	no
Controls	no	yes	yes	yes	yes

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 4 reports the estimation results for adolescents' soda consumption (equation 2). Again, the first column reports the fixed-effects model without control variables. The second adds the GDP per capita and disposable income per capita as control variables. The third fixed-effects specification additionally adds the education and weather controls. The fourth specification adds the school policy control to the third specification. We also report the OLS estimation. Again, the OLS coefficient is aligned with the official purpose of Coca-Cola partnerships, as it finds a negative impact of the spending in sports and health partnerships on adolescents' soda consumption, although it is not significant. However, if we consider the fourth fixed-effects specification (the most complete one), the within group estimator provides a positive and statistically significant effect of the intensity of the Coca-Cola spending in sports and health partnerships on soda consumption. But the size of the coefficient is very small, as a one percent increase in the amount spend in sports and health partnerships increases the proportion of individuals than consume at least one soda per day only in 0.0007 percentage points.

As a robustness check for table 4 results, in table 5 we report the same model and specifications, but adding the amount spent in nutrition partnerships to the main regressor, because, although the magnitude spent in nutrition partnerships is low compared to the one of sports and health partnerships, it is logical to

---

percent increase in the amount spent by Coca-Cola in sport partnerships would increase the proportion of physically inactive adults  $(0.01)\beta_1$  percentage points.

Table 4: FE/OLS estimations for soda consumption (adolescents)

Soda consumption (adolescents)	(1) FE	(2) FE	(3) FE	(4) FE	(5) OLS
Log (partnership sports+health)	0.0694** (0.0276)	0.0789*** (0.0282)	0.0807*** (0.0278)	0.0765*** (0.0272)	-0.0346 (0.04350)
Log (GDP per capita)		-17.8500*** (5.7820)	-18.6900*** (5.9950)	-18.9600*** (6.1590)	9.5420*** (1.3390)
Log (income)		26.9400*** (8.1390)	26.8400*** (7.7770)	27.0800*** (7.6640)	-31.1900*** (3.2900)
Education (% secondary at least)			0.2100* (0.1060)	0.2170** (0.1050)	-0.3650*** (0.1130)
Temperature C °			-0.0629 (0.1030)	-0.0645 (0.1040)	0.1140*** (0.0338)
Policy (% schools allow drinks)				-0.0342 (0.0342)	0.0470* (0.0282)
Observations	408	408	408	408	408
R-squared	0.827	0.845	0.848	0.849	0.483
Number of states	51	51	51	51	51
State F.E.s	yes	yes	yes	yes	no
Year F.E.s	yes	yes	yes	yes	no
Controls	no	yes	yes	yes	yes

Robust standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

think that they may also influence sugar drinks' consumption. Nevertheless, the coefficients barely change.

Table 5: FE/OLS estimations for soda consumption (adolescents)

Soda consumption (adolescents)	(1) FE	(2) FE	(3) FE	(4) FE	(5) OLS
Log (partnership sports+health+nutrition)	0.0679** (0.0276)	0.0764*** (0.0282)	0.0786*** (0.0276)	0.0739*** (0.0272)	-0.0422 (0.0431)
Log (GDP per capita)		-18.0600*** (5.8430)	-18.8700*** (6.0470)	-19.1300*** (6.2090)	9.5750*** (1.3100)
Log (income)		26.4400*** (8.1260)	26.3000*** (7.7570)	26.5500*** (7.6620)	-31.0600*** (3.2800)
Education (% secondary at least)			0.2130** (0.1060)	0.2200** (0.1050)	-0.3710*** (0.1140)
Temperature C°			-0.0589 (0.1020)	-0.0605 (0.1030)	0.1150*** (0.0339)
Policy (% schools allow soda drinks)				-0.0339 (0.0322)	0.0475* (0.0282)
Observations	408	408	408	408	408
R-squared	0.827	0.844	0.847	0.849	0.483
Number of states	51	51	51	51	51
State F.E.s	yes	yes	yes	yes	no
Year F.E.s	yes	yes	yes	yes	no
Controls	no	yes	yes	yes	yes

Robust standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 6 reports the results adding the one-year lagged value of soda consumption as an additional regressor. First, we report the OLS results, where we find that the sports and health partnerships have a negative non-significant impact. In column 2 we report the within group estimator, which shows a significant

positive effect. However, the coefficient is less than a half of the one found in the fourth specification of table 4, providing supportive evidence to the omitted variable bias concern. As the strict exogeneity assumption is not satisfied, both the OLS and the fixed-effects models provide biased and inconsistent estimates, and we cannot rely on their coefficients.

