

APPROVED: 4 March 2022

doi:10.2903/sp.efsa.2022.EN-7213

EU Insights study on consumers and dietary sugars

European Food Safety Authority (EFSA), Laura Maxim, Mario Mazzocchi, Stephan Van den Broucke, Fabiana Zollo, Matthias Rasche, Paul Ortega, Tobin Robinson, Claire Rogers, Domagoj Vrbos, Giorgia Zamariola, Anthony Smith

Abstract

EFSA undertook consumer research on nutrition and dietary sugars awareness, knowledge and risk perception, preferred information sources and trust in different actors, plus additional research on stakeholder perspectives. The research results informed EFSA's communications and engagement for a public consultation on its draft scientific assessment of a Tolerable Upper Intake Level for dietary sugars, and upon its subsequent final publication. Interviews with the representatives of nine stakeholder organisations and two institutional partners were analysed for qualitative insights, which were used to validate and reinforce EFSA's outreach to partners and civil society organisations. A consumer survey was conducted among a representative sample of 7,469 citizens (aged between 18 and 76) across EU Member States, Iceland and Norway in October and November 2020. The analysis of the quantitative data using segments derived from knowledge and risk perception indexes delivered important improvements for audience identification, messaging and choice of formats and channels for communication to the general public. The production of tips for risk communication on this topic used in combination with country-specific data, provided both accessible and comprehensive support to risk communicators at the national competent authorities in EU Member States, Iceland and Norway.

© European Food Safety Authority, 2022

Key words: consumer insights, risk perception, audience segmentation, risk communication, dietary sugars, nutrition

Requestor: EFSA

Question number: EFSA-Q-2022-00089

Correspondence: socialscience@efsa.europa.eu

Acknowledgements: EFSA wishes to thank the following for the support provided to this scientific output: Silvia Valtueña Martinez, Valeriu Curtui, Agnès de Sesmaisons-Lecarré, Leng Heng. EFSA wishes to acknowledge all European competent institutions, Member State bodies and other organisations that provided data for this scientific output

Suggested citation: EFSA (European Food Safety Authority), Maxim L, Mazzocchi M, Van den Broucke S, Zollo F, Rasche M, Ortega P, Robinson T, Rogers C, Vrbos D, Zamariola G, Smith A, 2022. EU Insights study on consumers and dietary sugars. EFSA supporting publication 2022:EN-7213. 39 pp. doi:10.2903/sp.efsa.2022.EN-7213

ISSN: 2397-8325

© European Food Safety Authority, 2022

Reproduction is authorised provided the source is acknowledged.

Summary

EFSA carried out an assessment to establish a science-based cut-off value (Tolerable Upper Intake Level) for daily exposure to dietary sugars from all sources from 2017 to 2021, at the request of the national competent authorities in five European countries (Denmark, Finland, Iceland, Norway and Sweden). EFSA prioritised its communication and engagement on this topic due to the issue's high public profile, expecting significant attention on EFSA's assessment both during a public consultation and following its final publication. To understand consumer awareness, knowledge, risk perceptions and information preferences as well as 'stakeholder' perspectives, EFSA sought to gather social insights on consumers and other interested parties in relation to dietary sugars.

While existing literature on this topic provides relevant findings, EFSA opted to generate new consumer data from across all EU countries, Iceland and Norway, and interview stakeholders to produce qualitative insights from important institutional partners and food chain stakeholders such as consumer organisations, primary producers, food manufacturers. The research would ensure comprehensive inputs and allow bespoke communication and engagement approaches both for EFSA and national authorities to adapt to their differing needs. In addition, EFSA's Working Group on Social Research Methods and Advice sought to pilot and test audience segmentation approaches identified in the 2021 EFSA scientific report on 'Technical assistance in the field of risk communication' during the analysis of data generated during this research.

EFSA regularly undertakes targeted social research projects (its 'EU Insights' series) to support its communication and engagement strategies on specific topics. An EU Insights study was commissioned to interview stakeholders and to conduct EU-wide consumer research on dietary sugars. Interviews with the representatives of nine stakeholder organisations and two institutional partners were held and a consumer survey was conducted among 7,469 citizens (aged between 18 and 76) across EU Member States, Iceland and Norway. Data collection ran between October and November 2020. The survey was distributed to a representative sample of each of the 29 target countries, and with respect to age, gender and socio-economic characteristics.

The stakeholder interviews were analysed for qualitative insights, which were summarised prior to a public consultation on EFSA's draft scientific opinion on dietary sugars, held in July-September 2021. The consumer survey data was analysed for insights in terms of interest in food and nutrition, awareness, knowledge and risk perception of dietary sugars, as well as preferred information sources and trust in different actors. These were translated into tips for communication on the specific issue.

The results of this consumer and stakeholder research both confirmed important strategic considerations for EFSA's communication and engagement and revealed additional factors to take into account. The qualitative findings strengthened outreach to key partners and stakeholders. The analysis of the quantitative data using segments derived from knowledge and risk perceptions indexes delivered important improvements for audience identification, messaging and choice of communication formats and channels to the general public. The production of tips for risk communication on this topic used in combination with country-specific data, provided both accessible and comprehensive support to risk communicators at the national competent authorities in EU Member States, Iceland and Norway.

Finally, the piloting of the analytical approach to derive these audience segments delivered rich insights and will be applied in future survey analyses at EFSA, while integrating the identified improvements.

Table of contents

Abstract.....	1
Summary.....	3
1. Introduction.....	5
1.1. Background and Terms of Reference as provided by the requestor	5
1.2. Interpretation of the Terms of Reference.....	6
2. Data and Methodologies	7
2.1. Data.....	7
2.1.1. Results	7
2.1.2. Limitations.....	8
2.2. Methodologies	8
2.2.1. Questionnaire development	8
2.2.2. Analytical approach	8
2.2.2.1. Dietary sugars knowledge.....	9
2.2.2.2. Dietary sugars risk perception.....	9
2.2.2.3. The two-dimensional model and additional factors considered	10
3. Assessment	11
3.1. Description of the data	11
3.2. Segments analysed along the two-dimensional model	11
3.3. Identifying segment characteristics	12
3.3.1. Low knowledge plus low risk perception audience segment	12
3.3.2. High knowledge plus high risk perception audience segment	13
3.4. Communication opportunities across countries included in the survey	13
3.5. Strategies for risk communication	15
3.5.1. Tips from society	15
3.5.2. EFSA's communications on dietary sugars 2021-2022.....	16
3.5.3. Behaviour related findings for use in risk management.....	18
4. Conclusions	19
5. Recommendations.....	20
References.....	20
Appendix A – Regression tables	22
Appendix B – Questionnaire	24
Appendix C – Stakeholder Interviews	35

1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

In 2017, EFSA received a request for a scientific opinion on the safety of dietary sugars¹ from the national competent authorities in five European countries (Denmark, Finland, Iceland, Norway and Sweden). In response to this request, EFSA's scientific Panel on Nutrition, Novel Foods and Food Allergens (NDA) carried out an assessment to establish a science-based cut-off value (a Tolerable Upper Intake Level, or UL) for daily exposure to dietary sugars from all sources, which would not be associated with adverse health effects. The scientific opinion was published in February 2022 (EFSA NDA Panel, 2022).

The presence of both natural and free/added sugars is widespread in the diets of European populations. Many scientific studies support, to varying degrees of certainty, links from intakes of dietary sugars to dental caries, a variety of metabolic health conditions (e.g. heart disease, type II diabetes, obesity) and some pregnancy-related conditions. Since sugars are classed as nutrients, they are assessed by EFSA within the framework of dietary reference values and managed by national public health authorities through the development of food-based dietary guidelines.

EFSA prioritised its communication on this topic due to its high public profile. The socio-cultural place of sugars in European diets and culinary traditions, known concerns about the health consequences of sugar consumption, and the economic importance of sugars as commodities and ingredients in food products, all combined to ensure close scrutiny of this scientific assessment by an assortment of interests and institutions. This combination of factors ensured significant attention on EFSA's assessment was expected both during a public consultation (held from 22 July to 30 September 2021) and following final publication of the scientific opinion in February 2022. Therefore, to understand consumer knowledge and perceptions as well as stakeholder perspectives, EFSA conducted social research to gather insights on consumers and other interested parties.

Since 2015 EFSA has undertaken targeted social research projects (called 'EU Insights') to support its communication and engagement strategies on specific topics (antimicrobial resistance, chemical mixtures, emerging risks, uncertainty) and to understand specific audiences better (Stakeholder Engagement Approach, Reputation Barometer). The findings are used to help shape communication messages on sensitive topics or those of broad interest, and tailor specific products. For example, the EU Insights study on chemical mixtures (ICF, 2019) was used directly to develop an interactive tool 'When chemicals mix'² aimed at the interested general public to help explain EFSA's work in this area.

Literature exists on European consumer knowledge/awareness and perceptions in relation to aspects of EFSA's assessment on dietary sugars and its work in the nutrition area more generally. Tierney et al. (2017) reported that consumer knowledge and understanding of the term 'added sugars' was very low among consumers in Northern Ireland, with little awareness of the World Health Organization (WHO) recommendations to restrict intakes of added sugars to 10% of energy. A survey of Canadian dietitians' and other health professionals' knowledge of WHO recommendations also revealed knowledge gaps among a specialist audience (Wang et al., 2020). Consumer research linked to front-of-pack (FOP) labelling on food is relatively common, for instance, Egnell et al., evaluated consumer knowledge and the effectiveness of different FOP labelling approaches for identifying food quality (Egnell et al., 2018). A Joint Research Centre review of FOP labelling schemes found some labels may be more effective than others in improving nutritional quality choices (Storcksdieck genannt Bonsmann et al., 2020). Other experimental studies exploring consumer choice and purchasing behaviour (Julia et al., 2016; Shangguan et al., 2019) would seem to indicate that labelling may help to improve 'the healthiness of the diets selected by consumers' (Temple, 2020). Studies on behavioural change although not directly related to EFSA's risk assessment role, are of interest to national public health authorities; for example Hagmann et al. (2018) explored consumer acceptance of different interventions used by public authorities to reduce sugar intake.

This literature provides insights of relevance in this area. EFSA opted to generate new consumer data from across all EU/EEA countries. This would ensure comprehensive support to national authorities and

¹ Request for an EFSA scientific opinion on the safety of dietary sugars: <https://open.efsa.europa.eu/questions/EFSA-Q-2016-00414>

² Interactive tool: <http://www.efsa.europa.eu/en/interactive-pages/MixTox>

produce qualitative insights from important institutional partners and food chain stakeholders (e.g. consumer organisations, primary producers, food manufacturers) to allow a bespoke engagement approach to adapt to the differing needs of EFSA and the national competent authorities in EU/EEA countries. Consequently, EFSA proposed to interview stakeholders and to conduct EU-wide consumer research in the form of an EU Insights survey in 2020.

The research proposal had the following objectives:

1. To inform EFSA's communication and engagement approaches in at least two phases:
 - a) During the launch/running of the public consultation, contributing to improving the quality of feedback and reducing the potential for misunderstanding of the draft conclusions, and
 - b) For dissemination of the final output to support decision-makers, partners, professionals and an interested/concerned public;
2. To provide additional communication and engagement support to members of EFSA's Communications Expert Network.

Members of EFSA's Communications Expert Network (CEN), including representatives of the requestor countries, had proposed nutrition and more specifically dietary sugars as potential topics for an EU Insights study prior to 2020. Subsequently, CEN members endorsed EFSA's proposal for a research study at its 28-29 April 2020 meeting. EFSA's management also supported the study to inform its engagement with stakeholders during the public consultation and to develop evidence-based communications on the topic, to target a variety of audiences.

1.2. Interpretation of the Terms of Reference

For EFSA, dialogue and cooperation with its stakeholders and institutional partners are fundamental to provide scientific inputs for its assessments and to ensure understanding of its scientific advice. Consequently, an important objective of social science at EFSA is to conduct targeted research among interested parties that provides a societal perspective on the subject being assessed. This strengthens engagement with society and communication with target audiences.

In relation to the EFSA scientific opinion on the Tolerable Upper Intake Level of dietary sugars, social research was required to examine the views of the general public through a consumer survey, and the perspectives of relevant professional categories through qualitative interviews³. Through these methods EFSA's intention was to collect evidence on: i) public attitudes towards dietary sugars; ii) perceptions of the related risks of the dietary intake of sugars; iii) the most trusted and frequently used information sources for learning about sugars and other nutrition-related topics; and iv) other factors that influence food choice and eating behaviour. The results were intended for use by EFSA and its national competent authority partners in the EU Member States, Norway and Iceland.

EFSA's Working Group on Social Research Methods and Advice, in consultation with EFSA's Nutrition Unit and representatives of the five national requestor authorities, determined that the research should address:

- **Awareness and understanding** – the study should indicate if consumers are aware of the presence of different sugars in different food types, if for reasons of health consumers would be willing to reduce sugar intake under different scenarios (e.g. 'less sweet' foods, substitutes for sugars), if non-technical audience segments understand terms such as 'added sugars' and 'free sugars'; it should also aim to understand if the potential misunderstanding of these terms by stakeholders would impact the quality of feedback on the draft assessment and their understanding of the draft/final conclusions.
- **Behaviours** – the study findings should indicate if consumers have changed their sugar intake as a result of past risk communication, if they take into account the risks/benefits of sugars in the diet, what other factors (e.g. price, taste, traditions) also influence their food consumption decisions, whether heuristics affect their ability to make balanced judgements, what influence

³ The results of these qualitative interviews are included in Appendix C.

special occasions (e.g. birthdays) may have on consumption, if consumers have other personal reflections on how consuming sugars makes people feel.

- **Information** – the study findings should indicate the most trusted sources and frequently-used information channels/formats for consumers to help formulate communications strategies and identify trusted voices and information channels for nutrition/health/dietary advice topics. Food product labelling is an important risk management tool; therefore, the study findings should provide insights on consumers' responsiveness to nutrition labelling and health claims to indicate their possible willingness to reduce their intake of sugars, for example by substituting high-sugar products with reduced-sugar or sugar-free alternatives.
- **Socio-economic factors** – during the development of EFSA's scientific assessment on dietary sugars, public debate on the potential harmful health effects and the possible use of a 'sugar tax' was ongoing in many European countries, e.g. Belgium, Finland, France, Hungary, Latvia, Norway, Portugal, and the UK. Economic considerations are outside EFSA's remit and therefore were not considered in the EFSA NDA Panel's scientific assessment. However, they may influence individual decision-making and the shaping of personal/public attitudes. Therefore, the study findings should include insights on consumer attitudes to these factors to contextualise these public debates, and to assist EU/national policymakers when considering possible public health options in response to EFSA's scientific opinion.

The research should include an online consumer survey on the general (consumer) population from the selected countries and semi-structured interviews with eight to ten representatives of selected stakeholders. The consumer survey should be conducted through consumer panels in EU Member States, Norway and Iceland (the two non-EU Member State requestor countries). The semi-structured interviews should be conducted with key-informants identified through EFSA's Stakeholder Forum supported by the EFSA Nutrition Unit.

Finally, EFSA should apply and test audience segmentation approaches identified in its scientific report on 'Technical assistance in the field of risk communication' (EFSA, 2021) during this research project. Specifically, the EFSA scientific report articulates a segmentation approach for the general public that relies on four factors—i) food safety knowledge; ii) personal risk perception; iii) use of food safety information and information sources and iv) trust in information coming from different actors—which can be further refined using socio-demographic information. The analysis of data generated during this social research, therefore, offered an opportunity to apply, test and finetune these approaches both to improve the impact of EFSA's communications and engagement on dietary sugars, and also to provide a segmentation model that can be applied to other food safety-related topics in the future.

2. Data and Methodologies

2.1. Data

2.1.1. Results

The consumer survey was conducted among 7,469 citizens (aged between 18 and 76) across all EU27 member states plus Norway and Iceland. Data collection ran between 14 October 2020 and 11 November 2020. The survey was distributed to a representative sample of each of the 29 target countries. Quota limits were set on age intersected with country to ensure a sufficient spread of age groups in each country. After 10% of the data was acquired, the fieldwork was paused and the data was checked for completeness and consistency before proceeding. In most countries, at least 250 questionnaires were completed, except for the smaller countries Cyprus, Iceland, Malta, and Luxembourg, where the target was 150 due to scarcity of sample. This ensures a 95% confidence interval of roughly 8 percentage points. These sample sizes provide robust results and ensure that responses are representative in each of the countries to be surveyed.

The sample was nationally representative with respect to age, gender and socio-economic grouping. Other demographic information collected was level of education and employment status. Respondents were also asked if they were parents so that comparisons could be made about the knowledge and opinions of parents compared to non-parents.

Semi-structured interviews with representatives of nine stakeholder organisations and two institutional partners were held.

2.1.2. Limitations

The survey was administered on-line, after selecting a representative sample of respondents aged between 18 and 75 from the sub-contractor proprietary panel. Respondents aged above 75 were not targeted because of difficulties in ensuring representativeness.

Another limitation arises from the multilingual character of the study. Translations have been performed by professional translators, small deviations and differences in understanding between different languages cannot be excluded, however. In some cases, EFSA noticed translations that are formally correct, but require different levels of subject knowledge. For example, the term “obesity” was translated into “Adipositas” for German speaking respondents in Germany, whereas it was translated into “Adipositas (Fettleibigkeit)” for German speaking respondents in Austria. The first term might be difficult to understand for members of the general population.

The analysis of the results imposes some limitations. There is only a limited number of other studies that cover knowledge and risk perceptions of dietary sugars in the context of EFSA’s study. The levels of knowledge and risk perception are therefore difficult to interpret, as no benchmark exists.

2.2. Methodologies

2.2.1. Questionnaire development

The questionnaire for the consumer survey was developed adapting questions available in the literature or creating new questions for the purpose of the study. The main source was the Special Eurobarometer on Food safety in the EU (2019) from which the questions on knowledge and risk perception related to health conditions, behaviour change, information sources and trust in different actors were extracted. The health conditions and the population groups potentially at risk were selected based on the protocol for the scientific assessment of the Tolerable Upper Intake Level of dietary sugar (2018) which outlined the strategy to be followed by EFSA. The protocol was also the source for identifying the terms that would have been used (added sugars, free sugars, total dietary sugars and tolerable upper intake level) and, therefore, for which understanding by the general public needed to be investigated.

The FSANZ (Food Safety Australia New Zealand) literature review on consumer knowledge, attitudes and behaviours relating to sugars and food labelling (2017) was used as source for drafting the question on interest in food and nutrition and the true/false statements assessing respondents’ knowledge. The format of this latter question was taken from the EU Insights study on chemical mixtures (ICF, 2019).

For the question on labelling, only the claims permitted under Regulation (EU) 1924/2006 (EC 2006) were considered. Lastly, a research report (Buxel, 2019) shared by the German Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) was used as source for the questions on behaviour change, which are of relevance for risk management.

The draft questionnaire was reviewed by scientific officers working on nutrition at EFSA to ensure the accuracy of the information, e.g., the statements assessing knowledge. Additionally, members of the Working Group on Social Research Methods and Advice commented on the draft and endorsed the final questionnaire. The five requester countries (Denmark, Finland, Iceland, Norway and Sweden) also commented on the draft and provided feedback on the behaviour-related questions linked to risk management. Lastly, the contractor (ICF) provided input on the content and the scripting of the online questionnaire.

The questionnaire for the stakeholder interviews (see Appendix C) included questions on i) awareness of EFSA’s mandate to provide a scientific opinion on the Tolerable Upper Intake Level of dietary sugars; ii) the role of EFSA related to nutrition in the EU, and iii) anticipated impacts the scientific opinion could have on stakeholders. The draft interview guide was reviewed by scientific officers at EFSA working on the scientific assessment to ensure that information gathered would support the engagement with stakeholders and the general public in the context of the public consultation.

2.2.2. Analytical approach

To generate insights for targeted risk communication from the consumer survey data, an audience segmentation approach was applied considering the following factors: i) food safety knowledge; ii) personal risk perception; iii) information sources and iv) trust in information coming from different actors. Socio-demographic factors were considered in providing insights into identified segments but were not used as a segmentation criterion per se. The proposed analytical approach was sourced from the findings of EFSA's scientific report on 'Technical assistance in the field of risk communication' (EFSA, 2021).

To support risk communication strategy development, the focus was placed on knowledge and risk perception, as the survey included a number of questions covering the two areas. To make these factors accessible as individual, numerical and dependent variables, two indices were constructed, both ranging between 0% and 100% (indicating either no knowledge and no risk perception, or high knowledge and 'full' risk perception). The two-dimensional model of knowledge and risk perception was then supplemented by findings on information sources, trust and socio-demographic characteristics.

2.2.2.1. Dietary sugars knowledge

To generate insights for targeted risk communication, an audience segmentation approach was applied considering the following factors.

Three survey questions⁴ tested the respondent's knowledge of sugar-related topics:

- Question 8 > a selection of true / false statements, testing knowledge around sugar-specific terms like "added sugar".
- Question 9 > a single option question with three possible answers, testing the understanding of the *tolerable upper intake level* concept, which is a technical term used in scientific outputs.
- Question 10 > a multiple choice question listing products, testing respondent's knowledge of products that contain added sugar.

To make use of these findings, a **knowledge index (KI)** was compiled, both individually for each question as well as within an aggregated version in which each question weighted 1/3. The index was calculated as the amount of correct answers as a share of all answers for any given knowledge question. For example, for question 8, if a respondent selected 10 correct answers out of the total 16 questions, that person would have an individual knowledge index of $10/16 = 62.5\%$ for question 8.

KI	=	$\frac{1}{3} \times \text{KI8}$	+	$\frac{1}{3} \times \text{KI9}$	+	$\frac{1}{3} \times \text{KI10}$
		Q8 Sugar-specific terms		Q9 Tolerable upper intake level		Q10 Products you expect sugar in

Figure 1: Calculation of the aggregated Knowledge Index (KI) using the individual questions' indices

2.2.2.2. Dietary sugars risk perception

To generate risk perceptions insights for targeted risk communication, an audience segmentation approach was applied.

Two survey questions⁵ tested the respondent's risk perception about consumption of sugars and health conditions:

⁴ See Appendix B for complete survey questionnaire.

⁵ Idem.

- Question 4 > a multiple-choice question listing health conditions, testing which health conditions (of those examined in relation to sugar consumption in the EFSA scientific opinion) respondents had heard of
- Question 5 > testing, based on the conditions that respondents had heard of, if they consider themselves at risk of these (tabular question, with options Yes, Maybe, No, Don't know for each of the conditions respondents were aware of).

To make use of these findings, a **risk perception index (KI)** was compiled, both individually for each question as well as within an aggregated version in which each question weighs 1/2. The risk perception index stood at 100 if a respondent has heard of all health conditions and thought they were at risk of all health conditions. It was 0 if a respondent has heard of none and, consequently, had no personal risk perception.

$$\text{RPI} = \frac{1}{2} \times \text{RPI4} + \frac{1}{2} \times \text{RPI5}$$

Q4
Conditions you
have heard of

Q5
Conditions you
are personally
at risk of

Figure 2: Calculation of the aggregated Risk Perception Index (RPI) using the individual questions' indices

2.2.2.3. The two-dimensional model and additional factors considered

Following the steps described in 2.2.2.1 and 2.2.2.2., a two-dimensional model was built, plotting the individual responses according to the respective knowledge and risk perception indices. The model was intended to assist with identification of potential segments, as shown in Figure 3.

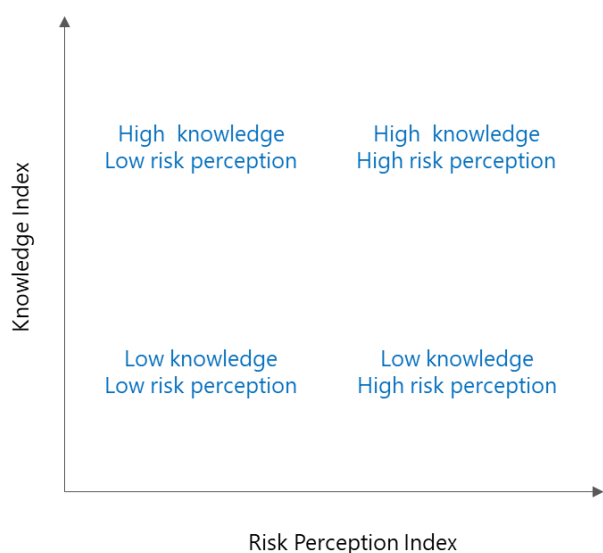


Figure 3: The base model for identifying potential audience segments

The characteristics of respondents belonging to the “low knowledge-low risk perception” and “high knowledge-high risk perception” segments were then further examined using a regression analysis, based on answers to questions related to interest in food and nutrition (Question 2A, see Appendix B), use of information sources (Question 18, see Appendix B), trust in different actors (Question 19, see Appendix B) and socio-demographic characteristics (Introductory questions D1 to D5, see Appendix B).

3. Assessment

This section presents the findings of the analysis of consumer data and the methodology described above (Section 2). A deep dive into identified audience segments is presented, along with an analysis of the distribution of these segments across EU countries. These are then turned into practical advice for risk communication in the area of dietary sugars targeting different segments of the population. Finally, the results overview also includes behaviour related findings stemming from the consumer survey for use in risk management.

The stakeholder interviews were analysed for qualitative insights, which were summarised prior to a public consultation on EFSA's draft scientific opinion on dietary sugars, held in July-September 2021. An overview of the findings is included in Appendix C.

3.1. Description of the consumer survey data

Segmentation allows for the study of characteristics of respondents in each group compared to the rest of the respondents. For this reason, the data analysis and the assessment followed a segmentation model that analyses knowledge and risk perception, then used in combination with findings from data on use of information sources, trust in information from different actors and socio-demographic characteristics.

The choice of the segment sizes⁶ was driven by the desire to analyse groups that are large enough, provide statistically significant results, and are of approximately the same size to be able to interpret results of the two opposite sides of the model in a comparative manner.

3.2. Segments analysed along the two-dimensional model

To identify potential segments stemming from the data collected in the consumer survey, a two-dimensional model plotting the individual responses according to both the knowledge and risk perception indices was constructed (see Figure 3).

Two groups of focus were then identified, based on the size parameters describe above, to study the characteristics of respondents on the lower and higher end of the spectrum (see Figure 4):

1. A segment with low knowledge and low risk perception (knowledge index up to 0.52; risk perception index up to 0.47)
2. A segment with high knowledge and high-risk perception (knowledge index above 0.79; risk perception index above 0.63)

⁶ The sizes were determined using a combination of the 33th and 67th percentile for both the knowledge and the risk perception indices.

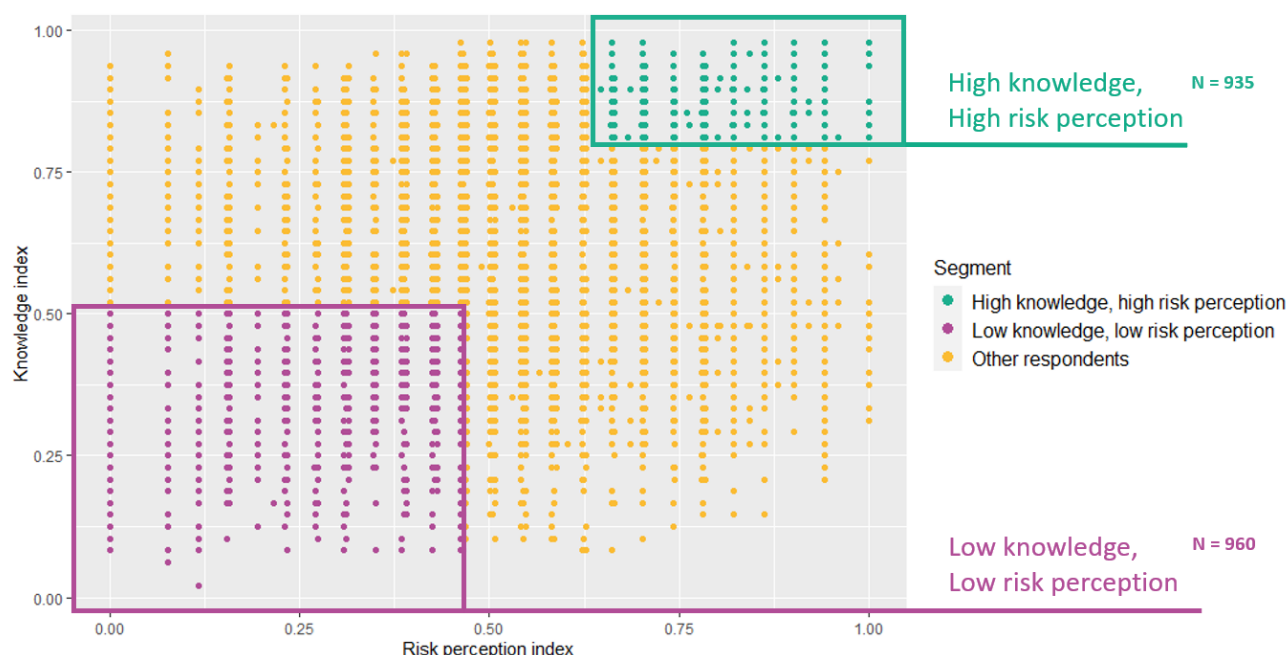


Figure 4: Segments identified below the 33th percentile of each index and above the 67th percentile of each index, subject to in-depth analysis

The regression analysis⁷ that followed provided insights into segment-specific characteristics, deemed relevant for the design of communication strategies.

3.3. Identifying segment characteristics

The following subsection describes the results obtained from the analysis of the two segments in the consumer survey data singled out from the two-dimensional model. For each audience segment, differences in the proportion of socio-demographic factors were identified, and the effects of several tendencies such as interest in food safety, consideration of different sources or trust in different actors with regards to information about healthy eating were studied.

3.3.1. Low knowledge plus low risk perception audience segment

The segment with low knowledge and low risk perception is found to have more males (57.6% of the segment) than respondents outside this group (47.1%). In terms of education, there are more primary school leavers (6.7% versus 3.7%) and fewer university degrees (39.1% as opposed to 45.8%) than among the other respondents. As for occupation, this segment consists of more manual workers (19.1% compared to 15.5%) and fewer office employees (20.7% compared to 25.3%) than the rest of respondents. Finally, respondents in this segment are generally younger, with more people aged 26-35 (23.3% versus 16.4%) and fewer people aged 56-65 (11.9% versus 18.2%) than in the rest of the sample.

Several factors were found to be significant predictors⁸ of the likelihood of belonging or not to the segment with low knowledge and low risk perception. Namely, using social media or events like lectures, seminars, workshops or conferences as source of information, trusting supermarkets, trusting

⁷ For each of the two identified segments, the regression was performed by comparing the characteristics of the segment to the remainder the population. This approach was chosen to study the factors that could describe the likelihood of belonging to that segment and does not preclude the existence of other segments of the population.

⁸ The logistic regression identified predictors that affect the likelihood of belonging to this segment, with a level of significance of 0.05 or lower. The odds ratios for the predictors that increase the likelihood ranged from 1.02 to 1.06, and those for the predictors that decrease the likelihood ranged from 0.92 to 0.97. See table A1 in appendices for the complete list of predictors, jointly with their respective odds ratios and significance level.

celebrities, bloggers and influencers, and trusting the food industry are contributors for this segment. In other words, these factors make it more likely to belong to this group. On the other hand, respondents being female, being parents, being very interested in food and nutrition, using the internet (excluding social media) as sources of information, trusting scientists and trusting their doctor or a specialist (e.g., dietician or nutritionist) are all factors that prevent inclusion in this segment, i.e. such respondents are less likely to belong to this group.

3.3.2. High knowledge plus high risk perception audience segment

Compared to other respondents, the audience segment with high knowledge and high risk perception contains a greater proportion of females (57.3% versus 50.3%), more university degrees (49.7% versus 44.2%), fewer primary school leavers (1.5% versus 4.5%), fewer students (6% versus 8%), more respondents aged 56-65 (20.9% versus 16.9%) and fewer respondents aged 26-35 (14.1% versus 17.7%).

The analysis also identified several factors that predicted⁹ to a great extent the likelihood of belonging or not to this high knowledge and high risk perception segment. Specifically, being female, using the internet (excluding social media), professional journals or radio as sources of information about healthy eating, and trusting in scientists are the contributing factors that make respondents more likely to belong to this segment. On the other hand, respondents being retired or self-employed, using information points such as street stands or festivals as source of information, and trusting NGOs or journalists are all factors that make respondents less likely to belong to this segment.

3.4. Communication opportunities across countries included in the consumer survey

In addition to inspecting the characteristics of the two groups of respondents, an analysis of their distribution across the countries included in the survey was undertaken. The purpose was to assess the relevance of and communication opportunities in relation to the abovementioned audience segments.

Across the countries, the two segments jointly accounted for between 16% and 35% of total respondents. The occurrence of the low knowledge-low risk perception segment varied between 5% and 23% while the high knowledge-high risk perception respondents ranged from 2% to 23% (see Figure 5).

⁹ The logistic regression identified predictors that affect the likelihood of belonging to this segment, with a level of significance of 0.05 or lower. The odds ratios for the predictors that increase the likelihood ranged from 1.03 to 1.04, and those for the predictors that decrease the likelihood ranged from 0.95 to 0.97. See table A2 in appendices for the complete list of predictors, jointly with their respective odds ratios and significance level.

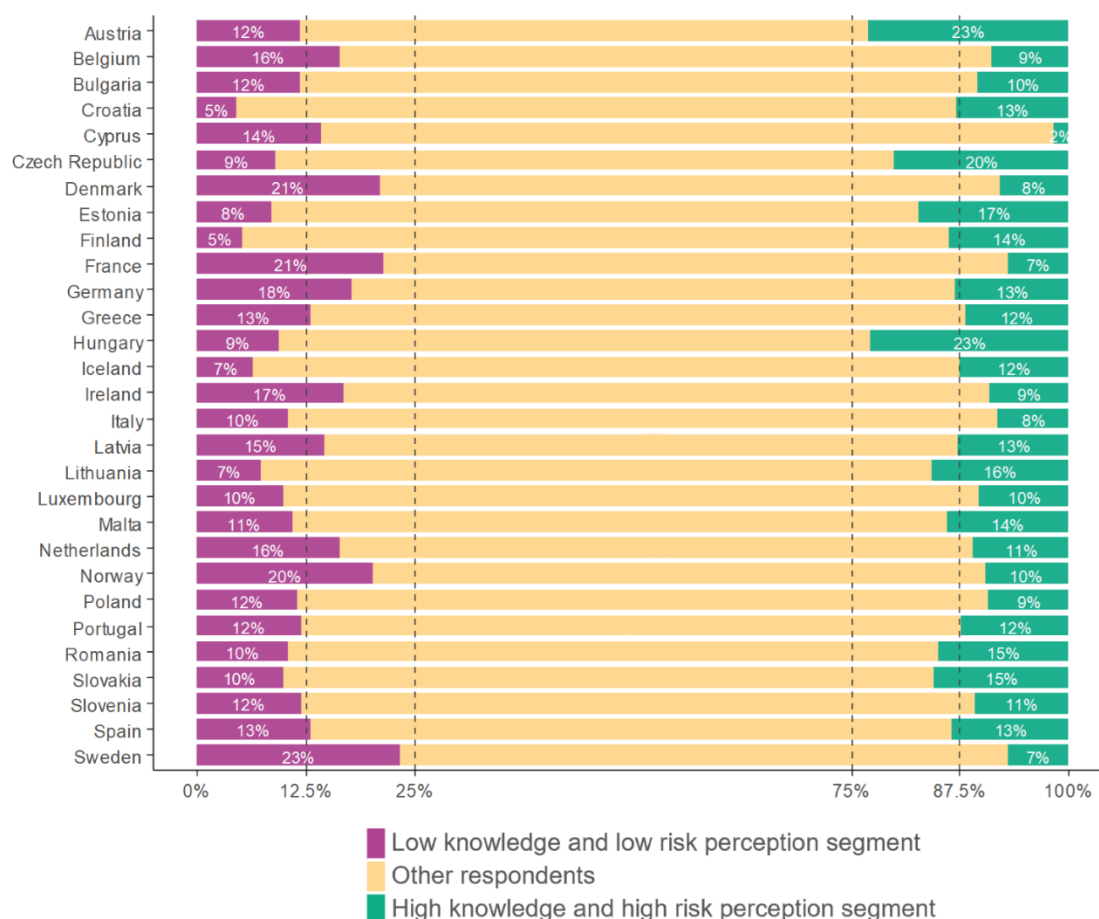


Figure 5: Proportion of respondents in the two segments across countries

The differences between countries implied that opportunities for using the segmentation findings and applying them in the relevant communication at country level varied both across countries and segments. At EU level, the proportion of the low-low segment accounted for 12.8% of the population while the high-high stood at 12.5%. The previous analysis undertaken with the totality of the EU data may therefore imply that for countries where percentages of individual segments are close or above the EU figure, the opportunity for communicating to that group is higher. Figure 6 compares the prevalence of both segments across the countries included in the survey – the darker the colour, the higher the number of respondents in the reference group and subsequently, the broader the applicability of the findings for the specific segments.

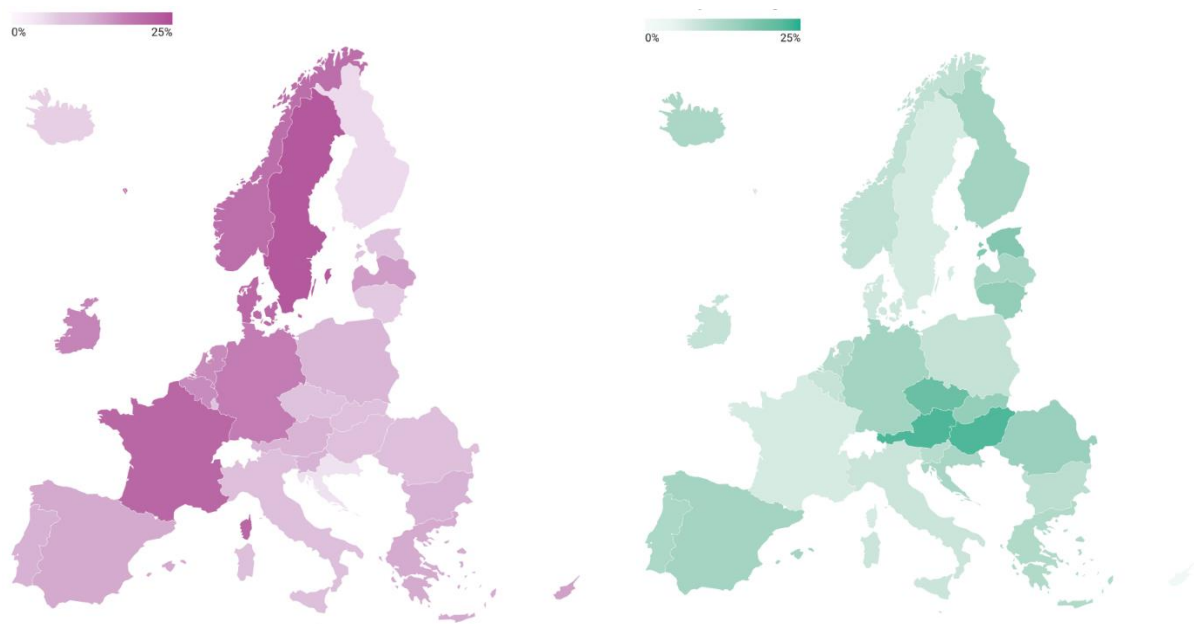


Figure 6: The distribution of the low-low (purple) and high-high (green) segments across the countries (as % of total country respondents)

3.5. Strategies for risk communication

3.5.1. Tips from society

The analysis of the survey data provided many insights which could potentially be used to inform risk communication strategies. From these insights, EFSA developed 'Tips from Society' to advise risk communicators about the topics which emerged as relevant or potentially sensitive and, in some cases, what strategies to follow to maximise the impact of communications. The tips go beyond the analysis presented in this report and were based on consideration of the totality of the survey insights.¹⁰

The tips centred around four key areas – i) European interest in food and nutrition, ii) understanding terminology, iii) risk perceptions around health conditions, and iv) applying knowledge to inform risk communication strategies.

i. Food and nutrition as communication topics

Some 3 in 4 Europeans said they were interested/very interested in food and nutrition, and 1 in 2 people reported that they regularly consume information on food and nutrition. Their eating habits had been affected too—2 in 3 respondents had, at some point in their life, tried to eat more fruit and vegetables while reducing their sugar intake; almost half had looked to reduce salt and fat in their diet. Therefore, communications on food and nutrition are topics that are likely to draw attention and interest of consumers.

ii. Need for clear terminology

At least 1 in 3 of the respondents found it difficult to understand terms related to sugars, in particular understanding of the 'free sugars' category was lower than for 'total sugars' and 'added sugars'. Using visual tools to explain these terms could help consumers understand the different categories and sources of sugars. This is crucial as EFSA's scientific opinion concluded that consumption of free and added sugars should be as low as possible (EFSA NDA Panel, 2022).

¹⁰ For the purposes of reproducibility, transparency and evidence re-use, we made the dataset from this survey available on the [EFSA Knowledge Junction](https://zenodo.org/record/6323326#.Yh-FMejMKUK), an open repository for the exchange of evidence and supporting materials used in food and feed safety risk assessments, <https://zenodo.org/record/6323326#.Yh-FMejMKUK>

- iii. **Awareness of sugar-related health conditions** in EFSA's scientific opinion
Awareness of these health conditions was high among respondents however risk perceptions varied across age and countries. Therefore, risk assessment findings should be considered in tandem with any specific health issues prevalent in each country together with the risk perception data. The latter is important as topics such as dietary sugars may lend themselves to cognitive biases¹¹, such as optimism bias (i.e. the tendency to consider oneself less at risk of a negative outcome), or negativism bias (i.e. the tendency to focus more, or to place more importance, on negative information rather than positive information).
- iv. **Use of knowledge and perception to design risk communication strategies**
Insights from the research indicate that general advice and explanations on the topics of food and nutrition should be communicated through the most popular sources – TV and the internet. Scientists and doctors were the most trusted source (and face) of risk communications when examining the overall survey population – engaging them in campaigns could, therefore, aid audience impact. Furthermore, if communicating to audiences with lower knowledge and risk perception, social media is a valuable source. Engaging with bloggers or influencers could boost social media presence, by partnering with one that shares the competent authority's core values, can amplify messages.

3.5.2. EFSA's communications on dietary sugars 2021-2022

As described above (Section 1), the principal driver for this research was EFSA's assessment of a Tolerable Upper Intake Level for dietary sugars (EFSA NDA Panel, 2022). EFSA's communications on this topic began with the acceptance of the request made by five European countries in March 2017 and continued with regular updates on progress throughout the evaluation. The outcome of the assessment was communicated to the public in two phases: 1) the draft conclusions during a public consultation in July 2021; 2) the final publication of the scientific opinion in February 2022.

EFSA followed this proactive approach due to the issue's high public profile. The social/cultural place of sugars in European diets, known concerns about the health consequences of excess sugar consumption, and the economic importance of sugars as commodities and ingredients in food products, all combined to ensure close scrutiny of this scientific assessment by an assortment of interests and institutions. These included health and consumer organisations, representatives of economic interests, specialist and general news media as well as a panoply of national, European and global advisory bodies and institutions.

Our consumer and stakeholder research confirmed these strategic considerations and guided our operational planning for communications (and engagement) at these two critical stages: the audiences to target, the key messages and information services to provide, the channels and formats to use. Table 1 summarises some of these activities and examples of research findings that informed their development. (N.B. This overview is not exhaustive and is included for demonstration purposes only.)

¹¹ In the context of food risk, some of the most relevant cognitive biases are arguably negative information bias and positive information bias (Van den Broucke, 2014). For a more extensive overview of biases related to risk perceptions, see Tversky and Kahneman, 1974; Kahneman, 2011.

Table 1: Selected EFSA communications on dietary sugars, July 2021 and February 2022

	Consumer insights	Stakeholder insights	Target audience	Communications
July 2021: Public consultation				
Understanding of terms (total, free, added sugars)	Lower understanding of the term “free sugars”	-	Consumers, consumer organisations, specialist news media	<i>Infographic</i> ¹² - visually explains categories, prominent in all communications activities. <i>Social media</i> - extensive use.
EFSA’s role (scientific assessor not policy-maker)	-	Generally understood among stakeholders. Some misunderstanding of the purpose of EFSA’s scientific opinion	NGOs, international partners	<i>EFSA explains</i> ¹³ - clear, concise summary of what EFSA does and doesn’t do. Mainly disseminated through EFSA website and newsletter. <i>News story</i> - strong emphasis on receiving comments on scientific aspects, i.e. not policy recommendations
February 2022: Final publication				
Knowledge of health effects and risk perceptions	High knowledge, lower risk perceptions for oneself	EFSA’s opinion can help raise awareness of diseases linked to sugars	Consumers, consumer organisations, specialist news media, general news media	<i>Infographic</i> - links with health effects presented visually.
Trust in sources of information	High trust in doctors (87%) and scientists (82%). Lower in EU (53%) and national authorities (54%)	-	Consumers, consumer organisations, general news media	<i>News story</i> - quote the head (a doctor of paediatric medicine) of EFSA’s expert panel on nutrition

Note: the messages and content types used overlapped in the two phases, however the emphasis varied in terms of EFSA’s main communications objectives, i.e. to elicit relevant feedback during the consultation, then to disseminate the final conclusions and inform about next steps following finalisation.

¹² Infographic on sugar consumption and health problems, 2022, <https://www.efsa.europa.eu/en/infographics/sugar-consumption-and-health-problems>

¹³ EFSA explains: draft scientific opinion on the Tolerable Upper Intake Level for dietary sugars, 2021, [EFSA explains: draft scientific opinion on the Tolerable Upper Intake Level for dietary sugars](https://www.efsa.europa.eu/en/efsa-explains/draft-scientific-opinion-on-the-tolerable-upper-intake-level-for-dietary-sugars)

3.5.3. Behaviour related findings for use in risk management

In accordance with the terms of reference (Section 1.2) the consumer survey included a selection of questions to provide insights on behavioural patterns among consumers in relation to: reduced sugar intake as a result of risk communication, consideration of risks/benefits of sugars in the diet vis-à-vis other factors (e.g. price, taste, traditions), and reflections on taste sensations related to consuming sugars.

Questions 13 to 17 in the questionnaire cover these aspects. Since behaviour change is outside EFSA's area of responsibilities, these questions were included as a service to national public health authorities in the EU Member States, Iceland and Norway. As stated above (section 2.2) these questions were developed in collaboration with representatives of the five countries that requested EFSA's safety assessment of dietary sugars.

There follows an overview of the summary EU-level findings related to these questions with considerations for Member States how to use this information to inform their communication strategies.

Impact of 'claims' on behaviour

Question 13 looked at the influence of the labels 'sugar-free', 'with no added sugar', and 'low sugar' on consumers' purchasing behaviour. The results indicate that over half of all EU27 consumers prioritise products with all three indications, ranging from 66% for 'low sugar' to 60% for 'with no added sugar' and 54% for 'sugar free' (40% indicated they would not take this term into account). Country variations were wide, with those prioritising such products ranging from 39% to 77% across countries. There was a 5-6% variation by gender with females more in favour than males. Age and education did not show significant variability and largely mirrored the aggregate findings.

Intervention measures affecting reduced sugar intake

Question 16 looked at measures leading consumers to reduce their personal sugar intake including front-of-pack (FOP) labelling, health warnings and public information campaigns, which are all instruments for public health authorities to influence consumer behaviour. Most EU27 consumers (60% or higher) reported responding positively to such information in moderating their sugar intake (the few objective assessments available indicate lower rates (<30%) of consumers really look at FOP labels when shopping (Storcksdieck genannt Bonsmann et al., 2020)), however, a sizeable minority did not. For example, 16% indicated FOP labels would not contribute to reducing their sugar intake, another 6% 'do not know'. The possible intervention measures registering the greatest levels of opposition were 'Increased price' (e.g. through taxes) at 20% and 'Prohibition of advertisements of products with large amounts of sugar' which was rejected by 30% of respondents. Variability among socio-demographic categories was limited, however there were wide differences between countries, e.g. results for those who do not use FOP labels ranged from 5% to 30% across countries. These findings were in line with available literature, for example showing that socio-demographic characteristics have little explanatory power when it comes to policy support or that high level of support for healthy eating policy does not translate into acceptance of higher taxes to fund them (Mazzocchi et al., 2015).

Substitution of products and substitution of sugars with sweeteners

Questions 14, 15 and 17 sought to profile consumers' openness to change their purchasing behaviour in order to limit their sugar consumption.

Question 14 asked if respondents would choose an alternative reduced-sugar product or one containing sugar substitutes (such as artificial sweeteners) to regular products. At least half of respondents would be willing to buy reduced-sugar alternatives of almost all the food categories considered (58% for 'fruit juices', 55% for 'breakfast cereals', 54% for 'dairy products', 52% for 'sweets or chocolate' and for 'cake and pastries', and 49% for 'soft drinks'), however the acceptance of sugar substitutes was considerably lower, ranging from 13% to 19%.

The factors consumers consider when buying products in these food categories were tackled in Question 15. Taste was the most important factor in all categories, ranging from 41% for 'chewing gum' to 61% for 'sweets or chocolate' and also for 'cake and pastries', followed by price which was given as a factor by over one-third or respondents in all categories except 'chewing gum' (22.6%). Health considerations was the third most cited factor, accounting for around 35% of responses in relation to 'dairy products',

'fruit juices' and 'breakfast cereals', but closer to one-quarter for 'sweets or chocolate', 'cake and pastries', and 'soft drinks'.

Finally, Question 17 tested the respondents' preference among three possible policy options regarding influencing the substitution of sugars with alternatives such as sweeteners: consumer choice only, government measures based on science, or a combination of these. For the EU27 freedom for consumers was preferred by 39%, however, some form of government intervention, either complete (31%) or in combination with consumer choice (29%) was supported by a clear majority. Age exerted a mild influence on the results, with the elderly (76+ years) more in favour of a combined approach (36%), whereas in the other age groups consumer freedom was more favoured (35%-40%). The widest differences can be seen in the cross countries comparisons where, for example, the results for consumer freedom ranged from 26% to 75%, albeit the latter being an outlier.

Overall, the results for these behaviour-related questions could be useful inputs for policy-makers at national competent authorities in devising communication strategies should they wish to gauge public sentiment in relation to the possible adoption of such actions in aiming to reduce or influence dietary intakes of sugars.

4. Conclusions

The results of this consumer and stakeholder research both confirmed important strategic considerations for EFSA's communication and engagement and revealed additional factors to take into account. Consumer interest in the nutrition/sugars topic and the importance of understanding terminology were expected to be critical, yet, the analysis of the findings using the knowledge index and risk perceptions index allowed a more sophisticated profiling of audiences into 'low knowledge-low risk perception' and 'high knowledge-high risk perception' segments. Awareness raising and informing about risks are important objectives of risk communication to the general public, therefore, knowing that visual content and social media was the preferred source of information on food safety topics among the 'low-low' segment allowed EFSA to target its activities using appropriate graphical formats and social platforms.

The findings also guided EFSA's messaging for communications (and engagement) on dietary sugars. For example, with regards to terminology the expected lower understanding of the term 'free sugars' was confirmed, yet more consumers were able to correctly define the seemingly more technical term 'Tolerable Daily Intake Level'. Consequently, communication on the categories of sugars were more prominent in EFSA's communications messages and materials aimed at the public.

The production of tips for risk communication on this topic used in combination with country-specific data, provided both accessible and comprehensive support to risk communicators at the national competent authorities in EU Member States, Iceland and Norway. Information about their use of these tools and the impact of any such efforts was incomplete at the time of writing, however, initial feedback from members of EFSA's Communications Expert Network was enthusiastic about using the approaches in their own communications and engagement activities on dietary sugars. The results from behaviour-related questions provided additional useful inputs for national competent authorities in devising communication strategies—should they wish—to gauge public sentiment in relation to the possible adoption of actions aiming to reduce or influence dietary intakes of dietary sugars.

The analysis of the consumer survey data using the audience segmentation approaches from the 2021 EFSA scientific report on 'Technical assistance in the field of risk communication' delivered important improvements as a tool for refining audience identification, messaging and choice of communication formats and channels, as indicated above. The approach allowed, for the first time in an EFSA EU insight study, identification, and characterisation of a specific segment of population based on cognitive variables that can be targeted with tailored communication strategies. The analytical approach could be improved by identifying additional segments in the two-dimensional model and performing a regression analysis comparing segments with one another; this would predict the likelihood of belonging to one or other segment more robustly. Also, cluster analysis with multiple clustering variables as opposed to drawing the segments from the two-dimensional model of knowledge and risk perception solely, would allow further refining of the segments.

5. Recommendations

In addition to insights regarding audiences and their characteristics, the consumer survey provided limited data on behavioural intentions in terms of current food purchasing and possible behavioural change. These insights could be complemented by more experimental studies, including field studies, to test whether these intentions are consistent. Additional follow-up studies could also explore the impact of sugar-related labelling on consumers' perceived healthiness and food choices to inform risk management decisions.

Overall, the analysis strongly focused on knowledge and risk perception data; the link between these and behavioural intentions is to be explored further. Testing the validity of behaviour change in the area of food safety—with respect to knowledge, attitudes and beliefs concerning the risks and benefits—is to be considered a research priority within the EU food safety knowledge ecosystem.

References

- Buxel H, 2019. Zucker- und Fettreduktion bei Lebensmitteln: Verbraucherakzeptanz von zucker- und fettreduzierten Lebensmitteln sowie Akzeptanz von staatlichen Maßnahmen zur Reduktion des Zuckerkonsums. Available online: <https://www.fh-muenster.de/oecotrophologie-facility-management/downloads/holger-buxel/studie-zuckerredzierte-lebensmittel-zuckersteuer-akzeptanz-buxel.pdf>
- European Commission, Joint Research Centre, Storcksdieck genannt Bonsmann S, Marandola G, Ciriolo E, van Bavel R, and Wollgast J, 2020. Front-of-pack nutrition labelling scheme: a comprehensive review, Publications Office, <https://data.europa.eu/doi/10.2760/180167>
- EFSA (European Food Safety Authority), Maxim L, Mazzocchi M, Van den Broucke S, Zollo F, Robinson T, Rogers C, Vrbos D, Zamariola G and Smith A, 2021. Scientific report on technical assistance in the field of risk communication. EFSA Journal 2021;19(4):6574, 113 pp. <https://doi.org/10.2903/j.efsa.2021.6574>
- EFSA (European Food Safety Authority), 2019. Special Eurobarometer - Food safety in the EU. Available online: https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/Eurobarometer2019_Food-safety-inthe-EU_Full-report.pdf
- EFSA (European Food Safety Authority), 2018. Protocol for the scientific opinion on the Tolerable Upper Intake Level of dietary sugars. EFSA Journal 2018; 16(8):5393, 47 pp. <https://doi.org/10.2903/j.efsa.2018.5389>
- EFSA NDA Panel (EFSA Panel on Nutrition, Novel Foods and Food Allergens), Turck D, Bohn T, Castenmiller J, de Henauw S, Hirsch-Ernst KI, Knutsen HK, Maciuk A, Mangelsdorf I, McArdle HJ, Naska A, Peláez C, Pentieva K, Siani A, Thies F, Tsabouri S, Adan R, Emmett P, Galli C, Kersting M, Moynihan P, Tappy L, Ciccolallo L, de Sesmaisons-Lecarré A, Fabiani L, Horvath Z, Martino L, Muñoz Guajardo I, Valtueña Martínez S and Vinceti M, 2022. Scientific Opinion on the Tolerable upper intake level for dietary sugars. EFSA Journal 2022; 20(2):7074, 337 pp. <https://doi.org/10.2903/j.efsa.2021.7074>
- Egnell M, Talati Z, Hercberg S, Pettigrew S and Julia C, 2018. Objective Understanding of Front-of-Package Nutrition Labels: An International Comparative Experimental Study across 12 Countries. Nutrients, 10(10):1542. <https://doi.org/10.3390/nu10101542>
- Hagmann D, Siegrist M and Hartmann C, 2018. Taxes, labels, or nudges? Public acceptance of various interventions designed to reduce sugar intake. Food Policy, Volume 79, pp. 156-165, ISSN 0306-9192, <https://doi.org/10.1016/j.foodpol.2018.06.008>
- ICF, McEntaggart K, Chirico S, Etienne J, Rigoni M, Papoutsis S and Leather J, 2019. EU Insights – Chemical mixtures: awareness, understanding and risk perceptions. EFSA supporting publication 2019:EN-1602, 113 pp. doi:10.2903/sp.efsa.2019.EN-1602

- Julia C, Blanchet O, Méjean C, Péneau S, Ducrot P, Allès B, Fezeu LK, Touvier M, Kesse-Guyot E, Singler E, Hercberg S, 2016. Impact of the front-of-pack 5-colour nutrition label (5-CNL) on the nutritional quality of purchases: an experimental study. *International Journal of Behavioral Nutrition and Physical Activity*, Dec;13(1):1-9.
- Kahneman D, 2011. *Thinking, Fast and Slow*. Macmillan.
- Mazzocchi M, Cagnone S, Bech-Larsen T, Niedźwiedzka T, Saba A, Shankar B, Verbeke W and Bruce Traill W, 2015. What is the public appetite for healthy eating policies? Evidence from a cross-European survey. *Health Economics, Policy and Law*, 10, pp 267-292 <https://doi.org/10.1017/S1744133114000346>
- Shangguan S, Afshin A, Shulkin M, Ma W, Marsden D, Smith J, Saheb-Kashaf M, Shi P, Micha R, Imamura F, Mozaffarian D, 2019. A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. *American journal of preventive medicine*, 56(2):300-14.
- Temple NJ, 2020. Front-of-package food labels: A narrative review, *Appetite*, Volume 144, 104485, ISSN 0195-6663, doi.org/10.1016/j.appet.2019.104485
- Tierney M, Gallagher AM, Giotis ES, Pentieva K, 2017. An Online Survey on Consumer Knowledge and Understanding of Added Sugars. *Nutrients*, 9(1):37. <https://doi.org/10.3390/nu9010037>
- Tversky A and Kahneman D, 1974. Judgment under uncertainty: heuristics and biases. *Science*, 185, 1124–1131.
- Ueland Ø, 2019. How to make risk communication influence behavior change. *Trends in Food Science and Technology*, 84, 71- 73. <https://doi.org/10.1016/j.tifs.2018.02.003>
- Van den Broucke S, 2014. Health literacy: a critical concept for public health. *Archives of Public Health*, 72, 10.
- Wang F, Diangelo CL, Marsden SL, Pasut L, Kitts D and Bellissimo N, 2020. Knowledge of Sugars Consumption and the WHO Sugars Guideline among Canadian Dietitians and Other Health Professionals. *Canadian Journal of Dietetic Practice and Research*, 81(3): 142-145. <https://doi.org/10.3148/cjdpr-2020-004>

© EFSA, 2022

Appendix A – Regression tables

Table A1. Predictors that affect the likelihood of belonging or not to the audience segment with low knowledge and low risk perception.

Predictors	Odds ratio ¹⁴	Significance
Using social media as source of information	1.03	**
Using events like lectures, seminars, workshops or conferences as source of information	1.02	*
Trusting supermarkets	1.05	*
Trusting celebrities, bloggers and influencers	1.06	**
Trusting the food industry	1.05	**
Gender is female	0.95	***
Respondent is a parent	0.97	*
Respondent is very interested in food and nutrition	0.97	**
Using the internet (excluding social media) as source of information	0.95	***
Trusting scientists	0.94	***
Trusting your doctor or a specialist, e.g., dietician or nutritionist	0.92	***

Model: logit regression; significance levels: *** p<0.001; ** p<0.01; * p<0.05.

Table A2. Predictors that affect the likelihood of belonging or not to the audience segment with high knowledge and high risk perception.

Predictors	Odds ratio ¹⁵	Significance
Gender is female	1.03	***
Using the internet (excluding social media) as source of information	1.04	**
Using professional journals as source of information	1.03	*
Using radio as source of information	1.03	*
Trusting scientists	1.04	*
Job is retired	0.95	*
Job is self-employed	0.96	*

¹⁴ Odds ratios represent the predicted odds of belonging (or not) to this segment when respondents meet the feature indicated by the predictor, compared to respondents who do not meet this feature. Odds ratios that are greater than 1 indicate that respondents who meet the aspect stated by the predictor are more likely to belong to this segment, while odds ratios that are less than 1 indicate that respondents who do not meet such aspect are more likely to belong to this segment. The interpretation of each predictor is made holding all other variables constant.

¹⁵ Idem.

Using information points such as street stands or festivals as source of information	0.96	**
Trusting NGOs (Non-Governmental Organisations)	0.97	***
Trusting journalists	0.95	**

Model: logit regression; significance levels: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Appendix B – Questionnaire

EU Insights study in support of risk communication related to EFSA's scientific opinion on dietary sugars

Survey questionnaire

Note to contractor: Please do not reveal to respondents that the survey focuses on sugars, to avoid a bias in questions 1 – 3.

Introduction text

Hello and welcome to the survey.

Today we would like to ask you a few questions regarding your opinion about a variety of health topics.

D1: Please tell us your age

Single selection:

- 18-20
- 21-25
- 26-35
- 36-45
- 46-55
- 56-65
- 66-75
- 76+

D2: With which of the following gender identities do you most closely identify?

Single selection:

- Male
- Female
- Other, please specify (Open end option)
- Prefer not to say

D3: What is the highest level of education you have achieved?

Single selection:

- Primary school or below
- Secondary school or high school
- University degree or higher
- Prefer not to say

D4: As far as your current occupation is concerned, would you say you are...

Single selection:

- Student
- Self-employed
- Manager

- Office employee
- Manual worker
- Unemployed, looking for a job
- Unemployed, not looking for a job
- Retired
- Prefer not to say

D5: Are you a parent?

- Yes
- No
- Prefer not to say

Q1 How important are the following, in your opinion, for human health?

(Rows randomised)
(Single selection per row)

	<- Not important					Important ->				
	1	2	3	4	5	6	7	8	9	10
Physical exercise										
Food and nutrition										
Air and water quality										
Access to health system										
Mental wellbeing										
Striking a work-life balance between professional and private time										

Q2A How interested are you in the topic of food and nutrition?

Single selection:

- I am very interested in food and nutrition
- I am interested
- I am moderately interested
- I am not particularly interested in food and nutrition
- I am not at all interested

Q2B Do either of the following statements apply to you? [Ask only if very interested or interested]

Multiple selection:

- I regularly consume information on food and nutrition, for example by reading magazines, online information or actively seeking professional advice
- Nutrition interests me when I make choices about food
- None of the above (Exclusive option)

Q3 When it comes to eating habits, which of the following diet options have you ever tried?

(Answers randomised)

Multiple selection:

- Less sugar
- More fruit and vegetables
- Fewer artificial sweeteners
- Less fat
- Fewer ready-to-eat meals
- More dietary supplements like vitamins and minerals
- Fewer industrially processed foods
- Fewer preservatives
- Less alcohol
- Fewer calories
- Less salt
- Less red meat
- More fish
- More organic products
- Overall eat and drink less
- More proteins
- Less caffeine
- More dietary fibre/whole grains
- Other (Fixed position, open end box)
- None of the above (Fixed position, exclusive option)

Q4 Which of the following health conditions have you heard of?

(Randomised)

Multiple selection:

- Obesity
- Hypertension (high blood pressure)
- Vitamin and mineral deficiency diseases (e.g. anaemia)
- Type-2-diabetes
- Cardiovascular diseases (diseases of the heart and blood vessels)
- Dental caries
- None of the above (Fixed position, exclusive option)

Q5 Do you think you personally may be at risk of any of the below conditions as a result of high sugar consumption?

(Show only those options chosen in previous question; Rows randomised)
Single selection per row:

	Yes	Maybe	No	Don't know
Obesity				
Hypertension (high blood pressure)				
Vitamin and mineral deficiency diseases (e.g. anaemia)				
Type-2-diabetes				
Cardiovascular diseases (diseases of the heart and blood vessels)				
Dental caries				

Q6 Are you concerned that some of the following groups may suffer from any of the following negative health effects due to high consumption of sugar?

Please tick each box where you think there may be a concern

(multiple choice per row)
(Randomise columns)

	Obesity	Hypertension (high blood pressure)	Vitamin and mineral deficiency diseases (e.g. anaemia)	Type-2-diabetes	Cardiovascular diseases (diseases of the heart and blood vessels)	Dental caries	None of these conditions (fix position, exclusive option)
Infants (4-12 months)							
Toddlers (Young Children 1-3 years)							
Other Children (3-10 years)							
Adolescents (10-17 years)							

Adults (18-65 years)							
Elderly adults (Over 65 years)							

Q7 On a scale from 1 to 10, how well would you say you understand the following terms?

(Rows randomised)
Single choice per row:

	<- No understanding at all					Good understanding of the concept ->				
	1	2	3	4	5	6	7	8	9	10
Added sugars										
Free sugars										
Total dietary sugars										

Q8 For each of the following statements, please indicate whether you think it is true or false. Please indicate 'Don't know' if you really don't know.

(Rows randomised)
Single choice per row:

	True	False	Don't know
A product with "no added sugars" contains no sugar			
Added sugars are all artificial			
Sugars and added sugars are the same			
Fructose can be used as added sugar			
Honey can be used as an added sugar			
Added sugars can be from natural sources			
Added sugars are added during food preparation			
Added sugars are added during manufacturing			
Free sugars and added sugars are the same			
A product with "free sugars" contains no sugar			
Fruit contains sugars			

Added sugars can be found in savoury foods			
Added sugars are only added to sweet foods			
Honey is a source of free sugars			
Syrup is a source of free sugars			
100% fruit juice contains free sugars			

Q9 Which of the following statements do you think is the correct definition of "Tolerable upper intake level (UL)"?

Don't worry, this isn't a test. If you don't know, just give us your best guess.

(Randomised)
Single choice:

- The maximum intake of substances in food that can be consumed daily over a lifetime without negative health effects
- The maximum intake of substances in food that can be consumed weekly without decreasing one's life expectancy
- The maximum intake of substances in food that can be consumed daily over a lifetime without causing fatal consequences

On next page (remove back button):

The correct definition of "Tolerable upper intake level (UL)" is "The maximum intake of substances in food that can be consumed daily over a lifetime without negative health effects"

Q10 In which of the following products do you expect to find added sugar?

(Randomised)
Multiple choices allowed:

- Fresh vegetables
- Ready-to-eat meals
- Fresh fruits
- Plain yogurt
- Fruit yogurt
- 100% Fruit juice
- Honey
- Ice cream
- Breakfast cereals (cornflakes, bran flakes)
- Milk
- Baked goods (cookies, cakes, pastries)
- Sweets and chocolate
- Sauces and condiments
- Soft drinks
- Energy drinks
- Sports drinks
- Alcoholic beverages
- None of the above (Fix position, exclusive option)

Q11 How likely is it in the following situations for you to think about the amount of sugar that you consume?

(Rows randomised)
Single choice per row:

	Very likely	Fairly likely	Not very likely	Not at all likely	Don't know
When cooking at home					
When I consume a ready-to-eat meal					
When dining out					
On special occasions such as birthday parties					
Snacking					
At events (e.g. sport, cinema)					
When shopping for food					

Q12 Which of the following statements applies to you the most?

"Information that you heard or read about how sugar intake can influence your health..."

(Randomised)
Single choice:

- ... made you permanently change your consumption behaviour (e.g. diet) at least once in your life"
- ... made you change your consumption behaviour for a while at least once in your life"
- ... grabbed your attention, but you never changed your consumption behaviour"
- ... never grabbed your attention nor made you change your consumption behaviour"

Q13 When you shop for products, do you prioritise buying products with the following claims, disregarding other factors?

(Rows randomised)
Single choice per row:

	Yes	No	Don't know
Sugar-free			
With no added sugar			
Low sugar			

(Show only if yes selected for at least one row of previous question)

Q14 Suppose you are buying the following products in a supermarket and you have the choice between the regular product and an alternative product that has reduced sugar content or contains sugar substitutes (such as artificial sweeteners). Would you consider buying/consuming the alternative product?

(Rows randomised)
Multiple selections allowed:

	Yes, I would buy this product with reduced sugar	Yes, I would buy this product with artificial sweetener	No, I would not consider buying the alternative (exclusive option)	I never buy these (exclusive option)
Cake and pastries				
Soft drinks				
Sweets or chocolate				
Fruit juice				
Dairy products				
Breakfast cereals (cornflakes, bran flakes)				
Chewing gum				

Q15 When you consider what products of the following categories to buy which of the following do you consider?

Please select the three most important considerations.

(Rows and columns randomised)
3 answers per row:

	Taste	Price	Health considerations	Brand loyalty	Impact on the environment (e.g. sustainable farming)	Peer or family endorsement	Habits (have been consuming one particular product my whole life)	None of these (fix position, exclusive option)
Cake and pastries								
Soft drinks								
Sweets or chocolate								
Fruit juice								

Dairy products								
Breakfast cereals (cornflakes, bran flakes)								
Chewing gum								

Q16 Do you think the following measures would lead you to reduce your personal sugar intake?

(Rows randomised)
Single option per row:

	Yes, considerably	Yes, somewhat	Yes, by a small amount	No, not at all	Don't know
Front-of-pack label (e.g. traffic light, the Keyhole, Nutri-Score, Heart-label)					
Increased price (e.g. tax on products with large sugar amounts)					
Health warning on packages for products high in sugar					
Public information campaigns					
Statutory upper limits on sugar in products					
Prohibition of advertisements of products with large amounts of sugar					

Q17 Now specifically on the subject of substituting sugars with products such as sweeteners; which of the following statements would you most agree with?

(Randomised, Single choice)

- Consumers should have the freedom to decide whether to substitute sugars without any intervention from government or health organisations
- Government should consider measures that promote healthy consumer behaviour, based on evidence from science
- A combination of consumer choice and government intervention is the most appropriate solution

Q18 To what extent do you consider the following sources of information when it comes to information about healthy eating?

(Rows randomised)
Single choice per row:

	To a large extent	To a moderate extent	To a small extent	Not at all	Don't know
Information points such as street stands or festivals					
Social media					
Newspapers and magazines					
Internet (excluding social media)					
Events like lectures, seminars, workshops or conferences					
Television					
Professional journals					
Radio					

Q19 To what extent do you trust the following people or organisations to give you accurate information about healthy eating?

(Rows randomised)
Single choice per row:

	Totally trust	Tend to trust	Tend not to trust	Do not trust at all	Don't know
Scientists					
NGOs (Non-Governmental Organisations)					
Supermarkets					
Restaurants					
Journalists					
EU Institutions					
Celebrities, bloggers and influencers					
National authorities					
Food industry					
Consumer organisations					
Farmers					

Family, friends and neighbours					
Your doctor or a specialist, e.g. dietician or nutritionist					
Your local grocer					

Close message

That is all the questions we have for you today, thank you for your help!

Appendix C – Stakeholder Interviews

ICF interviewed nine stakeholders, representing distinct types of categories, i.e., consumer organisations, NGOs and advocacy groups, business and food industry, practitioners' associations, and farmers and primary producers. Additionally, representatives of the European Parliament and international organisations were also interviewed. The topic guide included questions on:

- Awareness of EFSA's mandate to provide a scientific opinion on the Tolerable Upper Intake Level of dietary sugars;
- The role of EFSA related to nutrition in the EU;
- Anticipated impacts the scientific opinion could have on stakeholders.

EFSA provided ICF with the list of stakeholders to be interviewed and the topic guide. The topic guide for the stakeholder interviews was then reviewed and refined in partnership with EFSA. ICF used the details provided by EFSA to approach representatives via email.

The contact email included a cover letter which explained the purpose and aims of the research, and the data privacy information. Interviews were completed between December 2020 and January 2021 using online using tools such Microsoft Teams or Skype for Business. Interviews were structured and followed the topic guide.

All interviews were conducted in English and lasted approximately 30 minutes. All interviews were recorded and transcribed.

The following section presents summaries of the answers provided by stakeholders for each question.

Context and awareness

Q1 Have you heard of this ongoing scientific assessment previously? What was the context?

The organisations that had heard of this assessment previously were all part of the EFSA stakeholder forum. They had heard it directly from EFSA or from one of their member organisations. The remaining interviewees had not previously heard of it or were not very sure whether they knew about it or not.

All the stakeholders interviewed expressed that the assessment was relevant for their organisation and some questioned why they had not heard about the assessment before.

There was some perception from NGOs and advocacy groups and international organisations that EFSA's stakeholder forum should have a more 'balanced' representation between industry and other stakeholders.

EFSA's role

Q2 In your opinion, what is EFSA's role in the nutrition area?

Interviewees expressed that they felt EFSA's role was to present scientific, evidence-based information on the topic of nutrition in the EU. All stakeholders also agreed that EFSA was perceived as an independent body that provides advice to EU institutions and Member States.

Civil society and government representatives described EFSA's role as leading EU's opinion and guiding policy makers with their publications in a transparent and un-biased manner. All but one of the six health/nutrition-focused stakeholders interviewed mentioned directly that they saw that EFSA's duty to all European Member States was to specifically *not* be influenced by industry and remain independent.

Industry representatives explained that they did not think EFSA should be publishing recommendations. These stakeholders argued in favour of a purely neutral, unbiased, scientific role for EFSA. They discussed that this was a complex topic where multiple factors could influence the outcomes, and EFSA should focus on providing a scientific risk analysis and background to European Union institutions and national authorities.

Q3 Regardless of your level of knowledge of this specific scientific assessment, what would you say is the purpose of EFSA's advice?

All but one of the organisational representatives interviewed recognised EFSA's role as a risk assessor, as opposed to being a risk manager, in the EU. In most cases, interviewees described EFSA's work to be a review and summary of the up-to-date evidence on a given nutritional matter, which could then be used by national policy makers to inform recommendations issued in their respective Member States.

Some interviewees did not perceive EFSA's final outputs to be achieving the desired impacts. They explained that there was a vast amount of science on the topic and (according to them) robust global recommendations for the tolerable upper intake level of sugar already. They did not understand the added value of this assessment.

On the other hand, others mentioned that EFSA had a role to provide clarity on the topic and support Member States and EU institutions design policies based on EFSA's scientific advice. Two stakeholders welcomed the assessment, and the credibility the advice would give to any national recommendation or policy development on this area. They considered that the purpose of EFSA's advice in practice was to play a supporting role to nationally set recommendations, providing a credible basis on which to formulate policy.

Finally, industry representatives were concerned that any 'recommendation' from EFSA would be negatively perceived by broader stakeholders. They expressed that EFSA's role is not to give recommendations or opinions, but to provide a summary of the science on the topic (sugars), so others are informed and can take decisions based on science.

Anticipated impacts of the assessment**Q4 Do you believe that this assessment could impact the organisation and the stakeholders that you represent? If yes, how?**

Stakeholders agreed that EFSA's work on this topic would impact all their stakeholders. Should the assessment follow current guidance published by WHO and other organisations, most interviewees agreed that it would benefit their stakeholders.

The positive aspects mentioned were that it would provide clarity on the area, it would reinforce the messages from international organisations, and it would enable policymakers to develop new laws and national guidelines on the topic. These interviewees mentioned that the simpler and more explicit the assessment, the better it would be for their stakeholders.

One stakeholder, for example, explained that if EFSA published a nutrient profile, its members could reformulate their products and adapt quickly. Another one elaborated that EFSA's assessment could provide Nordic authorities with evidence to work on stronger national guidelines.

On the other hand, the representatives of growers, suppliers and manufacturers in the sugar industry perceived their members would be negatively impacted from an assessment by EFSA. They perceived any recommendation on this area could negatively impact their reputation and their businesses. They perceived reductions in nationally recommended sugar intake would cause demand for sugar to fall. The potential negative impacts would depend on the final conclusions from EFSA and on how nuanced they are. Industry stakeholders mentioned that the assessment should consider several types of sugar and have different recommendations for each.

International organisations mentioned having published similar reviews of evidence recently and assumed EFSA would align with the findings. They would question EFSA's study if this is not the case.

Q5 Do you believe that this assessment could impact other stakeholders, including citizens? If yes, how?

All the interviewees agreed that this work would have a significant impact on EU citizens, among others. Most of them believed the impacts would be positive, as consumers would reduce their sugar consumption. Interviewees mentioned specific human health risks could be reduced such as exposure

to dental caries and risk of non-communicable diseases associated with obesity, such as type two diabetes.

Some envisaged these benefits arising through EFSA increasing public awareness of these risks directly, most saw EFSA's assessment as a lever for creating policy and industry change, which would bring secondary public benefits if acted upon accordingly by key decision-makers.

All interviewees acknowledged negative impacts the assessment would have on the sugar-related industry, because of a reduction in sugar consumption. The conclusion was that consumer health benefits outweigh the negative impacts on industry.

Next steps

Q6 EFSA will hold a public consultation on this scientific assessment before it is finalised. If your organisation intended to provide feedback, what areas would you be particularly interested in? Would you be willing to participate in a virtual meeting where EFSA will present the draft advice?

All the interviewees except two expressed that they were willing to collaborate further with EFSA on this topic.

Areas highlighted were:

- links between food and chronic non communicable diseases, and attempts to formulate an action plan to address this;
- a diversified food supply, and the health drawbacks of replacing sugar with alternative sweeteners;
- emphasis on sugar as not, in isolation, the direct and only cause of NCDs;
- references made to fructose – i.e. in fructose corn syrup – which is increasingly used as a sweetener;
- products aimed at children, and formulated for infants, and especially to food provided for their consumption in schools and pre-schools;
- use of different disciplinary lenses of nutritional epidemiology and nutritional physiology to sugar discussions, as well as specification made in relation to health promotion specifically;
- the prevalence and danger of sugars in highly processed foods, marketing of sugary foods (especially to children), and labelling and specification of diverse types of sugars;
- differences in sugar tolerance between infants, children, and adults; and
- approach, scope, and methodology used in the risk assessment.

Nutrition Research Interview Guide

Introduction

EFSA is currently working on a mandate for a scientific assessment on the Tolerable Upper Intake Level of dietary sugars requested by five national authorities (Denmark, Finland, Iceland, Norway and Sweden) on EFSA's Advisory Forum.

EFSA would like to gather your thoughts on this mandate, exploring its purpose and the impact it might have in your view on your organisation and other stakeholders. The interview includes six questions and will last around 20-30 minutes.

To facilitate data analysis, can we kindly ask your permission to record this interview? Please bear in mind that your answers will be kept anonymous and your name will not appear in the final report.

N.B.

Bold = question

(Italics) = prompts

[Italics] = aim of the question

1. **Have you heard of this ongoing scientific assessment previously? What was the context?**

(Have you heard of it through EFSA's Stakeholders Engagement Approach?; Have you found information directly on EFSA's website or register of questions, i.e., the online database of EFSA's mandates?; Have you heard of it through connections within your organisation?; Was it mentioned to you by external organisations or entities?)

N.B. If the interviewee answers No, please do not provide information on the mandate.

[This question is intended to understand if stakeholders are aware of the mandate and from which sources they received the information]

2. **In your opinion, what is EFSA's role in the nutrition area?**

(Would you consider it appropriate for EFSA to advise on such a topic?; Do you think that EFSA might play a role in nutrition policy in the EU?)

[This question is intended to gather stakeholders' expectations of EFSA's remit both in general and specifically in this assessment]

3. **Regardless of your level of knowledge of this specific scientific assessment, what would you say is the purpose of EFSA's advice?**

(Would you say it relates more to the assessment of the scientific evidence or to the policies around dietary sugars?; Would you say that its aim is to set a recommendation for exposure to sugars or to provide a scientific basis for such a task?)

[This question aims at investigating stakeholders' awareness about the aim of the assessment and the possible outcome]

4. **Do you believe that this assessment could impact the organisation and the stakeholders that you represent?**

If, yes, how?

(Would it have no impact?; Would the impact be positive or negative and in what way?; Would it change how you work in any way?)

[This question aims at understanding the stakeholder's perspective on the effects that this assessment might have for the organisation and the people represented]

5. **Do you believe that this assessment could impact other stakeholders, including citizens?**

If yes, how?

(Would it have no impact?; Would the impact be positive or negative and in what way?; Would it change how other stakeholders work in any way or public perceptions of nutrition and sugar in the diet?)

[This question aims at understanding the stakeholder's perspective on the effects that this assessment might have for other stakeholders and the general public]

6. **EFSA will hold a public consultation on this scientific assessment before it is finalised. If your organisation intended to provide feedback, what areas would you be particularly interested in? Would you be willing to participate in a virtual meeting where EFSA will present the draft advice?**

(Would you be willing to take part in the public consultation?; What sort of input could you and your organisation provide?)

[This question is intended to gather the stakeholder's opinions on the kind of feedback, i.e. scientific or other types of comments that could be provided to EFSA in the context of the public consultation]

Thank you for the time you have dedicated to this interview and the input you provided. EFSA received a mandate requesting scientific advice on the daily intake of dietary sugars in food. The Authority aims to establish a science-based cut-off value for daily exposure to dietary sugars from all sources which is not associated with adverse health effects. For more information you can visit EFSA's website or contact socialscience@efsa.europa.eu