



A mixed-method analysis of the #SugarTax debate on Twitter

Gemma Bridge^{1,2,*} , Stuart W Flint^{3,4}  and Ralph Tench¹

¹Leeds Business School, Leeds Beckett University, Leeds LS1 3HB, UK; ²Institute of Population Health Sciences, Centre for Clinical Trials & Methodology, Queen Mary University London, London E1 4NS, UK; ³School of Psychology, University of Leeds, Leeds LS2 9JT, UK; ⁴Scaled Insights, Nexus, Discovery Way, University of Leeds, Leeds LS2 3AA, UK

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Abstract

Objective: To explore the #SugarTax debate on Twitter to assess actors involved, their connections and the topics being discussed during the implementation and first anniversary of the UK Soft Drink Industry Levy.

Design: The structure of the #SugarTax debate on Twitter was assessed using social network analysis. The actors involved, their connections and the topics of discussion taking place were also explored using content, sentiment and thematic analyses.

Setting: Twitter between 2017 and 2019.

Participants: Twitter users engaging in discussions relating to the hashtag 'SugarTax'.

Results: Tweets (n 5366) posted between 5 August 2017 and 7 May 2019 containing #SugarTax were downloaded from Twitter using Network Overview for Discovery and Exploration in Excel. The network included 1883 users, with 686 unique edges and 4679 edges with duplicates. The majority of tweets were negative in sentiment, when assessed by both automatic (64%, n 141) and manual sentiment analysis (52%, n 115) methods. Nine key themes were identified and grouped into two groups according to 'support for a sugar or SSB tax' or 'opposition for a sugar or SSB tax'.

Conclusions: Twitter was used as a platform for debating the benefits and limitations of sugar-sweetened beverage taxes. The findings indicate that numerous actors are involved in the debates on Twitter, with advocates and lobbyists using the platform to raise support for their campaigns and reshape public perceptions. The findings and the methods used may be of interest to policymakers as well as to academics and members of the public looking to explore and engage in policy debates.

Keywords
Social network analysis
Sugar tax
Health policy
Social media
Thematic analysis

Consumption of free sugars, in particular from sugar-sweetened beverages (SSB), has been associated with poor dental health and obesity^(1,2). Correlations have also been reported between SSB and increases in body weight in children⁽³⁾. As a result of such correlations, the WHO recommended the 'implementation of an effective tax on SSBs'⁽⁴⁾. The evidence and support for the potential benefits of such fiscal policies to public health have increased through evaluations and widespread implementation, and as such policymakers across the world have implemented and are considering the implementation of beverage taxes to raise revenue and reduce consumption⁽⁵⁾.

In response to a 2015 Public Health England report that recommended a tax on SSB to reduce sugar consumption in children⁽⁶⁾, and mounting evidence for the potential effectiveness of such policies elsewhere⁽⁷⁾, in his March 2016 budget, the then Chancellor of the Exchequer, George

Osborne, announced that the UK Government would introduce a Soft Drink Industry Levy (SDIL) in 2018⁽⁸⁾. The SDIL, unlike most other policies to reduce sugar intake from SSB consumption, aimed to influence industry behaviour by placing a levy on manufacturers and importers of soft drinks based on total sales of drinks⁽⁹⁾. The SDIL was designed as a two-tiered levy to incentivise reformulation, with the higher tier (drinks containing over 8 g of sugar per 100 ml) levied at £0.24/l and the lower tier (drinks containing between 5 and 8 g of sugar per 100 ml) levied at £0.18/l. Several types of soft drink were excluded from the levy, including 100% fruit juice, drinks made up of over 75% milk and those with <5 g of sugar⁽⁸⁾. Despite a 2-year window to give the soft drinks industry time to reformulate and respond to the SDIL, and growing evidence of potential effectiveness^(7,10), like other policies implemented to curb consumption of SSB, the SDIL faced stiff opposition especially from industry members.

