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Public perception of the tax on sweetened beverages in France

Barthélemy Sarda^{1,*}, Charlotte Debras¹, Eloi Chazelas¹, Sandrine Péneau¹, Yann le Bodo², Serge Hercberg^{1,3}, Mathilde Touvier¹, Chantal Julia^{1,3}

¹Sorbonne Paris Nord University, Inserm, INRAE, Cnam, Nutritional Epidemiology Research Team (EREN), Epidemiology and Statistics Research Center, University of Paris (CRESS), 93017 Bobigny, France

²University of Rennes, EHESP School of Public Health, CNRS, ARENES – UMR 6051, F-35000 Rennes, France

³Department of Public Health, Avicenne Hospital, APHP, Bobigny, France

***Corresponding author:** Barthelemy Sarda, b.sarda@eren.smbh.univ-paris13.fr

Short title: Acceptance & perception of the French soda tax in 2021



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None.

Authorship:

All researchers had access to all the data. B.S. wrote the statistical analysis plan, analyzed and interpreted the data, drafted, and revised the paper. He is the guarantor. C.J. developed the questionnaire, supervised data analysis, contributed to data interpretation and revised the paper for important intellectual content. C.D.; E.C.; S.P.; Y.LB.; M.T. developed the questionnaire, contributed to data interpretation and critically revised the paper for important intellectual content. S.H. designed the data collection tools, monitored data collection for the whole study, contributed to data interpretation and critically revised the paper for important intellectual content.

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Ethical Standards Disclosure:

The NutriNet-Santé study is conducted in accordance with the Declaration of Helsinki, and all procedures were approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB Inserm 94 0000388FWA00005831) and the Commission Nationale de l'Informatique et des Libertés (CNIL 95 908450 and 909216). The protocol is registered at clinicaltrials.gov as NCT03335644. All participants provided informed consent with an electronic signature.

Abstract

Objective: To assess in 2021 the acceptance and perception of the French tax on sweetened beverages, following its revision in 2018, and factors associated with a higher level of acceptance.

Design: A cross-sectional survey within the NutriNet-Santé cohort study. Participants were invited to complete a self-reported questionnaire in March 2021. Weighting was applied to the sample to allow inferences on the French population. Individual characteristics associated with support for the tax were investigated using logistic regression modelling.

Settings: NutriNet-Santé prospective cohort study.

Participants: Adults engaged in the NutriNet-Santé cohort, aged 18 or older (n = 28,344), living in mainland France.

Results: Almost two thirds (63.4%) of the participants were aware of the existence of a tax on sweetened beverages, although less than a quarter had specific knowledge regarding its design and the 2018 revision. In turn; 64.7% of participants expressed a favourable opinion toward the taxation scheme. This proportion was higher if tax revenues were used to finance health-related measures (respectively 68.8% of favourable opinion if used to finance a reduction in prices of healthy products and 76.4% if used to finance the healthcare system). Multivariable analyses showed that support toward the tax varied among sub-groups of the population. Groups who tended to be less financially affected by the measure and those who perceived sugar-sweetened beverages as having detrimental effects were more likely to support the tax.

Conclusion: The revised French sugar-sweetened beverage tax appeared to be favourably received and perceived by the public.

Keywords: food taxes; sugar-sweetened beverages, acceptance, public perception; nutrition policy.

Introduction

In the last decade, an increasing number of countries around the world have implemented taxes on sweetened beverages ⁽¹⁾. Attention for this measure can be related to the growing burden of nutrition-related chronic diseases and the scientific consensus regarding the detrimental effects of sweetened beverage consumption on multiple health outcomes: weight status and obesity ^(2,3), diabetes ⁽⁴⁾, non-alcoholic fatty liver disease ⁽⁵⁾, oral health ⁽⁶⁾ cardiometabolic diseases and associated mortality ⁽⁷⁾. Scientists, health professionals and health organizations have called for implementing policies in order to decrease the consumption of sugar-sweetened beverages ⁽⁸⁾, ranging from public education, changes in the food environment including food labelling, restrictions on ads and specific taxation schemes ⁽⁹⁾.

In 2012, France became one of the first European countries to tax sweetened beverages (i.e. beverages containing either added sugar or an artificial sweetener) along with Finland, Hungary and Denmark. However, the newly implemented policy faced multiple challenges that may have limited its impact. The tax rate was flat and considered of low magnitude (0.076€ per litre), which is in contrast with recommendations from the World Health Organization (WHO), which advocates for progressive taxation with taxation levels of at least 20% of the final price ⁽¹⁰⁾. Although the government initially emphasized the health-related aspect of the measure, the focus was later changed to highlight the importance of the tax to balance the national public budget, which undermined the public health dimension of the measure ⁽¹⁾.

In 2018, the French law was amended and several changes were made to the tax's initial design. Its rate went from being flat to progressive, with a tier system depending on added sugar content (from 0.03€ to 0.24€ per litre). For a typical sugar-sweetened soda, this modification represented a substantial increase (for drinks with 12g of added sugars per litre, the tax doubled). The revision also distinguished beverages sweetened with sugar from those sweetened with artificial sweeteners with the application of different tax rates depending on the type of sweetener used, unlike the first version of the tax. Lastly, advocates of the revised taxation scheme highlighted the public health dimension of the measure during the parliamentary debates. The measure was integrated into the 2018 Social Security Finance Bill, which is used to fund the French healthcare system, whereas the general Finance Bill was used for the 2012 version of the tax. A detailed comparison between the two versions of

the tax is proposed in Supplemental Material 1. As a result, the tax was better aligned with its public health objectives following these modifications.

Although there is growing evidence of the overall effectiveness of sweetened beverage taxation to reduce consumption ^(11,12), which is of importance when it comes to political decision-making, past research has also identified the key role of public acceptance in the design, the adoption and the implementation of such measures ^(13–15). More intrusive measures, such as taxes, are less accepted by the public than less intrusive ones (e.g. public education or labelling requirements) even though they tend to be more effective ^(15,16). Additionally, given the strong industry opposition ⁽¹⁷⁾, it can be challenging to implement an adequately designed tax scheme. Favourable public opinion and acceptance are therefore critical to support such public health policies to modify health-related behaviours ⁽¹⁸⁾.

Given modifications made to the French tax on sweetened beverages in 2018, perception and acceptance may have been impacted. We, therefore, investigated the knowledge, acceptance and perception of the tax on sweetened beverages in France after its revision in 2018. This study follows a previous study conducted after the initial implementation of the scheme in France in 2012 ⁽¹⁹⁾. In addition, we explored individual characteristics that were associated with a favourable attitude regarding the tax on sweetened beverages.

Methods

Population

Participants were French volunteers -aged 18 years and older- who participate in the NutriNet-Santé Study, an online prospective, observational cohort which started in May 2009 and is still ongoing. The objectives of the NutriNet-Santé study are to investigate the associations between nutrition and health as well as to identify determinants of nutrition-related behaviours. Details regarding the design and the methods of the NutriNet-Santé study have been previously described ⁽²⁰⁾.

Data collection

Tax knowledge, perception and acceptance

A questionnaire regarding knowledge, perception and acceptance of the tax on sweetened beverages was developed by a multidisciplinary research team based on a previous study conducted in 2012 pertaining to the first version of the French soda tax ⁽¹⁹⁾. The questionnaire was then administered to participants of the NutriNet-Santé cohort on a voluntary basis, from

March 8th 2021 to June 28th 2021. Participants were informed by e-mail that a new questionnaire was available on the NutriNet-Santé platform. The title of the questionnaire and its introductory text were general on taxes and did not indicate to the participant that the questionnaire would focus on sweetened beverages. In addition, this online questionnaire was designed in such a way that the participant could not go back to modify his/her previous answers.

The first part of the questionnaire investigated the knowledge of respondents regarding the tax on sweetened beverages. Participants were first asked whether they knew about the existence of a specific tax on several products including both taxed and untaxed products (alcohol, tobacco, petrol, sweetened beverages – all of which have specific taxation systems; sugary foods (drinks were explicitly excluded), foods rich in fat, foods rich in salt, ultra-processed foods – all of which do not have specific taxation systems). Items were presented in random order. Participants could answer on a 5-point Likert scale ranging from “Yes, for sure” to “No, for sure” and “I do not know”. Then, participants were informed that in 2018 the French law regulating the tax on sweetened beverages was amended and were asked about (1) the overall result of the revision process of the law in 2018, (2) products that are covered by the tax, and (3) the design of the tax rate.

The perception and acceptance of the tax were then assessed through propositions to which participants could answer on a 5-point Likert scale, from “strongly disagree” to “strongly agree”, and “I do not know”. The following proposition was used to evaluate the overall acceptance of the tax: “I am in favour of taxing sodas and sweetened beverages”. Two additional propositions were added: “I am in favour of taxing sodas and sweetened beverages only if prices of healthy products go down (e.g. fresh produce)” and “I am in favour of taxing sodas and sweetened beverages only if the revenue is used to improve our health system”. The perception of the potential impact of the tax on sweetened beverages was investigated with the following propositions: “A tax on sweetened beverages increases prices and reduces purchasing power”, “A tax on sweetened beverages is a useful measure to promote population health”, “A tax on sweetened beverages reduces the purchase of these products by the population in France”, “A tax on sweetened beverages increases the national budget (and/or reduces public debt)” and “A tax on sweetened beverages is unfair because poor people will pay the same tax as rich people”. Items were presented in random order.

Finally, attitudes regarding sweetened beverages were collected with propositions regarding the impact on health: “Sweetened beverages are bad for your health” or “Sweetened

beverages are products of poor nutritional quality”; regarding the environment: “Producing sweetened beverages require a great quantity of pesticides” or “Production of sweetened beverages consumes a significant amount of resources (water, arable soil)”. Answers were given with a 5-point Likert scale, with items going from “strongly disagree” to “strongly agree”, and “I do not know”.

Sweetened beverage consumption and evolutions

The questionnaire included a set of questions regarding the consumption of sugar-sweetened beverages, artificially-sweetened beverages, fruit juices and the modification of the frequency of consumption in the last 12 months. Possible answers were the following: “strongly decreased”, “decreased”, “remained stable”, “increased”, “strongly increased”, “do not consume this kind of product”, “do not know”. Participants were considered to be consumers of a given type of beverage if they reported a modification in consumption frequency (including “strongly decreased”, “decreased”, “remained stable”, “increased”, “strongly increased”) and to be non-consumers if they reported not consuming that particular type of beverage.

Demographic and socioeconomic data

Upon inclusion in the cohort, participants are asked to complete a set of 5 questionnaires regarding demographic and lifestyle characteristics, health status, dietary intake, physical activity and anthropometrics. These questionnaires are administered every 6 to 12 months during follow-up for an update.

The following data were retrieved for the present study: age, sex, educational level, household income, household composition including number and age of children living in the household, weight and height of the respondent. As these questionnaires are repeated over time to update information regarding participants, we used data the closest from the time window of the study. Age was categorized into five groups: less than 30 years old, 30-45 years old, 45-55 years old, 55-65 years old, and more than 65 years old. Educational level was categorized into three groups: no high school diploma, high school diploma, and graduate degree. Income per consumption unit was calculated based on income and household composition, according to the definition provided by the National Institute of Statistics and Economic Studies (INSEE). The following categories of income were used: <1300€, 1300€-2600€, >2600€/month/consumption unit. Household composition was

categorized into four categories: no children, one or more children at home (aged 0–13 years), one or more adolescents at home (aged 14–18 years) and both children and adolescents at home. Finally, body mass index (BMI) was computed based on self-reported height and weight. It was categorized into four groups :<18.5, 18.5-25, 25-30, >30kg/m². Self-reported anthropometrics in the NutriNet cohort can be considered valid, given that validity has been confirmed in the past after being compared with paper-anthropometrics questionnaires and face-to-face declarations.

Statistical analyses

Only fully completed and validated questionnaires were eligible for analysis. We excluded participants who did not live in mainland France, or who had missing or incomplete demographic, socioeconomic information or anthropometric data. Participants who systematically answered “I do not know” to acceptance and tax knowledge questions were also excluded.

To allow better inferences on the general French population⁽²¹⁾, the final sample was weighted using the macro CALMAR and calibrated on the French population demographic and socioeconomic structure, using data from the 2009 national census from the National Institute of Statistics and Economic Studies (INSEE)⁽²²⁾. The following variables were used to adjust the sample: sex, age, educational level, occupation, region of residence, marital status and number of children.

Answers to perception and acceptance questions were grouped into three categories: “I disagree”, “I neither agree nor disagree” and “I agree”.

Associations between tax acceptance and demographic variables were investigated with logistic regressions. Tax acceptance was modelled as a dependent variable, with the categories “I disagree” grouped with “I neither agree nor disagree” used as reference. Independent variables included in the model were the following: age, sex, educational level, income per consumption unit, household composition, BMI; sweetened beverage (sugar and artificially sweetened distinguished) and fruit juice consumption; and items reflecting the attitude of the participant on sweetened beverages (one regarding health impact and one regarding the environmental impact). Participants declaring not knowing about their sweetened beverage consumption were excluded from the multivariable analysis.

We performed a sensitivity analysis for descriptive analyses on tax knowledge by conducting a similar analysis with only participants who knew about the existence of a specific tax on sweetened beverages (Supplemental material 2).

Statistical analyses were conducted with SAS 9.4. All tests were two-sided and significance level was set at <5%.

Results

Study population

A total of 32,475 validated questionnaires were completed and a total of 28,344 participants met the inclusion criteria (i.e. lived in mainland France, had no missing or incomplete information and did not answer systematically “I do not know”). For multivariable analyses, sample size was further reduced to 26,690 participants after exclusion of participants who answered “I do not know” when asked if they were in favour of taxing sweetened beverages and those who did not report their sweetened beverages consumption. A detailed flowchart is proposed in Supplemental Material 3. Individual characteristics of included participants are presented in Table 1. Overall, our final sample was composed of 52.4% women and 47.6% men. Participants ranged in age from 18 to 85 yr (mean=52.5 +13.8 yr).

Tax awareness and knowledge

Overall, a majority of participants (63.4%, Table 2) were aware of the existence of a tax on sodas and sweetened beverages. Other taxes, which have been enforced for a longer time and regularly covered by news media, such as tobacco, petrol and alcoholic drinks, showed higher levels of knowledge as expected, with between 86.6% to 93.5% of participants identifying that they were subject to specific taxes. By contrast, non-existent taxes were identified as existing taxes by a steady proportion of participants (from 26.6% to 32.5% of participants except for sugary foods, with 43.5% of participants answering that this category was specifically taxed).

When focusing more specifically on the tax on sweetened beverages, almost 2 participants out of 3 (63.3%, Table 3) reported not knowing about the revision of the tax in 2018. Only 13.9% of participants gave a correct answer regarding the result of the revision as it resulted in changes in the mode of calculation going from a flat-rate tax to a progressive tax based on added sugar content, thus modifying the amount of taxation on most products.

Similarly, half of the participants declared not knowing the specific calculation of the tax and factors which influence the level of taxation. Only a quarter of participants answered correctly that the tax was calculated based on the amount of sugar added to the beverage and

less than a fifth, that the tax rate depended on the type of sweetener used or the category of the product.

When looking at the perceived scope of the tax (Table 4), sugar-sweetened sodas were the category of product the most identified as covered by the tax with 75.9% of participants giving a correct answer. While also covered by the tax, beverages with artificial sweeteners were systematically less identified as being covered than their sugar-sweetened equivalents (respectively 61.0% vs 75.9% for sodas; 33.9% vs 42.9% for teas and infusions; 24.8% vs 31.7% for flavoured water). Regarding fruit juices, fresh fruit juices were correctly the least reported category as covered by the tax (15.9%). However, results show that participants distinguished between fresh fruit juices and fruit juices obtained from concentrate (respectively 15.9% vs 32.7%), even though both products are not covered by the tax as they do not contain any added sugar unlike fruit nectars (35.3%).

Tax acceptance and perception

The tax on sweetened beverages was supported by a majority of participants (64.7%. Table 5). The adhesion to the measure increased when tax revenues were proposed to be directly used to fund health-promoting initiatives (68.8% for a reduction in prices of healthy products, 76.4% for reinvesting the tax in the health system). Moreover, the tax was perceived as useful to promote the health of the population (60.2%). By contrast, the only item with more opponents than supporters regarded the regressive nature of the tax and its unfairness (respectively 34.4% who agreed vs 39.0% who disagreed).

Factors associated with tax acceptance

Multivariable analyses showed that tax acceptance varied among sub-groups of the population (Table 6). Participants older than 45-55 y/o were more likely to hold a favourable position concerning the tax (OR=1.14 [1.04-1.25] for participants 55-65 years and OR=1.38 [1.26-1.52] for participants over 65 years vs. 45-55 years; $p<0.001$). Participants with higher household income and educational level were more likely to support the tax (respectively OR=1.13 [1.04-1.23] for participants with more than 2600€/month/CU vs 1300€-2600€/month/CU; $p<0.001$; OR=1.81 [1.70-1.94] for participants holding a graduate degree vs. those with a high school diploma; $p<0.001$). Being a woman or the presence of one or more children less than 13 years was associated with less support for the tax (OR=0.58 [0.55-0.62] for women vs men; $p<0.001$; OR=0.85 [0.80-0.92] for participants with one or more

children vs. those without children; $p < 0.001$). Participants with higher BMI were less likely to be in favour of the tax and by contrast, underweight participants were more likely to support the tax (OR=1.33 [1.15-1.54] for participants who are underweighted; OR=0.87 [0.81-0.93] for those who are overweighed; OR= 0.55 [0.51-0.60] for those who are obese vs. those of normal weight; $p < 0.001$). Consumers of sugar-sweetened sodas were less likely to support the tax scheme (OR=0.57 [0.52-0.61] for consumers vs. non-consumers; $p < 0.001$) whereas consumers respectively of fruit juices and artificially-sweetened sodas showed a similar level of adhesion when compared to non-consumers. Finally, having a negative attitude towards sweetened beverages, on either their health or environmental impact, was found to be associated with higher support of the tax (OR=2.32 [2.11-2.54] for participants with a negative attitude regarding the health impact vs. those who do not have any attitude; $p < 0.001$; OR=1.78 [1.67-1.89] for participants with a negative attitude regarding the environmental impact vs. those who do not have an attitude; $p < 0.001$).

Discussion

Results presented in this study show the extent to which the French tax on sweetened beverages is known, perceived and supported by the French population in 2021, three years after its revision and nine years after its initial implementation. Overall, a majority of respondents knew about the existence of the tax, although few of them had specific knowledge regarding the 2018 revision. The overall perception of the tax on sweetened beverages was favourable, particularly in regard to its ability to improve the health of the population. Support for the measure was high with almost two thirds of respondents being in favour of it. Finally, multivariable analysis showed that support for the tax varied among subgroups of the population.

Overall, awareness of the tax on sweetened beverages among the population was high, with 63.4% of respondents identifying the tax as existing, in line with the international literature on the subject. Several studies have focused on the awareness of similar taxes -one in the municipality of Berkeley (US) ⁽²³⁾, one in the municipality of Oakland and Berkeley (US) ⁽²⁴⁾ and one in Mexico ⁽²⁵⁾ – and have found mixed results (varying from 39% in Oakland (immediately after its implementation), 65.2% in Mexico (3 years after) to 68.2% (1 year after) and 70% (3 years after) in Berkeley). Local context plays an important role in making people aware of taxation schemes ⁽²⁶⁾, especially due to varying media coverage and communication campaign from public authorities or private actors. Additionally, one study

⁽²³⁾ found that tax awareness increased over time, which may further explain the variability in results. Very high levels of awareness obtained for other taxes, such as taxes on petrol or tobacco, tend to be in line with these elements as these taxes have been enforced for a longer time and have been covered extensively by the media. In contrast, non-existing taxes were incorrectly cited by a substantial and steady proportion of the respondents (around 30%). Nevertheless, achieving higher rates of awareness is of importance as tax policies have a “signalling effect”, which may contribute to raising consumers’ awareness about the health consequences of consuming the taxed products ⁽²⁷⁾. In Mexico, this effect led to a greater reduction in sweetened beverage consumption in groups aware of the tax ⁽²⁵⁾. Additionally, it appeared that in our study, respondents had poor knowledge of the modifications made in 2018 and also of the calculation method. However, given that the questionnaire was administered three years after the revision of the tax and that specific knowledge questions required to be aware of technical details, it is not surprising that very few participants were able to answer correctly to these items. Furthermore, the French government, during the 2018 parliamentary debates, made clear that the main purpose of the revision of the tax was to incentivize food manufacturers to reformulate their recipes and thus reduce the sugar content in sodas. In this regard, the use of a progressive tax rate was indeed adequate as the lower the sugar content is, the lower the tax rate will be. Since consumer behaviour was not directly targeted with this revision, the lack of specific knowledge should not be regarded as a limit.

The perceived scope of the tax provided interesting insights into the different perceptions of beverage categories. For drinks containing added sugar (with the exception of fruit nectars), we observed a gradient according to the added sugar content with products containing the highest added sugar content (sodas and to a lesser extent still drinks) being the most reported as covered by the tax. These perceptions suggest that products with the greatest added sugar content were more frequently identified as sweetened beverages and thus are covered by the tax whereas products such as flavoured waters or teas which contain in comparison less sugar were less often considered to be part of the scope of the tax. Interestingly, artificially-sweetened beverages were identified as covered by the tax in somewhat similar proportions than sugary beverages. This result suggests that artificial sweeteners are perceived by a majority of the public in beverages as having somewhat similar effects as sugar, even though international recommendations mainly focus on the reduction of sugar-sweetened beverage consumption according to nutritional criteria ⁽⁸⁾. Finally, fruit-based beverages, and especially fresh fruit juices, were among the less identified as being targeted by the tax as they tend to

be considered as healthy⁽²⁸⁾. Remarkably, fresh fruit juices and fruit juices from concentrates appeared with differing perceptions, while neither are targeted by the taxation scheme.

Public support for the taxation scheme in this study was relatively high when compared with previously reported data. A French study performed in 2015 in the NutriNet-Santé cohort found that 48.5% of the population was in favour of the tax implementation following the launch of the tax in 2012⁽¹⁹⁾. More globally, a recent systematic review⁽¹⁴⁾ found an overall 42% (CI 95%= 39% - 47%) of the public supporting the implementation of a tax on sugar-sweetened beverages with great disparities between studies/countries (ranging from 27% to 55% of public acceptance). However, as pointed out by the authors, most studies were conducted in the USA, Australia and in the UK, which may make difficult to extrapolate these results to others countries as local context is of importance. In addition, very few studies in the systematic review were conducted after the implementation of a tax which may further make our results difficult to compare. Consistently with the body of literature, our findings also indicate that allocating tax revenues to specific health-promoting initiatives impacted positively the acceptance of the taxation scheme⁽¹⁴⁾. Unlike other jurisdictions which already implemented a tax on sweetened beverages⁽²⁹⁾, tax revenues of the French version of the tax are not dedicated to specific actions but rather to the overall healthcare system. In this regard, the French public-health agency – HCSP- recommended using tax revenues to create targeted measures to incentivize consumers (e.g. through coupons or direct help) and food manufacturers (e.g. through subsidies) to adopt more sustainable practices⁽³⁰⁾. Additionally, our results indicate a clear rise in acceptance over time which has been supported by changes in perception. When comparing with the 2015 French study, we observed a slight increase in the proportion of the population who perceived the measure as useful (57.7% in 2015 vs 60.2% in 2021) and an important decrease in the proportion of the population who qualified the tax as unfair (49.3% in 2015 vs 34.4% in 2021). Perceived effectiveness and perceived fairness have been found to be positively associated with public acceptance⁽³¹⁾. The 2018 revision of the tax appeared to be an opportunity for the government to reframe the policy as a public health measure and these changes may have further led to an increase in acceptance⁽³²⁾.

The policy development and media coverage of the tax on sweetened beverages may have also played a role in its perception. Indeed, the literature suggests that the social acceptance of taxes, such as soda taxes, is influenced by public debate and the political context. For example, in the UK, the soft drink industry levy - among other measures - gained traction as

the ‘Responsibility Deal’ was found inadequate to solve nutritional issues⁽³³⁾. In France, although the 2012 version of the tax was adopted after fierce parliamentary debates⁽¹⁾ and other nutritional policies are continuously considered⁽³⁴⁾, the implementation of food taxes continued to arouse the interest of stakeholders as shown by several parliamentary reports⁽³²⁾. It should also be noted that when the bill was voted in 2017, the vote of the members of parliament was rather consensual and several factors may have played a role. First, this revision was an opportunity to clearly reframe the policy as a public health measure⁽³²⁾. Then, in 2016, in the framework of the revision of national food-based dietary guidelines, the French National Agency for Food Safety published reports underlining the association between sugar-sweetened beverages consumption with weight gain and comorbidities⁽³⁴⁾. Finally, analyses showed that in 2017 media coverage was less intense and more favourable toward the measure when compared with the extensive coverage in 2011⁽³⁶⁾. Private stakeholders, including the beverage industry, appeared to not be as opposed to a revision of the tax⁽³²⁾, which may have contributed to a less heated debate. These elements may further contribute to explain the rise in acceptance and the overall better perception of the tax observed in the study.

The associations between tax acceptance and demographic characteristics highlighted disparities among subgroups of the population. We found that being a man increased the likelihood of supporting the taxation scheme. This result is surprising as numerous previous research suggested that there was no association with sex^(37–40). However, despite the lack of association reported in the past study conducted in the NutriNet-Santé cohort study in 2015⁽¹⁹⁾, in univariate analysis, men were found to be significantly more prone to be in favour of the taxation scheme. Thus, the observed effect may be caused by residual confounding and it needs to be further explored in other studies on the French population. Then, the odds of supporting the tax were greater for respondents older than 45-55 y/o and lower for respondents younger than 45-55 y/o when compared with respondents aged 45-55 y/o. This could be interpreted by the fact that older individuals tend to be more health-conscious⁽⁴¹⁾ and thus would be more supportive of health prevention initiatives or by the fact that they tend to consume less sweetened beverages⁽⁴²⁾ or have greater financial resources⁽⁴³⁾ and thus would feel less affected by this kind of measure than younger individuals. Lastly, having at least one or more young children at home was associated with less acceptance of the tax, which was already highlighted in the previous study in the NutriNet-Santé cohort⁽¹⁹⁾. However, in the Netherlands, among a representative sample of the Dutch population, no significant

association between tax acceptance and household composition was found⁽³⁷⁾. An explanation of these results could be that parents of young children engage less in health-promoting behaviours. Indeed, studies found that young parents (between 25 and 44 y/o) spent less time doing physical activity^(44,45). For diet, results are mixed with studies finding higher energy and saturated fat intake as well as higher BMI^(44,46) in young parents vs. non-parents and other studies finding no significant differences^(47,48). Finally, older parents (over 45 y/o) appeared to engage more in behaviours favourable to health⁽⁴⁶⁾, which could explain why parents of adolescents in the study, which were on average older, were as likely as individuals without children to support the tax scheme, unlike younger parents. However, this hypothesis needs to be further explored as intended health behaviours may differ widely from actual behaviour, and both may interact in the acceptance of public health policies such as taxation.

Socioeconomic variables also appeared to be important factors associated with tax support. Adults with a higher level of education were found to be more likely to be in favour of the tax scheme. It has been reported consistently in past research that taxes on sweetened beverages are more heavily supported by individuals with higher educational level^(19,37,38,49). An explanation may be that education is associated with a higher level of nutrition knowledge⁽⁵⁰⁾ and thus awareness of nutritional-related health issues. Additionally, greater income was associated with a higher level of support. Individuals with greater disposable resources were found to be less sensitive to price increases⁽⁵¹⁾ whereas others may fear a reduction in their purchasing power with the implementation of new taxes. In turn, people who were overweight or obese tended to be less supportive of the tax than those with a body mass index between 18 and 25 kg/m². Current body of literature has found inconsistent results with studies reporting no associations between weight status and tax acceptance^(40,49,52) and other studies showing the decreased likelihood of support for overweight or obese people^(37,53). Lower support for individuals with higher BMI observed in the study could be partly explained by the fact that the consumption was only assessed through a qualitative aspect. In other words, we did not make a distinction between low and high consumers and BMI could have been a proxy for this dimension. A systemic assessment of beverage consumption in the world found that greater BMI was associated with greater sugar-sweetened beverage consumption⁽⁵⁴⁾. All other things being equal, individuals with greater BMI would be more financially affected by the tax and thus potentially less supportive of the measure.

Consumption of sugar-sweetened sodas was found to be associated with less support for the tax. On the other hand, no significant effects were detected for artificially-sweetened

beverages or fruit juice consumption. Regarding the association between sugar-sweetened soda consumption and tax acceptance, several studies have identified a similar effect^(37,55,56) even though in the 2015 study in France, only sociodemographic factors played a role in tax acceptance. Artificially-sweetened beverage and fruit juice consumption was rarely explored in the past as potential factors influencing tax support. As expected, individuals with a negative attitude toward sweetened beverages whether in regard to health or the environment, were more favourable to a taxation scheme. The importance of personal opinion and perceived detrimental effects especially on health have been consistently shown in previous studies^(38,39). This finding reinforces the importance of public campaigns to raise awareness regarding the impact of consuming sugar-sweetened beverages, especially in regard to health, as these factors were found to have a higher odds ratio than demographic or socioeconomic determinants.

To our knowledge, this study is the first to explore public acceptance and perception since the 2015 study in the NutriNet-Santé cohort in a country that has already been enforcing a tax on sweetened beverages. In addition, we explored multiple dimensions (i.e. awareness, knowledge, perception and acceptance) which allowed us to identify important stakes when advocating in favour of a food tax. Several limitations should also be acknowledged. Given that the questionnaire was available for a limited amount of time (4 months) and that answering the questionnaire was optional, we aimed to collect at least 30,000 questionnaires before closing access. This procedure selected the more active members of the cohort, considering that the cohort is already voluntary. Thus, respondents were more likely to have a higher socioeconomic status and educational level and to engage in health-conscious behaviours than the general population. In addition, to assess the representativeness of the final weighted sample, we compared sodas and juices consumption in the study with the national representative consumption study INCA 3⁽⁴²⁾. According to INCA 3, 41.1% of the population consumed non-alcoholic soft drinks in 2017 which includes any sugar-sweetened beverages except fruit juices (vs. 31.2% for equivalent products in our study (weighted data)), and 50.3% consumed fruit juices (vs. 52.2% in our study (weighted data)). Furthermore, the questionnaire was administered three years after the tax revision. Knowledge and perception may have been altered over time. Finally, as respondents were more likely to be aware of nutritional issues, answers may have been subject to social desirability bias and we may have overestimated tax acceptance. Another concern might be that a self-reported online questionnaire with knowledge items could incentivize respondents to search for the correct

answer on the Internet. However, we observed very high percentages of non-correct answers in questions regarding knowledge, which suggest that respondents answered spontaneously, as expressly asked by the instructions. We further limited the possibility of correction of wrong answers by preventing returns to previous questions.

Conclusion

In conclusion, the French tax on sweetened beverages appeared to be supported by almost two thirds of the public. In accordance with a recent meta-analysis ⁽¹⁴⁾, our results tend to confirm the elements of success of the 2018 revision of the French soda tax in regard to its impact on public acceptance, as (i) revenues were used to fund health-related measures rather than the general budget and (ii) the true purpose of the tax was clearly communicated. Overall, the tax was more heavily supported by sub-groups of the population that were less affected by the measure (i.e. sub-groups with greater financial resources, with fewer consumption of sugar-sweetened beverages, with greater awareness of the impact of consuming covered products). Such elements are of interest when developing and implementing novel public health measures, especially food taxes which tend to be less accepted by the public.

Table 1: Individual characteristics of included participants (n = 28,344) (weighted data), NutriNet-Santé cohort, France, 2021

	Number of participants (n)	Percentage (%)
Total	28,344	100%
Sex		
Men	13,492	47.6%
Women	14,852	52.4%
Age		
18-30	2,154	7.6%
30-44	9,552	33.7%
45-54	5,782	20.4%
55-65	4,648	16.4%
Over 65	6,207	21.9%
Household income		
Less than 1300€/month/CU	6,519	23.0%
1300€-2600€/month/CU	12,500	44.1%
Over 2600€/month/CU	5,102	18.0%
Do not want to declare	4,223	14.9%
Educational level		
No high school diploma	3 997	14.1%
High school diploma	13,548	47.8%
Graduate degree	10,799	38.1%
Sugar-sweetened beverage consumption		
Non-consumer	20,086	70.9%
Consumer	8 090	28.5%
Did not know	168	0.6%
Artificially-sweetened beverage consumption		
Non-consumer	22,722	80.2%
Consumer	5,437	19.1%
Did not know	185	0.7%
Fruit juice consumption		
Non-consumer	13,438	47.4%
Consumer	14,789	52.2%
Did not know	117	0.4%

Table 2: Global knowledge of the existence of taxes in France among participants from the NutriNet-Santé cohort (n = 28,344), France, 2021

	Yes, the product is under a specific taxation system		No, the product is not under a specific taxation system		I do not know	
	N	%	N	%	N	%
	<i>Petrol</i> ¹	26,499	93.5%	1,374	4.8%	471
<i>Tobacco</i> ¹	25,634	90.4%	2,460	8.7%	250	0.9%
<i>Alcoholic drinks</i> ¹	24,545	86.6%	2,900	10.2%	899	3.2%
<i>Sweetened beverages</i> ¹	17,980	63.4%	6,591	23.3%	3,773	13.3%
Sugary foods (other than drinks)	12,340	43.5%	9,100	32.1%	6,904	24.4%
Meat	7,547	26.6%	12,794	45.1%	8,003	28.2%
Foods high in fat	8,547	30.2%	11,741	41.4%	8,056	28.4%
Foods high in salt	8,586	30.3%	11,461	40.4%	8,297	29.3%
Ultra-processed foods	9,210	32.5%	11,174	39.4%	7,960	28.1%

¹Items in italics correspond to categories of product that are specifically targeted by a taxation scheme

Table 3: Knowledge regarding the 2018 revision of the tax on sweetened beverages among participants from the NutriNet-Santé cohort (n = 28,344), France, 2021

In 2018, the tax on sweetened beverages was amended. What was the result of the revision?	N	%
The tax was repealed	511	1.8%
The tax was maintained but its scope was modified	3,801	13.4%
<i>The tax was maintained but its amount was modified¹</i>	2,176	7.7%
<i>The tax was maintained but its mode of calculation was modified¹</i>	1,761	6.2%
The tax was maintained identically	2,163	7.6%
I do not know	17,932	63.3%
Which factors affect the tax rate?²	N	%
The tax rate is flat, which means that all sodas and sweetened beverages are identically taxed	3,316	11.7%
Depends on the origin of sodas and sweetened beverages	3,576	12.6%
Depends on the sugar content of sodas and sweetened beverages	7,992	28.2%
<i>Depends on the added sugar content of sodas and sweetened beverages¹</i>	7,194	25.4%
<i>Depends on the type of sweetener used¹</i>	5,078	17.9%
<i>Depends on the category of product¹</i>	4,994	17.6%
I do not know	14,317	50.5%

¹Items in italics were considered to be correct answers²Several answers were possible for this question.

Table 4: Knowledge regarding the scope of the tax on sweetened beverages among participants from the NutriNet-Santé cohort (n = 28,344), France, 2021

	This category is covered		This category is not covered		I do not know	
	N	%	N	%	N	%
Fresh fruit juice	4519	15.9%	18188	64.2%	5637	19.9%
Fruit juices obtained from concentrate	9273	32.7%	13315	47.0%	5756	20.3%
<i>Fruit nectars¹</i>	9992	35.3%	12426	43.8%	5926	20.9%
<i>Sugar-sweetened sodas¹</i>	21506	75.9%	2780	9.8%	4058	14.3%
<i>Artificially-sweetened sodas¹</i>	17293	61.0%	6293	22.2%	4758	16.8%
<i>Sugar-sweetened still drinks¹</i>	15058	53.1%	8148	28.7%	5138	18.1%
<i>Sugar-sweetened teas and infusions¹</i>	12171	42.9%	10382	36.6%	5791	20.4%
<i>Artificially-sweetened teas and infusions¹</i>	9609	33.9%	12663	44.7%	6194	21.9%
<i>Flavoured water with sugar¹</i>	8976	31.7%	13174	46.5%	6194	21.9%
<i>Flavoured water with artificial sweeteners¹</i>	7031	24.8%	15069	53.2%	6244	22.0%

¹Items in italics corresponds to categories targeted by the sweetened beverage tax

Table 5: Tax acceptance and perception among participants from the NutriNet-Santé cohort

(N=28 344), France, 2021

	Agree		Disagree		Neither agree nor disagree		I do not know	
	N	%	N	%	N	%	N	%
I am in favour of taxing sodas and sweetened beverages	18,337	64.7%	3975	14.0%	4295	15.2%	1737	6.1%
I am in favour of taxing sodas and sweetened beverages only if prices of healthy products go down (e.g. fresh produce)	19,493	68.8%	3154	11.1%	3932	13.9%	1765	6.2%
I am in favour of taxing sodas and sweetened beverages only if the revenue is used to improve our health system	21,662	76.4%	2328	8.2%	2874	10.1%	1480	5.2%
A tax on soft drinks is a useful measure to promote the health of the population	17,057	60.2%	6163	21.7%	3436	12.1%	1688	6.0%
A tax on soft drinks reduces the purchase of these products by the population in France	12,252	43.2%	9081	32.0%	4515	15.9%	2496	8.8%
A tax on soft drinks increases the national budget (and/or reduces the public debt)	10,601	37.4%	6863	24.2%	5865	20.7%	5015	17.7%
A tax on soft drinks increases prices and reduces purchasing power	13,833	48.8%	7076	25.0%	5312	18.7%	2123	7.5%
A tax on soft drinks is unfair because poor people will pay the same tax as rich people	9740	34.4%	11051	39.0%	5706	20.1%	1847	6.5%

Table 6: Multivariable analysis between tax acceptance, demographic and socioeconomic characteristics and individual behaviours and attitudes toward sweetened beverages among participants from the NutriNet-Santé cohort (n = 26 690), France, 2021

	Odds- Ratio	95% CI¹	P-value
Sex			<0.001
<i>Reference: Men</i>	1	-	-
Women	0.58	[0.55-0.62]	
Age			<0.001
18-30 years	0.91	[0.81-1.03]	
30-45 years	0.89	[0.82-0.97]	
<i>Reference: 45-55 years</i>	1	-	-
55-65 years	1.14	[1.04-1.25]	
Over 65 years	1.38	[1.26-1.52]	
Household composition			<0.001
<i>Reference: No children</i>	1	-	-
One or more children (less than 13 years)	0.85	[0.80-0.92]	
One or more adolescents (14 to 18 years)	1.07	[0.96-1.18]	
Children of both age categories	0.95	[0.81-1.09]	
Household income			<0.001
Less than 1300€/month/CU	1.04	[0.96-1.11]	
<i>Reference: 1300€ to 2600€/month/CU²</i>	1	-	-
More than 2600€/month/CU	1.13	[1.04-1.23]	
Did not disclose their income	0.71	[0.66-0.77]	
Educational level			<0.001
No high school diploma	0.73	[0.67-0.80]	
<i>Reference: High school diploma</i>			
Graduate degree	1.81	[1.70-1.94]	
Body mass index			<0.001
Less than 18.5 kg/m ² (Underweight)	1.33	[1.15-1.54]	
<i>Reference: 18.5-25 kg/m² (Normal weight)</i>	1	-	-
25-30 kg/m ² (Overweight)	0.87	[0.81-0.93]	
Over 30 kg/m ² (Obesity)	0.55	[0.51-0.60]	

Consumer of sugar-sweetened soda			<0.001
<i>Reference: No</i>	1	-	-
Yes	0.57	[0.52-0.61]	
Consumer of artificially-sweetened soda			0.38
<i>Reference: No</i>	1	-	-
Yes	1.04	[0.95-1.13]	
Consumer of fruit juice			0.28
<i>Reference: No</i>	1	-	-
Yes	1.04	[0.97-1.11]	
Attitude on “Sugar-sweetened beverages and sodas are bad for your health”			<0.001
Disagree	0.60	[0.49-0.72]	
<i>Reference: Neither agree nor disagree</i>	1	-	-
Agree	2.32	[2.11-2.54]	
Attitude on “Sugar-sweetened beverages and sodas consumes a significant amount of resources (water, arable soil)”			<0.001
Disagree	1.12	[0.99-1.28]	
<i>Reference: Neither agree nor disagree</i>	1	-	-
Agree	1.78	[1.67-1.89]	

¹95% CI: 95% confidence interval; ²CU: consumption unit

Results were obtained using a logistic regression model. All variables were included simultaneously in the model.

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