Table 6: GMM/FE/OLS estimations for soda consumption (adolescents)

	(1)	(2)	(3)	(4)
Soda consumption (adolescents)	OLS	FE	Diff-GMM	System-GMM
Log (partnership sports+health)	-0.0139 (0.0105)	0.0270* (0.0146)	0.03620** (0.0148)	0.0323** (0.0148)
Log (income)	-1.3400* (0.7200)	15.9500*** (3.4790)	15.6600*** (4.5450)	14.9200*** (4.5280)
Log (GDP per capita)	0.3350 (0.3210)	-8.8350*** (2.926)	-4.7370 (4.2740)	-3.9150 (4.3300)
Temperature C°	-0.0045 (0.0065)	0.0179 (0.0515)	0.0387 (0.0470)	0.1410** (0.0557)
Education (% secondary school at least)	0.0320 (0.0238)	0.1420 (0.0885)	0.1370 (0.0916)	-0.1010 (0.0927)
Policy (% schools allow soda drinks)	-0.0037 (0.0060)	-0.0272* (0.0158)	-0.0114 (0.0178)	-0.0097 (0.0178)
Lag (soda consumption)	0.9580*** (0.0125)	0.6980*** (0.0338)	0.6680*** (0.0417)	0.6860*** (0.0440)
Observations	357	357	306	357
R-squared	0.977	0.927		
Number of states	51	51	51	51

Robust standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

In the third column of the same table 6 we report the results for the difference GMM model. The difference GMM model suggests that a one percent increase in the intensity of sports and health partnerships' investment by Coca-Cola increases the percentage of adolescents who consume at least one soda per day in 0.0004 percentage points. The coefficient is statistically significant. In the fourth column we present the results of the system GMM model. The estimated impact of the partnerships on the soda consumption of adolescents is almost the same that we found in the difference GMM specification (positive but very small), and it is also statistically significant. The coefficient is 0.03, which means that a one percent increase in the intensity of sports and health partnerships' investment by Coca-Cola increases the proportion of adolescents who consume at least one soda drink per day in 0.0003 percentage points.

During the overall period covered by our dataset (2010-2017), 14 out of the 51 states of our sample did not receive any fund from the Coca-Cola sports and health partnerships. This relatively high proportion of zeros could bias the estimated impact of the partnerships downwards. To account for it, in table 7 we replicate the estimates of the table 6 restricting our sample to the states

that received a positive amount of Coca-Cola investment in sports and health partnerships between 2010 and 2017 (removing the 14 with zeros for all the periods). Our estimates barely change.

Considering a one percent increase in the amount of expenditures in partnerships by Coca-Cola is not very informative of the size of the effect it has on soda consumption. To find more interpretable magnitudes, we sort the states according to the average annual amount of money received from Coca-Cola in the form of sports and health partnerships in the period covered by our panel (2010-2017). If a state located in the median of the average sports and health partnership expenditures' distribution experiences an increase in the amount spent that puts him in the top position, becoming the state with the highest expenditure, then the proportion of adolescents who consume at least one soda per day would only increase in this state would only increase in 0.17 percentage points. If the state located in the third quartile in terms of partnership spending becomes the first, the percentage of adolescents who consume at least one soda per day in this state would increase in 0.1 percentage points. Then, although the coefficient for sports and health partnerships found in the GMM models is positive and statistically significant, the size is very low.