*Corresponding author. Email gemma.bridge@qmul.ac.uk

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Due to the body of evidence in support of SSB taxes^(7,10), public health advocates pushed for the SDIL to be implemented. As research suggests that direct connections (or strong ties) to policymakers, for example, through attendance at meetings, can support advocacy efforts that influence policy decisions^(11–13), it is relevant to study this in relation to SSB taxes. Evidence suggests that such ties serve as paths for information and resource sharing and can create opportunities for collective action⁽¹⁴⁾. Granovetter⁽¹⁵⁾ also argues that weak ties (i.e. ties between acquaintances) are key to achieving influence as they can provide cohesive power ('the strength of weak ties') and enable information diffusion. Network Theory suggests that actors who have the greatest control over the spread of information within a network have the greatest potential influence⁽¹⁶⁾. Identifying these actors is important in understanding how debates are shaped. Beyond official advocacy efforts, the general public can also influence policy change through placing increased pressure on policymakers⁽¹⁷⁾. In this vein, social media platforms such as Twitter (a widely used microblogging site) are becoming an increasingly important platform for political and policy debates due to large userbases and the widespread use of social media as a source of news⁽¹⁸⁾. For instance, it was recently found that Australian ultraprocessed food industry actors used Twitter to influence food and health policy debates, suggesting that social media can be used to extend lobbying practices to reshape public perceptions⁽¹⁹⁾. However, little is known about how actors are connecting through social media to discuss SSB taxes, or indeed advance policy positions in relation to SSB taxes. Consequently, this study aimed to explore the influence of actors (i.e. users on Twitter), the network (i.e. connection of actors) and conversations (i.e. what actors are talking about) involved in SSB tax debates on Twitter.

Methods

NodeXL (Network Overview for Discovery and Exploration in Excel) is an open-source template for Microsoft Excel that allows for automated collection, analysis and visualisations of social media data⁽²⁰⁾. NodeXL has been employed in health research^(21,22) and has also been employed to explore the processes of consensus-seeking, alliance-building and strategic action, integral to the development of policy⁽²³⁾. In this study, NodeXL was used to gather and analyse data from Twitter. All tweets gathered were posted between 5 August 2017 and 7 May 2019 and either contained '#SugarTax' or were posted in response to tweets that included the hashtag. No geographical restrictions were placed on Tweets gathered but as this period was at a key period during the implementation and first anniversary of the SDIL, many of the tweets were posted by those in the UK. Hashtags give tweets more significance by linking them to broader issues and campaigns⁽²⁴⁾. They also allow for the formation of networks which can be

investigated computationally⁽²⁵⁾. The #SugarTax hashtag was selected since it was widely used to brand the debate, archive messages and allow those not personally connected to a user to see and comment on messages that use the hashtag⁽²⁵⁾.

Social network analysis

First Social Network Analysis (SNA) was conducted to assess the ties between actors and identify influential actors in the network using NodeXL. SNA has roots in pluralist, network theories of policymaking⁽²⁶⁾ and can help to explore the actors involved in such networks. In this study, the process of SNA involved gathering tweets containing the hashtag #SugarTax from Twitter and collating the data in an Excel spreadsheet. From there, the tweets and their associated metadata were explored using automated NodeXL pro features. Definitions of the terms used throughout the paper are provided in Table 1. Measures of centrality were assessed to make assumptions about the way traffic flows through the network^(27,28). Centrality measures assessed included betweenness centrality, that is, the number of shortest paths that pass through each actor, with high betweenness suggesting high influence⁽²⁹⁾ and closeness centrality, that is, the distance between one node and the next; a high closeness centrality suggests proximity to other nodes and thus high influence⁽³⁰⁾. Twitter communities in the network were identified using the Clauset–Newman–Moore cluster analysis algorithm, which identifies clusters in a network by placing participants into the cluster they best fit based on their patterns of interconnection⁽³¹⁾.

Sentiment and thematic analyses

As there were over 5000 tweets gathered (n 5366), a subsample of tweets (5%, n 220) were obtained to conduct an in-depth qualitative analysis. After the removal of duplicate tweets, the subsample was selected in Excel using a random number generator. Once obtained, the tweets were analysed via content, sentiment and thematic analyses. Themes were assessed manually by one researcher following the six-step process of thematic analysis outlined by Braun and Clarke⁽³²⁾. This involved familiarisation with the data (i.e. reading and re-reading of the tweets), the development of initial codes, collation of the codes into potential themes (with extracts gathered for support) and then reviewing and naming of the themes for clarity. Themes were identified inductively via a data-driven approach⁽³³⁾ and were discussed between the authors through a process of peer debriefing which helped to triangulate the thematic analysis to increase credibility and trustworthiness. Theme discrepancies were discussed, final theme names were decided and each theme was supported with verbatim quotes.

The sentiment was assessed automatically using MeaningCloud, an Excel plug-in that is used to extract meaning from unstructured content such as Tweets⁽³⁴⁾.



