UCSF
UC San Francisco Electronic Theses and Dissertations

Title
Evaluating how innovative nutrition policies promote healthy diets to reduce the burden of non-communicable diseases

Permalink
https://escholarship.org/uc/item/0x95w79q

Author
Pedroza-Tobias, Andrea

Publication Date
2022

Peer reviewed|Thesis/dissertation

eScholarship.org Powered by the California Digital Library
University of California

Evaluating how innovative nutrition policies promote healthy diets to reduce the burden of non-communicable diseases

by
Andrea Pedroza-Tobias

DISSERTATION
Submitted in partial satisfaction of the requirements for degree of
DOCTOR OF PHILOSOPHY

in

Global Health Sciences

in the

GRADUATE DIVISION
of the
UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

Approved:

DocuSigned by:
Laura Schmidt
1A59CBA2C842477...

Laura Schmidt
Chair

DocuSigned by:
Jaime Sepulveda
DocuSigned by:
Kartika Palar
DocuSigned by:
Justin White
3F8DAEF9D5BD492...

Jaime Sepulveda
Kartika Palar
Justin White

Committee Members

Copyright 2022

by

Andrea Pedroza-Tobias

Dedication

To my son, Belko

Acknowledgements

I want to express my gratitude to my mentors, colleagues, friends, and family that made this dream possible.

To my advisor, Laura Schmidt: You are an inspiring person. I will always be grateful for your guidance and support in my professional career and personal life during my pregnancy and motherhood. I admire you so much; I am sure I could not have done it without you.

To my academic advisor, Jaime Sepulveda: I am very grateful for your support. Thank you for allowing me to be here and learn from you.

To Justin White: thank you for introducing me to the econometrics world and for your endless time, patience, and support.

To Kartika Palar and Sheri Weiser: Thank you for your tremendous support, patience, and passion for research and making a better world.

To Alicia Fernandez: You have been my most significant support in San Francisco. Thank you for teaching me not only about academics but about life. Thank you for your remarkable support during the Ph.D.and motherhood journey.

To the program directors Elizabeth Fair and Ali Mirzazadeh: for leading the Ph.D. program and for your support during this time.

To my classmates, Teresa Kortz, Naomi Beyeler, and Bailor Barrie: I am very grateful for your support and insights during the early stages of the Ph.D.

To my mentors in Mexico, Simon Barquera and Juan Rivera: Thank you for your support and for believing in me even when I didn't believe in myself. *To Celia Aradillas, Raul Martínez Zuñiga, and Alejandro Chevaile:* Thank you for introducing me to the research and public health world.

To my sisters, Tere, Isabel, and Sofia: I am lucky to have three sisters and friends who always have been cheering for me even when they have no idea what I am doing. Thank you for always being there.

A mis papás Tere y Pedro: Muchas gracias por dejarme volar desde chica, por siempre apoyar mis sueños, y por siempre creer en mí. Soy muy afortunada de ser su hija.

To my husband, Abdou: Thank you for being there, listening to me, and supporting me in ways I never imagined. This dissertation would not have been possible without your encouragement and love.

To my son, Belko: You are my greatest accomplishment in this journey and my best teacher. Thank you for your love and kindness and for reminding me how happy we are every day. Thank you for making this journey funnier.

Contributions

The text of the Chapter 2 in this dissertation is a reprint of the material as it appears in in BMJ Global Health in collaboration with Eric Crosbie, PhD, Melissa Mialon, PhD, Angela Carriedo, PhD, and Laura A. Schmidt, PhD. The co-authors listed in this publication directed and supervised the research that forms the basis for this chapter. The published material represents research comparable to a standard dissertation chapter and was primarily conducted and written by Andrea Pedroza-Tobias during the period of study at the University of California, San Francisco.

Approved:

Laura A. Schmidt, Dissertation Chair

Abstract

Evaluating how innovative nutrition policies promote healthy diets to reduce the burden of non-communicable diseases

Andrea Pedroza-Tobias

Non-communicable diseases (NCDs) are a global public health problem, causing 74% of all deaths worldwide. High systolic blood pressure and an unhealthy diet are the first and second most important contributors to the burden of cardiovascular diseases.

In this dissertation, I analyze policies implemented in micro-and macro-environments aiming to modify the food environment to address the burden of diet-related non-communicable diseases (DR-NCDs). I follow Hawke's framework that highlights the food environment as a mediator between preference learning and actual food consumption. Thus, policies that address the food environment are more likely to succeed because they address the main barriers to healthy eating.

The first paper provides evidence of the food industry's tactics in weakening and preventing the national and international diffusion of the sugar-sweetened beverages (SSB) tax's policy effectiveness, implemented in Mexico in 2014. The food industry paid scientists to produce evidence aligned with their interests, showing that the tax was ineffective in improving health and harming the economy. The second paper examines how a workplace SSB sales ban at the University of California, San Francisco (UCSF) reduced SSB consumption at work and outside work. Heavy SSB drinkers reduced their consumption by half at work and outside workplaces. Finally, the third paper evaluates the impact of a Food Pharmacy Program (FPP) at clinics in the San Francisco Health Network. The FPP is associated with significant systolic and diastolic

blood pressure reduction in low-income adults with hypertension, with greater effects among those with poor blood pressure control, and those that attended the FPP at least five times.

I conclude that to reduce the burden of DR-NCDs, a package of interventions and policies at different levels that modify the food environment may be effective in reducing the access to health-harming products and increase the availability and access to healthy food. In addition, governments and policymakers should be free of conflict of interest and implement policies based on independent peer-reviewed evidence.

Table of Contents

List of Figures

List of Tables

List of abbreviations

ABA	American Beverage Association
ANPEC	National Alliance of Small Merchants
ANPRAC	Association of Soda and Carbonated Water Producers
ASN	American Society for Nutrition
BEVQ-15	Beverage Intake Questionnaire
CVD	Cardiovascular disease
DID	Difference-in-differences
DR-NCDs	Diet-related non-communicable diseases
FIMI	Food is Medicine interventions
FPP	Food Pharmacy program
GDP	Gross Domestic Product
ICBA	International Council of Beverages Association
ILSI	International Life Sciences Institute
IPW	Inverse probability weights
ITAM	Mexican Autonomous Institute of Technology
NCDs	Non-communicable diseases
SFDPH	San Francisco Department of Public Health
SFHN	San Francisco Health Network
SSB	Sugar-sweetened beverages
UCSF	University of California at San Francisco
UN	United Nations
US	United States of America
WHO	World Health Organization

Chapter I

Introduction

Non-communicable diseases (NCDs) are a global public health problem, causing 74% of all deaths worldwide. Among the NCDs, cardiovascular disease (CVD) and diabetes are respectively the first and fifth causes of mortality worldwide.[1] High systolic blood pressure and dietary risk factors are the first and second most important contributors to the burden of cardiovascular diseases.[1] Daily consumption of fruit and vegetables is associated with a lower risk of obesity[2], hypertension,[3,4] coronary heart disease[5,6], stroke[7], and cancer[6,8]. Conversely, sugar-sweetened beverage (SSB) consumption increases CVD mortality by increasing the risk of obesity, diabetes, coronary heart disease, and stroke.[9]

The American Heart Association recommends consuming five servings or 400 grams of fruit and vegetables per day.[10] However, in Mexico, only 12% of adult women and 13% of adult men met these recommendations in 2016.[11] In the United States (US), only 9.3% of adults met these recommendations in 2015 with a lower percentage of Black adults (5.5%), and those in the lowest income category (7.0%).[12] A simulation study found that a 30% subsidy in the price of fruit and vegetables in adults enrolled in Medicare or Medicaid would prevent 1.9 millions of cardiovascular deaths and save 39.7 billion in healthcare costs.[13]

Furthermore, the World Health Organization recommends no more than 10% of calories from added sugar in the diet.[14,15] However, added sugars contribute 12.5% and 13% of the total daily calories consumed in Mexico and the U.S., respectively. SSBs represent the primary source of

added sugars in both countries, contributing 47% of the total added sugars to the US[15] and 74.3% in Mexico.[16]

Consumption of SSBs is disproportionally high in racial/ethnic minorities compared with whites, and low-income compared with high-income populations in the US.[15,17] This contrasts with consumption of SSBs in Mexico, where consumption is equally high across socioeconomic strata.[18] Simulation analyses find that reducing SSB consumption by 20% would prevent 23,000 and 368,000 cases of diabetes in California[19] and Mexico[20], respectively, within ten years. This reduction could save $623 million in California and $1.9 billion in Mexico in direct healthcare costs related to diabetes over a 10-year period.

Food choice is not a simple individual decision. Food choices are the result of a complex interaction of different factors that lead an individual to consume specific foods.[21] Our current food system plays an essential role in the individual's diet. The reduction in the supply of healthy foods, the increase in the supply of energy-dense food in the past decades, and the improvement in the food distribution systems have played crucial roles in the rise of diet-related non-communicable diseases.[22,23] This food system is tightly interrelated with the food environment. According to the ANGELO framework,[24] the food environment can be classified by its size: microenvironmental or macroenvironmental, and by its type: physical (food availability), economic (costs of food, income), political (rules, laws, and regulation), and sociocultural (attitudes, beliefs, and values). Food environment, therefore, also heavily influences people's food choices:[24] Unhealthy food environments promotes a low-quality diet and energy overconsumption, leading to obesity and poor control of NCDs[25,26].

An unhealthy food environment can exacerbate health disparities and poverty through a vicious cycle. Individuals with lower socioeconomic status and/ or food insecurity are more likely to be exposed to an unhealthy food environment that promotes a low-quality diet, which increase the risk of development NCDs. Furthermore, low-income communities are more likely to have restricted access to health care, late diagnoses of NCDs, and poorer disease control.[27] Finally, NCDs may lead to poverty due to the high economic burden of the disease through direct health costs and loss of productivity (job loss, presenteeism, absenteeism, and premature mortality).[28] Such effects exacerbate poverty and food insecurity, which creates a vicious cycle that perpetuates health and economic inequities.[29,30]

Multinational processed food and beverage corporations play a key role in the food environment. This industry uses strategies and approaches (e.g., marketing, lobbying, corporate social responsibility, and extensive supply chains) to promote products and choices that are detrimental to human health.[31] The best-studied case of corporate organizations' influence is the tobacco industry[32], whose tactics have been replicated by the food and beverage industry[33]. Likewise, successful public health strategies for tobacco control have been adapted to interventions for food and beverage products, such as sales bans in schools and workplaces, taxes, marketing regulations, and labeling[34].

Evidence suggests that individual-level interventions focused on behavioral change, such as individual nutritional counseling, can be effective, but their sustainability and affordability are two significant challenges.[35] These interventions are also likely to increase health inequities

when individuals with higher socioeconomic status have more resources to support engagement with the interventions compared with those with low socioeconomic status.[36,37] In contrast, scholars have argued that policies that modify the food environment and affect the whole population are more sustainable and cost-effective. [18 23,25] These policies have the potential to influence population behaviors and to reduce health disparities systematically. Governmental policies, such as SSB taxes and warning labels, tend to face strong opposition from the food and beverage industries.[34,38] Thus, interventions in microenvironmental settings, such as workplaces and clinics, are an advantageous alternative because they experience less industry opposition, are easier to implement, target a population at risk, and can change people's behaviors. In addition, these interventions can help to build evidence of the effectiveness of healthy food environments and health, that can support other government policies.

The conceptual model for this dissertation follows Hawkes and colleagues[39] theory of change, which identifies the mechanisms of how food policies could work. They suggest diet depends on four main characteristics of the food environment: a) food preferences and how the social and food environments can shape those preferences; b) barriers that people, particularly those with low socioeconomic status, face in accessing, preparing, and eating healthy food; c) food prices and food presentation that modify purchase and consumption choices; and d) the food system (i.e., distribution, production), which is affected by food policies. Thus, given that the food environment is a mediator between learned preferences and eating behaviors, food policies that modify the food environment by limiting the accessibility of unhealthy food and beverages have the potential to change behavior, which can in turn provide an enabling environment for healthy preference learning.

In this dissertation, I evaluate and provide recommendations on health policies in both Mexico and the US that modify the food environment through the three mechanisms suggested by Hawkes et al. (**Figure 1.1**). I first discuss the tactics of the food industry in weakening and preventing the national and international diffusion of the SSB tax's policy effectiveness, which was implemented in Mexico in 2014. The objective of the SSB tax is to encourage consumers to reassess their preferences at the point of purchase, changing the economic food environment.

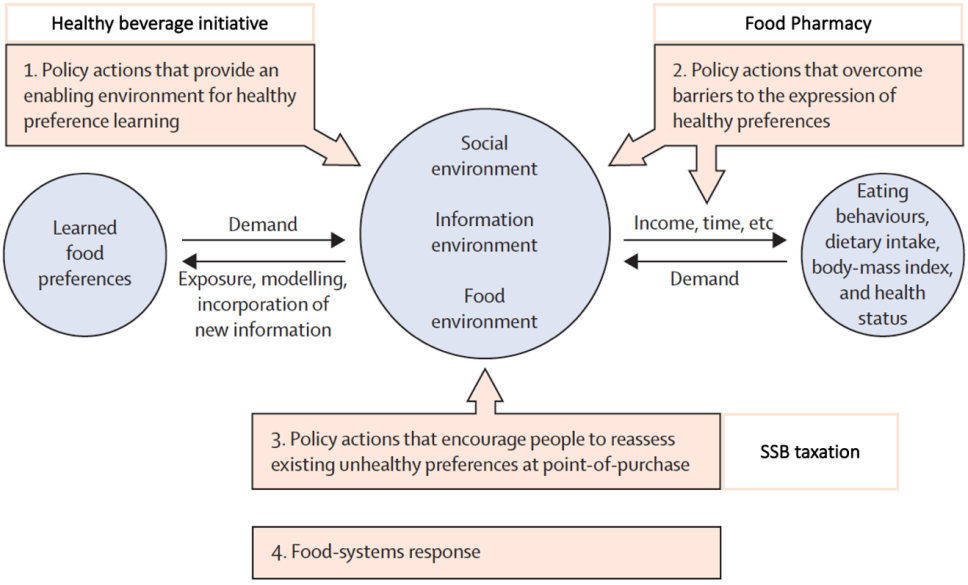

Figure 1.1 Hawke's framework of theory of change and policies in each mechanism through which food policy could be expected to work.
Source: adapted from Hawkes C, et al. Smart food policies for obesity prevention. *Lancet*. 2015;385(9985):2410-2421.

Second, I evaluate the change in SSB consumption among UCSF employees after implementing a workplace ban on SSB sales. This policy aims to modify the physical food environment, restrict access to unhealthy food, and provide an enabling environment that could induce healthier preference learning. Finally, I assess the impact of a Food Pharmacy Program (FPP) implemented by the San Francisco Department of Public Health on reducing systolic and

diastolic blood pressure. This strategy aims to increase access to healthy food and overcome barriers to meeting healthy preferences caused by poor financial access, thus improving the physical and economical food environment. The findings of this dissertation will provide both evidence and recommendations to implement policies and strategies that tackle unhealthy food environments in order to prevent NCDs in high-burden communities.

References

1. Institute for Health Metrics and Evaluation. Global Burden of Disease. Compare Data Visualization. Seattle, WA IHME, University of Washington. Published 2019. Accessed June 21, 2022. https://www.healthdata.org/data-visualization/gbd-compare
2. Bertoia ML, Mukamal KJ, Cahill LE, et al. Changes in Intake of Fruits and Vegetables and Weight Change in United States Men and Women Followed for Up to 24 Years: Analysis from Three Prospective Cohort Studies. Razak F, ed. *PLOS Med*. 2015;12(9):e1001878. doi:10.1371/journal.pmed.1001878
3. Wu L, Sun D, He Y. Fruit and vegetables consumption and incident hypertension: dose–response meta-analysis of prospective cohort studies. *J Hum Hypertens*. 2016;30(10):573-580. doi:10.1038/jhh.2016.44
4. Borgi L, Muraki I, Satija A, Willett WC, Rimm EB, Forman JP. Fruit and Vegetable Consumption and the Incidence of Hypertension in Three Prospective Cohort Studies. *Hypertension*. 2016;67(2):288-293. doi:10.1161/HYPERTENSIONAHA.115.06497
5. Joshipura KJ, Hu FB, Manson JE, et al. The Effect of Fruit and Vegetable Intake on Risk for Coronary Heart Disease. *Ann Intern Med*. 2001;134(12):1106. doi:10.7326/0003-4819-134-12-200106190-00010
6. Aune D, Giovannucci E, Boffetta P, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol*. 2017;46(3):1029-1056. doi:10.1093/ije/dyw319
7. Hu D, Huang J, Wang Y, Zhang D, Qu Y. Fruits and Vegetables Consumption and Risk of Stroke. *Stroke*. 2014;45(6):1613-1619. doi:10.1161/STROKEAHA.114.004836

8. Feskanich D. Prospective Study of Fruit and Vegetable Consumption and Risk of Lung Cancer Among Men and Women. *J Natl Cancer Inst*. 2000;92(22):1812-1823. doi:10.1093/jnci/92.22.1812

9. Malik VS, Hu FB. Sugar-Sweetened Beverages and Cardiometabolic Health: An Update of the Evidence. *Nutrients*. 2019;11(8):1840. doi:10.3390/nu11081840

10. American Heart Association. Fruits and vegetables serving sizes. Published 2017. https://www.heart.org/en/healthy-living/healthy-eating/add-color/fruits-and-vegetables-serving-sizes

11. Batis C, Aburto TC, Sánchez-Pimienta TG, Pedraza LS, Rivera JA. Adherence to Dietary Recommendations for Food Group Intakes Is Low in the Mexican Population. *J Nutr*. 2016;146(9):1897S-906S. doi:10.3945/jn.115.219626

12. Lee-Kwan SH, Moore L V., Blanck HM, Harris DM, Galuska D. Disparities in State-Specific Adult Fruit and Vegetable Consumption — United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(45):1241-1247. doi:10.15585/mmwr.mm6645a1

13. Lee Y, Mozaffarian D, Sy S, et al. Cost-effectiveness of financial incentives for improving diet and health through Medicare and Medicaid: A microsimulation study. Gregg E, ed. *PLOS Med*. 2019;16(3):e1002761. doi:10.1371/journal.pmed.1002761

14. World Health Organization W. *Guideline: Sugars Intake for Adults and Children*. (World Health Organization W, ed.).; 2015.

15. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2020-2025 Dietary Guidelines for Americans.* 9th editio.; 2020. DietaryGuidelines.gov

16. Sánchez-Pimienta TG, Batis C, Lutter CK, Rivera JA. Sugar-Sweetened Beverages Are the Main Sources of Added Sugar Intake in the Mexican Population. *J Nutr*.

2016;146(9):1888S-96S. doi:10.3945/jn.115.220301

17. Vieux F, Maillot M, Rehm CD, Barrios P, Drewnowski A. Opposing Consumption Trends for Sugar-Sweetened Beverages and Plain Drinking Water: Analyses of NHANES 2011–16 Data. *Front Nutr*. 2020;7. doi:10.3389/fnut.2020.587123

18. Aburto TC, Batis C, Pedroza-Tobías A, Pedraza LS, Ramírez-Silva I, Rivera JA. Dietary intake of the Mexican population: comparing food group contribution to recommendations, 2012-2016. *Salud Publica Mex*. 2022;64(3, may-jun):267-279. doi:10.21149/13091

19. Mekonnen TA, Odden MC, Coxson PG, et al. Health Benefits of Reducing Sugar-Sweetened Beverage Intake in High Risk Populations of California: Results from the Cardiovascular Disease (CVD) Policy Model. Berthold HK, ed. *PLoS One*. 2013;8(12):e81723. doi:10.1371/journal.pone.0081723

20. Sánchez-Romero LM, Penko J, Coxson PG, et al. Projected Impact of Mexico's Sugar-Sweetened Beverage Tax Policy on Diabetes and Cardiovascular Disease: A Modeling Study. *PLoS Med*. 2016;13(11):e1002158. doi:10.1371/journal.pmed.1002158

21. Just DR, Wansink B. Food Choice: Behavioral Aspects. In: *Encyclopedia of Human Nutrition*. Elsevier; 2013:277-281. doi:10.1016/B978-0-12-375083-9.00115-X

22. Baker P, Machado P, Santos T, et al. Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. *Obes Rev*. 2020;21(12). doi:10.1111/obr.13126

23. Swinburn BA, Sacks G, Hall KD, et al. Obesity 1 The global obesity pandemic : shaped by global drivers and local environments. *Lancet*. 2011;378(9793):804-814. doi:10.1016/S0140-6736(11)60813-1

24. Swinburn B, Egger G, Raza F. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Prev Med (Baltim)*. 1999;29(6):563-570. doi:10.1006/pmed.1999.0585

25. Roberto CA, Swinburn B, Hawkes C, et al. Patchy progress on obesity prevention: Emerging examples, entrenched barriers, and new thinking. *Lancet*. 2015;385(9985):2400-2409. doi:10.1016/S0140-6736(14)61744-X

26. Marteau TM, Hollands GJ, Fletcher PC. Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes. *Science (80-)*. 2012;337(6101):1492-1495. doi:10.1126/science.1226918

27. Loring B, Robertson A. *Obesity and Inequities. Guidance for Addressing Inequities in Overweight and Obesity.* WHO: Regional Office for Europe; 2014.

28. Niessen LW, Mohan D, Akuoku JK, et al. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. *Lancet*. 2018;391(10134):2036-2046. doi:10.1016/S0140-6736(18)30482-3

29. Beaglehole R, Bonita R, Horton R, et al. Priority actions for the non-communicable disease crisis. *Lancet*. 2011;377(9775):1438-1447. doi:10.1016/S0140-6736(11)60393-0

30. Seligman HK, Schillinger D. Hunger and socioeconomic disparities in chronic disease. *N Engl J Med*. 2010;363(1):6-9. doi:10.1056/NEJMp1000072

31. Kickbusch I, Allen L, Franz C. The commercial determinants of health. *Lancet Glob Heal*. 2016;4(12):e895-e896. doi:10.1016/S2214-109X(16)30217-0

32. World Health Organization. *WHO Framework Convention on Tobacco Control*. 2005th

ed. WHO Document Production Services; 2003.

33. Capewell S, Lloyd-Williams F. The role of the food industry in health: lessons from tobacco? *Br Med Bull*. 2018;125(1):131-143. doi:10.1093/bmb/ldy002

34. Crosbie E, Schmidt LA. Preemption in Tobacco Control: A Framework for Other Areas of Public Health. *Am J Public Health*. 2020;110(3):345-350. doi:10.2105/AJPH.2019.305473

35. Cecchini M, Sassi F, Lauer J a, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. *Lancet*. 2010;376(9754):1775-1784. doi:10.1016/S0140-6736(10)61514-0

36. Backholer K, Beauchamp A, Ball K, et al. A framework for evaluating the impact of obesity prevention strategies on socioeconomic inequalities in weight. *Am J Public Health*. 2014;104(10):e43-50. doi:10.2105/AJPH.2014.302066

37. Benach J, Malmusi D, Yasui Y, Martínez JM, Muntaner C. Beyond Rose's Strategies: A Typology of Scenarios of Policy Impact on Population Health and Health Inequalities. *Int J Heal Serv*. 2011;41(1):1-9. doi:10.2190/HS.41.1.a

38. Mialon M, Gomes F da S. Public health and the ultra-processed food and drink products industry: corporate political activity of major transnationals in Latin America and the Caribbean. *Public Health Nutr*. 2019;22(10):1898-1908. doi:10.1017/S1368980019000417

39. Hawkes C, Smith TG, Jewell J, et al. Smart food policies for obesity prevention. *Lancet*. 2015;385(9985):2410-2421. doi:10.1016/S0140-6736(14)61745-1

Chapter II

Food and Beverage Industry Interference in Science and Policy: Efforts to Block Soda Tax Implementation in Mexico and Prevent International Diffusion

Introduction

Mexico is the largest soft drink market in the world, with average consumption at 151 liters per capita per year.[1] The country also has disproportionately high rates of obesity and type 2 diabetes.[2] Due to strains on the nation's productivity and healthcare spending, Mexican lawmakers implemented one of the world's first public health taxes on sugar-sweetened beverages (SSBs) on January 1, 2014 as part of its federal budget.[3] At the time, a few developed countries with low consumption rates had soda taxes (e.g., France, Denmark)[4] but there was no empirical research on their effectiveness, only price-elasticity simulations based on alcohol and tobacco taxation. These simulations suggested that a 10% increase in the price of SSBs was associated with a 11% decrease in consumption.[5,6].

Since Mexico implemented its tax, soda taxation has become an international movement.[7] Thirty-five countries around the globe have adopted SSB taxation policies, including in the UK.[4,8] Three systematic reviews now conclude that taxation is effective for reducing SSB consumption,[9–11] with the first empirical studies based on Mexico.[12–17]

Because they are designed to reduce SSB consumption, soda tax proposals and related strategies to reduce SSB (e.g., warning labels, public education campaigns, SSB sales ban in schools) have routinely faced opposition by transnational food and beverage corporations in Mexico and

globally.[18,19] A key opposition strategy is to fund scientists to produce evidence favorable to industry interests.[18,20] Although the food industry's opposition preceding passage of the Mexican soda tax has already been documented,[19,21–24] little is known about the industry's tactics once the policy took effect.

We reviewed previously secret internal industry documents contained in the University of California at San Francisco's *Food Industry Documents Archive* to identify industry strategies to undermine Mexico's tax and to prevent the international diffusion of the soda taxation.[25] This online repository contains internal memos, emails, and other private communications between executives from leading transnational beverage corporations, such as Coca-Cola, and the researchers they fund. (See supplementary data for details on document sources and research methods.) We also used standard qualitative analysis methods to review all available evaluations of Mexico's tax policy, comparing results and discussion from industry-funded and non-industry-funded studies. We found that beverage companies paid scientists in Mexico, the US, and Canada to produce credible-seeming evidence that the Mexican tax policy was a failure.

They did so in what would prove a largely unsuccessful effort to block implementation in Mexico, and to stall or prevent the international diffusion of soda taxation. We argue that ultimately, Mexico provided a real-world context for the first non-industry-funded, peer-reviewed studies documenting the effectiveness of soda taxation—studies that were ultimately promoted by the global health community.

The Food and Beverage Industry's Response to Mexico's Implementation of a Soda Tax

During 2014, Mexico's Health Minister, Mercedes Juan, who formerly directed a Nestlé-funded research organization, created the Mexican Observatory on Non-Communicable Diseases to monitor obesity and diabetes, including the effects of the soda tax.[26] Juan appointed an Advisory Council with representatives tied to the food and beverage industry,[21,27] including key trade groups that had opposed passage of the tax, arguing that it would harm the economy.

In June 2015, Mexican government scientists reported that nationwide, SSB purchases appeared to have gone down by 6% because of the tax.[28] In July, the National Alliance of Small Merchants (ANPEC) gave a press conference to present data suggesting that 30,000 small stores had been forced to close down due to the tax.[29] Shortly thereafter, the National Association of Soda and Carbonated Water Producers (ANPRAC) released a study claiming that the tax was regressive because it negatively impacted Mexicans with low purchasing capacity.[30] Soon came another industry-funded study reporting that SSB sales had decreased by only 3-4.4%, amounting to a negligible reduction in daily calories for the average Mexican, while producing 10,815 job losses.[31] Industry-funded researchers at the Mexican Autonomous Institute of Technology (ITAM) released yet another study concluding that, while SSB purchases had decreased by 6.5%, total calories were reduced by only 1%, with no impact on obesity.[32] (See supplementary data for details on all studies.)

In late 2015, Coca-Cola and its Mexican bottlers began lobbying for reductions in the tax on lower-sugar beverages to create "an incentive based on the reduction of the caloric content to

effectively impact the fight against obesity."[33] The idea appeared in recommendations by the Finance Commission of the Deputies Chamber for the 2016 federal budget.[34,35]

One month prior to the federal budget vote, the Mexican Branch of the International Life Sciences Institute (ILSI Mexico), a Coca-Cola-funded scientific front group at the time,[36] sponsored the national symposium, *Sweeteners and Health*. Co-sponsoring was the RIPPE Lifestyle Institute of Shrewsbury, Massachusetts, a center providing research services to beverage corporations including Coca-Cola and PepsiCo.[37] In a series of private emails, its founder, Dr. James Rippe, networked with other US academics to recruit scientists to present research at the symposium, promising "a modest honorarium if you decide to turn your presentation into one of the [ASN American Society for Nutrition] journals or another academic journal."[38] Rippe noted that "the symposium comes at a very important time in Mexico and relates to a number of issues that are very important in this country."[38] Speakers at the symposium argued that "sugar is not the enemy, the problem is calories,"[39] and questioned whether Mexico was "taxing the right food group, if their intention is to curb obesity."[40] In the plenary session, Rippe stated that: "Taxing SSBs will not reduce consumption, and will not do anything meaningful for obesity and diabetes."[41] During the symposium a report was circulated claiming that even with a much-large tax of 20-40%, the "the impact on BMI [body mass index] would be marginal".[42]

The symposium drew negative press for ILSI Mexico,[43] including criticisms that American scientists had been recruited to "fight the tax."[43,44] ILSI International ultimately suspended ILSI Mexico's membership "for engaging in activities that can be construed to be policy advocacy

and/or public relations efforts to influence policy."[45] In a private email, Alex Malaspina, former Coca-Cola executive and Director of ILSI International, wrote to a Coca-Cola-funded scientist at the University of Colorado, Dr. James Hill, about "the mess ILSI Mexico is in because they sponsored in September a sweeteners conference when the subject of soft drinks taxation was discussed…A real mess."[46] The proposal to reduce the Mexican soda tax ultimately passed in the Chamber of Deputies[47] but failed in the Senate, leaving the original tax policy in place.[48]

Contrasting Messages from Industry-Funded and Non-Industry-Funded Research

Industry-funded reports, none of which were peer-reviewed, became available within the first year of policy implementation. However, it was not until January of 2016 that non-industry-funded evaluations of the Mexican tax policy began to appear in the peer-reviewed scientific literature. (See supplementary data for details on all studies.)

Industry-funded studies documented numerous negative impacts on the Mexican economy, particularly on vulnerable low-income households, whereas non-industry-funded evaluations found none. Industry-funded researchers criticized the tax as regressive: Even though tax revenues were collected "mainly from the richest households, the tax burden [was] heavier in the poorest households."[31] It was further estimated, using an input-output econometric model, that the tax had led to 10,815-42,385 job losses and an economy-wide loss of 6.4 billion pesos (U.S.$378M) during its first year, amounting to a 0.4% loss of GDP.[31] Non-industry-funded studies concluded that the economic effects of the tax were more benign. For example, the first peer-reviewed paper on the tax, published in 2016 by BMJ,[12] found disproportionately large reductions in SSB purchases by lower-income households and concluded that this, plus health

and productivity gains in these households, could potentially amount to a progressive, not regressive, tax effect. Another non-industry-funded study[49] analyzed three nationally representative surveys to estimate changes in unemployment rates after adjusting for contextual variables. Authors found no significant employment changes associated with the tax, noting that sales of untaxed beverages had increased to "offset the potential negative effect on employment."

Two additional industry-funded studies[31,32] and three non-industry-funded studies[12,13,50] evaluated changes in SSB sales following implementation of the soda tax. Although all reported statistically significant reductions in SSB sales, which ranged from 3.4% to 7.3%, the interpretation of results differed depending on who funded the research. Industry-funded studies interpreted these declines as neglible. They did so in part by translating decreases in sales into calorie reductions for the average Mexican's diet, arguing that such changes were meaningless from a health standpoint; one went on to argue that consumers could easily make up for such a small beverage calorie reduction by consuming more high-calorie foods. Two additional industry-funded studies emphasized that no changes had been observed in rates of obesity during the first two years of the tax.[31,32] Studies conducted by scientists without industry ties, in contrast, assumed that with such a small tax and only two years of implementation, empirical studies could not realistically be expected to find changes in obesity rates.[51] However, three non-industry-funded studies published projections that found significant reductions in the prevalence of obesity over a 10-year period.[52–54]

The Mexican Soda Tax in International Context

Our analysis of internal industry documents revealed that numerous Coca-Cola executives leveraged their global networks to disseminate the industry-funded studies just reviewed, along with their key messages that the Mexican tax failed to lower SSB consumption and was harmful to the economy.[55–60] In 2015, Coca-Cola International's Manager of Public Affairs emailed some of these studies to executives in Communications and Government Relations as "relevant and useful updates on the excise tax in Mexico…[for] engaging stakeholders to demonstrate why excise taxes on our products are not effective policy mechanisms and can have unintended negative consequences, such as significant job losses."[61] Coca-Cola's Vice President of Government Relations and Public Affairs further disseminated the studies to company executives on the Global Pacific leadership team, noting that, "After the call today, please find all of the latest materials to us in responding to the claims that the excise tax in Mexico has been effective."[61]

A February-March 2016 "classified—internal use only" document underscored the degree to which Coca-Cola executives internally viewed soda taxes to be a significant threat to the company's global enterprises. **Figure 2.1** is reprinted from an international strategy document found in the *Food Industry Documents Library*, called the "Radar Screen," which was produced by senior managers in Government Relations for Coca-Cola Europe. The very image of a radar screen captured its purpose in monitoring ongoing threats to the company's bottom line. This radar screen was in fact a "public policy risk matrix." It compared 49 governmental policy threats to Coca-Cola's business interests in the EU (on the Y axis) against the likelihood that each could materialize in member countries (on the X axis). Notably, of all 49 public policy

threats, new tax policies were assessed to have the greatest "business impact" on Coca-Cola and were also assessed to have a strong "likelihood to materialize."[60]

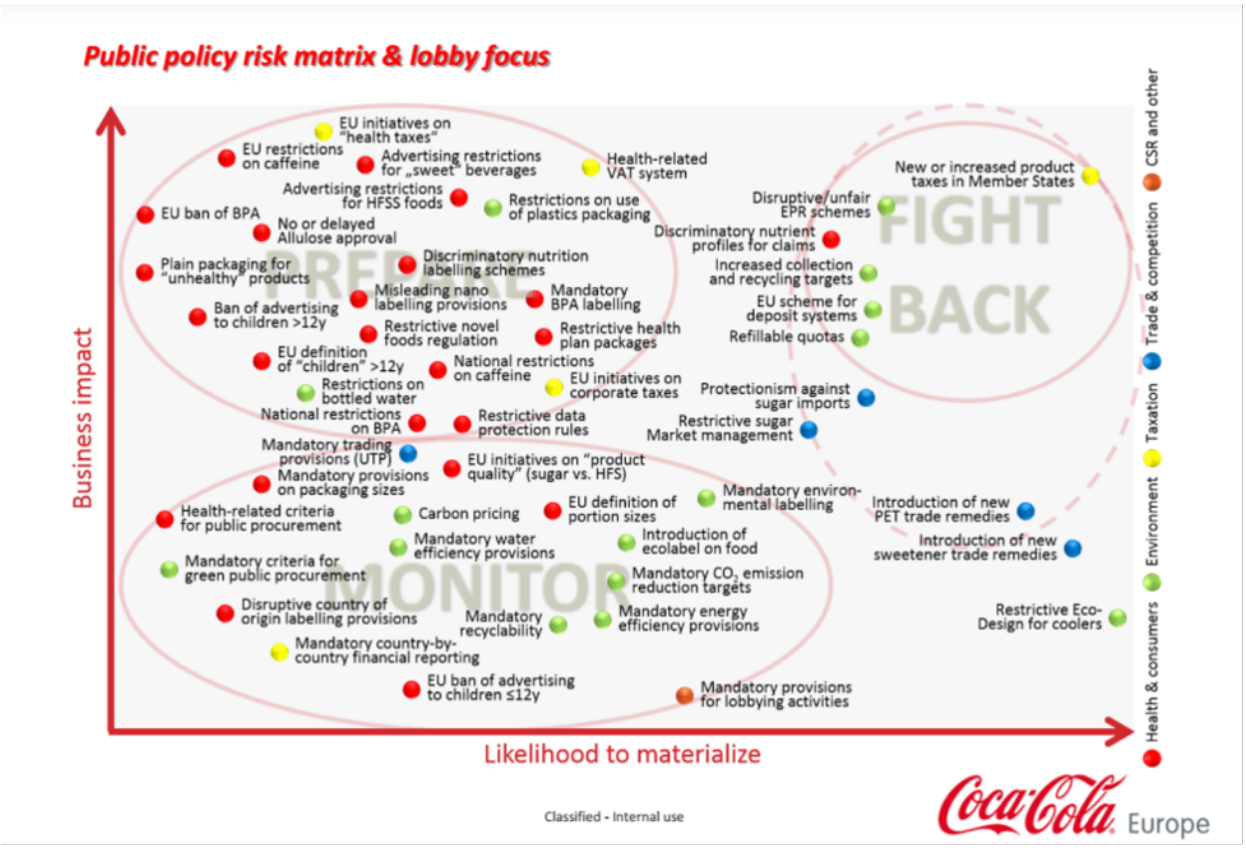

Figure 2.1 Coca-Cola Europe: *Radar Screen* for Monitoring Public Policy Threats
Source: University of California at San Francisco's *Food Industry Documents Archive*.[60]

In 2016, after the first peer-reviewed empirical study evaluating the Mexican soda tax appeared in BMJ,[12] ANPRAC launched the website, *calorictaxes.com*, to disseminate industry-funded research showing that the tax had failed to impact SSB consumption or obesity, while imposing significant economic hardships on the poor. Another academic symposium featured Mexican, US, and Canadian industry-funded scientists presenting findings that soda taxes fail to impact obesity.[62]

Following an inquiry by the *Wall Street Journal* about the 2016 BMJ study showing the tax had decreased SSB sales, Coca-Cola's Director of Global Affairs and Communications referred reporters to trade groups that had "multiple studies from well-respected institutions in Mexico (ITAM, ColMex, UANL, supported by funding from industry) that make clear the tax was ineffective."[63] He also provided a pre-release study funded by the American Beverage Association (ABA) showing that SSB consumption in Mexico had returned to its pre-tax baseline alongside 3,000 job losses—claims that made their way into newsprint.[63] When a *New York Times* reporter expressed interest in "exploring the premise that there has been a rise in the number of city and state beverage tax proposals… [and] that this rise can be linked to the 'success' of the tax in Mexico," the ABA's Vice President of Policy shared data from a industry-funded Mexican study[32] showing that "the tax has failed to improve health as its proponents claimed, is regressive and costs jobs."[64]

When in 2017, the third peer-reviewed paper on the Mexican tax appeared in *Health Affairs* showing a sustained national decline in SSB consumption over two years,[13] the International Council of Beverages Association (ICBA) stepped in. As the main trade association for the global beverage industry, ICBA released a statement that "the study does not show any impact from the tax on the obesity rates in Mexico," and called for alternative "evidence-based solutions" via local partnerships between government and industry.[65] Citing industry-funded studies, ICBA disseminated a fact sheet to its global partners outlining "a dozen reasons why soft drink taxes fall flat."[66]

Noting the peer-reviewed evidence emerging from Mexico, in 2016, the World Health Organization (WHO) began issuing recommendations that nation states consider soda taxes for the prevention of obesity and non-communicable diseases (NCDs).[67,68] In 2018, in preparation for the United Nations (UN) High Level Meeting on Non-Communicable Diseases, global health commissions discussed soda taxation as an evidence-based NCD prevention strategy, citing peer-reviewed research on the Mexican tax.[69] Internal email communications among Coca-Cola executives called this meeting "the most important event ahead in the NCD field" and expressed concerns that the Mexican delegation was among "the most vocal proponents of restricting private sector engagement with the WHO [World Health Organization]."[70] In preparation for the high-level meeting, WHO released the report, *Time to Deliver,* which proposed "best buys" for the prevention and management of NCDs, including tobacco and alcohol taxation.[71] In a public comment, ICBA levied methodological criticisms of the *Health Affairs* paper on the Mexican tax, noting that "regrettably, the authors of this article are relying on a theoretical model."[72] WHO's final report, *Time to Deliver,* stopped short of formally recommending soda taxes due to dissent by the US delegate,[73] but noted "broad support from many Commissioners."[71]

Conclusion

It is well documented that health-harming industries fund scientists to produce research to undermine new health regulations that, if enacted, could threaten commercial interests.[22–24,74,75] The case of the Mexican soda tax shows that industry resistance can persist well after new policies have become law as vested interests seek to roll back legislation, and to stall or prevent policy diffusion on an international basis. Immediately upon implementation, the same food and beverage industry stakeholders that had opposed passage of the Mexican tax took oversight

positions on government panels monitoring its effects and lobbied lawmakers to reduce the tax rate. Previously secret internal industry documents show that food and beverage executives feared the international diffusion of soda taxation and sought to combat emerging evidence that Mexico's tax was effective. Ultimately, Mexico successfully implemented its tax, and since then 35 countries have adopted similar measures.[4,8]

When health policy innovations are so new that they lack empirical research, industry-funded studies can be mobilized quickly to define an industry-friendly narrative.[76–78] It took two years for independent evaluations of the Mexican tax to begin appearing in peer-reviewed scientific journals. In the breech, industry stakeholders within Mexico, supported by a global infrastructure of trade organizations and scientific front groups, were able to quickly generate credible-seeming evidence that the policy was a failure. Industry-sponsored studies were rapidly published and disseminated at scientific meetings to establish a narrative that this policy was disproportionately affecting low-income households, producing job losses, and lowering Mexico's GDP, all while failing to lower SSB consumption or tackle obesity. This narrative drew upon the image of neutral, unbiased science for legitimacy. Thus, when the Mexico-based scientific front group for the industry, ILSI Mexico, became too blatant in its efforts to undermine the tax, it was quickly censured and closed down.

Industry-funded research was deployed within Mexico to pressure lawmakers to lower the tax—a proposal that passed in the Mexican Chamber of Deputies but ultimately failed in the Senate. Over time, the same industry-funded studies were disseminated globally by beverage industry executives in an international effort to contain the diffusion of soda taxation beyond Mexico. As

the threat of international diffusion grew, executives in transnational beverage corporations, such as Coca-Cola, aided by their global trade associations, amplified the narrative of a failed Mexican tax across their global communication networks, helping it to gain traction in the international press. Media outlets within Mexico were important for exposing industry's recruitment of US-based scientists to advocate against the tax. This highlights the ongoing need to educate scientists, policymakers, and media outlets about scientific conflicts of interest and why commercial interests can bias research.

Findings from this study underscore the decisive role that peer-reviewed research can play in implementing progressive public health policies. Mexico created a real-world context for the first peer-reviewed empirical studies demonstrating the effectiveness of taxing SSBs. Despite an impressive degree of global industry opposition, peer-reviewed evaluations of the Mexican tax eventually garnered the attention of international expert panels on NCDs.[67–69] This gave impetus to measured endorsements of soda taxes by the UN and WHO, setting the stage for their growing adoption by countries around the globe.

References

1. Conway J. Soft drink per capita consumption in the ten most populated countries worldwide 2019. statista. Published 2020. https://www.statista.com/statistics/505794/cds-per-capita-consumption-in-worlds-top-ten-population-countries/
2. World Health Organization. Global Health Observatory. 2015. Accessed December 21, 2020. https://www.who.int/data/gho
3. Diario Oficial de la Federacion. LEY DE INGRESOS DE LA FEDERACIÓN PARA EL EJERCICIO FISCAL DE 2014 . Capítulo I De los Ingresos y el Endeudamiento Público. Published 2014. Accessed May 20, 2019. http://www.diputados.gob.mx/LeyesBiblio/abro/lif_2014.htm
4. World Cancer Research Fund International. *Building Momentum: Lessons on Implementing a Robust Sugar Sweetened Beverage Tax*.; 2018. https://www.wcrf.org/buildingmomentum
5. Barquera S, Hernandez-Barrera L, Tolentino ML, et al. Energy Intake from Beverages Is Increasing among Mexican Adolescents and Adults. *J Nutr*. 2008;138(12):2454-2461. doi:10.3945/jn.108.092163
6. Colchero MA, Salgado JC, Unar-Munguía M, Hernández-Ávila M, Rivera-Dommarco JA. Price elasticity of the demand for sugar sweetened beverages and soft drinks in Mexico. *Econ Hum Biol*. 2015;19:129-137. doi:10.1016/j.ehb.2015.08.007
7. Nestle M. *Soda Politics. Taking Soda (and Winning)*. Oxford University Press; 2015.
8. Global Food Research Program. Sugary drink taxes around the world. Published 2020. http://globalfoodresearchprogram.web.unc.edu/files/2020/08/SugaryDrink_tax_maps_2020_August_REV.pdf

9. Teng AM, Jones AC, Mizdrak A, Signal L, Genç M, Wilson N. Impact of sugar-sweetened beverage taxes on purchases and dietary intake: Systematic review and meta-analysis. *Obes Rev*. 2019;20(9):1187-1204. doi:10.1111/obr.12868

10. Redondo M, Hernández-Aguado I, Lumbreras B. The impact of the tax on sweetened beverages: a systematic review. *Am J Clin Nutr*. 2018;108(3):548-563. doi:10.1093/ajcn/nqy135

11. Backholer K, Sarink D, Beauchamp A, et al. The impact of a tax on sugar-sweetened beverages according to socio-economic position: a systematic review of the evidence. *Public Health Nutr*. 2016;19(17):3070-3084. doi:10.1017/S136898001600104X

12. Colchero MA, Popkin BM, Rivera JA, Ng SW. Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *BMJ*. 2016;352:h6704.

13. Colchero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, Evidence Of Sustained Consumer Response Two Years After Implementing A Sugar-Sweetened Beverage Tax. *Health Aff (Millwood)*. 2017;36(3):564-571. doi:10.1377/hlthaff.2016.1231

14. Sánchez-Romero LM, Canto-Osorio F, González-Morales R, et al. Association between tax on sugar sweetened beverages and soft drink consumption in adults in Mexico: open cohort longitudinal analysis of Health Workers Cohort Study. *BMJ*. Published online May 6, 2020:m1311. doi:10.1136/bmj.m1311

15. Colchero MA, Molina M, Guerrero-López CM. After Mexico Implemented a Tax, Purchases of Sugar-Sweetened Beverages Decreased and Water Increased: Difference by Place of Residence, Household Composition, and Income Level. *J Nutr*. 2017;147(8):1552-1557. doi:10.3945/jn.117.251892

16. Ng SW, Rivera JA, Popkin BM, Colchero MA. Did high sugar-sweetened beverage purchasers respond differently to the excise tax on sugar-sweetened beverages in Mexico? *Public Health Nutr*. 2019;22(4):750-756. doi:10.1017/S136898001800321X

17. Barrientos-Gutiérrez T, Colchero MA, Sánchez-Romero LM, Batis C, Rivera-Dommarco J. Posicionamiento sobre los impuestos a alimentos no básicos densamente energéticos y bebidas azucaradas. *Salud Publica Mex*. 2018;60(5, sep-oct):586. doi:10.21149/9534

18. Fooks GJ, Williams S, Box G, Sacks G. Corporations' use and misuse of evidence to influence health policy: A case study of sugar-sweetened beverage taxation. *Global Health*. 2019;15(1):1-20. doi:10.1186/s12992-019-0495-5

19. Gómez EJ. Coca-Cola's political and policy influence in Mexico: Understanding the role of institutions, interests and divided society. *Health Policy Plan*. 2019;34(7):520-528. doi:10.1093/heapol/czz063

20. Barnoya J, Nestle M. The food industry and conflicts of interest in nutrition research: A Latin American perspective. *J Public Health Policy*. 2016;37(4):552-559. doi:10.1057/jphp.2015.37

21. Carriedo A, Lock K, Hawkins B. Policy Process And Non-State Actors' Influence On The 2014 Mexican Soda Tax. *Health Policy Plan*. 2020;35(8):941-952. doi:10.1093/heapol/czaa060

22. Ojeda E, Torres C, Carriedo Á, Mialon M, Parekh N, Orozco E. The influence of the sugar-sweetened beverage industry on public policies in Mexico. *Int J Public Health*. 2020;65(7):1037-1044. doi:10.1007/s00038-020-01414-2

23. James E, Lajous M, Reich MR. The Politics of Taxes for Health: An Analysis of the Passage of the Sugar-Sweetened Beverage Tax in Mexico. *Heal Syst Reform*. 2020;6(1).

doi:10.1080/23288604.2019.1669122

24. Carriedo Lutzenkirchen A. *A Policy Analysis of the 2014 Mexican Soda Tax.*; 2017. doi:https://doi.org/10.17037/PUBS.04648204

25. University of California San Francisco. Food Industry Documents. Published 2020. Accessed December 20, 2020. https://www.industrydocuments.ucsf.edu/food/

26. Diario Oficial de la Federacion. Acuerdo por el que se crea el Consejo Asesor del Observatorio Mexicano de Enfermedades No Transmisibles. Published 2014. http://www.dof.gob.mx/nota_detalle.php?codigo=5361364&fecha=24/09/2014

27. Barquera S, Sánchez-Bazan K, Carriedo A, Swinburn B. The development of a national obesity and diabetes prevention and control strategy in Mexico: actors, actions and conflicts of interest. In: Mwatsama M, ed. *Public Health and the Food and Drinks Industry: The Governance and Ethics of Interaction Lessons from Research, Policy and Practice*. UK Health Forum; 2018:18-30.

28. Colchero M, Rivera J, Ng S-W, Popkin B. Reducción en el consumo de bebidas con impuesto después de la implementación del impuesto en México. Instituto Nacional de Salud Pública. Published 2015. Accessed October 28, 2020. https://www.insp.mx/epppo/blog/3666-reduccion-consumo-bebidas.html

29. Ramirez M. Cierran 30 mil "tienditas" por reforma fiscal e inseguridad. *Milenio*. https://www.milenio.com/negocios/cierran-30-mil-tienditas-reforma-fiscal-inseguridad. Published 2015. Accessed October 28, 2020.

30. Romero-Tellaeche J, Caldiño-García E, Minor-Campa E, Romero-Hernandez C. *Efectos Producidos En El Bienestar de La Sociedad Por La Política de Tributar Alimentos y Bebidas Altamente Calóricos. Gastos y Demanda Por Refrescos Por Hogar, 2012-2014.*;

2015.

31. Chapa-Cantú J, Flores-Curiel D, Zuñiga-Valero L. *La Industria de Las Bebidas No Alcohólicas En México*.; 2015. https://impuestosaludable.org/wp-content/uploads/2013/06/La-industria-de-las-bebidas-no-alcohólicas-en-méxico_vf_UANL.pdf
32. Aguilar A, Gutiérrez E, Seira E. *Taxing Calories in Mexico*.; 2015. http://cie.itam.mx/sites/default/files/cie/15-04.pdf
33. Consejo Coordinador Empresarial. *Recomendaciones de Ajustes a La Legislación Fiscal*.; 2015. Accessed October 29, 2020. http://www.diputados.gob.mx/comhaciendaLXIII/Presentaciones/1_CCE/CCE_Presentacion.pdf
34. El Contribuyente. Las refresqueras empujaron la reducción del IEPS, denuncia ONG.https://www.elcontribuyente.mx/2015/10/las-refresqueras-empujaron-la-reduccion-del-ieps-denuncia-ong/. Published October 27, 2015. Accessed October 29, 2020.
35. Maerker D. No hay interés de beneficiar a refresqueros: dip. PRI. Con Denise Maerker. Published online 2015. Accessed October 29, 2020. https://www.radioformula.com.mx/audio-y-video/atando-cabos/20151021/no-hay-interes-de-beneficiar-a-refresqueros-dip-pri-con-denise-maerker/
36. ILSI México : International Life Sciences Institute. Accessed July 28, 2019. http://ilsi-mexico.org/
37. Rippe Lifestyle Institute: Partners & Programs. Accessed July 28, 2020. http://rippehealth.com/rippelifestyle/partnersprograms.htm
38. John, Peters C; Hill J, University of Colorado. Slight Change in Plans for Mexico

Symposium: From Dr. James Rippe. 2015 May 14. *USRTK Food Ind Collect US Right to Know*. Accessed October 20, 2020. https://www.industrydocuments.ucsf.edu/docs/qzyk0228

39. EFE. Obesidad es un problema de calorías, no de consumo de azúcar, según expertos. Published September 2, 2015. Accessed April 18, 2020. https://www.efe.com/efe/america/mexico/obesidad-es-un-problema-de-calorias-no-consumo-azucar-segun-expertos/50000545-2702788
40. Federación Mexicana de Diabetes. Expertos hablan sobre relación entre consumo de azúcares y aumento de obesidad. Published September 2, 2015. Accessed April 19, 2020. http://fmdiabetes.org/expertos-hablan-sobre-relacion-entre-consumo-de-azucares-y-aumento-de-obesidad/
41. Rippe J. Sweeteners and Health. Published online 2015.
42. White J, Sievenpiper J, Rippe J, et al. *Sweeteners and Health: A Review of the Scientific Literature*. ILSI Mex. (ILSI de Mexico A.C., ed.).; 2015.
43. Reforma Redacción. Denuncian "ciencia chatarra." *Reforma*. https://www.reforma.com/aplicaciones/articulo/default.aspx?id=632456&v=3&referer=--7d616165662f3a3a6262623b727a7a7279703b767a78--. Published September 2, 2015. Accessed December 9, 2020.
44. Alianza por la Salud Alimentaria. Corporaciones de alimentos y bebidas traen "ciencia chatarra" a México para negar daños a salud y combatir el impuesto - Alianza por la Salud Alimentaria. Published September 3, 2015. Accessed October 28, 2020. https://alianzasalud.org.mx/2015/09/corporaciones-de-alimentos-y-bebidas-traen-ciencia-chatarra-a-mexico-para-negar-danos-a-salud-y-combatir-el-impuesto/

45. ILSI. International Life Sciences Institute Suspends ILSI Mexico's Charter. Published 2015. Accessed April 4, 2020. https://ilsi.org/wp-content/uploads/2019/06/ILSI-Mexico-Suspension.pdf

46. Peters JC, University of Colorado Anschutz Health and Wellness Center. [Email from John C Peters Regarding the Update]. *2015 November 09. USRTK Food Industry Collection. US Right to Know.* https://www.industrydocuments.ucsf.edu/food/docs/#id=hmlk0228. Accessed October 28, 2020.

47. Comisión de Hacienda y Crédito Público. *Declaratoria de Publicidad de Dictámenes*.; 2015. Accessed October 29, 2020. http://gaceta.diputados.gob.mx/PDF/63/2015/oct/20151019-III-1.pdf

48. Senado de México. *Sesión Ordinaria de La H. Cámara de Senadores Celebrada El Miércoles 28 de Octubre Del 2015*.; 2015. Accessed October 29, 2020. https://www.senado.gob.mx/64/version_estenografica/2015_10_28/1660

49. Guerrero-López CM, Molina M, Colchero MA. Employment changes associated with the introduction of taxes on sugar-sweetened beverages and nonessential energy-dense food in Mexico. *Prev Med (Baltim)*. 2017;105(February):S43-S49. doi:10.1016/j.ypmed.2017.09.001

50. Colchero MA, Guerrero-López CM, Molina M, Rivera JA. Beverages sales in Mexico before and after implementation of a sugar sweetened beverage tax. *PLoS One*. 2016;11(9):4-11. doi:10.1371/journal.pone.0163463

51. Popkin BM. Mexican cohort study predates but predicts the type of body composition changes expected from the mexican sugar-sweetened beverage tax. *Am J Public Health*.

2017;107(11):1702-1703. doi:10.2105/AJPH.2017.304097

52. Basto-Abreu A, Barrientos-Gutiérrez T, Vidaña-Pérez D, et al. Cost-Effectiveness Of The Sugar-Sweetened Beverage Excise Tax In Mexico. *Health Aff (Millwood)*. 2019;38(11):1824-1831. doi:10.1377/hlthaff.2018.05469

53. Barrientos-Gutierrez T, Zepeda-Tello R, Rodrigues ER, et al. Expected population weight and diabetes impact of the 1-peso-per-litre tax to sugar sweetened beverages in Mexico. *PLoS One*. 2017;12(5):1-15. doi:10.1371/journal.pone.0176336

54. Sánchez-Romero LM, Penko J, Coxson PG, et al. Projected Impact of Mexico's Sugar-Sweetened Beverage Tax Policy on Diabetes and Cardiovascular Disease: A Modeling Study. *PLoS Med*. 2016;13(11):e1002158. doi:10.1371/journal.pmed.1002158

55. Goltzman M, Chantereau E. FW: INFORM: France Tax Threats Defeated. 2015 December 21. DC Leaks Coca Cola Emails. DC Leaks. Accessed December 12, 2020. https://www.industrydocuments.ucsf.edu/food/docs/#id=rtcl0226

56. Goltzman M. Fwd: JQ Interview El Tiempo Colombia 013016. *2016 January 31. DC Leaks Coca Cola Emails. DC Leaks.* https://www.industrydocuments.ucsf.edu/food/docs/#id=mycl0226. Accessed December 2, 2020.

57. Goltzman M, Waichungo W, Sancroft. Please Take Note: SRA Top Issues - Policy Briefs. 2016 January; DC Leaks Coca Cola Emails. DC Leaks. Accessed December 2, 2020. https://www.industrydocuments.ucsf.edu/food/docs/#id=mycl0226

58. Goltzman M, Banks H. INFORM: Israel tax threat. 2016 April 18. DC Leaks Coca Cola Emails. DC Leaks. Accessed February 2, 2020. https://www.industrydocuments.ucsf.edu/food/docs/#id=tmcl0226

59. Goltzman M. FW: INFORM: Global Government Relations Dashboard - March 2016. 2016 April 04. DC Leaks Coca Cola Emails. DC Leaks. Accessed February 2, 2020. https://www.industrydocuments.ucsf.edu/docs/grcl0226

60. Coca Cola Europe. Radar Screen of EU Public Policies. Monthly Issue update: February and March 2016. Accessed December 2, 2020. https://www.documentcloud.org/documents/3409808-EU-Radar-Screen-Issue-Update-2016-02-03.html

61. Goltzman M. FW: INFORM: Mexico Excise Tax Materials & Resources. 2015 July 15. DC Leaks Coca Cola Emails. DC Leaks. Accessed July 12, 2019. https://www.industrydocuments.ucsf.edu/food/docs/#id=pfdl0226

62. Conferencia "Obesity: Causes and Public Policy Responses" | Eventos y Noticias. Accessed December 10, 2020. https://eventos.itam.mx/es/3/eventos/2016/03/09/conferencia-obesity-causes-and-public-policy-responses

63. Goltzman M, Tressler K. INFORM: Walls Street Journal Study in beverage tax impact in Mexico. DC Leaks. Coca Cola Emails. Published April 30, 2016. Accessed February 2, 2020. https://www.industrydocuments.ucsf.edu/docs/gkcl0226

64. Lemming J, Goltzman M. INFORM: New York Times Article on Soda Taxes. 2016 March 14. DC Leaks Coca Cola Emails. DC Leaks. DC Leaks Coca Cola Emails. DC Leaks. Published March 14, 2016. Accessed February 20, 2020. https://www.industrydocuments.ucsf.edu/docs/lrcl0226

65. International Council of Beverages Association. International Council of Beverages Associations' Response to Health Affairs Journal Article on the Mexico Sugar-Sweetened

Beverage Tax. Press release. Published 2017. Accessed December 8, 2020. http://www.icba-net.org/news-events/news/details/19/

66. International Council of Beverages Association. A DOZEN REASONS WHY SOFT DRINK TAXES FALL FLAT (Fact sheet). https://www.icba-net.org/files/resources/final-icba_12-reasons-why_english.pdf

67. World Health Organization. *Report of the Commission on Ending Childhood Obesity.*; 2016. http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf?ua=1

68. World Health Organization. *Fiscal Policies for Diet and Prevention of Noncommunicable Diseases. Technical Meeting Report.*; 2015.

69. Sassi F, Belloni A, Mirelman AJ, et al. Equity impacts of price policies to promote healthy behaviours. *Lancet*. 2018;391(10134):2059-2070. doi:10.1016/S0140-6736(18)30531-2

70. Goltzman, Michael; Vermeulen W. FW: INFORM: World Health Assembly May 23-28. DC Leaks Coca Cola Emails. DC Leaks.2016 May 21. Accessed December 10, 2019. https://www.industrydocuments.ucsf.edu/docs/kqcl0226

71. World Health Organization. *Time to Deliver: Report of the WHO Independent High-Level Commission on - - Noncommunicable Diseases*. World Health Organization; 2018.

72. International Council of Beverages Association. Re: Comments on the Draft first report of the WHO Independent High-Level Commission on Non-Communicable Diseases. Published online 2018. https://www.who.int/ncds/governance/high-level-commission/International-Council-of-Beverages-Associations.pdf?ua=1

73. Keaten J, Cheng M. U.S. blocks UN health panel from backing taxes on sugar drinks. *PBS*. https://www.pbs.org/newshour/health/un-health-panel-backs-away-from-taxing-sugary-drinks. Published June 1, 2018. Accessed December 10, 2020.

74. Crosbie E, Sosa P, Glantz SA. Costa Rica's implementation of the Framework Convention on Tobacco Control: Overcoming decades of industry dominance. *Salud Publica Mex*. 2016;58(2):62-70. doi:10.21149/spm.v58i1.7669

75. White M, Barquera S. Mexico Adopts Food Warning Labels, Why Now? *Heal Syst Reform*. 2020;6(1):e1752063. doi:10.1080/23288604.2020.1752063

76. Crosbie E, Thomson G, Freeman B, Bialous S. Advancing progressive health policy to reduce NCDs amidst international commercial opposition: Tobacco standardised packaging in Australia. *Glob Public Health*. 2018;13(12):1753-1766. doi:10.1080/17441692.2018.1443485

77. Bhatta DN, Crosbie E, Bialous SA, Glantz S. Defending Comprehensive Tobacco Control Policy Implementation in Nepal From Tobacco Industry Interference (2011–2018). *Nicotine Tob Res*. Published online April 20, 2020. doi:10.1093/ntr/ntaa067

78. Crosbie E, Sosa P, Glantz SA. The importance of continued engagement during the implementation phase of tobacco control policies in a middle-income country: the case of Costa Rica. *Tob Control*. 2017;26(1):60-68. doi:10.1136/tobaccocontrol-2015-052701

Chapter III

A Workplace Sales Ban Reduced Sugar-Sweetened Beverage Consumption in employees with heavy Sugar-sweetened beverages consumption

Introduction

Sugar-sweetened beverage (SSB) consumption is a key risk factor for obesity, diabetes, and other cardiometabolic diseases.[1] One serving per day increases the risk of obesity by 12%,[2] diabetes by 18%,[3] and coronary heart disease by 17%. Among working-age adults, SSB consumption is the top dietary risk factor in cardiometabolic mortality.[4,5] Economic productivity losses are estimated to be $13.4 billion due to obesity[6] and $9 billion for diabetes.[7] While SSB consumption in the U.S. has been in decline since the 1990s,[8] consumption levels remain disproportionately high in Hispanic, Black, and low socioeconomic populations,[9] resulting in pronounced health disparities in cardiometabolic diseases.[10]

The 2021 National Clinical Care Commission report, *Leveraging Federal Programs to Prevent and Control Diabetes and its Complications,* recommended to Congress the adoption of public health interventions that reduce the availability and marketing of SSBs within food outlets.[11] Following the movement for tobacco-free workplaces, employers throughout the U.S. have begun experimenting with workplace sales bans on SSBs.[12,13] This entails the removal of SSBs from all workplace food and vending outlets, replacing them with non-sugary beverage options while still allowing employees to bring SSBs in. Alcohol availability theory[14] suggests that workplace sales bans could drive down SSB consumption because they reduce environmental saturation and place greater demands on individuals to find and purchase SSBs.[15] Evidence from

smoke-free workplace research suggests that employers adopting sales bans can help to trigger normative changes that decrease public acceptability of SSBs.[16]

To date, there is limited research on the effectiveness of SSB sales bans. There is some evidence from SSB sales bans in middle schools that, while consumption declines when students are at school, total consumption does not significantly change due to compensation with increased sugar consumption at home.[17] A sales ban at the University of British Columbia found no changes in sales in nearby off-campus outlets, suggesting no compensation.[18] A pilot study of 214 heavy SSB drinkers (≥ 12 oz/day) at another university found that a workplace SSB sales ban was associated with a significant decline in consumption and waist circumference within ten months.[19] A simulation study based on these data estimated that the sales ban could save the employer $300,000 per 10,000 people over 10 years by reducing health care and productivity gains, with more significant savings among service/manual workers and minority employees.[20]

This paper presents findings from a large, representative panel study of employees exposed to a workplace SSB sales ban, stratifying by baseline SSB consumption. The objective is to examine whether the sales ban differentially benefitted participants with heavy vs. moderate/no baseline consumption of SSBs at 6 and 12 months post-implementation and the extent to which the change in consumption occurred at work and outside the workplace. We hypothesized that exposure to a workplace sales ban would be associated with significant declines in SSB consumption, particularly among those at higher baseline risk of chronic disease due to a pattern of heavy SSB consumption.

Methods

In November 2015, the University of California at San Francisco (UCSF)—the second largest employer in San Francisco—eliminated the sale of all beverages that contain added caloric sweeteners across all cafeterias, vending machines, hospital food services, and retail outlets in the campus and medical center venues. Four months prior to introducing the sales ban, we recruited a representative sample of UCSF employees for this study, assessing their SSB consumption at work and home, their attitudes about SSBs, and their work habits. We subsequently followed the sample at 6- and 12-month intervals to observe changes in SSB consumption following the sales ban. Information about the UCSF sales ban initiative and other aspects of the evaluation have been published elsewhere.[19,20,22,23]

Study participants

A representative sample of 2,568 employees stratified by job classification was randomly selected from a complete listing of full-time UCSF employees (staff and faculty). The human resources department provided a complete list of employees to the study team. Service and manual workers, the lowest-income stratum of nine job classifications, were oversampled by a factor of 5. Employees were invited to participate by email or in-person interviews. Those who accepted received a $20 gift card incentive at baseline, $25 at the 6-month follow-up, and $30 at 12 months. In addition, a subsample of 214 heavy drinkers (≥12oz/day) was recruited for a randomized clinical trial studying the combined effects of the sales ban and brief motivational counseling vs. the sales ban alone.[19] Three-hundred and seven study participants (12%) with missing data at baseline and 225 (8.8%) lost to both follow-ups were excluded from the analysis, resulting in a final sample of 2036 employees. The response rate was 87.6% at 6 months and

85% at 12 months. The Institutional Review Board at UCSF approved the study, and all participants provided informed consent.

Measures

Survey data were collected online or in-person, depending on employee preference, in English, Spanish, or Chinese (Cantonese). Study participants reported their SSB consumption at all three-time points while at work and outside the workplace using a standardized beverage intake questionnaire, the Beverage Intake Questionnaire (BEVQ-15)[24] that assesses the frequency and quantity of SSB and other consumption during the past week. We made minor adaptations to the questionnaire to capture beverages consumed at work and outside work. We also modified a question about coffee drinks to measure consumption of sweetened coffee and tea drinks (e.g., Arizona iced tea, Starbucks Frappuccino). Daily consumption of SSBs (ounces/day) was estimated by multiplying the frequency of consumption by serving size. SSBs were defined as any beverage sweetened with sugar, including sugar-sweetened soda, fruit drinks, sports and energy drinks, sugared coffee and tea drinks, and other beverage drinks (e.g., soy milk, chocolate milk, horchata). We considered as an outlier when the total SSB was over 4 SD (more than 126 oz/day), and excluded those observations from the analysis (13 observations). Following prior studies,[19,25] heavy SSB consumption was defined as ≥12 oz/day.

The survey included questions to identify attitudes and beliefs regarding SSBs, including the desire to cut down, health concerns, and reasons for drinking, all using a 5-point Likert scale. At each wave of data collection, study participants were also asked about the frequency of obtaining SSBs near work versus brought from home. Respondents also reported demographic

characteristics and described their work habits. Demographics included age, sex, race/ethnicity, and household size. At each wave, participants reported their primary campus location, exposure to the sales ban (i.e., days spent on campus), and whether the participant have and overnight shift

Statistical Analysis

All analyses were adjusted using inverse probability weights (IPW) to address the oversampling of service and manual workers, baseline non-response, and attrition rates. To calculate the weights, we first obtained the probability of being enrolled in the study based on job classification and race/ethnicity. Second, we obtained the predicted probability of retention in the study using logistic regression models with interaction terms for factors affecting participation (e.g., sex, race, job classification, shift work). Then, we used the result of multiplying these probabilities to calculate the participant-specific IPW. We imputed extreme weights (> 95th percentile) to the equal value at 95th percentile (n=98). **Supplementary Tables S3.1 and S3.2** show the unadjusted results. All analyses were performed using Stata, version 16 (StataCorp, College Station, TX, USA).

Sociodemographic and employment characteristics at baseline were presented as frequency and proportion distributions. We performed Chi-square tests to compare baseline characteristics across SSB consumption categories (heavy vs. no/moderate consumption). To estimate the within-person change in SSB consumption (ounces/day) during the study in the overall population and by baseline consumption (heavy and moderate/no consumption) at work and outside work, we performed linear regression models with individual fixed effects. The individual fixed effects adjusted for all measured and unmeasured factors that did not vary within

person during the study period, such as sex and race.[26] Models were adjusted for time-varying covariates (monthly average temperature, the number of days working at any UCSF location, shift work, and participation in the brief motivational counseling sub-study[19]). We log-transformed the dependent variable (SSB) to account for the right-skewed distribution. Coefficients were exponentiated to present percent change in consumption.[27]

A final set of exploratory analyses considered within-person changes in employees' individual-level characteristics (e.g., SSB purchasing patterns, attitudes) during the study period, stratified by consumption at baseline. Here, we performed individual-level fixed-effects models to evaluate the change at 12 months in access to SSB and attitudes and reasons for consuming SSB. Models were adjusted for the same time-varying covariates as above.

Results

Table 3.1 shows the baseline characteristics of employees of study participants by SSB consumption. Approximately two-thirds of the sample is female, and most are under 60 years of age. Weighted analyses suggest 42.1% are white, 37.2% Asian, 10.8% Hispanic, and 6.2% African American. Participants that reported consuming more than 12 oz of SSBs (heavy consumption) were more likely to be Asian, Hispanic, or Black/African American, work as a medical technician or in the service/police/maintenance departments and have overnight shifts. In contrast, participants that reported consuming <12 oz of SSBs per day (moderate/no consumption) were more likely to identify as White, have an academic position, and not have overnight shifts.

Table 3.1. Study sample characteristics by heavy and non-heavy SSB consumption at baseline.[a]

	Total n=2036 (%)	**Moderate/no consumption** (< 12 oz/day) n=1432 (%)	**Heavy consumption** (≥12 oz/day) n=604 (%)	**P Value[b]**
Gender				
Women	64.6	64.7	64.3	0.883
Men	35.4	35.3	35.7	
Age				
20-39	49.8	50.1	48.9	0.604
40-59	43.3	42.7	44.9	
60 +	6.9	7.2	6.2	
Race/ethnicity				
Non-Hispanic White	42.1	47.8	24.7	<0.001
Black/African American	6.2	5.2	9.1	
Hispanic	10.8	9.3	15.2	
Asian	37.9	34.8	47.3	
Other	3.0	2.9	3.6	
Job Classification				
Medical technician	12.2	10.3	18.1	<0.001
Support staff, clerk, analyst	31.5	30.5	34.5	
Service/maintenance/police	5.6	3.3	12.6	
Medical provider (physician, nurse)	17.8	18.7	15.1	
Academic (faculty, postdoctoral fellow)	22.2	25.7	11.6	
Administrative, IT, miscellaneous	10.6	11.4	8.2	
Days per week at any UCSF location				
0-4 days/week	17.2	18.1	14.6	0.113
5-7 days/week	82.8	81.9	85.4	
Overnight shift worker				
No	87.2	88.7	82.8	0.003
Yes	12.8	11.3	17.2	

[a] Analyses were weighted for design effects, baseline non-response and attrition.
[b] Chi-square tests comparing heavy vs. moderate/no consumption

Figure 3.1 and **Supplementary Table S3** show the within-person changes in SSB consumption following exposure to the workplace sales ban. At the 12-month follow-up, there was a 9.0% reduction in SSB consumption across the whole employee population. The impact of the sales ban was more pronounced among those reporting heavy SSB consumption at baseline: Heavy drinkers decreased their SSB consumption by 59.3% at the 6-month follow-up and 60.8% at 12 months. In contrast, those with moderate/no SSB consumption at baseline increased their SSB intake at 12 months by 10.5%. Finally, comparisons of changes in SSB consumption at work and outside work revealed that SSB significantly declined at both places at 6 and 12 months among heavy drinkers and increased at 12 months among moderate/no SSB drinkers. We found no statistically significant changes at work vs. outside work among heavy and non-heavy drinkers.

Figure 3.2 includes bar charts showing trends in the types of SSBs consumed over the course of the study. On average, study participants drank 9.2 oz of SSBs per day at baseline, with 2.2 oz/day among moderate/no drinkers, compared to 30.3 oz/day among heavy drinkers. The primary source of SSBs was sweetened coffee/tea drinks, followed by regular (non-diet) soda for both heavy and moderate/no drinkers at all time points. When comparing the adjusted changes in each type of SSB with the fixed-effects models (**Supplementary Table S3.3**), we found that at the 12-month follow-up, the beverage types with greater reduction among heavy drinkers were soda (-44.8%) and coffee/tea drinks (-43.7%), with similar changes at six months. Conversely, participants with moderate/no SSB consumption increased intake of coffee/tea drinks by 15.8% at 6 and 12 months but did not change the intake of any other SSB.

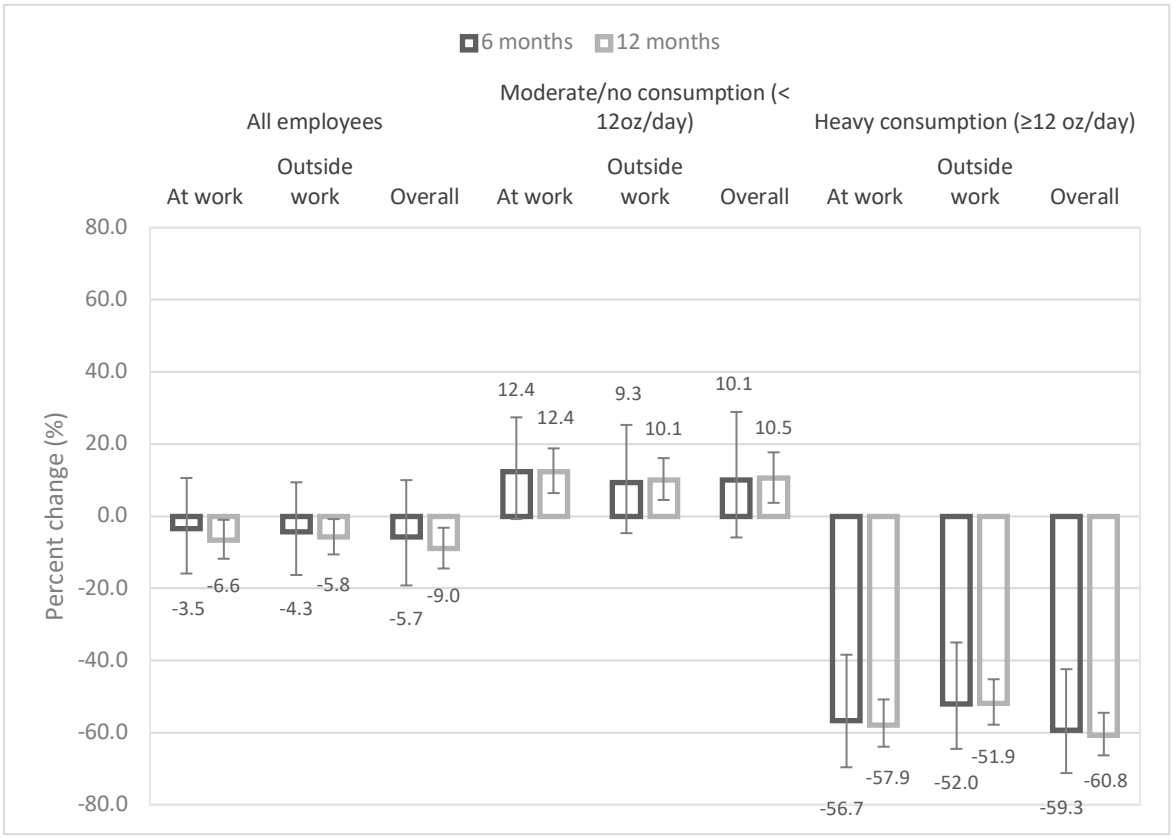

Figure 3.1. Percent change in sugar-sweetened consumption at 6- and 12-months following introduction of a workplace SSB sales ban: Results for employees with heavy versus moderate/no SSB consumption at baseline [a]

[a] Percent change in SSB consumption as reflected by coefficients from fixed effects models adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects, baseline non-response, and attrition.

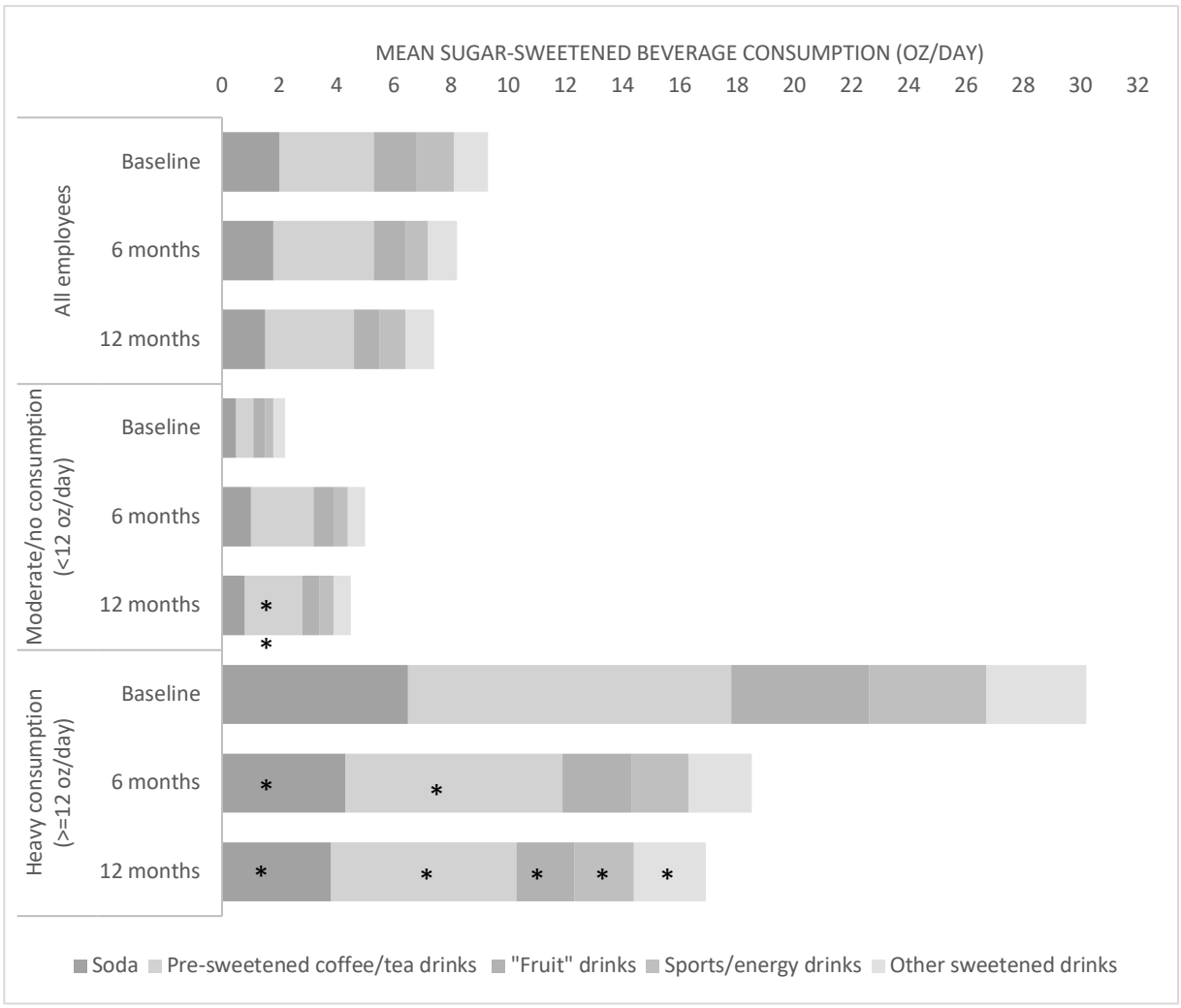

Figure 3.2. Types of sugar-sweetened beverages[a] consumed by employees at baseline, and 6- and 12- months following introduction of a workplace SSB sales ban: Heavy versus moderate/no consumption at baseline[b]

[a] "Fruit drinks" are drinks with zero or less than 100% real juice fruits. "Pre-sweetened Coffee/tea drinks" does not include coffee/tea that you add sugar to yourself. "Other sweetened drinks" (like sweetened soy beverages, chocolate milk, horchata).

[b] Mean (oz/day) weighted for design effects and attrition.

*Statistically significant decrease in consumption compared with baseline, as reflected by coefficients from fixed effects model adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects, baseline non-response and attrition (see supplementary table 4 for coefficients and 95%CI).

** Statistically significant increase in consumption compared with baseline, as reflected by coefficients from fixed effects model adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects, baseline non-response and attrition (see supplementary table 4 for coefficients and 95%CI).

A final exploratory analysis considered possible reasons why the sales ban appeared to be effective, particularly for heavy SSB drinkers at baseline, by considering changes in purchasing patterns, attitudes, and reasons for consuming SSB at 6 and 12 months. (**Table 3.2** and **Supplementary Table S3.4**). By the 12-month follow up, the proportion of heavy drinkers that stopped bringing SSBs to work decreased by 7.2 percentage points (pp) (95% CI: -14.2, -0.2). The proportion of heavy-drinkers that stopped buying SSBs in nearby off-campus locations decreased by 3,7 pp (95% CI: -10.8, 3.3), whereas the percentage of moderate/no consumers that begun to buy SSBs in nearby off-campus locations increased by 5.5 pp (95% CI: 0.3, 9.9).

Heavy drinkers were significantly less likely to report that other people encouraged them to cut down their SSB consumption at 12 months compared to baseline. A lower percentage of heavy drinkers at 12 months compared with baseline reported that they sometimes or frequently consumed SSBs because they are thirsty (9.3 pp reduction, 95% CI: -15.4, -3.2), and because they always have one at a particular time (14.7pp reduction, 95% CI: -22.6, -6.8). At baseline, most employees reported feeling somewhat or very positive about the SSB ban sales, with 70.1% of employees who drank no SSBs or drank moderately expressing positive views versus 56.4% heavy drinkers. At 12 months, the percentage of employees feeling positive about the SSB ban sales increased by 3.4pp among no/moderate consumers and by 8.5pp among heavy drinkers.

Table 3.2. Change in the purchasing of sugar-sweetened beverages (SSBs), attitudes and reasons for drinking SSBs 12 months following introduction of a workplace SSB sales ban

	Moderate/no consumption at baseline			**Heavy consumption at baseline**		
	Unadjusted prevalence		Adjusted percentage-point change	Unadjusted prevalence		Adjusted percentage-point change
	Baseline (%) *n=1432*	*12 month (%)* *n= 1340*	*Baseline to 12 months (95%CI)*[a]	*Baseline (%)* n=604	*12 month (%)* n=551	*Baseline to 12 months (95%CI)*[a]
SSB purchasing patterns						
I some/most of the time...						
Buy SSBs nearby worksite	40.7	43.2	**5.1 (0.3, 9.9)**	60.6	54.8	-3.7 (-10.8, 3.3)
Bring SSBs to work	26.8	28.4	0.4 (-3.9, 4.7)	59.0	52.6	**-7.2 (-14.2, -0.1)**
SSB Attitudes						
I sometimes or frequently…						
Am concerned that SSBs are not good for my health	69.7	62.3	-6.7 (-11.3, -2.1)	75.6	73.6	-0.7 (-6.7, 5.3)
Wish I could cut down	47.8	43.9	-5.0 (-9.5, -0.4)	70.3	68.4	-4.4 (-10.4, 1.7)
Other people encourage me to cut down	26.4	24.0	-2.4 (-6.1, 1.2)	53.8	43.8	-7.1 (-13.2, -0.9)
Reasons for consuming SSB						
Sometimes or frequently consume SSBs because I…						
Am thirsty	58.7	59.9	-0.8 (-5.4, 3.9)	77.8	72.6	**-9.3 (-15.4, -3.2)**
Enjoy the taste	84.5	83.8	-0.5 (-4.0, 2.9)	91.8	90.1	-2.4 (-6.8, 2.0)
Just feel like it	78.4	77.2	-1.0 (-5.0, 3.0)	82.1	82.0	-3.0 (-9.1, 3.0)
Need an energy boost	53.8	59.0	3.3 (-1.5, 8.1)	73.8	73.6	-4.4 (-11.1, 2.4)
Always have one at a particular time	28.7	32.1	3.4 (-1.6, 8.4)	65.4	51.0	**-14.7 (-22.6, -6.8)**
Am stressed out	30.0	33.9	3.6 (-1.0, 8.1)	50.2	48.0	2.0 (-4.2, 8.3)
Want to reward myself	46.7	50.3	1.8 (-2.7, 6.3)	60.7	60.6	1.0 (-5.8, 7.8)
Feel an urge for one	64.8	68.0	**4.8 (0.4, 9.2)**	74.8	77.5	2.8 (-3.5, 9.1)
Feeling positive/somewhat positive about the sales ban	70.1	73.9	**3.4 (0.5, 6.4)**	56.3	61.7	**8.5 (1.6, 15.8)**

[a] Percentage-point change in SSB consumption as reflected by coefficients from fixed effects model adjusting for ambient temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects and attrition. Statistically significant differences at the 5% level are displayed in bold type.

Discussion

Employers in the U.S. are increasingly experimenting with sales bans on SSBs as an obesity and diabetes prevention strategy.[12,13] This evaluation found that, overall, employees exposed to a workplace sales ban led to a persistent decline in SSB consumption over 12 months of 9.0%. Further, heavy drinkers experienced more pronounced effects: a 60.8% decline in SSB consumption at the 12-month follow-up. Heavy drinkers were 67.6% more likely to be racial/ethnic minorities and were disproportionately represented in the lowest occupational stratum, being employed as service and manual workers (**Table 3.1**). Our findings of more pronounced declines in SSB consumption among heavy drinkers suggest that sales bans could be most effective for those at greatest risk of obesity and non-communicable diseases by heavy SSB consumption and, in doing so, could help to improve employees' health.

Heavy drinkers were also more likely to be racial/ethnic minorities and of lower occupational status. These results are important because heavier consumers are at higher risk for obesity, diabetes, and cardiovascular diseases;[28] suggesting that sales bans could help to narrow the gap on health disparities. Prior studies suggest that individual-focused interventions, such as those focused on diet and exercise, disproportionately benefit participants with better access to education, health, and economic resources.[29] In contrast, environmental interventions, such as the sales ban, could have an equal or higher impact on disadvantaged populations whose socioeconomic, cultural, and environmental factors constrain dietary and health behaviors.[21]

We found no evidence that participants compensated for the reduced SSB consumption at work by consuming more SSBs outside of work, contrary to prior studies of sales ban policies at

school.[17] Heavy drinkers reduced their SSB consumption by more than 50% both at work and outside work, suggesting that sales ban initiative in the workplace can help employees to make healthier choices regarding beverage consumption. We also found that the policy was widely accepted by all employees. Our findings suggest the ban may have worked not only by decreasing the convenience of accessing SSBs, but also by changing drinking patterns (e.g., heavy drinkers reduced SSB consumption when they are thirsty) and routine drinking activities (e.g., heavy drinkers reduced SSB intake at a particular time of the day and stopped bringing SSBs at work). The fact that we observed changes in employees' attitudes towards SSBs, it is possible that over time could help to shifting norms in the workplace surrounding the consumption of SSBs. Heavy drinkers stopped bringing SSBs at work, which one explanation could be that policy denormalized consuming SSBs at work. Prior studies of workplace smoking bans also find that employees reduced tobacco consumption outside work, and that families implement voluntary smoking restrictions at home.[30]

Moderate/no drinkers increased overall SSB consumption by 10% (0.3 oz/day), which was explained by increasing coffee drinks while not changing any other SSB intake. One potential explanation is that moderate/no drinkers may have misclassified coffee/tea drinks consumption. The survey asked about sweetened coffee or tea drinks (not including coffee/tea that you add sugar to yourself). However, it is possible that at follow-up, participants were more aware of all the sources of sugar in their drinks, and they reported regular coffee in this question, not only sugared coffee drinks. A sensitivity analysis removing coffee drinks shows no change in overall SSB consumption among non-heavy drinkers (0.1%, 95%CI:-4.9, 5.4) and a slightly smaller

effect in heavy drinkers (-47.6%, 95%CI:-55.2, -38.8) than when including the coffee drinks in the SSB classification. (**Supplemental Table S3.4**).

This study has several limitations. First, we did not have a control group; rather, we included individual fixed effects to estimate within-person changes in SSB consumption during the study. However, it is possible that some of the changes in consumption observed in our analyses can be attributed to time-varying external factors. For example, when the sales ban took effect, there was active debate in San Francisco over an SSB tax ballot initiative. Communication campaigns about the SSB tax could have contributed to changes in consumption in this population. Second, this study was performed in a health organization, for which SSB consumption behaviors may differ from other workplaces. For example, employees might have had greater awareness of the negative health effects of SSBs and greater interest in a healthy diet. Changes observed in this population might therefore not be representative of other types of workplaces, and further studies in diverse environments evaluating the initiative are recommended.

Lastly, we have some expected limitations regarding self-reported dietary information. Although we used a validated questionnaire, the consumption data may be susceptible to measurement error and social desirability bias. If participants perceived SSBs as unhealthy, they may have felt more pressure to underreport their SSB consumption.[31] If the underreporting was similar at baseline and follow-up, it does not bias our results. However, if the underreporting was exacerbated at follow-up compared to baseline, we could have overestimated the true impact of the policy.

Public Health implications

Most of the debate over public health strategies to reduce SSB consumption focuses on governmental policies, such as SSB taxation and product labeling strategies. These policies have faced significant barriers to adoption due to well organized, powerful opposition by beverage corporations and the trade organizations that represent them.[32,33] A workplace SSB sales ban, like tobacco-free workplace initiatives, represents a voluntary private-sector initiative that largely bypasses political opposition by the beverage industry while still achieving the objective of reducing the availability of health-harming commercial products.[34] Employers may be positively predisposed to sales bans and other food environment reforms in the workplace. Working-age adults have the highest burden of diabetes—an extremely costly condition for employer-based health plans and productivity losses.[35] As this study found, the SSB sales ban was viewed favorably by the majority of employees, and disproportionately benefitted heavy-drinking employees, who were also more likely to be racial/ethnic minorities and of lower occupational status. If the spillover effects observed here for out-of-work SSB consumption are replicated in further research, the employer-based SSB sales ban could have broader impacts on dietary habits outside the workplace.

References

1. Malik VS, Hu FB. The role of sugar-sweetened beverages in the global epidemics of obesity and chronic diseases. *Nat Rev Endocrinol*. 2022;18(4):205-218. doi:10.1038/s41574-021-00627-6
2. Qin P, Li Q, Zhao Y, et al. Sugar and artificially sweetened beverages and risk of obesity, type 2 diabetes mellitus, hypertension, and all-cause mortality: a dose–response meta-analysis of prospective cohort studies. *Eur J Epidemiol*. 2020;35(7):655-671. doi:10.1007/s10654-020-00655-y
3. Imamura F, O'Connor L, Ye Z, et al. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. *BMJ*. 2015;351:h3576. doi:10.1136/bmj.h3576
4. Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, Mozaffarian D. Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States. *JAMA*. 2017;317(9):912. doi:10.1001/jama.2017.0947
5. Malik VS, Hu FB. Sugar-Sweetened Beverages and Cardiometabolic Health: An Update of the Evidence. *Nutrients*. 2019;11(8):1840. doi:10.3390/nu11081840
6. Cawley J, Biener A, Meyerhoefer C, et al. Job Absenteeism Costs of Obesity in the United States. *J Occup Environ Med*. 2021;63(7):565-573. doi:10.1097/JOM.0000000000002198
7. American Diabetes Association. Economic Costs of Diabetes in the U.S. in 2017. *Diabetes Care*. 2018;41(5):917-928. doi:10.2337/dci18-0007
8. Nestle M. *Soda Politics. Taking Soda (and Winning)*. Oxford University Press; 2015.
9. Lacko AM, Maselko J, Popkin B, Ng SW. Socio-economic and racial/ethnic disparities in

the nutritional quality of packaged food purchases in the USA, 2008–2018. *Public Health Nutr*. 2021;24(17):5730-5742. doi:10.1017/S1368980021000367

10. Link BG, Phelan J. The social shaping of health and smoking. *Drug Alcohol Depend*. 2009;104:S6-S10. doi:10.1016/j.drugalcdep.2009.03.002
11. National Clinical Care Commission. *Report to Congress on Levering Federal Programs to Prevent and Control Diabetes and Its Complications*.; 2021. https://health.gov/sites/default/files/2022-01/NCCC Report to Congress.pdf
12. Moran A, Lederer A, Johnson Curtis C. Use of Nutrition Standards to Improve Nutritional Quality of Hospital Patient Meals: Findings from New York City's Healthy Hospital Food Initiative. *J Acad Nutr Diet*. 2015;115(11):1847-1854. doi:10.1016/j.jand.2015.07.017
13. Practice GreenHealth. The legacy of Healthier Hospitals. Accessed May 24, 2020. https://practicegreenhealth.org/healthierhospitals
14. Stockwell T, Gruenewald P. Controls on the physical availability of alcohol. In: Heather N, Stockwell T, eds. *The Essential Handbook of Treatment and Prevention of Alcohol Problems*. John Wiley & Sons, Ltd; 2004:213-225.
15. Zoellner J, Estabrooks PA, Davy BM, Chen Y-CY, You W. Exploring the theory of planned behavior to explain sugar-sweetened beverage consumption. *J Nutr Educ Behav*. 44(2):172-177. doi:10.1016/j.jneb.2011.06.010
16. Byron MJ, Cohen JE, Frattaroli S, Gittelsohn J, Jernigan DH. Using the theory of normative social behavior to understand compliance with a smoke-free law in a middle-income country. *Health Educ Res*. 2016;31(6):738-748. doi:10.1093/her/cyw043
17. Taber DR, Chriqui JF, Powell LM, Chaloupka FJ. Banning all sugar-sweetened beverages in middle schools: reduction of in-school access and purchasing but not overall

consumption. *Arch Pediatr Adolesc Med*. 2012;166(3):256-262. doi:10.1001/archpediatrics.2011.200

18. Di Sebastiano KM, Kozicky S, Baker M, Dolf M, Faulkner G. The University of British Columbia healthy beverage initiative: changing the beverage landscape on a large post-secondary campus. *Public Health Nutr*. 2021;24(1):125-135. doi:10.1017/S1368980020003316
19. Epel ES, Hartman A, Jacobs LM, et al. Association of a Workplace Sales Ban on Sugar-Sweetened Beverages With Employee Consumption of Sugar-Sweetened Beverages and Health. *JAMA Intern Med*. 2020;180(1):9. doi:10.1001/jamainternmed.2019.4434
20. Basu S, Jacobs LM, Epel E, Schillinger D, Schmidt L. Cost-effectiveness of a workplace ban on sugar-sweetened beverage sales: A microsimulation model. *Health Aff*. 2020;39(7):1140-1148. doi:10.1377/hlthaff.2019.01483
21. Backholer K, Beauchamp A, Ball K, et al. A framework for evaluating the impact of obesity prevention strategies on socioeconomic inequalities in weight. *Am J Public Health*. 2014;104(10):e43-50. doi:10.2105/AJPH.2014.302066
22. Patel AI, Schmidt LA. Healthy beverage initiatives in higher education: an untapped strategy for health promotion. *Public Health Nutr*. 2021;24(1):136-138. doi:10.1017/S1368980020003766
23. Cleveland DA, Jay JA. Integrating climate and food policies in higher education: a case study of the University of California. *Clim Policy*. 2021;21(1):16-32. doi:10.1080/14693062.2020.1787939
24. Hedrick VE, Savla J, Comber DL, et al. Development of a Brief Questionnaire to Assess Habitual Beverage Intake (BEVQ-15): Sugar-Sweetened Beverages and Total Beverage

Energy Intake. *J Acad Nutr Diet*. 2012;112(6):840-849. doi:10.1016/j.jand.2012.01.023

25. Schulze MB. Sugar-Sweetened Beverages, Weight Gain, and Incidence of Type 2 Diabetes in Young and Middle-Aged Women. *JAMA*. 2004;292(8):927. doi:10.1001/jama.292.8.927

26. Wooldridge J. *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. The MIT Press; 2010.

27. Bellemare MF, Wichman CJ. Elasticities and the Inverse Hyperbolic Sine Transformation. *Oxf Bull Econ Stat*. 2020;82(1):50-61. doi:10.1111/obes.12325

28. Thornton PL, Kumanyika SK, Gregg EW, et al. New research directions on disparities in obesity and type 2 diabetes. *Ann N Y Acad Sci*. 2020;1461(1):5-24. doi:10.1111/nyas.14270

29. Beauchamp A, Backholer K, Magliano D, Peeters A. The effect of obesity prevention interventions according to socioeconomic position: A systematic review. *Obes Rev*. 2014;15(7):541-554. doi:10.1111/obr.12161

30. Mons U, Nagelhout GE, Allwright S, et al. Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe Surveys. *Tob Control*. 2013;22(e1):e2-e9. doi:10.1136/tobaccocontrol-2011-050131

31. Althubaiti A. Information bias in health research: definition, pitfalls, and adjustment methods. *J Multidiscip Healthc*. 2016;2016(9):211-217. doi:10.2147/JMDH.S104807

32. Crosbie E, Pomeranz JL, Wright KE, Hoeper S, Schmidt L. State Preemption: An Emerging Threat to Local Sugar-Sweetened Beverage Taxation. *Am J Public Health*. 2021;111(4):677-686. doi:10.2105/AJPH.2020.306062

33. Pedroza-Tobias A, Crosbie E, Mialon M, Carriedo A, Schmidt LA. Food and beverage industry interference in science and policy: efforts to block soda tax implementation in Mexico and prevent international diffusion. *BMJ Glob Heal*. 2021;6(8):e005662. doi:10.1136/bmjgh-2021-005662

34. Crosbie E, Schmidt LA. Preemption in Tobacco Control: A Framework for Other Areas of Public Health. *Am J Public Health*. 2020;110(3):345-350. doi:10.2105/AJPH.2019.305473

35. Asay GRB, Roy K, Lang JE, Payne RL, Howard DH. Absenteeism and Employer Costs Associated With Chronic Diseases and Health Risk Factors in the US Workforce. *Prev Chronic Dis*. 2016;13:E141. doi:10.5888/pcd13.150503

Chapter IV

Effectiveness of a Food Pharmacy Program on reducing systolic and diastolic blood pressure in low-income participants with hypertension

Introduction

Hypertension is the leading risk factor for cardiovascular mortality in the US.[1,2] According to the National Health and Nutrition Survey in 2018, 32% of adults had hypertension. Among them, only 44% had their blood pressure under control.[3] Hypertension disproportionately affects the Black and African American population, with the highest prevalence, poorest control, and highest mortality rates compared to other ethnic/racial groups.[4] In 2019, the mortality rate due to hypertension was 56.7 per 100,000 in Black males compared to 25.7 per 100,000 in White males.[4] Hypertension ranked among the top ten health conditions in healthcare spending in the US, with estimated spending of $79 billion in 2016.[5]

Food insecurity is associated with a higher incidence and poorer control of hypertension.[6,7] A study with data from the National Health and Nutrition Survey suggests that adults experiencing food insecurity are 20% more likely to have hypertension.[8] In the US, 10.5% of households were food insecure in 2020, with the highest prevalence of 21.7% amongst Black/African American households.[9] According to the Food insecurity and Health framework, food insecurity is associated with poor health through three main mechanisms: nutrition, mental health, and behavior.[10] First, adults experiencing food insecurity are more likely to have a poor-quality diet,[11] a key element in the management and control of hypertension.[12,13] Food insecurity is associated with higher consumption of snacks high in sodium, sugar-sweetened beverages, and lower consumption of vegetables.[11] Second, food insecurity is also associated with poor mental

health, such as depression, anxiety, and stress, increasing the risk of hypertension and other non-communicable diseases.[14] Third, food insecurity is linked to poor adherence to healthcare recommendations.[15] Compared with food-secure adults, those living with food insecurity and chronic illness are four times more likely not to take a medication, skip medication or not fill a prescription due to cost.[16] Likewise, hypertension and other chronic conditions intensify the household's economic burden by increasing out-of-pocket health expenses[17] and reducing productivity.[18,19] Such effects exacerbate poverty and food insecurity, which further creates a vicious cycle that perpetuates health and economic inequities.[6,20–22]

An unhealthy diet is associated with an increased risk of cardiovascular mortality. A study evaluating the association between diet and cardiometabolic disease estimated that 45% of cardiometabolic deaths were attributable to suboptimal diets, with higher proportion of deaths in Black (53%) than in White population (43%).[23] The main dietary contributors were a diet high in sodium, low in nuts/seeds, high in processed meats, low in omega 3- fats, low in vegetables and fruits, and high in sugar-sweetened beverages consumption. Although diet has been a principal component in managing hypertension and other cardiometabolic diseases,[12,13] the majority of adults in the US do not meet the dietary recommendations. For example, the US dietary guidelines recommend consuming 2-3 cups of vegetables per day and less than 2,300 mg of sodium per day. However, only 9.3% of US adults and a lower percentage of Black persons (5.5%), and those in the lowest income category (7.0%) met the vegetable recommendations.[24] Likewise, 97% of men and 84% of women exceed the sodium intake recommendation,[25] and non-Hispanic Black consume the highest amount of sodium.[26]

"Food is Medicine interventions" (FIMI) have emerged as a strategy to break the cycle between food insecurity, unhealthy diets, and poor control of diet-related diseases.[27] The FIMI movement aims to integrate food and nutrition interventions in the healthcare system to eliminate barriers to a high-quality diet by providing medically tailored meals or groceries to participants with chronic diseases. These interventions are hypothesized to work by reducing economic constraints and increasing access to healthy food.[27] A food pharmacy program—a common type of FIMI—involves providing healthy groceries to patients with chronic disease, usually accompanied by other components such as cooking demonstrations, recipes, and referral to other resources to eliminate barriers to adherence.[28] In the US, food pharmacies are gaining popularity in healthcare systems,[29] including in pediatric,[30] cancer,[31] and adult clinic settings.[32–34]

In San Francisco, food pharmacies have been implemented as part of a multi-pronged strategy to address disparities in hypertension among Black/African American patients. African American patients in the San Francisco Health Network (SFHN)—the safety-net clinic network overseen by the San Francisco Department of Public Health—had the lowest rates of blood pressure control of any racial/ethnic group.[35,36] To address this problem, five clinics from the SFHN launched a Food Pharmacy program (FPP) starting in 2016 to reduce these racial disparities. This program prioritized, but was not limited to, enrollment of Black and African American adults with hypertension. San Francisco's food pharmacies provide free healthy groceries, nutrition education, cooking demonstrations from a nutritionist, and blood pressure and blood glucose checks to low-income patients living with hypertension or diabetes at clinics from the SFHN.

Despite the promising strategy to improve the control of chronic diseases among low-income communities by reducing food insecurity, there is little evidence on the effectiveness of food pharmacies. A systematic review and metanalysis of 17 studies found that food pharmacies were associated with an increase in 0.77 servings of fruit and vegetable consumption but did not find effects on systolic blood pressure, which the authors attributed to lack of statistical power and not enough time to follow-up.[37] The objective of this study is to contribute to the evidence on the effectiveness of food pharmacies by evaluating whether the SFHN FPP is associated with a reduction in systolic and diastolic blood pressure in a racially diverse, low-income sample of adults with hypertension using a quasi-experimental design with medical record data over two years. We then examined whether this effect differed among Black and non-Black populations in order to assess the potential of the FPP to reduce racial disparities in blood pressure control.

Methods

This study assesses the effectiveness of the SFHN FPP using quasi-experimental methods applied to medical record data to compare blood pressure outcomes of FPP participants with hypertension, to a control group of patients who were subsequently enrolled in the intervention.

Description of the intervention

In 2016, the Food as Medicine Collaborative at the San Francisco Department of Public Health (SFDPH) began supporting clinics in implementing the FPP to complement clinical care approaches to chronic disease prevention and management. Participants with hypertension or diabetes are referred to the food pharmacy by their primary care provider or staff at the clinic. The program models for FPP vary by clinic, but typically, weekly food pharmacies provide free

healthy groceries, nutrition education, cooking demonstrations, and wellness check with a clinician (weight and blood pressure checks) to patients at the SFHN clinics that serve low-income and racially diverse population. Clinics started the FPP at different time points between 2016 and 2020, prioritizing clinics with a higher percentage of Black/African Americans and a higher proportion of patients with poor blood pressure control.

Study participants

We included non-pregnant participants 18 years or older that attended the FPP at least once. We included participants with either a medical diagnosis of hypertension before starting the FPP (ICD 10th revision code I10), or ≥2 elevated blood pressure measurements (systolic blood pressure ≥140 or diastolic blood pressure ≥90 mm Hg) in the six months before starting the FPP. We excluded participants without at least one measurement of blood pressure six months before and one measurement six months after their first visit to the FPP. Our final sample size was 478 participants. (**Figure 4.1**).

We obtained de-identified data from medical records of participants attending the FPP in 5 clinics from the San Francisco Health Network. Food Pharmacy program staff created a coded index variable relative to the date when the FPP first started to anchor the longitudinal analysis of program impact without providing identifiable data on visit dates to the investigative team. Therefore, visit dates are expressed as "days before/since the FPP started", whereby 0 indicates the date that the FPP started in the first SFHN clinic. A negative number represents days since the health metric was assessed prior to food pharmacy program and a positive number indicates days since the health metric was evaluated after the FPP (e.g., 90 would mean that a blood

pressure value, for example, was assessed 90 days after food pharmacy program started). Systolic and diastolic blood pressure measurements were obtained from medical records from one year before the first clinic started the FPP (day -365) to 1 year after the last clinic started its Food Pharmacy Program (day 1340) (**Figure 4.2**).

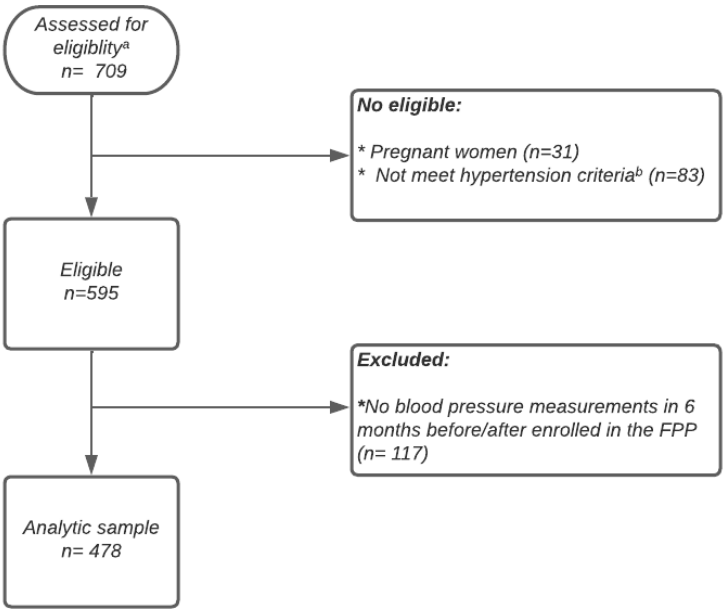

Figure 4.1 Flow diagram for the analytic sample

[a] Participants 18 years or older that attended the Food Pharmacy Program at least once.
[b] Medical diagnosis of hypertension or at least two blood pressure measurements >= 140/90 6 months before enrolling in the FPP.

Measurements and outcomes

We obtained the systolic and diastolic blood pressure from medical records. For each participant, we calculated the average systolic and diastolic blood pressure in each quarter. Baseline sociodemographic information was also obtained from medical records, including age, sex (male, female), insurance type (Medicare, Medicaid [Medi-Cal], no insurance, other), race (Black, White, Asian, other), ethnicity (Hispanic/non-Hispanic), employment status (disabled/retired,

employed, unemployed, unknown), and tobacco use (never, current or former smoker). In addition, FPP staff provided a de-identified list of participants with both the date of the participant's first visit and all dates each participant attended the FPP. The University of California San Francisco institutional review board approved the study.

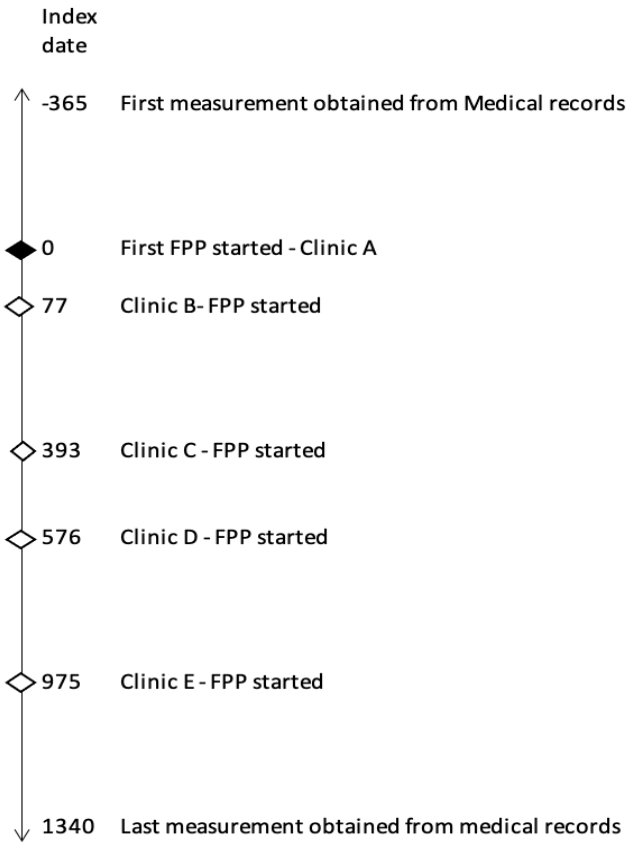

Figure 4.2 Timeline of Food Pharmacy
Index date defined as zero when the first food pharmacy started in Clinic A.

Analysis

Sociodemographic characteristics at baseline are presented as frequency and proportion distributions. We performed Chi-square tests to compare baseline characteristics between race categories of non-Hispanic Black (hereafter referred to as "Black") vs. non-Black. Non-Black races were aggregated into a single category because of their small sample size.

We used a difference-in-differences (DID) study design to evaluate the effect of the FPP on systolic and diastolic blood pressure, a common approach to evaluate policy changes. This method addresses time-dependent trends in the outcome that are not associated with the policy by using a comparable control group with similar pre-intervention trends compared to the intervention group. DID analysis compares the outcome difference before and after the policy started relative to a comparable control group as the counterfactual for what would have happened in the absence of the intervention.[38]

To take advantage of the fact that the enrollment of clinics and participants was staggered over time, we used the Callaway-Sant'Anna difference-in-differences (DID) approach, which is designed to accommodate staggered treatment.[39] We used as a comparison group those not-yet-treated instead of a "pure" control group of never-treated to prevent selection bias, as those who never attended the FPP might not be comparable in unmeasured ways. This approach estimates period-by-period effects relative to the time of the event (the start of the program) for each participant. It provides an estimate of the program's average effect among those treated, considering participants that have not had the intervention yet as the counterfactual. We used a "doubly robust" form of the estimator based on stabilized inverse probability weighting of belonging in the treatment group and ordinary least squares to model the outcome evolution.[40] We assessed differences in the pre-treatment outcome trends as indirect evidence of parallel trends, a key assumption in the DID analysis. The baseline covariates included in the model were race, age, legal sex, insurance, and employment status.

We further evaluated the effect of the FPP by sex (men vs. women), age (< 60 years and ≥60 years), and race (Black vs. no Black), by estimating stratified DID analyses. All analyses were estimated with bootstrap standard errors clustered by clinic to account for correlated outcomes among participants in the same clinic. Analyses were performed using Stata SE, version 17.0 (StataCorp, College Station, TX, USA).

Results

Table 4.1 shows the sociodemographic characteristics of the study participants, overall and by race category. Fifty-seven percent are women, about half are younger than 60, and the majority are Black or African American. Participants were primarily insured by Medicare (37.7%) and Medi-Cal (45.6%). Two-thirds of the study participants are unemployed, disabled, or retired. The average time participants spent in the FPP was 182 days; on average, participants attended the FPP 9 times during the study period (median 3, IQR 1-8). Compared with non-Black participants, Black participants were more likely to be older than 60 years (53% vs. 40%), disabled or retired (56.5% vs. 40.7%), and currently smoking (25.8% vs. 16.5%). Non-Black participants were more likely to be uninsured and less likely to have Medicare than Black participants. No statistically significant differences were observed in sex. Average systolic blood pressure at baseline was higher among Black (135.4 mmHg) than non-Black adults (132.1), and no statistically significant differences were observed in diastolic blood pressure.

Table 4.1. Baseline characteristics of participants that attended the Food Pharmacy Program at least once.

	Overall n=488	By racial group: Black n=283	By racial group: Non-Black* n=194	P Value**
Sex (%)				
Female	56.5	57.6	55.2	0.60
Male	43.5	42.4	44.8	
Age group (%)				
18-39	5.2	3.9	7.2	0.010
40-59	47.3	43.1	53.1	
60+	47.5	53.0	39.7	
Race/ethnicity group (%)				
Hispanic	12.6	-	30.9	<0.001
Black/African American	59.3	100.0	-	
Asian	9.9	-	24.2	
White	11.3	-	27.8	
Other	6.9	-	17.0	
Insurance type (%)				
No insurance	13.2	9.9	18.0	0.017
Medicaid (Medi-Cal)	45.6	44.5	46.9	
Medicare	37.7	42.4	30.9	
Other	3.6	3.2	4.1	
Employment status (%)				
Disabled/retired	50.0	56.5	40.7	0.005
Employed	6.1	4.2	8.8	
Unemployed	15.7	13.8	18.6	
Unknown	28.2	25.4	32.0	
Tobacco status (%)				
Never smoked	29.7	22.3	40.7	<0.001
Currently smoke	22.0	25.8	16.5	
Formerly smoked	6.3	8.1	3.1	
Unknown	42.1	43.8	39.7	
Clinics (%)*				
Clinic A (day 0)	22.6	20.5	25.3	
Clinic B (day 77)	17.6	22.6	10.3	<0.001
Clinic C (day 393)	36.4	43.8	25.8	
Clinic D (day 576)	16.9	8.8	28.9	
Clinic E (day 975)	6.5	4.2	9.8	
Time spent in FPP, mean (SD)	181.5 (235.4)	197.1 (251.5)	157.4 (207.9)	0.070
Number of visits at FPP				
Mean (SD)	9.0 (16.3)	9.1(16.3)	9.0 (16.6)	0.98
Median [IQ range]	3 [1-8]	3 [1-8]	3 [1-9]	0.65
Systolic blood pressure, mean (SD)	134.1 (19.0)	135.4 (18.6)	132.1 (19.5)	0.09
Diastolic blood pressure, mean (SD)	79.3 (10.5)	79.8 (10.8)	78.7 (10.0)	0.32

*White, Hispanics, Asian and other were aggregated in "non-Black" category because of small sample size

** Chi-square test of difference between Black and non-Black groups for categorical variables and t-test or ranksum test of the difference in groups for continuous variables

Figure 4.3 shows the average effects of the FPP on systolic and diastolic blood pressure by quarter from the DID specification. These estimates show the changes in systolic and diastolic blood pressure between those treated and not yet treated relative to 3 months before starting the intervention. Results suggest that the FPP was associated with a reduction in systolic and diastolic blood pressure in the overall population. The change in blood pressure trends increased over time, and it was sustained at 24 months of follow-up. We observed no substantial violations of the parallel trends during the pre-treatment period, which supports the assumption of parallel trends in DID analysis.

Table 4.2 shows the average effects of the FPP in the 24-months-period and by every six months. We found that the FPP was associated with an average reduction in systolic blood pressure of 4.3 mmHg (95% CI: -5.4 to 3.1, $p<0.001$) and diastolic blood pressure of 1.7 mm Hg (95% CI: -2.1, -1.3, $p<0.001$) in the 24-months-period. Although the average change in systolic and diastolic blood pressure in the first five months was not statistically significant, there was a sustained reduction in blood pressure in the following months. The largest effect was observed at the 12-17 months period for systolic blood pressure (-5.6 mmHg, 95%CI: -9.1 to -2.2, $p=0.001$) and at 18-23 months period for diastolic blood pressure (-2.5 mmHg, 95%CI: -4.4 to -0.6, $p=0.01$).

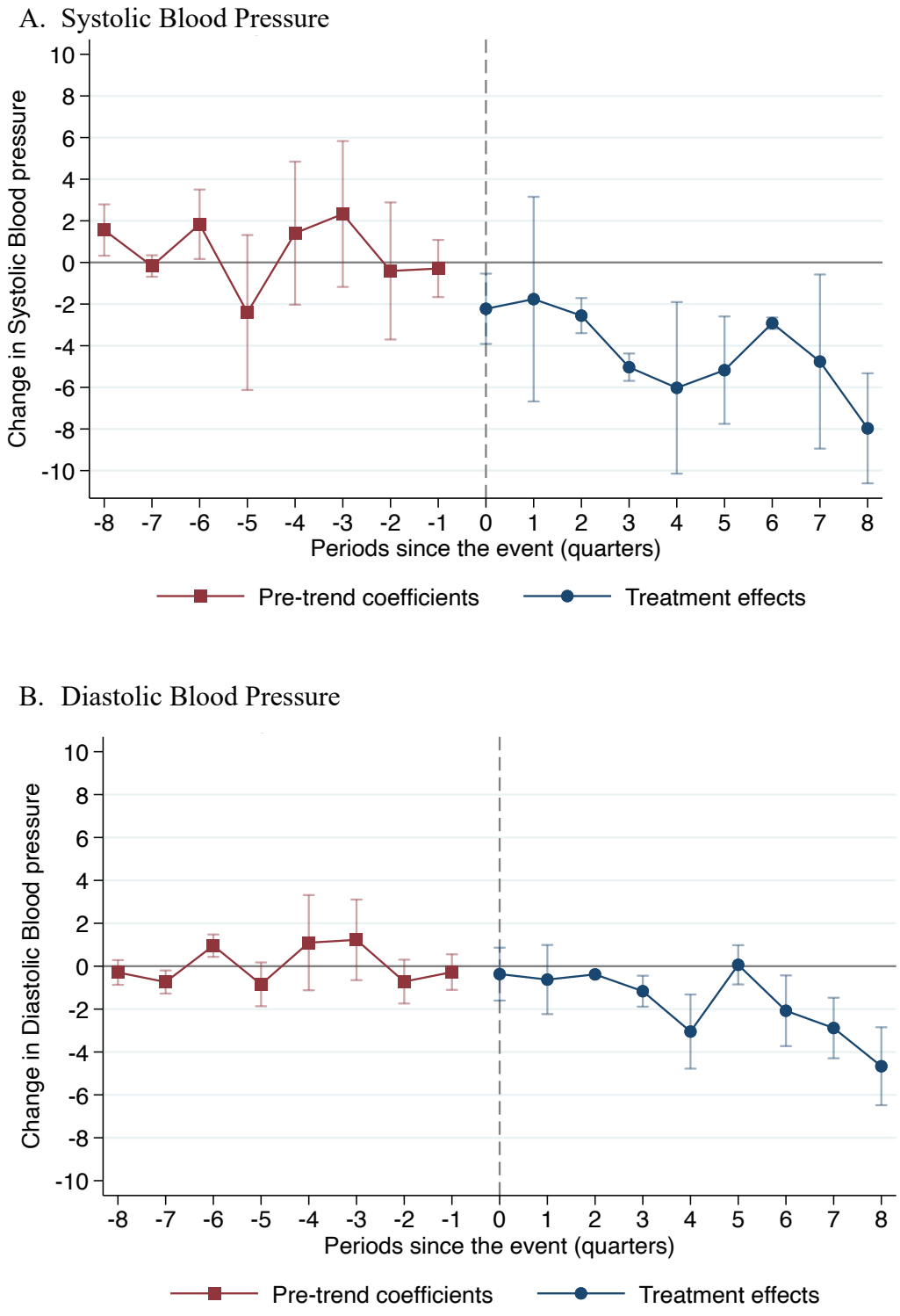

Figure 4.3. Event study of the effect of the Food Pharmacy Program on Systolic and Diastolic Blood Pressure in the overall population (n= 4,247 observations)

Difference-in-differences coefficients from the Callaway and Sant'Anna estimators. Models are adjusted for sex, age, race, insurance and employment status.

Table 4.2. Average change in systolic and diastolic blood pressure from 0 to 24 months in the overall population.

	Average treatment effect	
	Systolic blood pressure Coef. (95%CI)	Diastolic blood pressure Coef. (95%CI)
Overall treatment effect		
0-23 months	-4.27 (-5.40, -3.14)	-1.68 (-2.07, -1.30)
Treatment effect per periods:		
Months 0-5	-1.99 (-5.15, 1.16)	-0.50 (-1.92, 0.93)
Months 6-11	-3.79 (-4.51, -3.08)	-0.77 (-1.14, -0.41)
Months 12-17	-5.60 (-9.05, -2.15)	-1.49 (-2.09, -0.90)
Months 18-23	-3.84 (-6.23, -1.45)	-2.48 (-4.39, -0.57)

Difference-in-differences coefficients from the Callaway and Sant'Anna estimators. Models are adjusted for sex, age, race, insurance and employment status.

Figure 4.4 shows the average effect of the program at 12 months after the FPP started, by sociodemographic and clinical characteristics and exposure to the intervention. These results suggest that the policy was as effective in Black/African American participants as in non-Black participants. The FPP was associated with a reduction in systolic and diastolic blood pressure in female patients, while males had a statistically significant reduction in systolic but not in diastolic blood pressure. Regarding exposure to the program, participants that attended at least five times the food pharmacy had a higher reduction in systolic blood pressure (-7.32 mmHg, 95% CI: -9.13 to -5.51, $p<0.001$) than those that attended less than five times (-4.38 mmHg, 95% CI: -4.97 to -3.78, $p<0.001$). Similar results were observed for diastolic blood pressure (-4.90 mmHg, 95% CI: -5.31, $p<0.001$ to -4.48 vs. -1.50 mmHg, 95%CI: -2.49 to -0.51, $p<0.001$). Those with poor blood pressure control (>140/90) benefited the most, with a reduction of 17 mmHg (95%CI: -23.9, -10.2) in systolic blood pressure and of 5.7 mmHg (95%CI: -8.5, -2.9) in diastolic blood pressure.

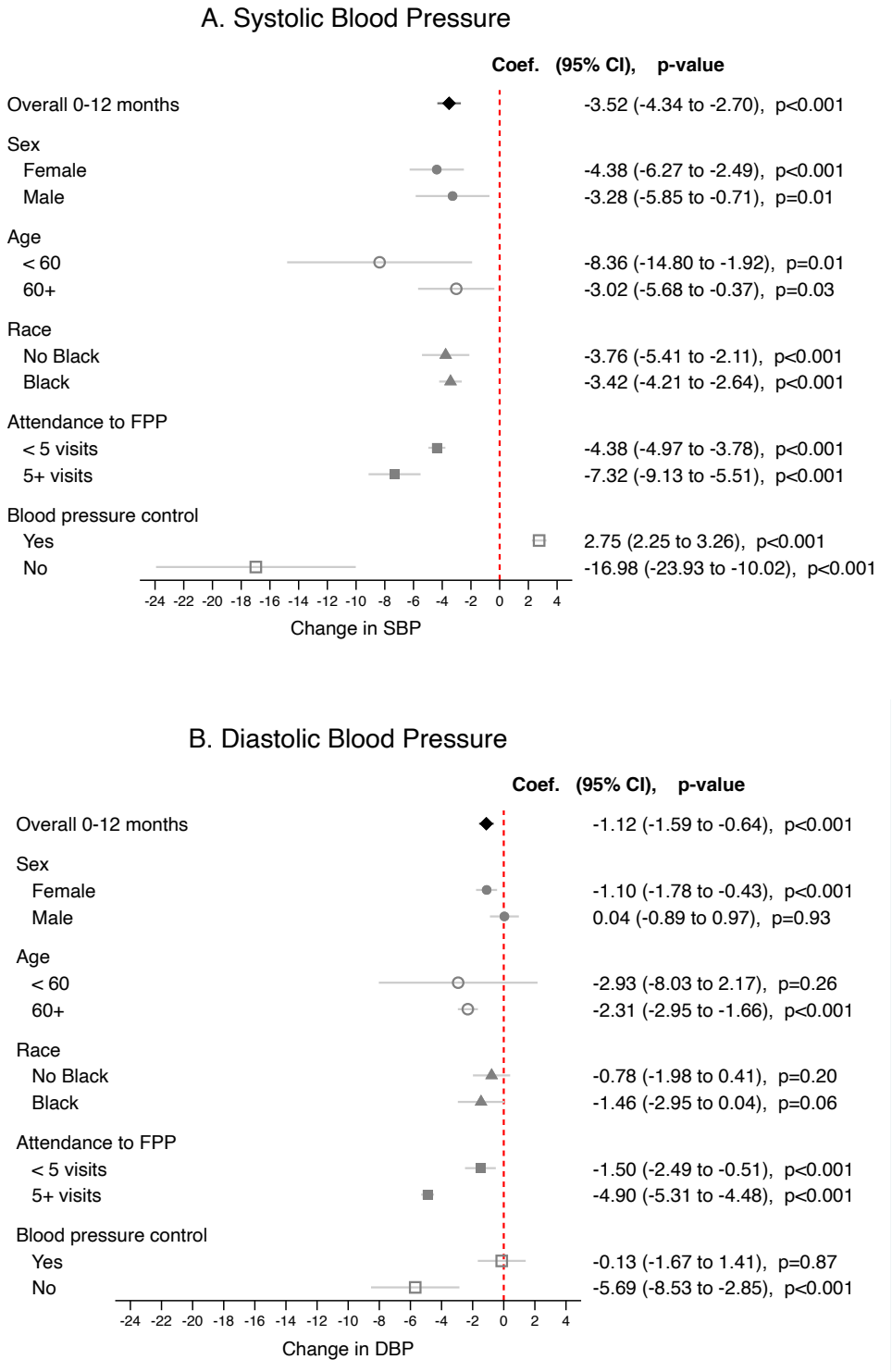

Figure 4.4 Average change on systolic and diastolic blood pressure from 0 to 12 months relative to 3 months before starting the Food Pharmacy Program

Average difference-in-difference coefficients from 0 to 12 months using the Callaway and Sant'Anna estimators. Stratified models adjusted for sex, age, race, insurance and employment status. Blood pressure control as <140/90 mmHg.

Discussion

In this study, with a high proportion of Black participants with hypertension, we found that the FPP was associated with a reduction in systolic and diastolic blood pressure sustained for up to two years after starting the program. The effect was more pronounced in participants that attended FPP five or more times, and it was as effective among the Black compared with non-Black patients, and in those with poorer blood pressure control at baseline. These findings have important implications for strategies aimed at reducing health disparities and improving hypertension control and management among patients in the safety-net clinic system.

The average effect of the systolic and diastolic blood pressure is clinically relevant for reducing the risk of cardiovascular events. Our study suggests an effect of -4.3 mmHg in systolic and -1.7 mmHg in diastolic blood pressure in the overall population, with a greater effect among those with poorer blood pressure control of -17.0 mmHg in systolic and 5.7 in diastolic blood pressure. The effect size of this intervention is comparable to what was observed in other interventions. A metanalysis that evaluated the effect of the Dietary Approaches to Stop Hypertension (DASH) diet, an intensive dietary intervention to reduce blood pressure, estimated a systolic/diastolic blood pressure reduction of -3.2/-2.5 mmHg.[13] Systematic reviews and metanalysis that evaluate the efficacy of different medications have found a mean systolic/diastolic blood pressure reduction of -6/-4 mm Hg for alpha and beta blockers,[41] -8/-5 mmHg for angiotensin-converting enzyme (ACE) inhibitors,[42] and a dose-dependent effect of -4/-2 to -11/-5 mmHg for thiazide diuretics (dose 6.25 to 50 mg/day)[43] and of -3/-2 to -11/-6 mmHg for renin inhibitors (dose 75 to 600 mg/day).[44] In addition, a systematic review and metanalysis found that a reduction of 5

mmHg in systolic blood pressure reduces the risk of major cardiovascular events by 10% and o cardiovascular mortality by 5%.[45]

The similar or greater effectiveness of FFP among Black patients compared with non-Black patients suggests the FFP does not worse inequities and may even help to reduce health disparities. Previous studies have shown that Black adults have the lowest adherence to dietary interventions due to economic barriers to comply with dietary interventions, lack of cultural alignment, and poor availability of healthy food in the communities.[46] This low adherence results in poorer control and comorbidities.[47] Evidence suggests that individual-level lifestyle interventions are likely to increase health inequities when individuals with higher socioeconomic status have more resources to support engagement with the interventions. At the same time, those with more limited resources would be less likely to engage in the intervention.[48,49] The advantage of a multilevel intervention such as the FPP compared with individual-level interventions[46] is that the FPP targets not only the individual but also the structural barriers, such as reducing economic constraints and providing physical access to free healthy food.[17] Therefore, our results suggest that having a multilevel intervention that addresses the barriers to adherence to lifestyle recommendations could reduce the gap in health disparities observed in diet-related diseases.

We found that the effect of the program was sustained for up to two years after starting. This sustained effect may be the consequence of an integrated intervention that provides not only healthy food but also other resources to empower the patients to manage their health. Although we were not able to measure the mediators that could explain the change in the blood pressure, an unpublished report that analyzed the experience and perceptions of the FPP in focus groups

with 29 participants of these clinics suggested that the FPP helped participants to change eating behaviors that extended beyond what they receive each week at the Food Pharmacy. The exposure to new food, cooking demonstration, and nutrition education empowered them to make healthier choices when cooking and buying food. In addition, participants described the FPP as social support where the staff and clinicians care about their health. Furthermore, previous evidence has shown that clinic-based Food Pharmacy or food prescription programs increased the percentage of households with food security from 16% to 35%[50] and reduced BMI by 0.74 kg/m^2.[51] Likewise, other studies found an increase fruit and vegetable consumption by 0.8 servings/day,[52], and a reduction in fast-food consumption from 1.3 days/week to 0.7 days/week,[52,51]. However, we recommend further mediation analysis to evaluate changes in Food insecurity, diet, self-efficacy, BMI, and medication adherence that could better explain these results.

Moreover, our positive results could also be attributable to the spillover benefits of having a clinic-based food pharmacy program. One of the main barriers to treatment adherence is mistrust of providers and health systems, especially among Black and African American patients.[53,54] Studies have shown that mistrust in the medical providers and healthcare system is associated with lower medication adherence,[53,55] disbelief of their medical diagnosis,[53] and a higher rate of missed medical appointments.[56] Consequently, these factors are associated with poorer control of their disease.[35] Therefore, one of the main advantages of a clinic-based program is that it could help to build patients' trust in their clinics and primary care providers and reducing barriers for adherence to their treatment.

This study has several limitations. There was a change in the medical record system midway through the assessment period in which the previous medical record system did not have reliable and time-linked data on hypertension medications. Therefore, we were not able to measure medication intake. Given that the participants started attending the clinics before implementing the FPP, we consider that the start in medication occurred at random and did not systematically start at the same time as the FPP. In addition, if there was any differential medication intensification or de-intensification, we consider that it is an effect of the FPP since the medication intake is not a confounder but a mediator. For example, the FPP had blood pressure checks that could have detected uncontrolled blood pressure leading to initiation or change in medications, or clinicians could have reduced medication in participants with better blood pressure control. Furthermore, food-based interventions, such as the FPP, are associated with better medication adherence. A study that provided medically tailored meals to patients with food insecurity and HIV found that the food intervention was associated with higher adherence to medications and control of their disease.[57] Nevertheless, we recommend measuring medication adherence and medication prescription changes in future studies.

Second, there may be differences in how medical providers measured and recorded blood pressure among the different clinics. If measurement errors were random, it would bias our results towards the null. In addition, other sociodemographic information, such as employment and tobacco use, may not be accurately captured in the medical records. In addition, we could not use gender or biological sex; instead, we used legal sex, as more than 50% of the gender and biological sex variables had missing values. Third, although the DID analysis adjusts for all factors that did not vary over the study period, it is possible to have confounding from time-

varying factors. For example, starting in 2014, the safety net clinics in San Francisco focused on improving the healthcare quality to address poor control of hypertension. Thus, we could not rule out confounding from other policies or programs implemented simultaneously as the FPP in the clinics. However, the fact that those that attended five or more times the FPP had a greater reduction in systolic and diastolic blood pressure than those that attended less than five times suggests that the FPP is likely to account for this improvement at least partially.

Despite these limitations, this study contributes to the evidence of the effectiveness of the FIMI. Studies evaluating the impact of food pharmacies or food prescriptions on blood pressure to date are primarily pre-post studies with inconclusive results. Four studies have shown improvements in systolic or diastolic blood pressure,[34,58–60], while two other studies did not find change.[61,62] For example, two pre-post studies that evaluated in-clinic food pharmacy programs showed a reduction in systolic blood pressure. One of these food pharmacies included a booklet with nutrition education and recipes and found a decrease of 7 mmHg among those that attended at least four times the program.[34] The second study included a more comprehensive intervention with nutrition counseling, physical activity sessions, and mindfulness meditation and found a reduction of 17 mmHg in systolic blood pressure but not a reduction in diastolic blood pressure.[60] In contrast, a community-based study that provided a voucher of $40 for up to 1 year to spend on produce at some grocery stores did not find statistically significant changes in systolic blood pressure.[62] The inconclusive results could be attributed to study limitations, such as small sample size and pre-post studies, as well as differences in the intervention. This study provides a more robust evaluation of the FPP, including a not-yet treated as control group to account for changes over time that are not attributable to the intervention. In addition, this study

compares the effect of the intervention among Black and non-Black participants, which is of great interest to assure that the intervention does not increase health disparities.

Conclusion

Our results suggest that FPP can potentially improve the management of chronic diseases in populations with higher economic and social constraints. Hypertension causes a high financial burden for the health system in the US, particularly for low-income and uninsured patients who may delay their treatment and are more likely to have hypertension-related hospitalizations.[63] The Food Pharmacy Program is a promising strategy to improve blood pressure control among the most vulnerable population and get opportune medical care to prevent complications and, ultimately, reduce the economic and societal costs of hypertension.

References

1 Institute for Health Metrics and Evaluation. Global Burden of Disease. Compare Data Visualization. Seattle, WA IHME, Univ. Washingt. 2019. https://www.healthdata.org/data-visualization/gbd-compare (accessed June 21, 2022).

2 Roth GA, Mensah GA, Johnson CO, *et al.* Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019. *J Am Coll Cardiol* 2020; **76**: 2982–3021.

3 Muntner P, Hardy ST, Fine LJ, *et al.* Trends in Blood Pressure Control Among US Adults With Hypertension, 1999-2000 to 2017-2018. *JAMA* 2020; **324**: 1190.

4 Tsao CW, Aday AW, Almarzooq ZI, *et al.* Heart Disease and Stroke Statistics-2022 Update: A Report From the American Heart Association. *Circulation* 2022; **145**: e153–639.

5 Dieleman JL, Cao J, Chapin A, *et al.* US Health Care Spending by Payer and Health Condition, 1996-2016. *JAMA* 2020; **323**: 863–84.

6 Seligman HK, Schillinger D. Hunger and socioeconomic disparities in chronic disease. *N Engl J Med* 2010; **363**: 6–9.

7 Gundersen C, Ziliak JP. Food Insecurity And Health Outcomes. *Health Aff* 2015; **34**: 1830–9.

8 Seligman HK, Laraia BA, Kushel MB. Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants. *J Nutr* 2010; **140**: 304–10.

9 Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2020. 2020.

10 Weiser SD, Palar K, Hatcher AM, S.L. Y, Frongillo EA. Food Insecurity and Public Health. In: Ivers L, ed. Food Insecurity and Public Health. CRC Press, 2015: 23–50.

11 Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia BA. Food Insecurity Is Inversely Associated with Diet Quality of Lower-Income Adults. *J Acad Nutr Diet* 2014; **114**: 1943-1953.e2.

12 Sacks FM, Svetkey LP, Vollmer WM, *et al.* Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med* 2001; **344**: 3–10.

13 Filippou CD, Tsioufis CP, Thomopoulos CG, *et al.* Dietary Approaches to Stop Hypertension (DASH) Diet and Blood Pressure Reduction in Adults with and without Hypertension: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Adv Nutr* 2020; **11**: 1150–60.

14 Spruill TM. Chronic Psychosocial Stress and Hypertension. *Curr Hypertens Rep* 2010; **12**: 10–6.

15 Wilder ME, Zheng Z, Zeger SL, *et al.* Relationship Between Social Determinants of Health and Antihypertensive Medication Adherence in a Medicaid Cohort. *Circ Cardiovasc Qual Outcomes* 2022; **15**. DOI:10.1161/CIRCOUTCOMES.121.008150.

16 Berkowitz SA, Seligman HK, Choudhry NK. Treat or Eat: Food Insecurity, Cost-related Medication Underuse, and Unmet Needs. *Am J Med* 2014; **127**: 303-310.e3.

17 Bernard DM, Johansson P, Fang Z. Out-of-pocket healthcare expenditure burdens among nonelderly adults with hypertension. *Am J Manag Care* 2014; **20**: 406–13.

18 Asay GRB, Roy K, Lang JE, Payne RL, Howard DH. Absenteeism and Employer Costs Associated With Chronic Diseases and Health Risk Factors in the US Workforce. *Prev Chronic Dis* 2016; **13**: E141.

19 MacLeod KE, Ye Z, Donald B, Wang G. A Literature Review of Productivity Loss

Associated with Hypertension in the United States. *Popul Health Manag* 2022; **25**: 297–308.

20 Beaglehole R, Bonita R, Horton R, *et al.* Priority actions for the non-communicable disease crisis. *Lancet* 2011; **377**: 1438–47.

21 Charkhchi P, Fazeli Dehkordy S, Carlos RC. Housing and Food Insecurity, Care Access, and Health Status Among the Chronically Ill: An Analysis of the Behavioral Risk Factor Surveillance System. *J Gen Intern Med* 2018; **33**: 644–50.

22 Garcia SP, Haddix A, Barnett K. Incremental Health Care Costs Associated With Food Insecurity and Chronic Conditions Among Older Adults. *Prev Chronic Dis* 2018; **15**: E108.

23 Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, Mozaffarian D. Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States. *JAMA* 2017; **317**: 912.

24 Lee-Kwan SH, Moore L V., Blanck HM, Harris DM, Galuska D. Disparities in State-Specific Adult Fruit and Vegetable Consumption — United States, 2015. *MMWR Morb Mortal Wkly Rep* 2017; **66**: 1241–7.

25 U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2020-2025 Dietary Guidelines for Americans., 9th editio. Washington, D.C., 2020 DietaryGuidelines.gov.

26 Dunford E, Poti J, Popkin B. Emerging Disparities in Dietary Sodium Intake from Snacking in the US Population. *Nutrients* 2017; **9**: 610.

27 Downer S, Berkowitz SA, Harlan TS, Olstad DL, Mozaffarian D. Food is medicine: actions to integrate food and nutrition into healthcare. *BMJ* 2020; : m2482.

28 Donohue JA, Severson T, Martin LP. The food pharmacy: Theory, implementation, and opportunities. *Am J Prev Cardiol* 2021; **5**: 100145.

29 Smith M, Levy R, Seligman H. Food is Medicine. Final project report. Washington, DC, 2021.

30 Hickey E, Phan M, Beck AF, Burkhardt MC, Klein MD. A Mixed-Methods Evaluation of a Novel Food Pantry in a Pediatric Primary Care Center. *Clin Pediatr (Phila)* 2020; **59**: 278–84.

31 Gany F, Lee T, Loeb R, *et al.* Use of Hospital-Based Food Pantries Among Low-Income Urban Cancer Patients. *J Community Health* 2015; **40**: 1193–200.

32 Feinberg A, Hess A, Passaretti M, Coolbaugh S, Lee T. Prescribing food as a speciality drug. *NEJM Catal* 2018. DOI:doi/full/10.1056/CAT.18.0212.

33 Greenthal E, Jia J, Poblacion A, James T. Patient experiences and provider perspectives on a hospital-based food pantry: a mixed methods evaluation study. *Public Health Nutr* 2019; **22**: 3261–9.

34 Wetherill MS, Chancellor McIntosh H, Beachy C, Shadid O. Design and Implementation of a Clinic-Based Food Pharmacy for Food Insecure, Uninsured Patients to Support Chronic Disease Self-Management. *J Nutr Educ Behav* 2018; **50**: 947–9.

35 Fontil V, Pacca L, Bellows BK, *et al.* Association of Differences in Treatment Intensification, Missed Visits, and Scheduled Follow-up Interval With Racial or Ethnic Disparities in Blood Pressure Control. *JAMA Cardiol* 2022; **7**: 204.

36 Selby K, Michel M, Gildengorin G, *et al.* Disparities in Hypertension Control Across and Within Three Health Systems Participating in a Data-Sharing Collaborative. *J Am Board Fam Med* 2018; **31**: 897–904.

37 Haslam A, Gill J, Taniguchi T, Love C, Jernigan VB. The effect of food prescription programs on chronic disease management in primarily low-income populations: A systematic review and meta-analysis. *Nutr Health* 2022; : 2601060211070718.

38 Dimick JB, Ryan AM. Methods for Evaluating Changes in Health Care Policy. *JAMA* 2014; **312**: 2401.

39 Callaway B, Sant'Anna PHC. Difference-in-Differences with multiple time periods. *J Econom* 2021; **225**: 200–30.

40 Sant'Anna PHC, Zhao J. Doubly robust difference-in-differences estimators. *J Econom* 2020; **219**: 101–22.

41 Wong GW, Laugerotte A, Wright JM. Blood pressure lowering efficacy of dual alpha and beta blockers for primary hypertension. *Cochrane Database Syst Rev* 2015; **2015**. DOI:10.1002/14651858.CD007449.pub2.

42 Heran BS, Wong MM, Heran IK, Wright JM. Blood pressure lowering efficacy of angiotensin converting enzyme (ACE) inhibitors for primary hypertension. *Cochrane Database Syst Rev* 2008; published online Oct 8. DOI:10.1002/14651858.CD003823.pub2.

43 Musini VM, Nazer M, Bassett K, Wright JM. Blood pressure-lowering efficacy of monotherapy with thiazide diuretics for primary hypertension. *Cochrane Database Syst Rev* 2014; published online May 29. DOI:10.1002/14651858.CD003824.pub2.

44 Musini VM, Lawrence KA, Fortin PM, Bassett K, Wright JM. Blood pressure lowering efficacy of renin inhibitors for primary hypertension. *Cochrane Database Syst Rev* 2017; **2017**. DOI:10.1002/14651858.CD007066.pub3.

45 Blood Pressure Lowering Treatment Trialists' Collaboration. Pharmacological blood

pressure lowering for primary and secondary prevention of cardiovascular disease across different levels of blood pressure: an individual participant-level data meta-analysis. *Lancet (London, England)* 2021; **397**: 1625–36.

46 Bertoni AG, Foy CG, Hunter JC, Quandt SA, Vitolins MZ, Whitt-Glover MC. A Multilevel Assessment of Barriers to Adoption of Dietary Approaches to Stop Hypertension (DASH) among African Americans of Low Socioeconomic Status. *J Health Care Poor Underserved* 2011; **22**: 1205–20.

47 Epstein DE, Sherwood A, Smith PJ, *et al.* Determinants and consequences of adherence to the dietary approaches to stop hypertension diet in African-American and white adults with high blood pressure: results from the ENCORE trial. *J Acad Nutr Diet* 2012; **112**: 1763–73.

48 Backholer K, Beauchamp A, Ball K, *et al.* A framework for evaluating the impact of obesity prevention strategies on socioeconomic inequalities in weight. *Am J Public Health* 2014; **104**: e43-50.

49 Benach J, Malmusi D, Yasui Y, Martínez JM, Muntaner C. Beyond Rose's Strategies: A Typology of Scenarios of Policy Impact on Population Health and Health Inequalities. *Int J Heal Serv* 2011; **41**: 1–9.

50 Jones LJ, VanWassenhove-Paetzold J, Thomas K, *et al.* Impact of a Fruit and Vegetable Prescription Program on Health Outcomes and Behaviors in Young Navajo Children. *Curr Dev Nutr* 2020; **4**. DOI:10.1093/cdn/nzaa109.

51 Cavanagh M, Jurkowski J, Bozlak C, Hastings J, Klein A. Veggie Rx: an outcome evaluation of a healthy food incentive programme. *Public Health Nutr* 2017; **20**: 2636–41.

52 Trapl ES, Smith S, Joshi K, *et al.* Dietary Impact of Produce Prescriptions for Patients

With Hypertension. *Prev Chronic Dis* 2018; **15**: 180301.

53 Hall GL, Heath M. Poor Medication Adherence in African Americans Is a Matter of Trust. *J Racial Ethn Heal Disparities* 2021; **8**: 927–42.

54 Cuevas AG, O'Brien K, Saha S. African American experiences in healthcare: "I always feel like I'm getting skipped over". *Heal Psychol* 2016; **35**: 987–95.

55 Ciechanowski PS, Katon WJ, Russo JE, Walker EA. The Patient-Provider Relationship: Attachment Theory and Adherence to Treatment in Diabetes. *Am J Psychiatry* 2001; **158**: 29–35.

56 Lacy NL. Why We Don't Come: Patient Perceptions on No-Shows. *Ann Fam Med* 2004; **2**: 541–5.

57 Palar K, Napoles T, Hufstedler LL, *et al.* Comprehensive and Medically Appropriate Food Support Is Associated with Improved HIV and Diabetes Health. *J Urban Heal* 2017; **94**: 87–99.

58 York B, Kujan M, Conneely C, Glantz N, Kerr D. Farming for Life: Pilot assessment of the impact of medical prescriptions for vegetables on health and food security among Latino adults with type 2 diabetes. *Nutr Health* 2020; **26**: 9–12.

59 Kerr D, Barua S, Glantz N, *et al.* Farming for life: impact of medical prescriptions for fresh vegetables on cardiometabolic health for adults with or at risk of type 2 diabetes in a predominantly Mexican-American population. *BMJ Nutr Prev Heal* 2020; **3**: 239–46.

60 Emmert-Aronson B, Grill KB, Trivedi Z, Markle EA, Chen S. Group Medical Visits 2.0: The Open Source Wellness Behavioral Pharmacy Model. *J Altern Complement Med* 2019; **25**: 1026–34.

61 Bryce R, Guajardo C, Ilarraza D, *et al.* Participation in a farmers' market fruit and

vegetable prescription program at a federally qualified health center improves hemoglobin A1C in low income uncontrolled diabetics. *Prev Med reports* 2017; **7**: 176–9.

62 Xie J, Price A, Curran N, Østbye T. The impact of a produce prescription programme on healthy food purchasing and diabetes-related health outcomes. *Public Health Nutr* 2021; **24**: 3945–55.

63 Berkowitz SA, Terranova J, Randall L, Cranston K, Waters DB, Hsu J. Association Between Receipt of a Medically Tailored Meal Program and Health Care Use. *JAMA Intern Med* 2019; **179**: 786–93.

Chapter V. Conclusions

Given the complexity of diet-related non-communicable diseases (DR-NCDs), effective policies and strategies should address different determinants as a whole or in conjunction to promote healthy food environments. In this dissertation, we analyzed policies implemented in micro-and macro-environments aiming to modify the food environment to address the burden of DR-NCDs. We followed Hawke's framework that highlights the food environment as a mediator between preference learning and actual food consumption. Thus, policies that address the food environment are more likely to succeed because they address the main barriers to healthy eating.

Summary of findings

In chapter II we evaluated the tactics of the food industry after the soda tax was implemented in Mexico. We analyzed previously secret internal industry documents from major corporations in the University of California at San Francisco's *Food Industry Documents Archive* to analyze the response of transnational Food and Beverage corporations. We found that the food and beverage industry and front groups paid scientists to produce evidence aligned with their interests, showing that the tax was ineffective in improving health and harming the economy. Despite not being peer-reviewed, these studies were rapidly disseminated by the Food industry worldwide before the first peer-reviewed study without ties with the industry was published. We also contrasted the studies funded by the Food and Beverage Industry vs. those not supported by the sector finding opposite results. Peer-reviewed studies without industry ties documented the effectiveness of the policy, showing that the soda tax was progressive and not regressive, and was not associated with a loss of jobs, as the Food and Beverage industry suggested. These studies were disseminated in the global health community, and after the soda tax in Mexico was

enacted, 20 other countries implemented similar policies. We highlighted that industry resistance could persist after new policies become law to roll back legislation or prevent policy diffusion. We concluded that peer-reviewed studies free of conflict of interest play an essential role in implementing innovative health policies.

In Chapter III we evaluated whether a workplace ban on sales of sugar-sweetened beverages (SSBs) reduced SSB consumption at six- and twelve-months post-implementation. We also assessed whether this effect differed among employees with heavy (≥12oz/day) vs. moderate/no (<12 oz/day) baseline SSB consumption. The policy decreased SSB consumption by 9.0%, with a more pronounced effect among heavy drinkers. Heavy drinkers reduced SSB consumption by 60.8% at 12 months, with similar changes at work (-57.9%) and outside work (-51.9%), suggesting a spillover effect outside work: we found no evidence that participants compensated for the consumption at work by consuming more SSB outside work. We also found that the acceptance of the policy among employees increased over time and employees changed drinking patterns, such as reducing SSB consumption when thirsty or stopping drinking an SSB at a particular time. These results suggest that the policy worked not only by decreasing the availability of SSB but also could have helped to de-normalize the SSB consumption, improve the decision-making regarding beverage consumption, and change dietary attitudes that, in the long term, could modify social norms about SSB consumption at work and outside work.

Finally, in Chapter IV, we evaluated the impact of the Food Pharmacy Program on systolic and diastolic blood pressure in patients with hypertension. The Food Pharmacy provides weekly free healthy groceries, nutrition education, cooking demonstrations, and wellness check with a

clinician to patients at clinics from the San Francisco Health Network that serves low-income and ethnically diverse populations. We found that the program was associated with a reduction in systolic (-3.5 mmHg) and diastolic (-1.1 mmHg) blood pressure 12 months after starting the program, and it was sustained for up to two years. The effect was more pronounced in participants that attended the Food Pharmacy five or more times and were as effective in Black/African American vs. Non-Black adults. Our results suggest that the Food Pharmacy Program can potentially improve the management of hypertension in populations with high social and economic constraints, which could ultimately reduce health disparities.

Global health implications and policy recommendations

The UN proposed a goal to reduce mortality from by one third premature mortality from by 2030 in their sustainable development goal.[1] Therefore, a comprehensive kit of policies and strategies complementing each other is required to meet the goal. Scholars have proposed a package of policies to promote healthy diets, including changes in the food environment to improve the availability, affordability, and acceptability of healthy diets.[2–6] The policies that we evaluated in this dissertation are aligned with these recommendations. We showed that these policies were successful reducing the consumption of SSB or improving health outcomes, however we also identified the tactics that the food industry use to prevent and weaken policies that affect their interests. Therefore, it is essential to consider challenges in implementing similar policies in other settings. For example, the soda tax has faced stronger opposition from the food industry in high-income countries such as the US, making less likely that the US can pass a national soda tax or food labeling policy like the one implemented in Mexico.

Implementing some interventions like the food pharmacy requires more resources that some low and middle-income countries cannot afford. However, a package of policies and interventions is needed to complement and reinforce each other. For example, the revenues obtained from the soda tax could be used to implement interventions to increase the access and availability of free and safe water and healthy food, such as the Food Pharmacy Program. In addition, we found that the healthy beverage initiative was successful and widely accepted at UCSF, but it is important to note that UCSF is a health institution in which the employees might be more aware about the risks of the sugar-sweetened beverages and might be more concerned about their health. Therefore, it is essential that this policy be accompanied with a communication and education campaigns adapted to the target population that helps to reinforce the benefits of the policy in the health of the employees.

Countries have different health policy priorities depending on the state of health and the nutrition transition.[7] Most middle-income countries are in the nutritional transition stage where non-communicable diseases are predominant. Middle-income countries, especially in Latin America, have taken significant steps in policies to prevent DR-NCDs, such as soda taxation, food labeling, and marketing regulation. Mexico and Chile have implemented a package of reinforcing policies over the last decade that has attracted the global health community's attention.

Mexico was the first country to rigorously evaluate the soda tax's effect, which has helped tax advocates and stakeholders implement similar policies in other countries. Chile was the first country to implement a comprehensive front of package food labeling based on a nutrient profile

that identified products as high in added sugar, saturated fat, and high in sodium. This nutrition profile was also the reference for other policies in the country, such as marketing restrictions for children and school sale bans. These health policies helped not only to reduce the consumption of unhealthy food but also to incentivize the food industry to reformulate its products. Following the success of Chile's policies, Mexico implemented similar policies but also included a warning legend when the food contains non-caloric sweeteners to avoid consumption in children. Like Chile, Mexico also has evaluated these policies and showed promising results. Now similar policies have been implemented in other countries such as Mexico, Peru, Argentina, Brazil, and Uruguay.

Some countries, especially in sub-Saharan Africa and South Asia, are starting to enter the nutritional transition stage characterized by a rapid increase in obesity and DR-NCDs, but with still high levels of undernutrition and infectious diseases facing what we know as the double burden of malnutrition.[8] In the majority of these countries, where infectious diseases and malnutrition are a significant burden, limited effort has been made in policies to prevent and control DR-NCDs.[9] They also are facing a rapid change in their food system and urbanization: the access and availability of ultra-processed foods with an excess of critical nutrients for the development of obesity and chronic diseases such as saturated fats, added sugars, and sodium has increased.[10]. Consequently, these countries are starting to experience higher burden of the DR-NCDs.[10] Therefore, it is imperative to apply the lessons we are getting from middle- and high-income countries in countries that are entering the stage of nutritional transition characterized by the high burden of DR-NCDs to prevent obesity and the DR-NCDs epidemic.

Some policies should be re-designed to tackle both, the malnutrition and obesity epidemic.[11] Food subsidies, school meals, and food pharmacies are good examples of policies that if well designed, could address stunting, micronutrient deficiencies, and overweight/obesity. Furthermore, access to fast food chains and ultra-processed food will continue to increase. Thus, fiscal policies, such as soda or junk food taxes, as well as sales ban in specific places (work, school), food labeling, and marketing regulation could help to educate and limit the consumption of these products in the population. Governments should also implement policies that preserve their local food system and protect traditional diets based on primary and unprocessed foods.

Finally, policymakers and those that design, implement, and evaluate the policies must be free of conflict of interest to have successful policies. As academics and health professionals, it is imperative to understand what conflict of interest is and how to prevent it. In 2020, the Mexican National Institute of Health launched an ethics code, “Nutricia Code," to which more than six thousand health professionals have subscribed. This code aims for health professionals and academics to conduct themselves ethically and professionally in clinical practice and research to prevent conflict of interest.[12] The Latin-American society of Nutrition also created a commission to evaluate conflict of interest, allowing them to have the first Congress in Nutrition free of conflict of interest. No funding from the food industry or organizations that opposed health policies was accepted, and speakers were requested to present their conflict-of-interest declaration in the first slide before their presentation.[13] We suggest similar tactics be implemented in the global health community to prevent conflict of interest. In addition, health professionals should be aware of the conflict of interest since their formation. An ethics course

that addresses conflict of interest in all schools in health-related professions should be mandatory.

Non-communicable disease is the major epidemic worldwide. Every two seconds, one person dies from a cardiovascular event.[14] NCD increases food insecurity and exacerbates health disparities.[15] Poor health affects not only the individual but also increases health care spending, impairs productivity, and reduces the overall economy of the countries.[17] Given that more than 50% of cardiometabolic deaths are attributable to an unhealthy diet,[18,19] it is imperative to have policies that protect the food system, limiting the availability of ultra-processed food, and promoting healthy and sustainable diets for a healthy population.

References

1. Independent Group of Scientists appointed by the Secretary General. *Global Sustainable Development Report 2019: The Future Is Now – Science for Achieving Sustainable Developmen*.; 2019.
2. Report by the Director General. *Political Declaration of the Third High-Level Meeting of the General Assembly on the Prevention and Control of Non-Communicable Diseases*.; 2021.
3. Swinburn BA, Kraak VI, Allender S, et al. The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *Lancet*. 2019;393(10173):791-846. doi:10.1016/S0140-6736(18)32822-8
4. Sassi F, Belloni A, Mirelman AJ, et al. Equity impacts of price policies to promote healthy behaviours. *Lancet*. 2018;391(10134):2059-2070. doi:10.1016/S0140-6736(18)30531-2
5. World Health Organization. *Report of the Commission on Ending Childhood Obesity.*; 2016. http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf?ua=1
6. WHO. Fiscal policies for diet and the prevention of noncommunicable diseases. *WHO Reg Off Eur*. 2015;(May):36. http://www.who.int/dietphysicalactivity/publications/fiscal-policies-diet-prevention/en/
7. Popkin BM, Gordon-Larsen P. The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes Relat Metab Disord*. 2004;28 Suppl 3:S2-9. doi:10.1038/sj.ijo.0802804
8. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. *Lancet*. 2020;395(10217):65-74. doi:10.1016/S0140-6736(19)32497-3

9. Laar AK, Addo P, Aryeetey R, et al. Perspective: Food Environment Research Priorities for Africa—Lessons from the Africa Food Environment Research Network. *Adv Nutr*. 2022;13(3):739-747. doi:10.1093/advances/nmac019

10. Reardon T, Tschirley D, Liverpool-Tasie LSO, et al. The processed food revolution in African food systems and the double burden of malnutrition. *Glob Food Sec*. 2021;28:100466. doi:10.1016/j.gfs.2020.100466

11. Hawkes C, Ruel MT, Salm L, Sinclair B, Branca F. Double-duty actions: seizing programme and policy opportunities to address malnutrition in all its forms. *Lancet*. 2020;395(10218):142-155. doi:10.1016/S0140-6736(19)32506-1

12. Barquera S. Codigo Nutricia: Nutrición y conflicto de interés en la academia [Nutricia code: Nutrition and conflict of interest in academia]. *Salud Publica Mex*. Published online 2020.

13. Sociedad Latinoamericana de Nutrición. *Postura Sobre El Manejo de Conflicto de Intereses Consejo Directivo de La SLAN 2015-2018*.; 2018.

14. Institute for Health Metrics and Evaluation. Global Burden of Disease. Compare Data Visualization. Seattle, WA IHME, University of Washington. Published 2019. Accessed June 21, 2022. https://www.healthdata.org/data-visualization/gbd-compare

15. Seligman HK, Schillinger D. Hunger and socioeconomic disparities in chronic disease. *N Engl J Med*. 2010;363(1):6-9. doi:10.1056/NEJMp1000072

16. Dessie ZG, Zewotir T. Mortality-related risk factors of COVID-19: a systematic review and meta-analysis of 42 studies and 423,117 patients. *BMC Infect Dis*. 2021;21(1):855. doi:10.1186/s12879-021-06536-3

17. Tremmel M, Gerdtham U-G, Nilsson P, Saha S. Economic Burden of Obesity: A

Systematic Literature Review. *Int J Environ Res Public Health*. 2017;14(4):435. doi:10.3390/ijerph14040435

18. Afshin A, Sur PJ, Fay KA, et al. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2019;393(10184):1958-1972. doi:10.1016/S0140-6736(19)30041-8

19. Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, Mozaffarian D. Association Between Dietary Factors and Mortality From Heart Disease, Stroke, and Type 2 Diabetes in the United States. *JAMA*. 2017;317(9):912. doi:10.1001/jama.2017.0947

Appendix 2.1. Supplementary material

Food and Beverage Industry Interference in Science and Policy: Efforts to Block Soda Tax Implementation in Mexico and Prevent International Diffusion

Research methodology

From June 2019 – May 2020, we analyzed internal industry documents relevant to the Mexican soda tax in the University of California at San Francisco's Food Industry Documents Archive (FIDA)[1]. The FIDA contains a collection of internal documents from companies, such as Coca-Cola, that were obtained through Freedom-of-Information (FOI) requests, or leaked documents, including internal memos, emails, and other private communications between corporate executives and researchers they fund. Bilingual searches confined to 2014-2018 were initiated with the keywords: "Mexico" AND "tax"; "soda tax"; "impuesto"; "refresco"; "impuesto a refresco"; "bebidas azucaradas,", and yielded 67 documents. We triangulated FIDA materials with publicly-available documents using online searches and snowball techniques (webpages, grey literature, government documents, press, social media accounts). We coded and analyzed all materials using standard qualitative methods for industry documents analysis.[2]

In addition, we conducted a comprehensive search for empirical studies on the effectiveness of the Mexican soda tax, both industry-funded and independent. We performed a search in PubMed with the key words "soda tax" OR "sugar-sweetened beverages tax" OR "SSB tax" AND "Mexico" from 2014-2020, and obtained 44 articles. We restricted the studies to those that evaluated changes in sales, consumption, or health outcomes, which yielded 12 papers. We performed additional searches in google to obtain non-peer-reviewed studies with the same criteria and keywords in English and Spanish, bringing in three additional studies. (see Suppl.

Table 1). We coded and analyzed the documents guided by the policy dystopia model.[3–5] This model divides industry strategies into instrumental (e.g., direct lobbying, lawsuits) and discursive (e.g., efforts to shape the debate through framing and messaging).

One author (A.P-T) prepared analytic memos, and organized the information chronologically and thematically. All authors reviewed memos to refine and focus research questions. We repeated this analytic process until the historical timeline was clear and we had reached theoretical saturation. All Spanish-language materials were translated by a native Spanish speaker on the team and back-translated by a native English speaker on the team.

Methodological Limitations: We did not analyze the role of civil society organizations, nutrition leaders, or academics involved in discussions around Mexico's soda tax. Although we supplemented FIDA materials with publicly available documents from a variety of industry representatives and trade groups, the FIDA collections provide a limited view. Many of the available FIDA documents come from the Coca-Cola Corporation, which is the third largest beverage company in the world and holds the dominant market share in Mexico.[6]

We did not interview key actors involved in the policy process. Data are limited to the information that captured by the FIDA and those that are publicly available. Some documents or webpages accessed online during data collection have been removed from the websites accessed.

Table S2.1 Timeline of events and instrumental strategies performed by the Food and Beverage Industry in regards to soda taxation in Mexico

Date	Event	Instrumental Strategies
01/01/14	National Soda tax in Mexico took effect.[7]	
09/14/14	Minister of Health appointed the advisory council of the Mexican Observatory on Non-Communicable Diseases with high representation of food and beverage industry.[8]	Direct involvement and influence in policy
05/15/15	WHO published the report "Fiscal policies for diet and the prevention of noncommunicable diseases" recommending taxes to discourage the consumption of unhealthy food.[9]	
06/14/15	Preliminary non-industry-funded results on the effectiveness of SSB tax in Mexico.[10]	
06/19/15	Coca-Cola email about Huffington Post article criticizing non-industry-funded preliminary results: "The international Council of Beverages Association provided background material to help with this piece".[11]	Information management (Suppression and reputation management)
07/09/15	ANPEC: Press conference claiming that 30,000 stores closed because fiscal measures, including soda taxation.[12]	Information management (Production)
07/10/15	Coca-Cola email about ANPEC press conference: "The head of the Mexican National Alliance of Retailers, Cuauhtémoc Rivera presented yesterday the results of a survey 'Popular consumptions, how is it doing?' ...For your background, Rivera has been a key member of the coalition created when the tax proposal was originally presented".[13]	Information management (Amplification)
07/15/15	Coca-Cola email about sharing information related to soda tax in Mexico: International's Manager of Public affairs to executives in Communications and Government relations sharing "relevant and useful updates on the excise tax in Mexico… to use these materials to engage with stakeholders".[14]	Information management (Amplification)
09/02/15	ILSI and RIPPE Lifestyle Institute symposium "Sweeteners and health".[15]	Information management (Supression)
10/19/15	Initiative in the Finance Commission of the Chamber of Deputies for reducing the SSB tax to 0.5 cents per liter in beverages with less than 5 grams of sugar per 100 ml. President of the SHCP Commission of the Congress stated that F&BI was behind the initiative.[16]	Direct involvement and influence in policy
10/20/15	Lower Chamber of Congress voted in favor of reducing the SSB tax. [17]	
10/28/15	Senate voted against reducing the SSB tax. Kept it at 1 peso per liter.[18]	
11/20/15	ILSI Mexico suspended "For engaging in activities that can be construed to be policy advocacy and/or public relations efforts to influence policy".[19]	Information management (Credibility)
11/2015	ITAM Industry-funded study claiming that the tax reduced calories for only 1%, with no impact in obesity.[20]	Information management (Production)
11/2015	COLMEX Industry-funded study claiming that the tax was regressive.[21]	Information management (Production)
12/2015	UANL Industry-funded study claiming that the tax had decreased by only 3-4.4%, and had produced 10,815 job losses.[22]	Information management (Production)

Date	Event	Instrumental Strategies
01/06/16	First peer-reviewed non-industry-funded quantitative assessment of the effects of SSB tax was published.[23]	
01/25/16	WHO Comission on Ending Childhood Obesity recommended soda taxes.[24]	
02/2016-03/2016	Coca-Cola Europe: "Radar screen" report stating the new taxes were assessed as "business impact" and "likelihood to materialize".[25]	
03/14/16	Coca-Cola email about paper in NYT related to soda taxes in Mexico "[ABA Vice President of Policy] shared the Mexico Autonomous Institute of Technology's study, which reveals that the tax has failed to improve health as its proponents claimed, is regressive and costs jobs. ABA will continue to manage this inquiry, with strong input and guidance from TCC system to ensure a balanced, factual piece".[26]	Information management (Amplification, supression)
03/16/16	ITAM (authors from industry-funded report) hosted a symposium "Obesity: causes and public policies response". Authors claimed that SSB tax would not change consumption.[27]	Information management (Amplification, credibility)
04/27/16	Coca-Cola email about article in Wall Street Journal: "Mike Esterl at WSJ is writing a story on the impact of the tax on the soft drink business in Mexico. [Mike] held conversations and interviews with the ABA and ANPRAC. He reviewed multiple studies from well-respected institutions in Mexico (ITAM, COLMEX, UANL, supported by funding from industry) that make clear the tax was ineffective."[28]	Information management (Amplification)
09/06/16	ANPRAC launched website impuestoscaloricos.com (calorictaxes.com), showing industry-funded reports and videos from ITAM symposium claiming soda tax is not working.[29]	Information management (Amplification)
02/22/17	Non-industry-funded paper published in Health affairs: In Mexico Evidence of sustained consumer response two years after implementing a Sugar-Sweetened Beverage tax.[30]	
02/23/17	International Council of Beverages Association released a statement Response to Health Affairs Journal Article on the Mexico Sugar-Sweetened Beverage Tax: "This study does not show any impact from the tax on the obesity rates in Mexico...here has been no demonstrated health benefit to Mexicans from taxation...What actually works is real, meaningful, coordinated efforts by government, industry, and healthcare and consumer stakeholders in local markets around the world working together to implement evidence-based solutions."[31]	Information Management (Suppression)
12/06/17	International Council of Beverages Association launches the Latin American Regional Group.	Coalition Management
04/04/18	LANCET task force: NCD and economics: recommended soda taxation.[32–34]	
05/15/18	First draft of "*Time to deliver*" (for UN High level meeting) for public consultation: ICBA claimed tax in Mexico was not working.[35]	Information Management (Suppression)
06/01/2018	Final Product from UN High Level meeting "Time to deliver": "Best buys" did not include SSB taxation. [36]	Information Management (Suppression) and Direct involvement and influence in policy
09/27/18	UN High Level Meeting: Mexican committee composed mainly by Food and Beverage Industry representatives.[37]	Direct involvement and influence in policy

Table S2.2 Studies evaluating the Mexican Soda Tax, 2015-2020

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2015	Aguilar A, et al.[20]	Report	Mexican Board of the Consumption Industry (ConMexico)	To estimate the impact of the introduction of a series of taxes on sugary drinks and other products with high energy density in Mexico.	• A decrease in purchases of sugar-sweetened beverages (SSB) ranges from 6.5 to 7%. • Calories purchased decreased by 1% • SSB tax did not decrease BMI.	• The tax did not substantially change the caloric intake, but increased the fiscal revenue. • Households whose head BMI are classifies as obese respond with a smaller decrease in purchases. • The tax has a smaller effect on the population for which it was intended.
2015	Chapa-Cantu J, et al. [22]	Report	Consultancy for Private sector	To evaluate trends in sales of SSBs in the past years.	• Soda sales reduction of 3-4.4%. • Soda sales reduction represents a deficit of 6.4-25.2 billion pesos.	• The caloric intake of sodas contributes to 7% of the total kcal per day and 20.5% of kcal surplus per day. Soda consumption, therefore, is not the main cause of obesity in the country. • The SSB tax reduced consumption by 15 ml representing 6.3 kcal per day. • SSB tax increased revenues but did not substantially reduce caloric intake.
2015	Romero-Tellaeche, et al. [21]	Report	National Association of Soda and Carbonated Water Producers (ANPRAC)	To estimate the change in the consumer's economic wellbeing after Mexico implemented the SSBs tax.	• A 10% increase in SSB prices in 2014 reduced economic wellbeing (the proportion of income to spend on food and beverages) by 1.65%, representing 56.9% of the total reduction in the economic wellbeing in 2014. • The higher impact was on the lowest tertile of socioeconomic status (SES)with a 2% reduction, while the lowest impact was in those with high SES with a decrease of 1.26%.	• The SSB tax negatively affects the wellbeing of consumers. • The cost of the policy is particularly harmful in a situation where inequity and poverty are notorious.

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2016	Colchero MA, et al. [23]	Peer-reviewed / BMJ	Bloomberg Philanthropies and Robert Wood Johnson Foundation	To evaluate changes in consumer beverage purchases after the implementation of the excise tax, using food purchase data from a representative group of households in cities with more than 50,000 residents.	• Six months of SSB tax implementation led to an average 5.6% decline in taxed beverages purchases. • After 12 months of SSB tax implementation sales decreased by 12%. • The average change in sales of SSB tax in 2014 was -6.1%. • Reductions in purchases were greater in low SES households reaching a decline of 17.4% by December and an average decline of 9.1% in 2014. • The average change in purchases of untaxed beverages was +4%.	• The reduction of more than 10% on SSB purchases in the last quarter of 2014 shows that the demand was price elastic and that even a relatively small tax can make some difference in the demand for SSB. • · Taxes on food and beverages have been argued to be regressive. However, larger reduction in purchases among households of low SES suggest that the burden of the tax was lower than it would have been if there was no differential impact by SES.
2016	Colchero MA, et al.[38]	Peer-reviewed / PLOS ONE	Bloomberg Philanthropies and US National Institutes of Health	To estimate changes in sales of SSBs and plain water after a 1 peso per liter excise SSB tax was implemented in Mexico.	• A decline in sales of 6.2-7.3% for the two-year post-tax (2014-2015) compared to the pre-tax period (2007-2013). • Increase in bottled water sales of 5.2-11.8% (2014-2015) compared to the pre-tax period (2007-2013).	• Comparing unadjusted SSB sales would incorrectly conclude that sales increased after the tax implementation. In contrast, when using a statistical model that adjusts for seasonality and economic activity, results showed a 7.3% sales reduction of SSB per capita in the 2-year post-tax period. • Results of this study provide additional evidence indicating the effectiveness of the SSB tax in reducing sales the first- and second-year post-tax.

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2016	Sanchez-Romero LM, et al.[39]	Peer-reviewed / PLOS ONE	US National Institutes of Health, UC-MEXUS CONACYT	To project the longer-term (2013 to 2022) impact of SSB tax on diabetes, coronary heart disease, stroke, mortality, and associated healthcare costs in Mexico.	• Considering 10% reduction in SSB consumption with 39% caloric compensation. • 35-44 y age group have the largest reductions in diabetes incidence. • 189,300 cases of diabetes, 46,300 cases of coronary heart disease (CHD), and 10,900 deaths of CHD and stroke prevented. • Savings in direct healthcare costs of 983 million international dollars.	• Mexico's SSB tax has the potential to decrease SSB consumption, reducing the burden of diabetes and cardiovascular disease (CVD) morbidity and mortality. • Healthcare savings resulting from reduced SSB consumption could be reallocated toward other public health promotion programs and to improve care for diabetes, CVD, and other diseases.
2017	Colchero MA, et al.[30]	Peer-reviewed / Health Affairs	Bloomberg Philanthropies, Robert Wood Johnson Foundation, and US National Institutes of Health	To estimate changes in purchases from stores of taxed and untaxed beverages two years after implementing the SSB tax.	• Decrease in SSB purchases by 5.5% in 2014, 9.7% in 2015, and an average of 7.6% in both years. • 9.0% in 2014 and 14.3% in 2015 among low-SES populations.	• In contrast to industry reports, results show that there was a further reduction in SSB purchases in 2015 beyond the reduction in 2014. • Decreases in purchases were higher among households of lower SES which could lead to higher health care savings.
2017	Colchero MA, et al.[40]	Peer-reviewed / Journal of Nutrition	Bloomberg Philanthropies, National Institute of Public Health (INSP), and US National Institutes of Health.	To examine changes in SSB and bottled water purchases after the SSB tax, and to evaluate heterogeneity by household income, urban and rural strata, and household composition.	• Reduction of 6.3% in SSB purchases vs. expected purchases in 2014 based on the 2008-2012 trend. • Urban areas had the greatest reductions and households with children and adolescents. • 16.2% increase in bottled water purchases; low-income households had the highest reductions in SSB purchases (10.3%) vs. middle (3.7%) and high SES (5.8%).	• SSB purchases decreased and bottled water purchases increased in 2014. • The article provides novel estimations on the heterogeneity of changes in household purchases of SSBs and water in 2014.

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2017	Guerrero-Lopez CM, et al.[41]	Peer-reviewed/ Preventive Medicine	Bloomberg Philanthropies; US National Institutes of Health	To assess changes in employment associated with the implementation of the SSB and non-essential energy-dense food taxes in Mexico.	• Statistically significant, but small, positive change in the employment trend in the post-tax session (monthly average increase 0.09%). • No changes in non-essential dense manufacturing industry. • Small but statistically significant change in post-tax trend (average monthly increase 0.03%) in commercial stores. • Small decreasing trend in national unemployment rate post-tax period (average monthly reduction -2%).	• There were no significant changes in employment after the implementation of the taxes. • It is unexpected that a potential reduction in employment in the manufacturing industries would have an impact on unemployment rates in the country as these industries account only for 1.7% (SSB) and 2.2% (non-essential energy-dense food) of all employees in the manufacturing industry.
2017	Barrientos-Gutierrez T, et al.[42]	Peer-reviewed / PLOS ONE	Bloomberg Philanthropies, Michigan Centre for Diabetes Translational Research, National Institute of Public Health (INSP), and Harvard University	To estimate the expected effect on body mass index (BMI), obesity, and diabetes from the SSB tax in Mexico. (two scenarios:10 % and 20% in SSB tax)	• 10% tax: BMI reduction of 0.15 Kg/m2; 2.54% decrease in prevalence of obesity after 10 years. • 92,000 cases of diabetes averted by 2030. • 20% tax: BMI reduction of 0.31 Kg/m2; 6.85% decrease in prevalence of obesity after 10 years. • 184,000 cases of diabetes averted by 2030.	• Achieving 0.15kg/m2 reduction in BMI at the population level with one single intervention is relevant, as it translates into 2.54% reduction in the obesity prevalence 10 years after the tax. • Largest declines in BMI were observed in low SES, it means that the benefits derived policy favors poorer households, which translates into savings due to reductions in medical attention and gains in productivity.

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2018	Alvarez-Sanchez C, et al.[43]	Peer-reviewed / PLOS ONE	Bloomberg Philanthropies and Tisch Doctoral Scholar Fund, Teachers College Columbia University	To evaluate the potential signaling effect of the Mexican tax on SSBs by analyzing the association between awareness of and opinions about its effectiveness with current consumption of SSBs.	• · 65.2% of participants reported being aware of the SSB tax, but only 20.3% of respondents said they thought the SSB tax helped decrease purchases of SSBs. • · Respondents that were aware of the SSB tax were 30% more likely to report a decrease in their SSB consumption.	• · Accompanying SSB taxes with highly visible educational/informational campaigns may contribute to amplifying their effect by further reducing consumption of SSBs.
2019	Ng SW, et al.[44]	Peer-reviewed / Public Health Nutrition	Bloomberg Philanthropies, US National Institutes of Health, and Robert Wood Johnson Foundation	To estimate the differential changes in taxed and untaxed beverages by volume of purchases associated with implementing the SSB tax, using data on beverage purchases among urban Mexican households.	• High shoppers of taxed beverages at baselinehad the highest reductions of taxed beverages purchases in 2014 (7.5% -8.6% in 2014, and 16.1% -20.1% in 2015). • Low shoppers of untaxed beverage at baseline increased the purchases of untaxed beverages (9.4%-19.2% in 2014 and 11.3%-14.0% in 2015). • High shoppers of untaxed beverage at baselinehad small reductions of untaxed beverages in 2014 (1.2-1.4%) but larger in 2015 (11.6% -13.2%). • Among higher shoppers of-taxed beverageat baseline, the highest reduction in taxed beverages was in low SES (-10.3% in 2014 and -23.7% in 2015).	• Although the tax is relatively low, the greater reductions of taxed beverages purchases among higher consumers may impact health outcomes countrywide, assuming no substitutions for beverages with high sugar content or any other food.

Date of publication	Article	Type of document /Journal	Funding	Objective	Results	Conclusions
2019	Basto-Abreu A, et al.[45]	Peer-reviewed / Health Affairs	Robert Wood Johnson Foundation, Bloomberg Philanthropies, Harvard University (Lown Scholars Program)	To estimate the ten-year impact on health outcomes and quality of life outcomes, and the cost-effectiveness of the SSB tax in Mexico.	• After two years of the soda tax implementation, there would be a reduction in the prevalence of obesity of 0.21 percentage points and would prevent approx. 239,900 cases of obesity. • In ten years, the tax would prevent 61,340 cases of diabetes, 695 cases of cancer, 3990 cases of stroke, 2830 cases of hypertensive heart disease, and 4380 cases of ischemic heart disease. • 2 pesos per litter would double or almost double the effect. The soda tax would add 918 life-years, 55,300 QALYs, and avert 5,840 DALYs. • The tax would save 91.6 million over ten years, resulting in a cost-saving intervention (3.98 dollars in savings health care costs per dollar spent on the implementation).	• The SSB tax is expected to have a modest effect reducing excess weight in children and adults. • In the long term SSB tax is expected to reduce key obesity-related diseases. • The tax could improve quality of life and save 3.98 USD in health care costs for every dollar spent on its implementation. • Increasing the current tax could lead to larger health benefits and future savings in health care costs.
2020	Sanchez-Romero L, et al. [46]	Peer-reviewed / BMJ	Bloomberg Philanthropies	To estimate the change in soda consumption categories three years after the implementation of the SSB tax, using two pre-tax waves and one post-tax wave of a Mexican adult cohort.	• After the tax was implemented, the probability of becoming a non-consumer and low soda consumer, increased by 4.7 and 8.3 percentage points, respectively. • The probability of becoming a medium and high soda consumer decreased by 6.8 and 6.1 percentage points, respectively.	• · The SSB tax in Mexico helped to reduce soda consumption three years after the implementation. • · A fiscal measure can be effective in helping to reduce intake of SSB.

Table S2.3. Contrasting claims made by food and beverage industry-sponsored research and independent peer-reviewed studies on the Mexican soda tax 2015-2020

		Arguments from industry-funded studies		Arguments from non-industry-funded studies	
Domain	**Argument**	**Quotes**	**Source**	**Quotes**	**Source**
The economy	Policy will lead to lost jobs	"A reduction of 3,674 in SSB sales, suggests a loss of 10,815 jobs."	Industry-funded report: UANL[22]	"Our results show that there were no significant changes in employment associated with the taxes in the manufacturing industries"	Guerrero-Lopez C et. Al., Prev Med (Baltim) 2017[41]
		"A second simulation, under a reduction on sales of 14.4 million pesos, employment get reduced by 42,382 jobs"		"There was an increase in sales of bottled water manufactured partially by the same industry that produces SSB, ... [and there] were increases in untaxed beverages... This increase could have offset the potential negative effect on employment associated with the reduction in sales of taxed beverages"	
	Policy will lead to store closures	"More than 30,000 small stores closed last year due to this tax and lack of safety and security, resulting in the loss of 50,000 jobs"	Industry-funded survey: ANPEC[12]	"As commercial establishments sell taxed and untaxed food and beverages, if they are offering more bottled water or other untaxed food or beverages, there is no reason to expect reductions in employment in this sector"	
	Policy will affect the economy of the country	"The reduction of 3.6 billion pesos in sales of SSB generates a reduction in the total production of Mexican economy of 6.4 billion pesos, representing of 0.4% of the GDP"	Industry-funded Report: UANL[22]	"It is unexpected that a potential reduction in employment in the manufacturing industries would have an impact on unemployment rates in the country as these industries account only for 1.7% (SSB) and 2.2% (nonessential energy-dense food) of all employees in the manufacturing industry."	

Domain	Argument	Arguments from industry-funded studies		Arguments from non-industry-funded studies	
		Quotes	**Source**	**Quotes**	**Source**
Social Justice	Policy is regressive	"Although the collection comes mainly from the richest households, the burden of the tax is heaviest in the poorest households. Therefore, the tax is considered regressive."	Industry-funded Report: UANL[22]	"Taxes on food and beverages have been argued to be regressive as the poor pay a higher proportion of their income. However, results from this study showing a larger reduction in purchases among households of low socioeconomic status suggest that the burden of the tax was lower than it would have been if there was no differential impact by socioeconomic status. Additionally, if the tax revenue is appropriated toward decreasing disparities in health or socioeconomic status, the broader fiscal effects of the tax could arguably be progressive."	Colchero et. Al. BMJ 2016; 352: h6704.[23]
	Policy is unfair to the poorest	"The SSB tax as a tool to attend health problems negatively affects the wellbeing of the consumers, and the population with the lowest income are the most affected, in which the costs of the tax policy is greater."	Industry-funded Report: COLMEX[21]	"The finding that larger declines in BMI were observed in the low SES is important. It means that the benefits derived from the reduction in purchases due to the tax favours the poorer households in terms of lower risks of obesity and chronic diseases in the medium and long run, which translates into savings due to reductions in medical attention and gains in productivity"	Barrientos, et al., PLoS One 2017; 12: 1–15.4[42]
		"The differentiated effects by SES show that the SSB tax affects the consumers with the lowest income. The cost of the policy is particularly harmful in a situation where is notorious the problems of inequity and poverty"	Industry-funded Report: COLMEX[21]	“The tax may have the potential to increase health care savings among low-income people, as they pay out of pocket for procedures not covered by Seguro Popular (a program that gives financial protection to the poor, the self-employed, and workers in the informal sector who lack full health coverage)"	Basto-Abreu et. Al., Health Aff (Millwood) 2019; 38: 1824–31.[45]

Domain	Argument	Arguments from industry-funded studies		Arguments from non-industry-funded studies	
		Quotes	**Source**	**Quotes**	**Source**
Social Justice	Policy is unfair to the poorest	“We estimate an increase in the cost of calories of about 4%. This increase is pretty homogeneous across socioeconomic levels. This means that the poorer segments of the population are facing an increase of a similar magnitude than the higher income population”	Industry-funded Report: ITAM[20]		
Governance	Revenues not invested in health	"Rather than reducing the consumption of soft drinks and combating obesity, the SSB tax made it possible to increase revenues significantly."	Industry-funded Report: UANL[22]	"Our cost-benefit analysis concluded that Mexican society could save nearly four dollars for every dollar spent in the implementation of the tax. However, our analysis did not consider the tax revenue...If revenues were earmarked for and invested in treating and preventing obesity and chronic diseases or in other key structural interventions to curb obesity—such as providing safe drinking water or subsidizing the cost of purchasing healthy food—these benefits would need to be accounted for in a cost-benefit analysis. Given the magnitude of the tax revenue, its investment in prevention activities has the potential to produce larger health benefits."	Basto-Abreu et. Al., Health Aff (Millwood) 2019; 38: 1824–31.[45]
Intended public health benefits	Policy will not reduce consumption	"The SSB tax, reduced the consumption by 15 ml per day. Thus, the SSB tax, in the best scenario, caused a decrease in the consumption of 6.3 kcal. The SSB tax contributed to reduce the average consumption by 0.21%, and the surplus of kcal in the Mexican population by 0.62%."	Industry-funded Report: UANL[22]	"[Mexican scholars and most researchers] recommend that taxes need to be set to 20% to observe the higher reduction in purchases and consumption that may have an effect on health outcomes. The current Mexican tax is half that level."	Colchero et.al. BMJ.2016; 352: h6704.[23]

Domain	Argument	Arguments from industry-funded studies		Arguments from non-industry-funded studies	
		Quotes	**Source**	**Quotes**	**Source**
Intended public health benefits	Policy will not reduce consumption			"While the 0.15 kg/m2 reduction achieved with the tax could seem small from an individual level perspective, achieving this reduction at the population level with a single intervention is relevant, as it translates into a 2.54% reduction in the obesity prevalence 10 years after the tax"	Barrientos, et al., PLoS One 2017; 12: 1–15.[42]
	Policy will not reduce sales	"Nielsen sales data shows that there was no significant reduction in liters consumed in the twelve months. Between these years, consumption of SSBs fell by 182 liters. 182 liters in a country that consumes over 11 billion liters of carbonated soft drinks is a flat result"	Industry-funded report: New Zealand Taxpayers Union[48]	Comparing unadjusted sales in millions of liters would lead to conclude that sales increased after the tax implementation. In contrast, when using a statistical model that adjusts for seasonality and economic activity, results showed a 7.3% sales reduction of SSB per capita in the 2-year post-tax period...The model showed the importance of adjusting for the GIEA [global indicator of the economic activity].	Colchero et. Al. PLoS One 2016; 11(9): e0163463.[38]
				"This paper illustrates the relevance of considering population growth (presenting sales per capita) and adjusting statistically for variables that change over time and that are associated with the demand for beverages when comparing sales over time for assessing effects of policies such as the SSB tax in Mexico. The use of unadjusted aggregate sales is clearly inappropriate."	Colchero et. Al. PLoS One 2016; 11(9): e0163463.[38]
				Some observers have looked at aggregate rather than per capita soda consumption and the fact that total volumes rose slightly in Mexico in 2015 (the positive growth rate in to suggest that the tax has	Cherukupalli R. LANCET Global Health. Blog, 2016[49]

Domain	Argument	Arguments from industry-funded studies		Arguments from non-industry-funded studies	
		Quotes	**Source**	**Quotes**	**Source**
Intended public health benefits	Policy will not reduce sales			lost its effect)...Mexico has a growing population (1·2% annual growth), so that, even if each person drank the same amount of soda from one year to the next, total sales levels should rise in any given year, and total sales growth should be positive. Any annual change in total soda volumes that is below 1·2% essentially implies Mexicans are drinking less soda on a per capita basis"	
	Policy will not reduce calories	"Although the price of calories increased by close 4 percent, the quantity of calories consumed by about 1 percent only... Although these "low" elasticities limit the power of taxes to decrease obesity, they imply high tax collection potential for these measures"	Industry-funded Report: ITAM[20]	"One line of criticism of Mexico's experience with its sugar-sweetened beverage tax was the focus on the magnitude of policy effects rather than the statistical significance of them…But put in perspective, the per capita consumption of soda fell over 2 years by nearly the amount that the average Indian drinks in the same 2 years. And that is a data point that that policymakers with the long game in mind should be able to toast to, with bottomless glasses of sparkling water."	Cherukupalli R. LANCET Global Health. Blog, 2016[49]
		" One important indicator of success in the fight against obesity is the decrease in total calories. Reduction sugary drinks liters may not change total calories consumption if consumers substitute to other foods or drinks"	Industry-funded Report: ITAM[20]	"Varying the degree of calorie compensation, a 10% reduction in SSBs could decrease the incidence by as few as 66,000 cases if 100% of calories reduced through lower SSB consumption were replaced by calories from other sources, or as many as 265,100 cases if all calories reduced through lower SSB consumption were translated into weight change."	Sanchez-Romero. PLoS Med 2016; 13: e1002158[39]

Domain	Argument	Arguments from industry-funded studies		Arguments from non-industry-funded studies	
		Quotes	**Source**	**Quotes**	**Source**
Intended public health benefits	Policy will not decrease obesity/diabetes rates	The sole graph is very telling: there is no discernible difference across the years in BMI... It seems that so far, the existing tax has not had a detectable decrease in BMI. This is consistent with the small impact on calories presented above."	Industry-funded Report: ITAM[20]	"Big beverage companies pretend that the tax does not work because weight and obesity did not decline quickly. No one expected to see any decline in obesity from this small tax after one or two years, and advocates and scholars have called for doubling or tripling the tax to truly affect energy and sugar intakes. No reputable scholar expected to see a quick decrease in obesity with such a small decrease in SSB consumption	Popkin BM. AJPH. 2017; 107(11):1702 (editorial) [50]
				"Our main policy simulations estimate that the SSB tax alone could prevent 189,300 cases of diabetes and save about 983 million international dollars in direct health-care costs attributable to diabetes over the time period 2013–2022"	Sanchez-Romero. PLoS Med 2016; 13: e1002158[39]
				"After 10 years, under the average tax effect the simulations indicate that the prevalence of obesity would decrease by 2.54%, while overweight and normal weight would increase 0.51% and 2.25%, respectively."	Barrientos, et al., PLoS One 2017; 12: 1–15.[42]
				"Evidence that the SSB tax was associated with a greater reduction in SSB purchases among higher purchasers of taxed beverages is relevant because higher consumers of taxed beverages have a greater risk of obesity, diabetes and other cardiometabolic outcomes, and a greater likelihood of undiagnosed or poorly treated cardiometabolic diseases."	Ng S, et. Al., Public Health Nutrition. 2019; 22(4): 750–756[44]

References

1 University of California San Francisco. Food Industry Documents. 2020.https://www.industrydocuments.ucsf.edu/food/ (accessed 20 Dec 2020).

2 Anderson SJ, McCandless PM, Klausner K, *et al.* Tobacco documents research methodology. *Tob Control* 2011;**20 Suppl 2**:ii8-11. doi:10.1136/tc.2010.041921

3 Ulucanlar S, Fooks GJ, Gilmore AB. The Policy Dystopia Model : An Interpretive Analysis of Tobacco Industry Political Activity. 2016;:1–21. doi:10.1371/journal.pmed.1002125

4 Mialon M, Swinburn B, Sacks G. A proposed approach to systematically identify and monitor the corporate political activity of the food industry with respect to public health using publicly. *Obes Rev* 2015;**16**:519–30. doi:10.1111/obr.12289

5 Mialon M, Julia C, Hercberg S, *et al.* The policy dystopia model adapted to the food industry : the example of the Nutri-Score saga in France. *World Nutr* 2018;**9**:109–20.

6 Conway J. Soft drink per capita consumption in the ten most populated countries worldwide 2019. statista. 2020.https://www.statista.com/statistics/505794/cds-per-capita-consumption-in-worlds-top-ten-population-countries/

7 Diario Oficial de la Federacion. LEY DE INGRESOS DE LA FEDERACIÓN PARA EL EJERCICIO FISCAL DE 2014 . Capítulo I De los Ingresos y el Endeudamiento Público. 2014.http://www.diputados.gob.mx/LeyesBiblio/abro/lif_2014.htm (accessed 20 May 2019).

8 Diario Oficial de la Federacion. Acuerdo por el que se crea el Consejo Asesor del Observatorio Mexicano de Enfermedades No Transmisibles.

2014.http://www.dof.gob.mx/nota_detalle.php?codigo=5361364&fecha=24/09/2014

9 World Health Organization. *Fiscal Policies for Diet and Prevention of Noncommunicable Diseases. Technical meeting report.* Geneva, Switzerland: 2015.

10 Colchero M, Rivera J, Ng S-W, *et al.* Reducción en el consumo de bebidas con impuesto después de la implementación del impuesto en México. Inst. Nac. Salud Pública. 2015.https://www.insp.mx/epppo/blog/3666-reduccion-consumo-bebidas.html (accessed 28 Oct 2020).

11 Goltzman M. FW: INFORM: Patrick Luciani Huffington Post Editorial on Mexico Tax. 2015 June 19. DC Leaks Coca Cola Emails. DC Leaks. 2015.

12 Ramirez M. Cierran 30 mil "tienditas" por reforma fiscal e inseguridad. Milenio. 2015.https://www.milenio.com/negocios/cierran-30-mil-tienditas-reforma-fiscal-inseguridad (accessed 28 Oct 2020).

13 Goltzman M, Quiros RF. FW: INFORM: More on the effects of the Tax Reform in Mexico. 2015 July 10. DC Leaks Coca Cola Emails. DC Leaks. https://www.industrydocuments.ucsf.edu/food/docs/#id=rfdl0226 (accessed 28 Oct 2020).

14 Goltzman M. FW: INFORM: Mexico Excise Tax Materials & Resources. 2015 July 15. DC Leaks Coca Cola Emails. DC Leaks. https://www.industrydocuments.ucsf.edu/food/docs/#id=pfdl0226 (accessed 12 Jul 2019).

15 John, Peters C; Hill J, University of Colorado. Slight Change in Plans for Mexico Symposium: From Dr. James Rippe. 2015 May 14. USRTK Food Ind. Collect. US Right to Know. https://www.industrydocuments.ucsf.edu/docs/qzyk0228 (accessed 20 Oct 2020).

16 Maerker D. No hay interés de beneficiar a refresqueros: dip. PRI. Con Denise Maerker.

2015.https://www.radioformula.com.mx/audio-y-video/atando-cabos/20151021/no-hay-interes-de-beneficiar-a-refresqueros-dip-pri-con-denise-maerker/ (accessed 29 Oct 2020).

17 Comisión de Hacienda y Crédito Público. Declaratoria de publicidad de dictámenes. Mexico: 2015. http://gaceta.diputados.gob.mx/PDF/63/2015/oct/20151019-III-1.pdf (accessed 29 Oct 2020).

18 Senado de México. Sesión ordinaria de la H. Cámara de senadores celebrada el miércoles 28 de octubre del 2015. 2015. https://www.senado.gob.mx/64/version_estenografica/2015_10_28/1660 (accessed 29 Oct 2020).

19 ILSI. International Life Sciences Institute Suspends ILSI Mexico's Charter. 2015.https://ilsi.org/wp-content/uploads/2019/06/ILSI-Mexico-Suspension.pdf (accessed 4 Apr 2020).

20 Aguilar A, Gutiérrez E, Seira E. Taxing calories in Mexico. 2015. http://cie.itam.mx/sites/default/files/cie/15-04.pdf

21 Romero-Tellaeche J, Caldiño-García E, Minor-Campa E, *et al.* Efectos producidos en el bienestar de la sociedad por la política de tributar alimentos y bebidas altamente calóricos. Gastos y demanda por refrescos por hogar, 2012-2014. Mexico City: 2015.

22 Chapa Cantú J, Flores-Curiel D, Zuñiga-Valero L. La industria de las bebidas no alcohólicas en México. 2015. https://impuestosaludable.org/wp-content/uploads/2013/06/La-industria-de-las-bebidas-no-alcohólicas-en-méxico_vf_UANL.pdf

23 Colchero MA, Popkin BM, Rivera JA, *et al.* Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *BMJ*

2016;**352**:h6704.

24 World Health Organization. *Report of the commission on ending childhood obesity.* Geneva, Switzerland: 2016. http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf?ua=1

25 Coca Cola Europe. Radar Screen of EU Public Policies. Monthly Issue update: February and March 2016. https://www.documentcloud.org/documents/3409808-EU-Radar-Screen-Issue-Update-2016-02-03.html (accessed 2 Dec 2020).

26 Lemming J, Goltzman M. INFORM: New York Times Article on Soda Taxes. 2016 March 14. DC Leaks Coca Cola Emails. DC Leaks. DC Leaks Coca Cola Emails. DC Leaks. 2016.https://www.industrydocuments.ucsf.edu/docs/lrcl0226 (accessed 20 Feb 2020).

27 Conferencia "Obesity: Causes and Public Policy Responses" | Eventos y Noticias. https://eventos.itam.mx/es/3/eventos/2016/03/09/conferencia-obesity-causes-and-public-policy-responses (accessed 10 Dec 2020).

28 Goltzman M, Tressler K. INFORM: Walls Street Journal Study in beverage tax impact in Mexico. DC Leaks. Coca Cola Emails. 2016.https://www.industrydocuments.ucsf.edu/docs/gkcl0226 (accessed 2 Feb 2020).

29 Impuestos Calóricos. http://impuestoscaloricos.com/ (accessed 7 Jan 2021).

30 Colchero MA, Rivera-Dommarco J, Popkin BM, *et al.* In Mexico, Evidence Of Sustained Consumer Response Two Years After Implementing A Sugar-Sweetened Beverage Tax. *Health Aff (Millwood)* 2017;**36**:564–71. doi:10.1377/hlthaff.2016.1231

31 International Council of Beverages Association. International Council of Beverages Associations' Response to Health Affairs Journal Article on the Mexico Sugar-Sweetened

Beverage Tax. Press release. 2017.http://www.icba-net.org/news-events/news/details/19/ (accessed 8 Dec 2020).

32 Sassi F, Belloni A, Mirelman AJ, *et al.* Equity impacts of price policies to promote healthy behaviours. *Lancet* 2018;**391**:2059–70. doi:10.1016/S0140-6736(18)30531-2

33 Summers LH. Taxes for health: evidence clears the air. *Lancet* 2018;**391**:1974–6. doi:10.1016/S0140-6736(18)30629-9

34 Jan S, Laba T-L, Essue BM, *et al.* Action to address the household economic burden of non-communicable diseases. *Lancet* 2018;**391**:2047–58. doi:10.1016/S0140-6736(18)30323-4

35 International Council of Beverages Association. Re: Comments on the Draft first report of the WHO Independent High-Level Commission on Non-Communicable Diseases. 2018.https://www.who.int/ncds/governance/high-level-commission/International-Council-of-Beverages-Associations.pdf?ua=1

36 World Health Organization. Time to deliver: Report of the WHO Independent High-Level Commission on - - Noncommunicable Diseases. Geneva, Switzerland: : World Health Organization 2018.

37 Velazquez K. Los omnipresentes asesores de la industria - Salud con lupa. https://saludconlupa.com/series/la-salud-en-la-mesa-del-poder/los-omnipresentes-asesores-de-la-industria/ (accessed 27 Jul 2020).

38 Colchero MA, Guerrero-López CM, Molina M, *et al.* Beverages sales in Mexico before and after implementation of a sugar sweetened beverage tax. *PLoS One* 2016;**11**:4–11. doi:10.1371/journal.pone.0163463

39 Sánchez-Romero LM, Penko J, Coxson PG, *et al.* Projected Impact of Mexico's Sugar-

Sweetened Beverage Tax Policy on Diabetes and Cardiovascular Disease: A Modeling Study. *PLoS Med* 2016;**13**:e1002158. doi:10.1371/journal.pmed.1002158

40 Colchero MA, Molina M, Guerrero-López CM. After Mexico Implemented a Tax, Purchases of Sugar-Sweetened Beverages Decreased and Water Increased: Difference by Place of Residence, Household Composition, and Income Level. *J Nutr* 2017;**147**:1552–7. doi:10.3945/jn.117.251892

41 Guerrero-López CM, Molina M, Colchero MA. Employment changes associated with the introduction of taxes on sugar-sweetened beverages and nonessential energy-dense food in Mexico. *Prev Med (Baltim)* 2017;**105**:S43–9. doi:10.1016/j.ypmed.2017.09.001

42 Barrientos-Gutierrez T, Zepeda-Tello R, Rodrigues ER, *et al.* Expected population weight and diabetes impact of the 1-peso-per-litre tax to sugar sweetened beverages in Mexico. *PLoS One* 2017;**12**:1–15. doi:10.1371/journal.pone.0176336

43 Álvarez-Sánchez C, Contento I, Jiménez-Aguilar A, *et al.* Does the Mexican sugar-sweetened beverage tax have a signaling effect? ENSANUT 2016. *PLoS One* 2018;**13**:1–18. doi:10.1371/journal.pone.0199337

44 Ng SW, Rivera JA, Popkin BM, *et al.* Did high sugar-sweetened beverage purchasers respond differently to the excise tax on sugar-sweetened beverages in Mexico? *Public Health Nutr* 2019;**22**:750–6. doi:10.1017/S136898001800321X

45 Basto-Abreu A, Barrientos-Gutiérrez T, Vidaña-Pérez D, *et al.* Cost-Effectiveness Of The Sugar-Sweetened Beverage Excise Tax In Mexico. *Health Aff (Millwood)* 2019;**38**:1824–31. doi:10.1377/hlthaff.2018.05469

46 Sánchez-Romero LM, Canto-Osorio F, González-Morales R, *et al.* Association between tax on sugar sweetened beverages and soft drink consumption in adults in Mexico: open

cohort longitudinal analysis of Health Workers Cohort Study. *BMJ* 2020;:m1311. doi:10.1136/bmj.m1311

47 Torres-Álvarez R, Barrán-Zubaran R, Canto-Osorio F, *et al.* Body weight impact of the sugar-sweetened beverages tax in Mexican children: A modeling study. *Pediatr Obes* 2020;:e12636. doi:10.1111/ijpo.12636

48 Riddiford J. *Fizzed out: Why sugar tax won't curb obesity*. New Zealand: 2015. https://d3n8a8pro7vhmx.cloudfront.net/taxpayers/pages/404/attachments/original/1436351583/Fizzed_out-v7.pdf?1436351583

49 Cherukupalli R. Growth rates and aggregates : bringing data to the soda wars. *Lancet Glob Heal* 2016;**Blog**:250–2.https://www.thelancet.com/journals/langlo/blog

50 Popkin BM. Mexican cohort study predates but predicts the type of body composition changes expected from the mexican sugar-sweetened beverage tax. *Am J Public Health* 2017;**107**:1702–3. doi:10.2105/AJPH.2017.304097

Appendix 3.1 Supplementary material

A Workplace Sales Ban Reduced Sugar-Sweetened Beverage Consumption on Employees at Higher Risk

Table S3.1 Study sample baseline characteristics by heavy and non-heavy drinkers (Unweighted)

	Total	**Moderate/no consumption** (< 12 oz/day)	**Heavy consumption** (≥12 oz/day)	
	n=2036	n=1432	n=604	P Value*
	%	%	%	
Gender				
Women	65.4	66.7	62.4	0.07
Men	34.6	33.3	37.6	
Age				
20-39	47.6	48.5	45.7	0.40
40-59	45.2	44.2	47.5	
60 +	7.2	7.3	6.9	
Race/ethnicity				
White	34.0	40.3	18.9	<0.01
Black/African American	7.0	6.0	9.3	
Hispanic	16.8	14.6	22.1	
Asian	31.9	29.7	37.2	
Other	10.3	9.4	12.5	
Job Classification				
Medical technician	12.6	10.6	17.2	<0.01
Support staff, clerk, analyst	37.1	38.1	34.8	
Service/maintenance/police	14.1	8.9	26.7	
Medical provider (physician, nurse)	13.9	15.9	9.1	
Academic (faculty, postdoctoral fellow)	12.2	15.1	5.5	
Administrative, IT, miscellaneous	10.0	11.4	6.8	
Days per week at any UCSF location				
0-4 days/week	15.0	16.2	12.2	0.02
5-7 days/week	85.0	83.8	87.8	
Overnight shift worker				
No	87.4	89.1	83.3	<0.01
Yes	12.6	10.9	16.7	

*Chi-square tests comparing heavy vs no/moderate SSB consumption

Table S3.2 Percentage change in overall and type of sugar-sweetened beverages consumption at 6 and 12 months after the workplace ban was implemented, by heavy and non-heavy drinkers [a] (Unweighted)

	Unadjusted SSB consumption[a] Mean oz/day (SD)			Adjusted percentage change[a] (95% CI)	
	Baseline	6 months	12 months	Baseline to 6 months	Baseline to 12 months
All employees					
Soda	2.5 (7.4)	2.0 (6.7)	1.9 (5.9)	-6.6 (-15.6, 3.3)	**-7.1 (-10.3, -3.7)**
"Fruit" drinks	1.9 (5.9)	1.4 (4.9)	1.2 (4.4)	0.0 (-10.6, 11.8)	**-4.8 (-8.6, -0.9)**
Sports/Energy drinks	1.6 (6.0)	1.0 (3.5)	1.1 (3.6)	0.7 (-7.5, 9.7)	-1.8 (-5.0, 1.4)
Pre-sweetened coffee/tea drinks	4.0 (10.1)	4.1 (10.7)	3.9 (10.4)	5.9 (-8.8, 23)	1.3 (-4.7, 7.6)
Other sweetened drinks	1.4 (4.5)	1.2 (3.8)	1.1 (3.8)	2.4 (-7.9, 14)	-3.4 (-7.0, 0.4)
Total SSB	11.5 (19.0)	9.7 (16.8)	9.1 (16.2)	-3.4 (-17.3, 12.8)	**-9.5 (-14.9, -3.8)**
Total SSB at work	5.4 (9.8)	4.5 (8.9)	4.2 (8.4)	-2.5 (-15.6, 12.8)	**-6.8 (-12.0, -1.4)**
Total SSB outside work	6.1 (10.4)	5.2 (8.9)	4.9 (8.7)	-2.9 (-14.9, 10.8)	**-6.3 (-11.0, -1.3)**
Moderate/No consumption (<12 oz/day)					
Soda	0.6 (1.3)	1.0 (5.1)	0.8 (4.2)	-1.0 (-9.8, 8.8)	-0.1 (-3.1, 3.1)
"Fruit" drinks	0.4 (1.2)	0.7 (3.4)	0.7 (3.1)	-6.6 (-15.3, 3.0)	1.5 (-2.0, 5.1)
Sports/Energy drinks	0.4 (1.1)	0.5 (2.3)	0.5 (2.3)	5.2 (-2.4, 13.3)	2.7 (-0.3, 5.7)
Pre-sweetened coffee/tea drinks	0.6 (1.6)	2.6 (8.2)	2.4 (7.6)	15.2 (-0.6, 33.5)	**21.1 (14.4, 28.1)**
Other sweetened drinks	0.4 (1.1)	0.7 (2.8)	0.6 (2.4)	0.3 (-8.7, 10.2)	0.3 (-3.1, 3.9)
Total SSB	2.4 (3.0)	5.5 (11.6)	5.1 (11.0)	14.4 (-2.4, 34)	**14.9 (7.9, 22.5)**
Total SSB at work	0.9 (1.6)	2.5 (6.3)	2.4 (6.0)	12.9 (-1.7, 29.7)	**16.7 (10.4, 23.3)**
Total SSB outside work	1.5 (2.1)	3.0 (6.1)	2.8 (5.6)	12.6 (-1.4, 28.6)	**13.5 (7.6, 19.6)**
Heavy consumption (>= 12 oz/day)					
Soda	7.3 (12.3)	4.5 (9.1)	4.3 (8.4)	**-26.9 (-42.6, -6.9)**	**-27.1(-34.6, -18.7)**
"Fruit" drinks	5.5 (9.8)	3.1 (7.2)	2.4 (6.3)	-1.9 (-25.5, 29.2)	**-24.5(-33.5, -14.2)**
Sports/Energy drinks	4.6 (10.3)	2.2 (5.4)	2.4 (5.4)	-15.4 (-31.5, 4.5)	**-16.0 (-23.9, -7.3)**
Pre-sweetened coffee/tea drinks	12.0 (15.7)	7.9 (14.6)	7.6 (14.5)	**-35.9 (-54.2, -10.3)**	**-45.5(-53.8, -35.7)**
Other sweetened drinks	3.8 (7.7)	2.2 (5.3)	2.2 (5.9)	-3.3 (-25.6, 25.6)	**-16.4 (-25.6, -6.1)**
Total SSB	33.1 (23.2)	20.0 (22.3)	18.8(21.7)	**-55.9 (-67.6, -40.0)**	**-60.5(-65.3, -55.0)**
Total SSB at work	16.1 (12.4)	9.5 (11.9)	8.8 (11.1)	**-51.8 (-64.6, -34.4)**	**-57 (-62.4, -50.8)**
Total SSB outside work	17.1 (13.7)	10.4 (12.0)	10.1(12.1)	**-49.3 (-61.4, -33.5)**	**-51.4(-56.7, -45.5)**

[a] Percent change in SSB consumption as reflected by coefficients from fixed-effects model adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Statistically significant differences at the 5% level are displayed in bold type. [a] "Fruit drinks" are drinks with zero or less than 100% real juice fruits. "Pre-sweetened Coffee/tea drinks" does not include coffee/tea that you add sugar to yourself. "Other sweetened drinks" (like soy milk chocolate milk, horchata or soy milk).

Table S3.3 Percentage change in overall and type of sugar-sweetened beverages consumption at 6 and 12 months after the workplace ban was implemented, by heavy and non-heavy drinkers [a] (Weighted)

	Unadjusted SSB consumption[a] Mean oz/day (SE)			*Adjusted percentage change* [b]	
	Baseline	6 months	12 months	Baseline to 6 months	Baseline to 12 months
All employees					
Soda	2.0 (0.1)	1.8 (0.2)	1.5 (0.1)	**-10.5 (-19.3, -0.8)**	**-6.8 (-10.2, -3.4)**
"Fruit" drinks	1.5 (0.1)	1.1 (0.1)	0.9 (0.1)	1.6 (-8.9, 13.2)	-3.6 (-7.5, 0.4)
Sports/Energy drinks	1.3 (0.1)	0.8 (0.1)	0.9 (0.1)	-1.4 (-8.5, 6.3)	-2.1 (-5, 0.9)
Pre-sweetened coffee/tea drinks	3.3 (0.2)	3.5 (0.3)	3.1 (0.2)	8.1 (-6.6, 25)	1.1 (-4.7, 7.3)
Other sweetened drinks	1.2 (0.1)	1.0 (0.1)	1.0 (0.1)	1.0 (-9.4, 12.5)	-2.2 (-5.8, 1.6)
Total SSB (total)	9.2 (0.4)	8.3 (0.4)	7.4 (0.3)	-5.7 (-19.2, 10)	**-9.0 (-14.5, -3.2)**
Total SSB at work	4.2 (0.2)	3.8 (0.2)	3.4 (0.2)	-3.5 (-15.9, 10.6)	**-6.6 (-11.8, -1.0)**
Total SSB (outside work)	5.0 (0.2)	4.5 (0.2)	4.1 (0.2)	-4.3 (-16.3, 9.4)	**-5.8 (-10.6, -0.8)**
Moderate/No consumption (<12 oz/day)					
Soda	0.5 (0.0)	1.0 (0.2)	0.8 (0.1)	-3.7 (-12.3, 5.7)	-0.2 (-3.2, 2.9)
"Fruit" drinks	0.4 (0.0)	0.7 (0.1)	0.6 (0.1)	-5.6 (-14, 3.5)	0.8 (-2.8, 4.5)
Sports/Energy drinks	0.3 (0.0)	0.5 (0.1)	0.5 (0.1)	2.7 (-3.8, 9.6)	2.3 (-0.5, 5.2)
Pre-sweetened coffee/tea drinks	0.6 (0.0)	2.2 (0.2)	2.0 (0.2)	**15.8 (0.7, 33.1)**	**15.8 (9.5, 22.4)**
Other sweetened drinks	0.4 (0.0)	0.6 (0.1)	0.6 (0.1)	3.3 (-4.7, 11.9)	0.4 (-2.9, 3.7)
Total SSB (total)	2.2 (0.1)	5.0 (0.3)	4.3 (0.3)	10.1 (-5.9, 28.9)	**10.5 (3.7, 17.7)**
Total SSB at work	0.8 (0.0)	2.2 (0.2)	1.9 (0.1)	12.4 (-0.8, 27.4)	**12.4 (6.4, 18.8)**
Total SSB (outside work)	1.4 (0.1)	2.7 (0.2)	2.4 (0.1)	9.3 (-4.7, 25.3)	**10.1 (4.5, 16.1)**
Heavy consumption (>= 12 oz/day)					
Soda	6.5 (0.5)	4.3 (0.4)	3.8 (0.4)	**-35.1 (-51.6, -13.1)**	**-29.5 (-37.8, -20)**
"Fruit" drinks	4.8 (0.4)	2.4 (0.3)	2.0 (0.2)	8.5 (-20.6, 48.5)	**-21.7 (-32, -9.8)**
Sports/Energy drinks	4.1 (0.4)	2.0 (0.2)	2.1 (0.2)	**-19.3 (-34.8, -0.2)**	**-18.9 (-26.5, -10.6)**
Pre-sweetened coffee/tea drinks	11.3 (0.8)	7.6 (0.5)	6.5 (0.5)	**-32.7 (-54.6, -0.3)**	**-43.7 (-53, -32.5)**
Other sweetened drinks	3.5 (0.3)	2.2 (0.2)	2.5 (0.3)	-12.4 (-37.7, 23.1)	**-13.9 (-24.5, -1.7)**
Total SSB (total)	30.3 (1.0)	18.6 (1.1)	16.9 (0.9)	**-59.3 (-71.2, -42.4)**	**-60.8 (-66.3, -54.5)**
Total SSB at work	14.5 (0.5)	8.7 (0.5)	7.7 (0.4)	**-56.7 (-69.6, -38.4)**	**-57.9 (-63.9, -50.8)**
Total SSB (outside work)	15.7 (0.6)	9.9 (0.6)	9.2 (0.5)	**-52.0 (-64.5, -35.0)**	**-51.9 (-57.8, -45.2)**

Percent change in SSB consumption as reflected by coefficients from fixed-effects model adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects, baseline non-response and attrition.[a] "Fruit drinks" are drinks with zero or less than 100% real juice fruits. "Pre-sweetened Coffee/tea drinks" does not include coffee/tea that you add sugar to yourself. "Other sweetened drinks" (like sweetened soy beverages, chocolate milk, or horchata).
Statistically significant differences at the 5% level are displayed in bold type.

Table S3.4 Change in the purchasing of sugar-sweetened beverages (SSBs), attitudes and reasons for drinking SSBs six months following introduction of a workplace SSB sales ban

	Moderate/no consumption at baseline			Heavy consumption at baseline		
	Unadjusted prevalence		*Adjusted percentage-point change baseline to six months (95%CI)*[a]	Unadjusted prevalence		*Adjusted percentage-point change baseline to six months (95%CI)*[a]
	Baseline (%)	*Six months (%)*		*Baseline (%)*	*Six months (%)*	
	n=1432	*n=1389*		n=604	n=557	
SSB purchasing patterns I some/most of the time...						
Buy SSBs nearby worksite	40.7	43.1	4.4 (-7.7, 16.5)	60.6	55.5	1.3 (-13.3, 16.0)
Bring SSBs to work	26.8	29.9	-6.9 (-19.3, 5.4)	59.0	52.9	-11.3 (-26.1, 3.4)
SSB Attitudes and norms						
I sometimes or frequently…						
Am concerned that SSBs are not good for my health	69.7	66.3	-11.2 (-23.0, 1.2)	75.6	76.5	1.9 (-12.5, 16.2)
Wish I could cut down	47.8	46.9	-6.8 (-16.8, 3.2)	70.3	72.3	0.3 (-11.5, 12.2)
Other people encourage me to cut down	26.4	24.8	-8.8 (-18.7, 1.2)	53.8	49.2	1.8 (-12.5, 16.1)
Reasons for consuming SSB Sometimes or frequently consume SSBs because I…						
Am thirsty	58.7	56.8	**-13.6 (-25.5, -1.7)**	77.8	71.5	**-20.7 (-35.5, -5.9)**
Enjoy the taste	84.5	84.3	**-10.2 (-20.0, -0.5)**	91.8	93.4	0.6 (-8.3, 9.4)
Just feel like it	78.4	77.2	-3.4 (-13.6, 6.8)	82.1	85.5	-3.25 (-16.6, 10.1)
Need an energy boost	53.8	56.3	-7.5 (-20.7, 5.5)	73.8	72.6	6.2 (-8.8, 21.3)
Always have one at a particular time	28.7	30.3	-8.2 (-20.4, 4.1)	65.4	51.3	-11.3 (-29.6, 7.0)
Am stressed out	30.0	32.0	-10.2 (-22.2, 1.7)	50.2	48.1	6.0 (-8.0, 19.9)
Want to reward myself	46.7	48	**-13.6 (-26.4, -0.9)**	60.7	58.4	-4.7 (-17.8, 8.5)
Feel an urge for one	64.8	66.2	-3.2 (-15.2, 8.8)	74.8	75.8	9.0 (-3.8, 21.8)
Feeling positive/somewhat positive about the sales ban	70.1	72.9	1.2 (-5.3, 8.2)	56.4	62.4	**15.8 (0.1, 33.8)**

[a] Percentage-point change in SSB consumption as reflected by coefficients from fixed effects model adjusting for ambient temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects and attrition. Statistically significant differences at the 5% level are displayed in bold type.

Table S3.5. Percentage change in sugar-sweetened consumption at 6 and 12 months, by heavy and non-heavy drinkers, excluding pre-sweetened coffee/tea drinks [a] (Weighted)

	Adjusted percentage change [b]	
	Baseline to 6 months	Baseline to 12 months
All employees		
Overall	-11.6 (-23.3, 1.9)	**-11.3 (-15.9, -6.5)**
At work	-9.2 (-19.3, 2.1)	**-8.7 (-12.7, -4.5)**
Outside work	-6.2 (-17, 6.1)	**-7.1 (-11.2, -2.8)**
Moderate/no consumption		
Overall	-3.2 (-15.2, 10.6)	0.1 (-4.9, 5.4)
At work	-1.6 (-10.8, 8.6)	1.5 (-2.7, 5.7)
Outside work	2.1 (-9.0, 14.5)	2.7 (-1.6, 7.2)
Heavy consumption		
Overall	**-47.2 (-63.6, -23.5)**	**-47.6 (-55.2, -38.8)**
At work	**-41.7 (-58.6, -18)**	**-41.9 (-49.5, -33.0)**
Outside work	**-40.3 (-56.7, -17.7)**	**-39.9 (-47.6, -31.0)**

Percent change in SSB consumption as reflected by coefficients from fixed effects model adjusting for monthly average temperature, night shift work, and exposure to a brief SSB motivational intervention. Analyses were weighted for design effects and attrition.

Appendix 4.1 Supplementary material

Effectiveness of a Food Pharmacy Program on reducing systolic and diastolic blood pressure in low-income participants with hypertension

Table S4.1. Event study of the effect of the Food Pharmacy Program on Systolic and Diastolic Blood Pressure in the overall population

	Systolic blood pressure coef (95% CI)	Diastolic blood pressure coef (95% CI)
Pre average	0.48 (0.06, 0.90)	0.05 (-0.17, 0.27)
Post average	-4.27 (-5.40, -3.14)	-1.68 (-2.07, -1.30)
Time to event (quarters)		
-8	1.56 (0.32, 2.79)	-0.29 (-0.87, 0.28)
-7	-0.17 (-0.69, 0.34)	-0.74 (-1.27, -0.20)
-6	1.83 (0.16, 3.50)	0.96 (0.44, 1.48)
-5	-2.41 (-6.13, 1.32)	-0.85 (-1.87, 0.17)
-4	1.41 (-2.03, 4.84)	1.10 (-1.12, 3.32)
-3	2.33 (-1.18, 5.83)	1.23 (-0.65, 3.11)
-2	-0.41 (-3.70, 2.88)	-0.72 (-1.74, 0.30)
-1	-0.29 (-1.67, 1.09)	-0.28 (-1.11, 0.55)
0	-2.23 (-3.91, -0.54)	-0.37 (-1.60, 0.86)
1	-1.76 (-6.68, 3.15)	-0.62 (-2.23, 0.99)
2	-2.55 (-3.40, -1.71)	-0.38 (-0.44, -0.33)
3	-5.03 (-5.69, -4.37)	-1.17 (-1.89, -0.44)
4	-6.02 (-10.15, -1.90)	-3.05 (-4.78, -1.32)
5	-5.17 (-7.75, -2.59)	0.06 (-0.85, 0.98)
6	-2.92 (-3.19, -2.64)	-2.08 (-3.73, -0.43)
7	-4.76 (-8.94, -0.58)	-2.88 (-4.29, -1.47)
8	-7.97 (-10.61, -5.33)	-4.66 (-6.48, -2.85)

Difference in Difference coefficients from the Callaway and Sant 'Anna estimators. Models are adjusted for sex, age, race, insurance and employment status.

Publishing Agreement

It is the policy of the University to encourage open access and broad distribution of all theses, dissertations, and manuscripts. The Graduate Division will facilitate the distribution of UCSF theses, dissertations, and manuscripts to the UCSF Library for open access and distribution. UCSF will make such theses, dissertations, and manuscripts accessible to the public and will take reasonable steps to preserve these works in perpetuity.

I hereby grant the non-exclusive, perpetual right to The Regents of the University of California to reproduce, publicly display, distribute, preserve, and publish copies of my thesis, dissertation, or manuscript in any form or media, now existing or later derived, including access online for teaching, research, and public service purposes.

DocuSigned by:
Andrea Pedroza-Tobias
B8C78214E8424AA...
Author Signature

8/17/2022
Date