Table 7: GMM/FE/OLS estimations for soda consumption (adolescents)

Soda consumption (adolescents)	(1) OLS	(2) FE	(3) Diff-GMM	(4) System-GMM
Log (partnership sports+health)	-0.0161 (0.0109)	0.0320* (0.0161)	0.0389** (0.0169)	0.0360** (0.0160)
Log (income)	-1.3030* (0.7630)	13.3400** (5.4260)	15.9200** (6.7090)	14.8200** (6.6940)
Log (GDP per capita)	0.3750 (0.3250)	-5.5720 (4.1110)	-3.2790 (4.1750)	-2.2340 (4.0620)
Temperature C°	-0.0083 (0.0064)	-0.0099 (0.0573)	0.0224 (0.0631)	0.1100 (0.0676)
Education (% secondary at least)	0.0271 (0.0244)	0.0623 (0.0646)	0.0478 (0.0655)	0.0108 (0.0722)
Policy (% schools allow soda drinks)	0.0016 (0.0069)	-0.0163 (0.0182)	0.0038 (0.0214)	0.0046 (0.0221)
Lag (soda consumption)	0.9480*** (0.0153)	0.7060*** (0.0429)	0.6970*** (0.0541)	0.7140*** (0.0541)
Observations	259	259	222	259
R-squared	0.978	0.935		
Number of states	37	37	37	37

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

## 7 Conclusions

Our study investigates the effect of the SSB industry partnerships' programs on both physical activity and sugar drinks consumption among US adolescents, which in turn are among the main causes of obesity. To do so, we build a panel dataset of the partnership spending of Coca-Cola at a state level for the period 2010-2017. We also divide the non-research partnerships of Coca-Cola into different groups according to the type of programs they support. We run two fixed-effects models.

The first uses the physical activity ratios of adolescent population as the dependent variable, and the expenditures of Coca-Cola in sports partnerships as the main regressor. We don't find any significant impact of the intensity of the partnerships intended to foster physical activity and the proportion of adolescents who practice sport regularly.

The second fixed effects model takes the percentage of adolescents who consume soda regularly as the dependent variable, and the Coca-Cola spending in sports and health partnerships as the main regressor. In that case we find a significant positive effect, suggesting that Coca-Cola partnership program not only has no significant effects on physical activity, but also increases soda consumption, but the size of the effect is very small.

Considering both outcomes, the results suggest that the Coca-Cola partnership program actually rises the risk of suffering obesity in the future. This point is supported by the GMM estimators, as they also find a positive (but small) and significant effect of the intensity of the partnership expenses and soda consumption. Then, we confirm our hypothesis that Coca-Cola partnerships are another marketing tool of the company, and instead of fighting effectively against obesity they are intended to strengthen its market position.

As long as we know, this is the first paper that tries to estimate the causal relationship between the SSB industry partnership programs and the soda consumption at a state level, and to use the Coca-Cola Transparency list for causal inference purposes. However, our findings must be seen cautiously. Due to data scarcity, our sample is not very large, and we can only identify the effect of the partnerships on the proportion of adolescents who practice physical activity or consume soda regularly. It would be interesting to see the effects on all age cohorts of population, as well as on the intensity of the SSB consumption among each cohort, instead of just the percentage of regular consumers. At the same time, we don't have data on Coca-Cola marketing expenditure at a state level, which could give us a wider picture of Coca-Cola marketing investment effort

and the relative weight of partnerships on it. The main reason is that the marketing strategy is designed at a national and supranational level.

It could also be interesting to look at what extent our results can be extrapolated in other contexts outside the USA, but Coca-Cola only publishes its Transparency list for the US. The state-level approach we take in this work assumes that there is no effect of the partnership intensity in one state on the outcomes of interest of other states. This assumption seems unrealistic, and future studies should take into account the potential effects of partnership spending on other states, specially in the neighbor ones.

Finally, our findings have interesting policy implications. First, they suggest that governments should make an effort to increase the transparency in the philanthropic activity of big SSB corporations. A transparent accountability exercise would prevent the companies to use their partners' network to influence individual consumption decisions. At the same time, in countries where philanthropic activities benefit from generous tax deductions due to their apparent social contribution, governments should probably rethink these tax benefit schemes.

