Institution: University of Cambridge		
Unit of Assessment: 2 Public Health, Health Services and Primary Care		
Title of case study: Improving health through reductions in population sugar consumption		
Period when the underpinning research was undertaken: 2013-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Nita Forouhi	Professor; Programme Leader	May 2013-present
Martin White	Professor; Programme Leader	Oct 2014-present
Jean Adams	Senior University Lecturer; Programme Leader	Oct 2014-present
Fumiaki Imamura	Senior Investigator Scientist	May 2013-present
Oliver Mytton	Academic Clinical Lecturer	Oct 2013-Aug 2020
Period when the claimed impact occurred: 2013-2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

Cambridge University research has characterised the link between consumption of sugary drinks and poor health, including obesity and type 2 diabetes – major problems that disproportionately affect people on low incomes. This research has contributed importantly to the scientific evidence base and to policy-making, culminating in the UK Soft Drinks Industry Levy of 2016. Manufacturers have responded by reducing the sugar content of drinks – the equivalent of 45 million kilograms less sugar every year, or 675g (a bag and a half) less sugar consumed per person per year in the UK. This effort has contributed to improvements in life expectancy and quality of life, and reductions in health inequalities. Cambridge evidence has also enabled health advocacy groups to give practical advice to people to improve their health, and has guided policies of the WHO, World Bank, International Diabetes Federation and several national dietary guidelines.

2. Underpinning research (indicative maximum 500 words)

Sugar consumption matters because of its role in dental caries, obesity, type 2 diabetes, and cardiovascular diseases (including heart attacks and strokes) – all problems that disproportionately affect low-income groups and increase health inequalities. University of Cambridge research has clarified the contribution of sugary drinks to these conditions and has informed the evidence base on how best to reduce sugary drink consumption.

Establishing the link between sugary drinks and poor health

Research led by the Centre for Diet and Activity Research, part of the MRC Epidemiology Unit at the University of Cambridge, has been crucial in establishing the link between sugar-sweetened beverages ("sugary drinks") and type 2 diabetes. The Cambridge-led EPIC-InterAct study is one of the world's largest longitudinal studies of dietary intake and type 2 diabetes, involving over 12,400 new-onset cases embedded in a pan-European cohort of over 500,000 participants [1]. It showed that just one sugary drink a day was linked to around 22% higher risk of diabetes, independent of obesity [1]. Further Cambridge-led research confirmed this link in a UK population, showing that for each 5% increase in a person's total energy intake provided by sugary drinks, the risk of developing type 2 diabetes was about 18% higher [2].

Cambridge researchers also modelled how, over a ten-year period from 2010 to 2020, the public health impact of sugary drink consumption was 80,000 cases of type 2 diabetes in the UK and two million cases in the USA [3]. An estimated 3.6% of type 2 diabetes cases in the UK and 8.7% of cases in the USA are attributable to sugary drink consumption [3]. The modelling suggested that preventing these cases could save GBP206 million in the UK and nearly GBP12 billion in the USA in healthcare costs (at 2016 prices) [3].

Establishing the effectiveness of policy interventions on sugary drinks

A study led by the London School of Hygiene and Tropical Medicine (LSHTM) with researchers from Cambridge was important in establishing that an additional tariff on sugary drinks could reduce sugar consumption [4]. It showed that, six months after putting an extra 10 pence on the

price of sugary drinks in a national restaurant chain in September 2015, sales of those drinks fell by 9.3%. Modelling work led by Cambridge also identified that reformulation of drinks (removing or reducing sugar content) could be the most impactful population health effect of a levy, with potential to achieve a 0.9% reduction in obesity prevalence in adults and children [5].

Cambridge researchers then led a study, in collaboration with colleagues at the University of Oxford and the LSHTM, which determined the impact of the UK Soft Drinks Industry Levy – a tax on soft drinks containing more than 5g of sugar per 100ml – after it was announced in March 2016. The research found that the levy was successful in encouraging manufacturers to reduce sugar content. Before the announcement, 52% of soft drinks were above the threshold for the tax. By February 2019, the percentage of levy-eligible drinks had fallen to 15%, indicating very substantial reformulation of the drinks or replacement with lower-sugar versions [6].

The research further showed that, one year after implementation of the levy, the total volume of soft drinks purchased had not changed, so the financial impact on the food and drinks industry was minimised. But the sugar content of soft drinks purchased reduced by 29.5g per UK household per week, or around 10%. This is equivalent to about three fewer teaspoons of sugar per person per week – the kind of reduction needed to reduce risk of type 2 diabetes.