Table 1 #SugarTax network data and definitions

Graph metric	Count	Definition
Vertices	1883	The fundamental unit of which network graphs are formed. In a Twitter network, vertices are the Twitter users.
Total edges	5365	Edges are the links that occur between two vertices in the network graph. In the Twitter network, they are the sent tweets.
Unique edges	686	Unique edges are those that occur only once in the network.
Edges with duplicates	4697	In a directed graph, edges with duplicates are those that have the same tail vertex and the same head vertex
Replies to	456	The number of tweets that were posted in response to another tweet.
Mentions	3669	The number of tweets that mention another user.
Maximum Geodesic Distance	14	Geodesic distance refers to the shortest path distance between two vertices. The maximum geodesic distance is the largest number of paths between any two vertices within the network.
Average Geodesic Distance	6.56	The average geodesic distance is the mean number of paths that connect any two vertices within the network.
Graph Density	0.001	Graph density is calculated by dividing the number of edges by the total number of possible edges.
Modularity	0.361	Modularity is the difference in the number of cross-cluster edges from its expected value.

The application can perform advanced opinion mining, including aspect-based polarity, objectivity/subjectivity distinction, discernment of disagreement and irony detection. MeaningCloud defined tweets into one of three sentiment states (positive, neutral or negative). As tweets often contain non-typical text elements such as website addresses, emoticons, hashtags and acronyms, the sentiment of the subsample of tweets was also analysed manually. This involved reading the tweets individually and assigning a sentiment value (negative, neutral or positive). This two-step process of sentiment analysis triangulated the process and improved trustworthiness.

Ethical approval

Social media data such as tweets are publicly available and users consent to Twitter’s terms of agreement to make tweets available publicly. However, due to the continued debates around the ethics of using social media data in research, for this study, ethical approval was granted for the study of publicly available tweets by Leeds Beckett University Review Board prior to data collection from Twitter.

Results

Tweets (*n* 5366) were automatically downloaded from Twitter using the NodeXL data importer. A network graph was produced using NodeXL (see Fig. 1). All downloaded tweets were included. In the figure, the circles represent individual Twitter users and the lines represent connections between each user such as mentions within Tweets. The network was directed (i.e. connections had a start and an end) and included 1883 users, with 686 unique edges (connections) and 4679 edges with duplicates. The maximum geodesic distance (the shortest path between two vertices) was 14, whilst the average geodesic distance between any two

nodes was 6.56. With <7 connections between actors in the network, it indicates that actors can interact relatively easily and share information quickly. The network is well connected, as shown by the density of tweets shared. The network and associated network data (summarised in Table 1) reveal that the debate was dispersed with many actors who were involved.

The #SugarTax debate includes several distinct groups, as can be seen by the clustering of actors in the network graph. This indicates that the #SugarTax debate had a community network shape, thanks to many groups of users conversing about this topic. The groups, although distinct, were not sharing content in silos, this is apparent as there are connections (edges) that traverse between groups as users are mentioning, replying to or sharing Tweets. There were also self-loops (an edge that connects a vertex to itself) which suggest that users were sharing their Tweets without mentioning or replying to a specific user. Self-loops can occur in this network as it was directed; therefore, when tweets are shared without a mention of another actor, they form loops rather than connections between actors. The actors within the network have the greatest influence over the flow of information, with low geodesic distances to others. Network data also reveal that the range of connections to and from each node (otherwise called the degree) was 1–77. The greater the degree, the more connections the user had to others in the network.

Within the network, a range of individuals and organisations were represented. Users include members of the public, health campaign groups, professional associations, as well as the food and drink industry, retailers and restaurants. Beyond the types of actors involved, the network graph (Fig. 1) helps to show this influence and thus provides insights into which actors are controlling the flow of information in the network. The most influential users in the network were scattered across the network which indicates that a range of influential actors were involved.

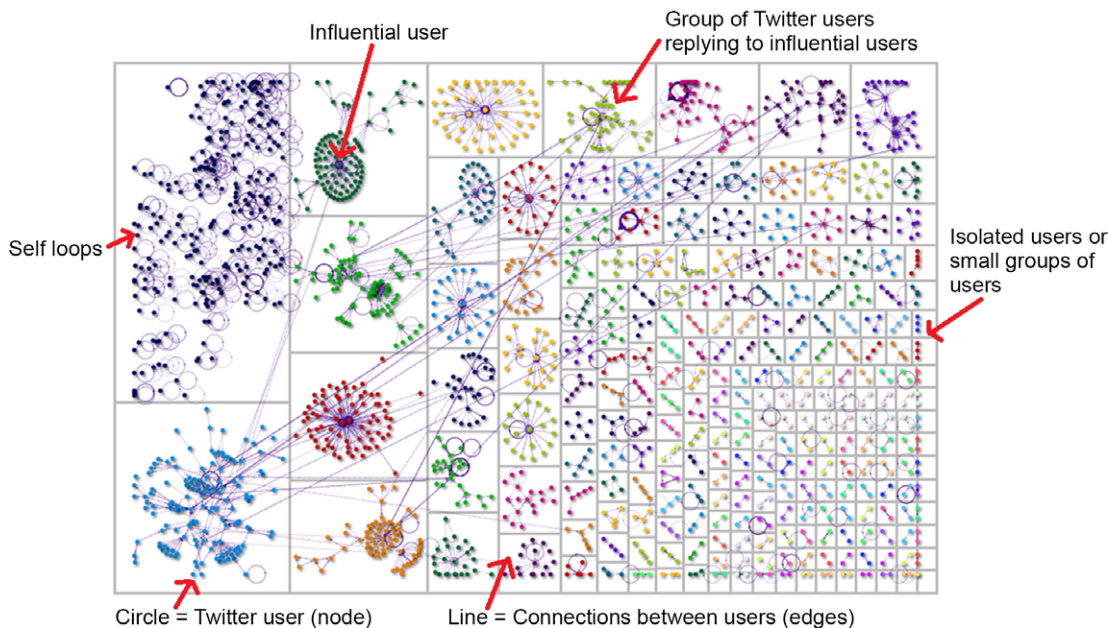


Fig 1 (colour online) Visualisation of the #SugarTax network on Twitter

The British Dietetic Association was a group which had a broadcast network structure which is typical of news media outlets and users with loyal followers who frequently retweet posts⁽³⁵⁾. The British Dietetic Association node also had a high degree (77), which highlights that they were interacting with many other users. Whilst the community surrounding the Jamie Oliver node (a celebrity chef and health campaigner) had a combined structure with some aspects of a broadcast network, that is some loyal followers retweeting content, and some aspects of a clustered network with multiple, disconnected communities mentioning, replying and retweeting Jamie Oliver tweets. Jamie Oliver and the British Dietetic Association had high betweenness centralities of 55 342·501 and 104 000·568, respectively, indicating higher influence over the network in terms of information flow. The most influential actor Twitter user identified in the #SugarTax network was ‘greedspam’, as indicated by having the highest betweenness centrality (104 000·568).

Sentiment and thematic analyses

The majority of tweets were negative in sentiment (automatic 64 %, n 141, manual 52 %, n 115). The key themes were grouped into two cross-cutting themes based on their ‘support for a sugar or SSB tax’ (Negative health impacts of sugar and SSB; Government intervention needed; Evidence to support an SSB tax; Extension of tax needed) or ‘opposition for a sugar or SSB tax’ (ineffective; regressive nature of tax; increase in artificial sweeteners; individual responsibility for health). See Table 2 for a summary of the themes. The themes, their key themes and supportive concepts are described below with verbatim tweets.

Support for a sugar or sugar-sweetened beverage tax

The arguments in support of an SSB tax were largely consistent and focused on only a few key areas. Many users discussed the incongruence between efforts to prevent obesity and the profit-driven business interests of food and drink companies. For instance, highlighting that policies have been influenced by vested interests and that the food and drink industry had shifted the blame for obesity and excess sugar intake to consumers: ‘#BigTobacco tactics #Coca-Cola Is Quietly Influencing #China’s #Obesity Policy—and Shifting Blame from Itself #SugarTax #obesity #sugar #SSBs’.

Building on this, users discussed the health impacts of sugar describing the implications of excess consumption on dental health and obesity: ‘Young children consume much more sugar than they should, around 2800 excess sugar cubes per year! #obesity #SugarTax #childhealth’, and the increasing cost of treating overweight and obesity: ‘We know within one generation #obesity, the direct and indirect costs, could potentially bankrupt the @NHSuk because the projections are that it will cost £50bn a year’. Some supported their arguments with academic research, citing evidence from other countries with SSB taxes: ‘Barbados SSB tax was associated with decreased sales of SSBs in a major grocery store chain after controlling for underlying trends.’

Despite the support for SSB taxes, several users highlighted the limitations of such taxes, arguing that SSB taxes should be extended to other food and drink products to reduce confusion and improve the effectiveness of health taxes: ‘#SugarTax Where people can have unlimited supply of calories at a @pizzabut buffet, yet I can’t have a regular #Pepsi with my salad in case I get fat!’



Table 2 Themes identified in the Tweets present in the #Sugartax network

Themes present in Tweets against SSB taxes	Description of theme	Exemplar quote
Ineffective	Tweets included in this theme argued that the increased costs due to a tax would not result in behaviour change but would likely lead to substitution to other high sugar products	<i>Sugar tax might not be the most effective tactic to fight childhood obesity, A study, found no direct link between the consumption of sugar-sweetened beverages and higher overall energy consumption in four to 10-year-olds. #sugartax #obesity Are we going to get a 'pudding tax'? Not convinced this will be very effective, given that the high taxes on petrol, tobacco and alcohol haven't really stopped us driving, smoking or drinking. #sugartax #puddingtax "Therefore, relying on a single-nutrient approach to tackling childhood obesity in the form of a soft drink tax might not be the most effective tactic." #SugarTax #ReformulationWorksTaxDoesnt</i>
Regressive nature of tax	Tweets argued that an SSB tax would result in increased prices which would be unfair and hit those on lower incomes the hardest	<i>@coopuk spotted in Barmouth, North Wales co-op. Why is the sugar free Ribena 35p more than the regular Ribena? #sugarfree #diabetes #sugartax So when my 11 year old #type1 son needs some full sugar coke, or jelly babies etc to sort his glucose levels out after/during an hours football, or 2 hrs karate is it appropriate he pays a #sugartax? Noticed interesting trend recently. Coldrinks sold by @CocaColaCo of #SouthAfrica have inserted #Aspartame into "conventional" non-diet drinks such as #StonyGingerBeer, #Fanta, etc. Is this a ruse to get around the SA #SugarTax? Aspartame is nasty worse than sugar. #SmallPrint My local #TescoExpress are stopping selling #Ribena as it's not selling... come on @RibenaUK, just go back to the original recipe, you'll sell more... I promise #sugartax #newrecipe #yuck I can't understand how forcing manufacturers in to filling foods with poisonous, unnatural, sweeteners to avoid sugar tax is improving our health?! help farmers to supply fruit and vegetables at a cheaper price if you want people to eat healthily! #sugartax #helpfarmers We have every right to eat or drink what we want. The majority shouldn't have to give in to a bunch of Soccer Moms and overly influential chefs/cooks such as Jamie Oliver. #SugarTax #PuddingTax Life is about choices. You should never be forced to do something. So 23g of sugar should be my choice to make. #sugartax Time to consider scrapping the #SugarTax?! Oh I forgot... This means allowing people to not only make their own choices, but keep more of their hard-earned money. Not allowed in this day and age... □</i>
Increase in artificial sweeteners	Posts included in this theme described how the tax would lead to increased use of artificial sweeteners which would in turn affect the taste of soft drinks and could result in negative health impacts particularly for those with allergies and/or existing health conditions	
Individual responsibility for health	Tweets included here argued against government intervention, stating that SSB taxes were reflective of a nanny state, and instead individuals should take responsibility for their diets and health	
Themes present in Tweets in support of SSB taxes	Description of theme	Exemplar quote
Negative health impacts of sugar and SSB	Tweets in this theme argued for an SSB tax due to the negative impacts of sugar on dental health and the risk of overweight and obesity	<i>SUGAR TIMEBOMB ... #SUGARTAX.on average a 10 year old child has had 18 years worth of sugar,,, Please remember even if you don't have a lot of sugar in your diet, you'll still be at risk of cavities if you don't brush and floss correctly #Sugar #SugarTax #Drink #cocktails #bar #food #party #drink #fun #friends #love</i>
Government intervention needed	Tweets here highlighted that consumption of sugar from SSB requires government intervention due to the abundance of sugar in the food environment and highlighted that the revenue could be used for health promotion	<i>To anyone complaining about the #sugartax £20K of the funds raised are going towards the building of an outdoor learning area in my school. money well spent if you ask me Sugar taxes also provide an easy way to fund new health initiatives. #sugartax</i>

Table 2 *Continued*

Themes present in Tweets against SSB taxes	Description of theme	Exemplar quote
Evidence to support an SSB tax	Tweets included in this theme shared research evidence to support an SSB tax, including reports from other countries describing the decreased sale of SSB following tax implementation	<i>"Barbados SSB tax was associated with decreased sales of SSBs in a major grocery store chain after controlling for underlying trends."</i> From: https://t.co/szdDj96wB #sugartax #foodchoice #healthpolicy Sugar taxes work. They raise money, but most importantly they reduce excess sugar in our food. #sugartax A modelling study of the Philippines found over 20 000 deaths are likely to be prevented and \$16b+ raised by a #sugartax over 20 years.
Extension of tax needed	Despite Tweets posted in support of an SSB tax highlighted potential benefits some also suggested that an SSB tax would need to be bolstered with other interventions and rethink the use of revenues to be most effective	@TheBDA: It's the 1st birthday of the #SugarTax, and of the £250m raised, not a penny has been spent fighting tooth decay Given the available evidence, it seems an appropriate move. However, it needs to be accompanied by attractive alternatives, such as lower priced fresh fruit (does not contain free sugars). #childhoodobesity #puddingtax I've been saying (literally for years) that an easier place to start with reducing sugar than a #sugartax would be a ban or, at least, agreed code of practice preventing manufacturers/retailers marketing very high sugar foods directly AT CHILDREN.

Opposition for a sugar or sugar-sweetened beverage tax

Several users also argued in opposition to SSB taxes; however, unlike the arguments presented by supporters, those shared by opponents were more varied. Some stated that there is limited evidence of the effectiveness of SSB taxes: *'I don't think it's made any difference to childhood obesity... just ruined perfectly refreshing drinks. All you need to do is eat less, move more. #SugarTax'*. Others stated that price increases would not be enough to change behaviour or improve health since consumers would likely substitute to other, high sugar but more affordable products. Some suggested that taxes should be focused on making healthier foods cheaper: *'A large bag chocolate e.g. min-strels/revels £1, a punet of raspberries/strawberries/blue-berries £2 -£3.00. Fruit is expensive.'*

Other arguments against SSB taxes related to extensive reformulation which users stated it was argued had increased the prevalence of artificial sweeteners and resulted in a reduced choice of SSB, especially for those with existing health conditions such as Phenylketonuria and attention deficit hyperactivity disorder: *'Reasons WHY we need to keep campaigning... #SugarTax could be extended in the future beyond drinks... We must make ourselves heard @PHE_uk #aspartame = neurotoxic if you have #pku'*

Price increases were also highlighted by some of those opposing an SSB tax, stating that an SSB tax is regressive and would unfairly *'hit people who are poor the hardest'*. Others were annoyed that they were having to pay more for a product that tasted worse: *'Most soft drinks taste like s*** now, totally ruined. And we have to pay more for the*

few good ones left! Furious. #SugarTax and #jamieoliver can both do one!'

Individual responsibility was another topic discussed by some of those opposing a tax, with users arguing that individuals should be able to choose what they consume since they are responsible for their health and weight: *'Why should everyone else suffer with this.#SugarTax nonsense all because people can't regulate their own or their kids diets properly, literally f***ing up all the best drinks and snacks'*. This argument was bolstered by users suggesting that a tax on SSB was a step too far in terms of government involvement in public health and that instead of less restrictive interventions should be considered.

Themes present across supportive and opposing groups

Highlighting the complexity of the discursive environment about SSB taxes on Twitter, some themes were apparent in both supportive and opposing discussion groups. Revenue use from the SDIL was one such theme. Whilst some users considered plans to use money generated by the policy as positive, for instance applauding plans to use the money for breakfast clubs so that children can *'start their day off right with a free breakfast thanks to "#SugarTax funding"*, several others argued that revenue would unlikely to be used to make any positive changes: *"#Lewisham is going to use £10 000 of the tax-payers" money, for a plan that will fail, because removing adverts will NOT improve health, and it is interfering with #business: via @MailOnline #taxationistheft.#SugarTax #libertarian #libertarianism'*.



It is also worth noting the difference in how individual advocates were received in the Twitter debate. For instance, users who supported SSB taxes stated that Jamie Oliver helped to improve public health in the UK by playing a key role in the development of the SDIL: '*Was great to hear @PHE_uk chief bigging up @jamieoliver and reminiscing about. #SugarTax select committees and for him to see @FifteenCornwall tying it all together #foodforchange*'. However, several others considered the actions of the celebrity chef negatively.

Discussion

This study aimed to examine the network of actors involved with the #SugarTax debate on Twitter and the topics being discussed using SNA. Supporting findings of Hunt (2020), this study indicates that Twitter is used to engage with the public, policy processes and decision-makers, with social media platforms such as Twitter enabling widespread sharing of information to the masses, for free and rapidly, changing how advocacy and lobbying is practised⁽³⁶⁾. In this study, it was found that many of the users associated with interest groups were connected as coalitions. Unlike debates occurring offline⁽³⁷⁾, findings from the current study indicated that there were not two clear clusters which would normally suggest arguments for and against an issue⁽²⁴⁾. Instead, the network on Twitter is a 'Bazaar' as there are many medium-sized groups and some isolates, more typically seen with political issue debates with various levels of community involvement. This may reflect the competition that exists between different framings of SSB taxes and the various issue cycles that occur⁽³⁸⁾. However, it may also be or could be explained by due to the unique characteristics of social media which allow users to easily join a group and get involved in different debates.

It was found that information was being shared by users who both supported and opposed a SSB tax. Research supports the growing importance of social media platforms as a source of news⁽¹⁸⁾ with a recent study finding that over half of the respondents to a thirty-six country survey had used social media for news in the past week⁽³⁹⁾. Although lobbyists and advocates likely recognise the importance of social media for their activities, using social media to influence the type or volume of information available to the public, the consistency of the messages shared varied between those supporting and opposing a SSB tax. It was found that organisations supporting a sugar tax were sharing information that focused on framing the issue of obesity in public health terms, supporting fiscal regulation and government intervention. In contrast, coalitions on Twitter who were not supportive of a SSB tax framed obesity and sugar consumption as issues of personal responsibility. By sharing information on social media that fits with their policy positions, these groups may be looking to make certain frames

more salient to attract the attention of the public and policy-makers and to encourage action (or not). A similar process has been described with offline advocacy and lobbying⁽⁴⁰⁾.

However, how the opposing arguments presented varied. The arguments presented by advocates of a SSB tax were largely consistent across individuals and coalitions of supporters, suggesting an aspect of unity among public health advocates on Twitter in terms of how the debate was framed, and what action is needed to be taken and why. This was evident in the thematic analysis of the tweets posted. There is theoretical support for consistent framing in debates and its influence on public perceptions⁽⁴¹⁾. The consistency could be due to the strong association between SSB consumption and poor health⁽³⁷⁾; however, it may also be possible that the coordinated framing of the debate was a concerted effort by advocates, who had developed a communication strategy.

Thematic analysis of tweets revealed a diversity of topics in the tweets shared by opponents of an SSB tax, supporting previous research⁽³⁷⁾. Such a 'cacophony' of information can result in public confusion⁽⁴²⁾ and could relate to the lack of evidence against SSB taxes⁽⁴³⁾. This finding contrasts with previous research which found that arguments in opposition to health policies were more likely to be dominated by central spokespeople, who shared information in a coordinated and consistent manner⁽⁴³⁾. The public nature of social media and the ability of the public to get involved but may have affected how opposing arguments were presented in this policy context.

Social media, democracy and public opinions

Previous research findings suggest that social media is an important tool for advocacy and lobbying campaigns, supporting previous research⁽⁴⁴⁾ and reflecting the potential of social media to promote democratic governance by helping to represent the interests of otherwise unheard actors, such as members of the general public⁽⁴²⁾. Thematic analysis of the tweets supports the importance of social media, revealing that advocates and lobbyists shared content to connect actors and develop a community to ensure users posted under the interest groups aims. This supports previous research which suggests that social media allows for information to be shared widely, helping with the development of communities and cohesive actions⁽⁴⁵⁾. Using social media to share information and gather support for certain policies may not always be successful because social media can promote a form of 'slacktivism' whereby users share a post, or follow a certain hashtag, but are not mobilised to effect real change^(46,47). However, there are examples from Twitter, such as '#ThisIsACoup', which was a collective campaign started by members of the public in protest of the Greek bailout demands in July 2015, that demonstrate the power of social media for signifying solidarity, raising awareness and rapidly spreading information across the globe⁽⁴⁸⁾. Such evidence suggests that policy



change can occur as a result of social media discussions and reflects the importance of information sharing about politics more generally. Furthermore, social media may allow organisations and individuals using it to disseminate alternative views and information rapidly to change perceptions about a public policy debate when new arguments start to appear^(49,50).

Influential users within the #SugarTax debate on Twitter

Analysis of the #SugarTax debate also revealed influential users within the network. Within tweets, the role of Jamie Oliver in the development of the SDIL was highlighted. SNA revealed that Jamie Oliver (or his organisation) tweeted frequently across the sample period and developed numerous weak ties with other actors who retweeted his posts. Many of the tweets highlighted the health risks associated with excess sugar consumption and called for a sugar or SSB tax as a solution to this problem. Such tweets amplified the wider advocacy coalitions message and framing of the debate. SNA supported the influential role of Oliver as data revealed that as a node, he had a betweenness centrality of 98 203.692. The size of this betweenness centrality suggests that he had more control over the network than most other users because more information passes through that node and suggests that he serves as a bridge from one part of the graph network to another. The extent to which other advocates shared tweets posted by Oliver may also have increased the interactive nature of the pro-sugar tax argument, which has been touted by Nisbet⁽⁵¹⁾ as essential in building support, according to the social constructivist and bottom-up model. Away from Twitter, Jamie Oliver and his organisation had a central position in the development of the SDIL. For example, working collaboratively with Sustain, Oliver launched a public petition in support of the SDIL in 2015⁽⁵²⁾. Oliver also actively debated in parliament to ensure political attention for the policy. The findings from this present study and consideration of Jamie Oliver's role offline suggest that he can be considered as a policy entrepreneur. It also supports research that suggests high-profile individuals, such as celebrities, are important to achieve political change^(53,54) especially if the actor: *'mobilizes support, writes letters, sends delegations, and stimulates its allies to do the same it can get government officials to pay attention to its issues'*⁽⁵⁵⁾.

However, the most influential actor, with a betweenness centrality of 104 000.568, was 'greedspam', a user who raised concerns about bots infiltrating the debate. The potential for automated accounts to interfere with debates on social media has been discussed academically for several years, with research suggesting that bots produce content that accounts for over 50 % of all content in a debate⁽⁵⁶⁾. Some such bots have been funded by political parties and industry organisations to manipulate public opinions.

Recently, Bradshaw and Howard⁽⁵⁷⁾ suggested that such bots are engaging in computational propaganda globally and doing so at an increasing rate. Whilst a bot detection test on greedspam suggested that the user was not an automated account, it shows the potential for members of the public to engage in and highly influence political or policy debates, and the lack of transparency about who produces and shares content on social media platforms. Therefore, the ability to identify key influencers on social media and their connections to others is more important than ever for policymakers and news organisations.

Strengths and limitations

As Wodak and Meyer⁽⁵⁸⁾ argue, understanding public debates on social media can offer a useful 'door opener to the backstage of politics'. SNA was used to investigate the stakeholders involved in the #SugarTax debate on Twitter and provides several novel insights into the network of stakeholders and the debates taking place, supporting the use of social media as a useful lens to examine current public views and opinions⁽²⁵⁾. However, the study is not without limitations. The analysis is based on Twitter data, which may be incomplete, inaccurate or untimely⁽⁵⁹⁾. Although Twitter provides near-complete access to its data, it can restrict data access for research purposes⁽⁶⁰⁾. Twitter itself is also not representative of the national offline population; therefore, the views expressed by users cannot be generalised to the offline population. Moreover, the analysis was based on the use of hashtags. Whilst this is a strength of the analysis as anyone can contribute to them making them ideal for exploring debates, it is also a limitation as hashtags may bias the data set as those that include hashtags in their tweets are often well acquainted with Twitter and the usage conventions. Those employing hashtags may also have a specific interest in the topic. Thus, the discussion explored in this study may reflect views of a select group rather than Twitter users in general. Next, although automated sentiment analysis, in this case using MeaningCloud, enables the rapid analysis of a large sample of tweets, such computer-aided analysis is limited since computer programmes can misinterpret the meaning of messages in particular sarcasm and irony. However, this limitation was reduced thanks to also conducting manual sentiment analysis. Moreover, although efforts were made to ensure objectivity through discussing the themes amongst all authors, and providing a detailed description of the methods employed, the themes present in the tweets were only assessed by one researcher. This may have introduced bias and should therefore be considered when assessing the results. Furthermore, the debates occurring on Twitter are only one arena among several in which political discourse unfolds, which may have excluded stakeholders who operate exclusively in print or other forms of media. However, prior research suggests that the number of organisations not engaging in debates



on social media is small. Penultimately, there is a possibility that some of the tweets included in the study were produced by automated accounts. Finally, due to the restriction of the study to social media, this research cannot comment on the parliamentary or judicial arenas, or any discussions that occur behind closed doors.

Conclusion

By combining sentiment, thematic and social network analyses of the #SugarTax debate on Twitter, this study provides new insights into the opinions people express about SSB on Twitter, the information sources they cite, identification of who is in the network and how big those networks are. The findings reveal that messaging was more consistent amongst those users supporting the implementation of an SSB tax relative to those opposing it. The study also indicated that social media platforms such as Twitter offer members of the public with the opportunity to engage in and potentially influence policy debates. However, any conclusions drawn must consider the mediation through the platform's rules and algorithms, for example, the 240-character limit on Twitter, and the fact that interactions can only be measured in retweets, direct messages and mentioned. Future research should seek both to compare mainstream with social media coverage of significant public issues and events such as the SDIL and explore what individuals are involved in the debate offline.

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