## References

- Aaron, D. G., & Siegel, D. G. (2017). Sponsorship of national health organizations by two major soda companies. *Am J Prev Med.* 2017;52:20–30.
- Arellano, M. (2003). *Panel Data Econometrics*. Oxford: Oxford University Press.
- Arellano, M., & Bond, S.R. (1991). Some Tests of Specification for Panel Data: Monte Carlo.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of errorcomponents models. *Journal of Econometrics* 68 (1), 29–51.
- Aveyard, P., Yach, D., Gilmore, A. B., & Capewell, S. (2016). Should we welcome food industry funding of public health research? *BMJ* 2016;353:i2161. 10.1136/bmj.i2161 27098491.
- Barlow, P., Serôdio, P., Ruskin, G., McKee, M., & Stuckler, D. (2018). Science organisations and Coca-Cola's 'war' with the public health community: insights from an internal industry document. *Journal of epidemiology and community health*, 72(9), 761–763. doi:10.1136/jech-2017-210375.

Barnes, D. E., & Bero, L. (1996). Industry-Funded research and conflict of interest: an analysis of research sponsored by The Tobacco Industry through The Center for Indoor Air Research. *J. Health Polit. Law.* Volume: 21.

Bero, L. (2003). Implications of the tobacco industry documents for public health and policy. *Annu Rev Public Health.* 24:267–288. [PubMed: 12415145].

Bes-Rastrollo, M., Sayon-Orea, C., Ruiz-Canela, M. & Martinez-Gonzalez, M. A. (2016). Impact of sugars and sugar taxation on body weight control: a comprehensive literature review. *Obesity.* 24:1410–26.

Biro, F. M., & Wien, M. (2010). Childhood obesity and adult morbidities. *The American journal of clinical nutrition,* 91(5), 1499S–1505S.

Bhurosy, T., & Jeewon, R. (2014). Overweight and obesity epidemic in developing countries: a problem with diet, physical activity, or socioeconomic status?. *TheScientificWorldJournal,* 2014, 964236. doi:10.1155/2014/964236.

Brownell, K. D., ° Warner, K. E. (2009). The perils of ignoring history: big tobacco played dirty and millions died. How similar is big food? *Milbank Q.* 87(1):259–294.

Catenacci, V. A., Hill J. O., & Wyatt, H. R. (2009). The obesity epidemic. *Clin. Chest Med.* 30 415–444. 10.1016/j.ccm.2009.05.001.

Della Torre, S.B., Keller, A., Depeyre, J.L., & Kruseman, M. (2016). Sugar-sweetened beverages and obesity risk in children and adolescents: a systematic analysis on how methodological quality may influence conclusions. *J Acad Nutr Diet.* 116(4):638–659.

Fabbri, A., Lai, A., Grundy, Q., & Bero, L. A. (2018). The Influence of Industry Sponsorship on the Research Agenda: A Scoping Review. *American journal of public health,* 108(11), e9–e16. doi:10.2105/AJPH.2018.304677.

Finkelstein, E. A., & Kiersten, L.S, (2010).The economics of obesity, *The American Journal of Clinical Nutrition,* Volume 91, Issue 5, Pages 1520S–1524S, <https://doi.org/10.3945/ajcn.2010.28701E>.

Fowler, S. P., Williams, K., & Hazuda, H. P. (2015). Diet soda intake is associated with long-term increases in waist circumference in a biethnic cohort of older adults: the San Antonio Longitudinal Study of Aging. *J Am Geriatr Soc*



2015;63(4):708–15.

Gardener, H., Moon, Y. P., Rundek, T., Elkind, M., & Sacco, R. L. (2018). Diet Soda and Sugar-Sweetened Soda Consumption in Relation to Incident Diabetes in the Northern Manhattan Study. *Current developments in nutrition*, 2(5), nzy008. doi:10.1093/cdn/nzy008.