3. References to the research (indicative maximum of six references)

1. InterAct Consortium. (includes **Forouhi NG**) Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct. *Diabetologia* 2013;56:1520–1530. https://dx.doi.org/10.1007/s00125-013-2899-8*
2. O'Connor L, **Imamura F**, […], **Forouhi NG.** Prospective associations and population impact of sweet beverage intake and type 2 diabetes, and effects of substitutions with alternative beverages. *Diabetologia* 2015;58:1474–1483. https://doi.org/10.1007/s00125-015-3572-1*
3. **Imamura** F, O'Connor L, […], **Forouhi NG.** 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. https://doi.org/10.1136/bmj.h3576*
4. Corenelsen L, **Mytton OT**, Adams J, […], **White M**, Cummins S. Change in non-alcoholic beverage sales following a 10-pence levy on sugar-sweetened beverages within a national chain of restaurants in the UK: interrupted time series analysis of a natural experiment. *J Epidemiol Commun Health* 2017;71:1107–1112. https://doi.org/10.1136/jech-2017-209947*
5. Briggs AD, **Mytton OT**, […], Scarborough P. Health impact assessment of the UK soft drinks industry levy: a comparative risk assessment modelling study. *Lancet Public Health* 2016;2:e15-e22. https://doi.org/10.1016/S2468-2667(16)30037-8 *
6. Scarborough P, […], **Adams J**, Cummins S, Penney T, **White M.** Impact of the announcement and implementation of the UK Soft Drinks Industry Levy on sugar content, price, product size and number of available soft drinks in the UK, 2015-19: A controlled interrupted time series analysis *PLoS Medicine* 2020;17: e1003025. https://doi.org/10.1371/journal.pmed.1003025 *

*These publications have been peer reviewed, providing evidence of research quality.

<u>Competitive funding received</u>

Forouhi NG (PI). Nutritional Epidemiology Programme Award. MRC, GBP4.5m, 2015-20.
White M (PI) et al. Evaluation of the health impacts of the UK Treasury Soft Drinks Industry Levy (SDIL). NIHR Public Health Research Programme (PHR 16/130/01), GBP1.5m, 2017-21.
White M (PI) et al. Evaluation of impacts on health of proposed UK industry levy on sugar sweetened beverages: developing a systems map & data platform, and collection of baseline/ early impact data. NIHR Public Health Research Programme (Rapid Funding Scheme, PHR16/49/01), GBP49,959, 2016-17.
Adams J (PI) et al. Examining Public Attitudes related to Sugar and the Soft Drinks Industry Levy. The Health Foundation GBP25,635, 2017-19.
Adams J (PI) et al**.** Examining Public Attitudes related to Sugar and the Soft Drinks Industry Levy. The Health Foundation, GBP25,152, 2018-19.

4. Details of the impact (indicative maximum 750 words)

Improving health through policy-mandated reductions in population sugar consumption

Overconsumption of sugar is a major contributor to poor health, implicated in childhood and adult obesity, type 2 diabetes, cardiovascular diseases, fatty liver disease, and dental caries. These conditions are responsible for widening inequalities in health and impose strain on health systems. For example, in the UK one in three children are overweight or obese by age 11, rising to two in three people in adulthood, at an annual cost to the NHS of GBP6 billion and cost to the wider economy of GBP27 billion (Public Health England statistics).

According to Diabetes UK, type 2 diabetes affects almost four million people in the UK and costs the NHS around GBP10 billion annually. Globally, around 450 million people have type 2 diabetes (International Diabetes Federation statistics), and around two billion people are overweight or obese (World Health Organization statistics), with numbers rising. Reducing consumption of sugar is therefore a key health goal nationally and internationally, and is identified as a priority by the UK government and by the World Health Organization (WHO).

Though the importance of sugar in contributing to health problems has been known for some time, it is through the recent studies of Cambridge University and other researchers that the specific – and major – role of sugary drinks has become more fully clear. Cambridge's research has directly informed international guidance and national policy.

Influencing national and international dietary policy

The body of evidence produced by University of Cambridge researchers on the effects of sugar consumption on health and on how to reduce sugar intake from sugary drinks has been influential in major UK policy initiatives and dietary guidance, as well as in international dietary guidelines. Cambridge researchers have engaged closely with key decision-makers at policy and system level, for example through submissions to major parliamentary committees and inquiries, involvement (by invitation) in stakeholder consultations, and directly briefing and advising policy-makers, guidance bodies and advocacy groups.

Influence was further achieved through Professor White's secondment as Specialist Adviser to the House of Lords Select Committee on Food, Poverty, Health and Environment and contributions to the 2018 annual report of the Chief Medical Officer of England and Wales, and through Dr Mytton's Parliamentary Academic Fellowship at the House of Commons Health and Social Care Select Committee and contribution to the Chief Medical Officer's report on childhood obesity [A]. Cambridge researchers have also forged productive collaborations with leading charities and other influencing bodies to secure impact.

Making the case for the sugar levy

WHO, International Diabetes Federation, multiple national guidelines: Cambridge evidence on sugary drinks and diabetes risk has been recognised globally in making the case for fiscal measures to reduce sugar consumption. It is cited in the WHO *Global Report on Diabetes* 2016, the International Diabetes Federation Diabetes Atlas report, and the World Bank report on disease control priorities [B]. The WHO report cited Cambridge research in noting *"an association between high consumption of sugar-sweetened beverages and increased risk of type 2 diabetes"* [B]. It recommended implementation of an effective tax on sugary drinks as one of several key measures to address childhood obesity. The Chief and the Director of the Division of Diabetes Translation, US Centers for Disease Control and Prevention, stated that the Cambridge-led systematic review of global research on sugary drinks [3] presents *"a compelling case that beverages sweetened with sugar should be a major target for policies aimed at reducing the risk of diabetes"* [C]. Cambridge research is now cited in dietary guidelines in the United States [C].

Public Health England: Cambridge research was extensively cited in the key policy documents leading to the introduction of the Soft Drinks Industry Levy in the UK. A key report from Public Health England, *Sugar reduction: responding to the challenge* (2014) [D], cited Cambridge's work on sugary drinks and the potential of taxation-based interventions. The 2015 report by the government's Scientific Advisory Committee on Nutrition, *Carbohydrates and Health* [D], citing

the EPIC-InterAct study among others, identified sugary drinks as a specific risk factor for weight gain and type 2 diabetes. It recommended that sugary drink consumption should be minimised to improve health. In line with the modelling work undertaken at Cambridge [5], Public Health England's subsequent sugar reduction strategy focused in particular on encouraging reformulation – reduction or removal of sugar from products by food and drinks companies – as the approach most likely to have an impact on health [D]. According to Public Health England's chief nutritionist, the Cambridge team's research was crucial in informing its strategies, with the Scientific Advisory Committee on Nutrition report providing *"a platform for subsequent policy actions to improve diets, including through legislation and taxation"* [D].

Wider influence: Cambridge researchers also worked closely with major influencing charities to provide evidence for policy change, helping them both to influence the political climate and make evidence-based calls for the introduction of specific policies. These include the Obesity Health Alliance, a coalition of 45 leading health charities and medical royal colleges, who confirm that *"Cambridge University's research has been key"* to their evidence-based advocacy [E]. Diabetes UK has described how Cambridge's research on sugary drink consumption *"fed into our discussions with other stakeholders including Public Health England.* […] *These discussions culminated in the introduction of the Soft Drinks Industry Levy, which has been so far successful in making companies reduce the amount of sugar in their drinks"* [E]. Diabetes UK's dietary guidance is now informed directly by Cambridge evidence [E]; they write that they are *"indebted to* [Cambridge researchers] *for improving our understanding of the role of sugar-sweetened beverages* […] *in increasing the risk of type 2 diabetes."* [E].

Fuelling sustained government action on sugary drinks

Cambridge researchers have contributed to parliamentary deliberation around sugary drinks policy through briefing papers, through Parliamentary Office of Science and Technology (POST) POSTNotes on the health impacts of sugar, and through interviews with POST that have informed parliamentary debate [F]. For example, Cambridge's modelling work comparing the likely impacts of various approaches to sugar reduction [5] was cited in the House of Commons Briefing Paper on the Soft Drinks Industry Levy [F].

Written and oral evidence submitted by Cambridge was cited extensively in the reports of the House of Commons Health and Social Care Committee that paved the way for the Soft Drinks Industry Levy. The 2015 report on the impact of diet and physical activity on health featured written and oral evidence from the Cambridge team throughout, while the 2018 report – which focused on childhood obesity – cited submissions from the group, and was supported by Dr Mytton in interpreting the evidence presented [G]. More broadly, Cambridge researchers provided evidence to wide-ranging forums that *"helped inform opinions and influence key policy makers in government, which supported the introduction of the soft drinks industry levy (SDIL) announced in 2016"* [D]. The then Chief Medical Officer, Professor Dame Sally Davies, confirms that the Cambridge team is *"at the forefront of generating evidence that has supported policymaking for childhood obesity, including strategies to reduce sugar consumption"* [H].

The work of Cambridge researchers has also been crucial in maintaining momentum and political support for the levy [E,H]. Members of the Obesity Health Alliance, for example, have maintained a close relationship with the Cambridge team, and *"used emerging findings from* [Cambridge research] *to advocate for changes to the structure of the policy to increase the impact"* [E]. In 2019, an interdisciplinary workshop organised by Cambridge [I] fed into the Prevention Green Paper of the government's Department of Health and Social Care [J]. The workshop findings were used, together with findings from the evaluation of the Soft Drinks Industry Levy [6], in a private briefing in May 2020 for the Prime Minister's Health Adviser, to inform the new obesity strategy. Published on 27 July 2020, the strategy reaffirmed the success of the levy and committed to its continuation [J].

Achievement of significant real-world reductions in sugar consumption

In a context where 35 million adults and over three million children in the UK are obese or overweight (Obesity Statistics 2019, House of Commons Library), the benefits of the Soft Drinks Industry Levy on sugary drinks are far-reaching [6]. It has helped to secure an 11% reduction in

sugar content [K]. Consumers have also shifted towards buying products that are not subject to the levy, meaning they are more likely to buy drinks with sugar levels below 5g per 100ml [K].

Modelling of the potential health benefits of these reductions suggests that, at a population level, the levy will appreciably increase life expectancy and improve quality of life for today's children and adolescents (the group that will benefit most). For example, modelling studies have suggested that the levy will achieve about a 1% reduction in obesity prevalence in adults and children, translating into long-term better health for tens of thousands of people in the UK alone, avoiding many cases of heart attack, stroke and other life-altering consequences of obesity [5]. The levy is important in addressing inequalities in outcomes most benefitting the least privileged; children will have the greatest relative health benefit in terms of obesity and dental health [5,E].

5. Sources to corroborate the impact (indicative maximum of 10 references)

A. **(i)** Health 2040 – Better Health Within Reach. Annual Report of the Chief Medical Officer, 2018. Editors and authors p. 4; Chapter 8, p. 1; **(ii)** Time to solve childhood obesity: CMO special report, 2019. Annex B, p. 5; Contributors p. 2
B. **(i)** WHO Global Report on Diabetes, April 2016, p. 12; **(ii)** International Diabetes Federation Diabetes Atlas report pp. 133-134; **(iii)** World Bank. Disease Control Priorities, Third Edition: Volume 5. Cardiovascular, Respiratory, and Related Disorders. Nov 2017, pp. 108, 113
C. **(i)** Compelling evidence linking sugary drinks with diabetes, Gregg & Albright, BMJ, p. 1; **(ii)** WUS Dietary Guidelines for Americans 2015-20, pp. 335, 343, 344, 346, 354
D. **(i)** Public Health England: *Sugar reduction: responding to the challenge,* 26/06/2014; **(ii)** The Scientific Advisory Committee on Nutrition recommendations on carbohydrates, including sugars and fibre, 17/07/2015; **(iii)** Public Health England. *Sugar Reduction: Achieving the 20%.* 2017; **(iv)** Testimony from Chief Nutritionist Public Health England
E. Influence on health charities: **(i)** Testimony from Obesity Health Alliance; **(ii)** Testimony from Diabetes UK; **(iii)** Evidence-based nutrition guidelines for the prevention and management of diabetes. Diabetes UK, March 2018
F. Government advisory documents: **(i)** Parliamentary Office of Science and Technology *POSTNote: Sugar and Health*; **(ii)** *POSTNote Sugar and Health Policy* p.2; **(iii)** Parliamentary debate pack, Debate on an e-petition on a tax on sugary drinks 30/11/2015; **(iv)** House of Commons Library. Briefing Paper 7876, The Soft Drinks Industry Levy. 2017. p. 17
G. Impact on soft drinks industry levy policy development: **(i)** House of Commons Health and Social Care Committee *Impact of Diet and Physical Activity on Health Inquiry, 2015*; **(ii)** House of Commons Health and Social Care Committee *Childhood Obesity Inquiry, April 2018*. pp. 28–30, 40–42.
H. Testimony from former Chief Medical Officer for England
I. **(i)** Workshop: *Identifying the most promising population preventive interventions to add 5 years to healthy life expectancy by 2035, and reduce the gap between the rich and the poor in Engla*nd www.repository.cam.ac.uk/handle/1810/294711/; **(ii)** *Increasing healthy life expectancy equitably in England by 5 years by 2035: could it be achieved?* The Lancet, 29/06/2019.
J. Continued impact on government strategy: **(i)** Department of Health and Social Care. *Advancing our health: prevention in the 2020s*; **(ii)** Department of Health and Social Care. *Tackling obesity: empowering adults and children to live healthier lives*. 2020
K. PHE Sugar Reduction Programme 2018, p. 5