Keller, A., Bucher Della Torre, S. (2015). Sugar-Sweetened Beverages and Obesity among Children and Adolescents: A Review of Systematic Literature Reviews. *Child Obes.* 11(4):338–346. doi:10.1089/chi.2014.0117.

Macintyre, A. K., Marryat, L., & Chambers, S. (2018). Exposure to liquid sweetness in early childhood: artificially-sweetened and sugar-sweetened beverage consumption at 4–5 years and risk of overweight and obesity at 7–8 years. *Pediatric Obesity*, 13: 755– 765. <https://doi.org/10.1111/ijpo.12284>.

Malik, V. S., Popkin, B. M., Bray, G. A., & Després, JP. Hu. FB. (2010). Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*. 2010;121(11):1356–1364.

O'Connor, A. (2015). Coca-Cola funds scientists who shift blame for obesity away from bad diets. *The New York Times*, 9 August. <https://well.blogs.nytimes.com/2015/08/09/coca-cola-funds-scientists-who-shift-blame-for-obesity-away-from-bad-diets/>.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011–2012. *JAMA*. 2014;311(8):806–814. doi:10.1001/jama.2014.732.

Johnson, R., Segal, M., Sautin, Y., Nakagawa, T., Feig, D., & Al., E. (2007). Potential role of sugar (fructose) in the epidemic of hypertension, obesity and the metabolic syndrome, diabetes, kidney disease, and cardiovascular disease. *Am J Clin Nutr*, 86: 899-906.

Rey-López, J. P., & Gonzalez, C. A. (2018). Research partnerships between Coca-Cola and health organizations in Spain, *European Journal of Public Health*, cky175, <https://doi.org/10.1093/eurpub/cky175>.

Park, S., Pan, L., Sherry, B., & Blanck, H. M. (2014). Consumption of sugar-sweetened beverages among US adults in 6 states: Behavioral Risk Factor

Surveillance System, 2011. Preventing chronic disease, 11, E65.

Park, S., McGuire, L. C., & Galuska, D. A. (2015). Regional Differences in Sugar-Sweetened Beverage Intake among US Adults. *Journal of the Academy of Nutrition and Dietetics*, 115(12), 1996–2002.

Schulze, M. B., Manson, J.E., Ludwig, D. S., Colditz, G. A., Stampfer, M. J., Willett, W. C., & Hu, F. B. (2004). Sugar-Sweetened Beverages, Weight Gain, and Incidence of Type 2 Diabetes in Young and Middle-Aged Women. *JAMA*. 292(8):927–934. doi:10.1001/jama.292.8.927.

Serôdio, P. M., McKee, M., & Stuckler, D. (2018). Coca-Cola - a model of transparency in research partnerships? A network analysis of Coca-Cola's research funding (2008-2016). *Public Health Nutr.* 21(9):1594–1607.

Soto, M. (2009). System GMM estimation with a small sample. Barcelona Graduate School of Economics. Barcelona Economics Working Paper Series Working Paper n° 395.

Terry-Mcelrath, Y.M., Chriqui, J.F., O'Malley P.M., Chaloupka F.J., & Johnston L.D. (2015). Regular soda policies, school availability, and high school student consumption. *American Journal of Preventive Medicine*, 48(4), pp.436-444.

Tremmel, M., Gerdtham UG., Nilsson, P.M., & Saha, S. (2017). Economic burden of obesity: a systematic literature review. *Int J Environ Res Public Health*. doi: 10.3390/ijerph14040435.

Vos M.B., Kaar J.L., Welsh J.A., Van Horn L.V., Feig D.I., Anderson C.A.M., Patel M.J., Cruz Munos J., Krebs N.F., Xanthakos S.A., et al. (2017). Added Sugars and Cardiovascular Disease Risk in Children: A Scientific Statement from the American Heart Association. *Circulation*. 135:e1017–e1034.

Woodward-Lopez, G., Kao, J., & Ritchie, L. (2011). To what extent have sweetened beverages contributed to the obesity epidemic?. *Public Health Nutr.*

World Health Organization. (2010). Global status report on noncommunicable diseases. Geneva: Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf).