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SCIENTIFIC REPORT

Frequency of consumption of different fish, crustacean and mollusc species contributing to methylmercury exposure and consumer awareness of national advice on their consumption

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The declarations of interest of all scientific experts active in EFSA's work are available at https://open.efsa.europa.eu/experts.

Abstract

Following a request of the European Commission, EFSA assessed fish and other seafood consumption patterns and consumer awareness of related health risks and benefits across the 27 Member States, Iceland and Norway. Awareness of existence of consumption national advice and to which extent this advice influence consumers consumption behaviour were also examined. To address these objectives, two surveys were conducted in 2023 and 2024 among adolescents, adults and pregnant women. Data were collected through computer-assisted telephone interviews by means of a combined Food Propensity and Awareness Questionnaire. The surveys covered 38 fish species grouped by their maximum levels of mercury (1.0, 0.5 and 0.3 mg/kg). Respondents were asked about consumption frequency, awareness of contaminants and knowledge of national dietary advice. The analysis showed that fish and other seafood consumption increased between the two surveys across all countries and species categories, regardless of whether updated advice was issued. Awareness of chemical contaminants was generally low, with mercury being the most recognised contaminant. Awareness of national advice was moderate and slightly higher among pregnant women but reported changes in consumption behaviour linked to this advice were limited. Information sources also played a role in shaping consumer behaviour and these varied per country and population group. Uncertainties were identified and recommendations listed to improve future assessments.

KEYWORDS

10+ population, awareness, consumption, fish and seafood, methylmercury, national advice, pregnant women

CONTENTS

SUMMARY

Concerns about methylmercury exposure from fish and other seafood have been longstanding in Europe. In 2012, EFSA established tolerable weekly intakes for mercury and concluded that high fish consumers, including pregnant women, could exceed these limits by up to six-fold. While fish and seafood consumption offers important health benefits, these must be balanced against the risks of mercury exposure. To address this, maximum levels for mercury in fish and seafood were set by EU legislation and Member States were encouraged to issue targeted consumption advice, particularly for vulnerable population groups.

In 2022, the European Commission requested EFSA to evaluate the effectiveness of this advice and to provide updated insights into consumption patterns and awareness across Europe. The mandate included assessing frequency of consumption of different fish and seafood species, awareness of contaminants, awareness of national advice and whether consumers follow this advice.

To meet these objectives, EFSA conducted two surveys, before and after national advice was updated and communicated. The surveys targeted adolescents, adults and pregnant women, using computer-assisted telephone interviews supported by visual aids. The first survey was fielded in 2023 (May to July) in all 27 Member States, Iceland and Norway. The second survey was fielded in 2024 (November to December) in 13 Member States, Iceland and Norway. Ten countries were selected for having issued updated consumption advice on fish and other seafood following the completion of the first survey fieldwork, while five countries were selected on the basis of high consumption frequencies as retrieved from the EFSA Comprehensive database and which did not issue any updated advice and served as 'control' countries. A Food Propensity Questionnaire captured the consumption frequency for 38 fish and other seafood species grouped by mercury maximum levels (1.0, 0.5 and 0.3 mg/kg) while an Awareness Questionnaire assessed knowledge of contaminants, health risks and benefits and sources of information. In total, 14,843 interviews were completed in the first survey and 7782 in the second.

Consumption patterns showed an overall increase between the two survey points, regardless of whether updated advice was issued. For species with a mercury maximum level of 1.0 mg/kg, high-frequency consumption nearly doubled among the general population (adolescents and adults) and pregnant women. Similar upward trends were observed for species in lower mercury categories.

Awareness of chemical contaminants was generally low. Most respondents answered only a few knowledge questions correctly, although mercury was the most recognised contaminant. Awareness of national advice was moderate and slightly higher among pregnant women but reported changes in consumption behaviour linked to this advice were limited.

Respondents who reported changing their consumption cited family and friends, television and online platforms as the most influential channels. Institutional websites and health-related settings were mentioned less frequently, indicating that official advice competes with informal and digital sources for attention.

A segmentation analysis based on consumption frequency and awareness was done to distinguish audience segments that are meaningful for future communications by public authorities about fish and seafood consumption levels and, specifically, the risks and benefits of their consumption. The segmentation revealed distinct consumer profiles. In the first survey, five segments were identified, ranging from infrequent consumers with little awareness to very frequent consumers with moderate awareness. In the second survey, four segments were selected, including a large group of very frequent consumers with little awareness.

Findings of the surveys indicate that taste, price and perceived health benefits remain primary drivers of fish and seafood consumption, outweighing safety concerns. National advice had limited influence on dietary behaviour and awareness of risks and benefits and varied widely across countries and population groups. There is a need for tailored communication strategies: frequent consumers may require targeted risk messages, while infrequent consumers may benefit from information emphasising health benefits and safe fish and seafood choices.

Uncertainties were identified related to the sampling design, sampling frame and representativeness of the sample. Recommendations are listed to improve future assessments, including clearer communication strategies, targeted campaigns for vulnerable population groups and continued monitoring to ensure that health benefits are balanced with risk mitigation.

1 | INTRODUCTION

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

1.1.1 | Background

In 2012, the EFSA Panel on Contaminants in the Food Chain (CONTAM Panel) adopted an opinion on mercury and methylmercury in food (EFSA CONTAM Panel, 2012). In that opinion, the Authority established a tolerable weekly intake ('TWI') for inorganic mercury of 4 μg/kg body weight ('b.w.') and for methylmercury of 1.3 μg/kg b.w. (both expressed as mercury) and concluded that the 95th percentile dietary exposure is close to or above the TWI for all age groups. High fish consumers, which might include pregnant women, may exceed the TWI by up to approximately six-fold. Unborn children constitute the most vulnerable group. The opinion concluded that exposure to methylmercury above the TWI is of concern but advised taking into account the beneficial effects of fish consumption, if measures to reduce methylmercury exposure were considered. To protect consumers against the adverse effects of mercury, under Regulation (EC) No 1881/2006[1] Maximum Levels (MLs) for mercury in fish and other seafood have been established.

In order to assess the beneficial effects of seafood consumption the NDA Panel adopted in 2014 an opinion on these benefits in relation to the health risks associated with exposure to methylmercury and concluded that consumption of about 1–2 servings of seafood per week and up to 3–4 servings per week during pregnancy has been associated with better functional outcomes of neurodevelopment in children compared to no consumption of seafood (EFSA NDA Panel, 2014). Such amounts have also been associated with a lower coronary heart disease mortality in adults.

In 2015, the EFSA Scientific Committee also adopted a statement on the benefits of fish/seafood consumption compared to the risks of methylmercury in fish/seafood, where it was concluded that, to achieve the benefits of fish consumption associated with 1–4 fish servings per week and to protect against neurodevelopmental toxicity of methylmercury, the consumption of fish/seafood species with a high content of mercury should be limited (EFSA Scientific Committee, 2015). Regulation (EC) No 1881/2006 states that in addition to the setting of MLs, targeted consumer advice is an appropriate approach for protecting vulnerable groups of the population from exposure to methylmercury. In addition, an information note on methylmercury in fish and fishery products responding to this need has been made available on the website of the DG SANTE.[2] This note indicates that:

- the consumption of fish/seafood species with a high content of mercury in the daily diet should be limited: when consuming species with a high methylmercury content, only a few numbers of servings (< 1–2) can be eaten on a weekly basis.
- as the consumption patterns for fish and seafood vary considerably within the European Union and even within Member States (MSs), this consumption advice should typically be refined at national level. As a follow-up several MSs have issued dedicated consumption advice to their population.

During the discussions on an update of the MLs for mercury in fish, several MSs requested an increase of the MLs for certain fish species (e.g., shark, swordfish, tusk and toothfish), because with the current MLs the rejection rates are very high. However, in view of the health risk related to mercury, the MLs for mercury in those fish species were maintained at the existing level, pending a further data collection and scientific assessment. It was agreed to issue a new monitoring Recommendation (SANTE 2021-10856) in which MSs are asked during the years 2022, 2023, 2024 and 2025 to:

- collect occurrence data on methylmercury and total mercury in fish, crustaceans and molluscs.
- develop and communicate specific national consumption advice for fish, crustaceans and molluscs to fully achieve the beneficial effects of fish and seafood consumption, whilst limiting the risks of mercury toxicity. In this advice the frequency of fish, crustaceans and molluscs consumption and the species consumed should be included. MSs were asked to send their consumption advice to EFSA by 1 October 2022 and to initiate their communication campaigns between April and September 2023.

With a view of a future updated risk assessment on mercury in food, the effectiveness of this consumption advice should be measured. Therefore, EFSA was asked to carry out a survey in the MSs to assess among others:

- the frequency of the consumption of different fish-, crustacean- and mollusc species by consumers in different MSs and to compare it with the consumption advice issued by the MSs' competent authorities. In any case, in the survey, fish species should be included for which a maximum level of 1.0 mg/kg is established under Regulation (EC) No 1881/2006;
- whether the consumers are aware of the presence of contaminants in specific fish, crustacean and mollusc species and, if yes, which contaminants;

[1]Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs (OJ L 364, 20.12.2006, pp. 5–24) ELI: http://data.europa.eu/eli/reg/2006/1881/oj, officially repealed by Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food and repealing Regulation (EC) No 1881/2006 (OJ L 119, pp. 103–157) ELI: http://data.europa.eu/eli/reg/2023/915/oj.

[2]https://food.ec.europa.eu/food-safety/chemical-safety/contaminants/catalogue/mercury_en.

- whether the consumers are aware of the existence of consumption advice for limiting the consumption of specific fish, crustacean and mollusc species due to the occurrence of mercury and, if yes, whether this concerns advice from the national competent authorities or from other sources;
- whether the consumers take into account the MSs' advice or not, or to a limited extent.

Because unborn children are the most vulnerable for mercury toxicity, the survey should include in any case pregnant women. Furthermore adolescents (10–17 years old) and adults (18–64 years old) for both genders should be included.

1.1.2 | Terms of Reference as provided by the requestor

In accordance with Art. 31 (1) of Regulation (EC) No 178/2002[3] the Commission asks EFSA for a scientific report to assess:

- the frequency of the consumption of different seafood (fish-, crustacean- and mollusc) species
- the effectiveness of MSs' advice on the consumption of different fish, crustacean and mollusc species in relation to their contamination with mercury.

1.1.3 | Interpretation of the Terms of Reference

The EFSA Comprehensive European Food Consumption Database (Comprehensive Database) provides a compilation of existing national information on food consumption at individual level and was first built in 2010 (Huybrechts et al., 2011; Merten et al., 2011). Details on how the Comprehensive Database is used are published in the Guidance of EFSA (EFSA, 2011).

The food consumption data present in the Comprehensive Database were collected using single or repeated 24- or 48-h dietary recalls or dietary records covering from three to seven days per participant. Data specifically on fish, crustaceans and mollusc species can also be found there, however, because of the differences in the methods used for data collection and the wide time range during which the different surveys were performed, they were not considered appropriate to assess the frequency of the consumption of different seafood (fish-, crustacean- and mollusc) species and cover the need for this mandate. In addition, fish is a food commodity that is sporadically consumed in several MSs and is very difficult to be captured during a 24-h recall or dietary record method. For such food commodities short-term measurement (such as 24-h recalls or food diaries) combined with a Food Propensity Questionnaire (FPQ) is the most appropriate method to record (Subar et al., 2006).

EFSA conducts social research to collect data on public and stakeholder awareness, understanding, perceptions and consumer's trusted sources of information in relation to food-related risks. These data inform the planning and execution of its communication with its audiences and of its engagement with interested parties in the EU food safety system. The data are shared with MS counterparts for their communication on food safety and may also be used by risk managers to better understand consumer behaviour in response to risk communication, for example about management measures such as dietary advice. However, upon receipt of the Commission's request EFSA did not possess EU-wide data on consumer awareness of national advice on fish and other seafood consumption or awareness of the related risks and benefits for human health.

2 | DATA AND METHODOLOGIES

EFSA outsourced new research titled 'European Survey on Fish and Other Seafood Consumption and related Consumer Awareness'.[4] A two-phase survey was requested to be conducted in 2023 and 2024, before and after national communication of updated fish consumption advice took place, to collect quantitative data on consumption of 38 fish species/categories and other seafood (crustaceans and molluscs) among the European population, and on Europeans' awareness of national advice related to chemical contaminants in fish and other seafood and of the associated human health risks and benefits of their consumption.

The collected data were managed and analysed to assess:

1. The frequency of consumption of different fish-, crustaceans- and mollusc species in different MSs and to compare it with the consumption advice issued by the MSs' competent authorities. Questions addressing fish species with a ML for mercury of 1mg/kg as established under Regulation (EC) No 1881/2006 were prioritised;
2. Whether consumers are aware of the presence of contaminants in specific fish, crustaceans and mollusc species and, if yes, which contaminants;

[3]Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (OJ L 31, 1.2.2002, pp. 1–24) ELI: http://data.europa.eu/eli/reg/2002/178/oj.

[4]Following an open competition a scientific contract was awarded to Ipsos European Public Affairs (Ipsos EPA) under the multiple framework contract OC/EFSA/COM/2021/01 LOT 1.

3. Whether consumers are aware of the existence of consumption advice for limiting the consumption of specific fish, crustacean and mollusc species due to the occurrence of mercury and, if yes, whether this concerns advice from the national competent authorities or other sources;
4. Whether consumers consider the MSs' advice or not, or to a limited extent.

A specific FPQ and an awareness questionnaire developed by EFSA were applied.

2.1 | FPQ questionnaire development

FPQ is a widely used instrument for dietary intake assessment in surveys designed to measure habitual consumption over an extended period (Okada et al., 2023). FPQs vary in listed food items, timeframe of interest, response intervals specifying frequency of consumption and manner of administration. Two basic elements of FPQs are a pre-defined limited list of food categories and an accompanying 'frequency of consumption' section. The list of food categories is specifically designed to answer the research question. FPQ does not consider portion sizes and therefore, provides only data on the frequency of consuming certain foods and thus on food-consumption rather than estimates of food intake.

EFSA developed the draft FPQ for the contractor to use. The basis for its development was Commission Regulation (EU) 2022/617[5] amending Regulation (EC) No 1881/2006 as regards MLs of mercury in fish and salt. In the Annex to this Regulation, fish species are divided into three categories according to the ML: 1.0 mg/kg of wet weight (26 species), 0.5 mg/kg of wet weight (crustaceans and fish species for which the ML is not set to 1.0 or 0.3 mg/kg of wet weight) and 0.3 mg/kg of wet weight (cephalopods, marine gastropods and 19 fish species). The decision on the 38 species that were finally included in the questionnaire relied on national data on fish and seafood consumption retrieved from EFSA's Comprehensive database and was agreed with DG SANTE (Appendix A).

To assess the frequency of fish consumption in the worst-case scenario, i.e. when it is consumed most often, the following question was posed to the participants: 'Think about your individual consumption of the following fish and seafood species (as fresh, cooked, tinned/canned or preserved) during the season when it is the most available to you, i.e. when you consume it most often. How often did you consume the following fish and seafood species during that season? This includes both your consumption at home, and outside your home (e.g. in restaurants, bars, canteens).'

Since consumers might not be familiar with the common name of the fish species, which could bias their answers, the questionnaire was accompanied with a set of related pictures to facilitate the species' identification. Moreover, for each fish species, although the common name in the national language and the picture were available, subjects were asked if they are familiar, i.e. if they recognise the fish species answering by yes or no. Consumption frequency was expressed in the following categories: Never, Less than once per week (e.g. once or twice a month or less), once per week, two times per week, three or more times per week and don't know. Finally, participants were asked in which season they consume the related species most often.

2.2 | Awareness questionnaire development

In line with the Terms of Reference provided by the requester and indicated above the 'Awareness questionnaire' developed by EFSA aimed to collect data on:

- Consumers' awareness of the presence of contaminants in specific fish, crustacean and mollusc species and, if yes, which contaminants.
- Consumers' awareness of the existence of consumption advice for limiting the consumption of specific fish, crustacean and mollusc species due to the occurrence of mercury and, if yes, whether this concerns advice from the national competent authorities or from other sources; and
- whether consumers take into account national advice or not, or to a limited extent.

The questionnaire followed a standard structure of simple closed and complex closed questions with a limited number of filter/follow-up questions, designed to gather quantitative data to meet the above three objectives. Additional questions that provide insights on potential moderating variables were also included. This type of information can be of great use to public authorities when devising communication strategies, e.g. audience segmentation, selection of messages, formats and channels, thereby allowing best use of resources for the highest possible impact.

Specifically, the Awareness questionnaire included the following sets of questions:

1. Consumer interest in the topics of food safety and nutrition more generally (included as potential moderating variables);

[5]Commission Regulation (EU) 2022/617 of 12 April 2022 amending Regulation (EC) No 1881/2006 as regards maximum levels of mercury in fish and salt (OJ L 115, 13.4.2022, pp. 60–63), ELI: https://eur-lex.europa.eu/eli/reg/2022/617/oj Implicitly repealed by Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in food (OJ L 119, pp. 103–157) ELI: http://data.europa.eu/eli/reg/2023/915/oj.

2. After being asked about their fish and seafood consumption using the FPQ (see above), consumer self-reporting of factors influencing their fish and seafood consumption, including possible behaviour change (i.e. increasing/decreasing their consumption overall of fish and seafood or of certain species);
3. Consumers' self-reported use of sources of information on fish and seafood consumption, including dietary advice provided by national authorities in EU MSs, Iceland and Norway;
4. Consumers' knowledge about the possible health risks and benefits of fish and seafood consumption as a proxy for possible awareness of national advice; and
5. Consumers' knowledge about chemical contaminants in fish and seafood including different contaminants and the different species contributing to exposure to these contaminants, also as a proxy for awareness of national advice.

The combined Food Propensity and Awareness Questionnaire was reviewed by experts of EFSA's Working Group on Social Research Methods and Advice and EFSA staff and finalised based on the findings from 10 pilot test interviews conducted in Ireland. The purpose of the pilot test interviews was to assess the effectiveness of the survey questions in eliciting the required information from respondents. Additionally, the questionnaire included a standard set of socio-demographic questions, asking about age, gender, socio-economic status as well as anthropometric measures (height and weight). The final questionnaire (Annex A) was translated by the contractors in-house translation team into the local languages of the countries covered by this survey.

2.3 | Target population and data collection method

Data were collected at two time points, which are subsequently referred to as the first point survey (FPS) and the second point survey (SPS). The target population of the FPS consisted of the general population aged 10 years up to and including 64 years of the 27 MSs of the European Union plus Norway and Iceland. The target population of the SPS covered the general population aged 10 years up to and including 64 years of the 13 EU MSs either having issued updated consumption advice (Austria, Belgium, Cyprus, Czechia, Denmark, Finland, Lithuania, Portugal, Spain), or being selected as control countries (France, Germany, Greece, Sweden), plus Iceland (control country) and Norway (issued updated advice). The selection of control countries was primarily based on high consumption as retrieved from the EFSA Comprehensive database.

Furthermore, pregnant women (defined as pregnant at the time of the survey fieldwork or in the 12 months prior to the survey fieldwork) were specifically considered as unborn children constitute the most vulnerable groups (EFSA CONTAM Panel, 2012) from exposure to mercury.

In all countries covered in both surveys, the data were collected by means of a telephone survey (computer-assisted telephone interview, CATI) with video-conferencing mode, allowing to show, during the interview, the related pictures to facilitate the identification of the fish and other seafood species that were included in the survey.

2.4 | Sampling frame and sampling design

2.4.1 | Sampling frame

Random digit dialling (RDD) was implemented across all countries using full-coverage mobile and landline frames including voice over internet protocol (VoIP) numbers linked to telephone numbers. Sampling frames were based on the latest numbering data from national telecommunications authorities and underwent rigorous quality checks to ensure only active numbers were included.

Landlines were stratified according to regional (NUTS[6]) levels based on the area codes. Instead, as this was not possible for mobile numbers (lacking region encoding), mobile lines were stratified by mobile phone providers, to reflect differing subscriber structure and regional distributions. Respondents' locations were captured during interviews to monitor and manage geographic distribution throughout fieldwork.

Samples were centrally released by the contractor in batches using a 24:1 ratio (e.g. 7200 numbers to achieve a sample size of $n = 300$). Each batch mirrored the overall mobile/landline proportions. Every number was dialled a minimum of five times, with attempts spread across different days and times (weekdays 9 AM to 8 PM, Saturdays 12 noon and 4 PM, no calls on public holidays) before they were considered exhausted. Daily monitoring ensured adherence to protocols and timely release of additional batches when needed.

Even if telephone samples are expected to be representative, bias could be introduced due to differences in response rates between subgroups (e.g. based on age), especially when response rates are overall low. To mitigate this, multiple contact attempts and structured call patterns were used. Residual imbalances were corrected at the weighting stage using post-stratification weights (Section 2.8).

Informed consent was retrieved from participants before enrolment. When a mobile number was called, the person answering, if aged 16+, was interviewed. For landline numbers, a random within the household selection (who most recently

[6] https://ec.europa.eu/eurostat/web/nuts.

had a birthday) was used for individuals aged between 10 and 65 years old. For participants aged 10–15, parental consent/consent from a legal guardian was required, with the parent/legal guardian present during the interview.

Targeted boost sample recruitment was conducted for adolescent and pregnant women via social media advertisement on Facebook, Instagram and TikTok through FFIND, the contractor's trusted partner. Interested individuals were shown a short description of the survey, asked to fill in a form with their contact details and were screened for eligibility.

Social sampling/recruitment involves a degree of self-selection. Therefore, efforts to sample a representative sample were taken through the setting of 'soft' quotas. Soft quota means that some leeway was granted to achieve the number of interviews for specific quota (e.g. region, gender). For the adolescents boost sample, soft quotas were set for gender and geographical region. For the pregnant women boost sample, soft quotas were set for geographical region. Any imbalance in the representativeness of the data was managed using post-stratification weights (2.8.2).

2.4.2 | Sampling design

The sampling design for the FPS and SPS consisted of two sampling approaches which were combined to meet (1) EFSA's general population random probability sampling request ($N = 240$, 18–64 year-olds) and (2) the pre-defined sample quota that were set by EFSA for the two population subgroups of specific interest: adolescents ($N = 130$, 10–17 year-olds, with a 50/50 gender distribution) and pregnant women ($N = 130$). Specifically, the sampling design per country consisted of:

- A general population random probability sampling design RDD based on full-coverage mobile and landline sampling frames to sample 300 European consumers (10–64 years old), of which it was expected to include 30 pregnant women and 30 adolescents due to natural fall out of the random general population sample
- An additional boost sample of +/− 100 pregnant women
- An additional boost sample of +/− 100 adolescents (10–17 years old), split equally between male and female adolescents.

2.5 | Fieldwork organisation and quality plan

The surveys were conducted using a centralised CATI across all countries and reaching both landlines and mobile phones. The contractor implemented an integrated system linking sample management, dialler, scripts and fieldwork monitoring tools enabling real time oversight of fieldwork progress and quality metrics such as response rate and interview duration. Local monitoring complemented central supervision for detailed controls.

Although systems were centralised, local fieldwork teams were involved in conducting the CATI interviews to ensure cultural and linguistic appropriateness. Interviewers were native speakers of the survey language within their respective countries with a minimum of 3 months' experience in conducting public opinion CATI surveys and trained in video-conferencing/screensharing tools. The contractor maintained a single communication channel between local teams and the central project lead for consistency. The senior local fieldwork staff comprising of fieldwork project managers and supervisors were briefed on the survey content, giving attention to difficult questions and terminology of the questionnaire, complex routings and important interview instructions. In addition, they were informed about technical and operational aspects such as sample handling or fieldwork timing as well as other methodological and GDPR-related aspects including the informed consent procedures, and specific coding of responses.

All interviewers participated in a training process conducted by senior fieldwork staff. The training focused on familiarising interviewers with key information about the survey. Interviewers were provided with a manual which contained a 'master' set of guidelines, including interview quality requirements, information about the contact procedures, how to code call outcomes, tips to minimise refusal rate, standard answers to common questions, etc. Each interviewer completed a test interview evaluated by senior staff before live interviewing.

The fieldwork and sample progress across all countries was monitored through a standardised and automated monitoring survey system. Key checks included operational compliance (calling times and call attempts), interviewer performance (flagging low-quality patterns like short interviews, high refusals, non-response) and automated statistical based data validation (permitted values checks, non-response, interview duration, response distribution and consistency check and straight lining, i.e. when identical answers were given for multiple consecutive questions).

Daily reports were shared with central and local teams. Additionally, supervisors reviewed at least 10% of recorded interviews. Interviews were removed from the sample in the following situations: if they were flagged on minimum two of the three quality criteria (interview was completed in less than half of the mean duration, more than 30% 'don't know/refusal' answers, identical answers were given for multiple consecutive questions), if they had more than 90% of non-response and if they was a mismatch between Q4 and Q5 (if Q4 = yes and Q5 = never/don't know on all items).

2.6 | Implementation of the survey and achieved sample

The FPS was fielded between 24 May and 13 July 2023[7] in the 27 EU MSs, plus Norway and Iceland. A one-week soft launch among a total of around 300 respondents was also commenced during the fieldwork of the FPS, to test the scripted questionnaire in a live environment and to further familiarise the interviewers with the survey. Overall, no adjustments to the script survey were needed. The SPS was fielded between 4 November and 20 December 2024 in 13 EU MSs, Iceland and Norway. Ten countries were selected for having issued updated consumption advice on fish and other seafood following the completion of the FPS fieldwork, while five countries selected on the basis of high consumption frequencies as retrieved from the EFSA Comprehensive database and which did not issue an updated advice served as 'control' countries. It is worth mentioning that two of the 10 countries, and particularly Portugal and Cyprus, had issued updated advice shortly before the FPS fieldwork.

In total, 14,843 interviews were completed for the FPS across all countries and 7782 for the SPS with a minimum of 500 interviews per country. The detailed unweighted sample size for the FPS and SPS and country are found in Appendix B. The average survey duration of both surveys was approximately 24 min. In all countries the achieved adolescent and adult samples are representative for region (NUTS 1) and gender (male, female) in line with the official population published in Eurostat. The boost sample for pregnant women was also representative for region (NUTS 1).

For the estimation of the response rates for both first- and second- point survey the contractor used the Response Rate 3 (RR3) of the American Association for Public Opinion Research (AAPOR). RR3 includes an estimation of the proportion of cases with unknown eligibility that are actually eligible. The calculation was based on the following formula:

$$I / (I + (R + NC + O) + e(UE))$$

Where
I = Completed interviews,
R = Refusals (refused (screener), refused (overall), soft refusal/ appointment),
NC = Noncontact (busy, no answer, answering machine),
O = Other non-interviews (inability to participate, other non-interview, status unknown),
UE = Cases with unknown eligibility (when the interviewer does not know that the person called is eligible for the survey, e.g. busy signal, no answer, refusal before screener questions) and
e = eligibility rate, respectively.

The overall response rate for RDD sample during the FPS was 10.8% and the higher response rate was observed in Belgium reaching the 25.9%. In the SPS, the overall response rate for the RDD sample was equal to 9.9% and the highest rate was observed in France reaching the 16.6%. The detailed response rates per survey and country for the RDD sample can be found in Appendix C.

2.7 | Data processing and weighting

2.7.1 | Data cleaning

Data of the FPS and SPS were stored centrally and were formatted as closely as possible to the final structure to reduce post-fieldwork cleaning and recoding. Data cleaning and processing were fully centralised to ensure a harmonised approach across countries and minimise potential errors. During data cleaning after fieldwork, the files were checked to ensure that all valid interviews were contained, all variables were included and correctly coded according to the data model provided by EFSA and variable values were checked in terms of their labelling and permitted range. Missing values were also checked to ensure that they appeared only in expected fields and were correctly labelled. Data were coded and structured using the data model (Annex B) and XSD schema provided by EFSA, including codification according to the FoodEx2 classification system (EFSA, 2015) and were submitted to EFSA Data Collection Framework application in xml format. Following data submission, a rigorous set of validation checks were applied using SAS Enterprise software to guarantee consistency among data points and eliminate errors.

2.7.2 | Weighting

After data collection, a post-stratification weighting procedure was applied to ensure that the sample reflects the population on key socio-demographic variables. As mentioned in Section 2.4.1 the survey used two sampling methods: a RDD for the general population and boost samples for the adolescents and pregnant women using soft quota sampling. The weighting process involved up to three stages:

- Design weights (for the random probability sample) to equalise selection probabilities. These account for factors such as

[7]An additional 1 month of fieldwork between 20 November and 20 December was needed to reach the targeted sample size for all countries.

household size and multiple phone numbers, which affect the likelihood of selection. For example, individuals in larger households had lower chances of being selected via landline, while those with multiple SIM cards had higher chances in the mobile sample. Probabilities were calculated during the survey, and design weights were computed as the inverse of these probabilities.
- Post-stratification weights to align the sample with population distribution (e.g. age, gender, region). This step used iterative proportional fitting, which adjusts weights across multiple variables until convergence. Missing data were handled by assigning cases to separate categories or merging very small regions with adjacent ones. To maintain efficiency and avoid extreme weights that could distort variance, weights were trimmed after each iteration.
- Population size weights to ensure that countries are represented proportionally to their population size, since sample sizes were similar across countries regardless of population size differences.

The aforementioned approach aimed to balance representativeness with efficiency, minimising the impact on effective sample size and statistical power. Overall, this multi-step approach ensured that the final weighted data reflected the target population structure while controlling costs and methodological bias. The detailed weighting approach and targets by sample target group are presented in Appendix D.

2.7.3 | Data management and analysis

The questionnaire (Annex A) included numerous detailed questions on fish and seafood consumption, awareness of associated risks and benefits and changes in consumption patterns. To enable meaningful data analysis and subgroup comparisons, nine variables were constructed based on the survey variable/questions from the questionnaire. Variables were generated to serve two main purposes: aggregation – to group original survey responders into interpretable categories and subgroup analysis – to examine differences across relevant indicators. While the findings presented in this report are based on these derived variables, all original survey responses remain accessible in Annex C ensuring transparency and traceability.

Three variables based on the question Q5.1 were generated to measure consumption frequency for fish and seafood species grouped by their maximum mercury level (see table in Appendix A). These variables served as indicators of how often the respondents consumed any of the fish and/or other seafood species per ML category in the last 12 months. For each of the three derived variables, a new scale was developed which indicates the cumulative consumption frequency across fish and seafood species that are categorised within the same mercury ML category. The original scale included six options: 1) never, (2) less than once per week (e.g. once or twice a month or less), (3) once per week, (4) two times per week, (5) three or more times per week, (6) don't know. If respondents indicated, for example, to only eat pike 'once per week' and shark 'three times per week', then that respondents would receive a cumulative score of 'three or more times per week' indicating the cumulative frequency with which any fish from the ML 1 mg/kg of wet weight was consumed.

There are a few points for attention on the computation and interpretation of these three derived variables on fish and seafood consumption frequency:

- if respondents indicated to eat fish or seafood 'less than once per week (e.g. once or twice a month or less)', this was equated with 'never' for the computation of the derived variable. The reason for this is that the frequency of consumption was not precisely known and therefore, this answer could not be used to compute a cumulative score
- the answer option 'don't know' was only coded for the computation of a derived variable if a responder answered 'don't know; for all original fish and seafood species that were included in the category.
- in the original FPQ an item was included referring to 'other fish species not mentioned'. This item was not included in the computation of the derived variables, as it was unclear under which ML category it would go.

Consequently, the base size of respondents who were included in a derived variable may differ from the base size of the initial variable(s) on which the derived variable is based. This difference occurred since the specific answer categories detailed above were excluded from the derived variable, reducing respectively its base size.

Three variables were also computed to assess responder's awareness of the risks and benefits of fish and seafood consumption. Each original question (Q11, Q12 and Q13) included multiple items requiring correct answers. The derived variables represent the total number of correct responses, with 'don't know' treated as incorrect.

Finally, for responders who reported reducing fish or seafood consumption intake in the past 12 months, three variables were generated based on questions Q8.2.1 and Q8.4.1 of the questionnaire. In particular, an aggregated dummy variable was created to classify consumers who reported reducing consumption of fish and seafood with contaminants or mercury vs. those who did not. Two additional separate dummy variables were also created to capture reduction of consumption of fish species contaminated with contaminants/mercury and of seafood species contaminated with contaminants/mercury.

2.7.4 | Segmentation analysis

The objective of the segmentation analysis was to distinguish audience segments that are meaningful for targeting communications from public authorities about fish and other seafood consumption limitations and, specifically, the risks and benefits of this consumption. To this end, the following segmentation base variables were included (one for the FPS and one for the SPS):

- The three derived fish/other seafood consumption frequency variables based on variable/question Q5.1 (FPQ). For each of the three categories of fish and other seafood species that are specified in accordance to their ML of mercury: 1.0 mg/kg of wet weight, 0.5 mg/kg of wet weight, 0.3 mg/kg of wet weight, a derived variable was computed that indicates how often respondents ate any of the fish and/or other seafood species per category in the last 12 months.
- The three derived 'awareness/knowledge' variable based on Q11, Q12 and Q13. For each of these original variables, a derived variable was computed which provides a cumulative score of respondents' correct answers across the question items. If respondents answered 'don't know' to one of the question items, this was treated as an incorrect answer for the computation of the derived variable.

Based on these six variables the segmentation analyses each resulted in a solution of audience segments that (a) maximally vary on the combination of these six variables, while (b) being within each segment maximally homogenous on these same characteristics.

In addition to the six variables that were used to drive the segmentations, the other variables/questions that were included in the survey were used to further describe each of the identified audience segments.

The segmentation analyses for both the FPS and SPS were conducted at the aggregate level, as the base size per country ($N = 500$) would have been too small to reliably identify segments at the national level. For the FPS, the analysis was carried out across all EU 27 MSs plus Iceland and Norway. For the SPS, the analysis included the nine EU MSs and Norway that issued updated consumption advice.

Only the 10+ general population random probability sample and adolescent boost sample from the FPS ($N = 11{,}765$) and SPS ($N = 4087$) were included in the segmentation analyses. This is due to the specific sampling design needed to meet the pregnant women sample targets which required assigning a different weight to the pregnant women that were sampled via the boost sample, vs. the pregnant women that were sampled via the random probability sample. As only one weight can be included in the segmentation analysis, the weight of the 'total sample', i.e. the random probability telephone survey combined with booster sample of adolescents (10–17 years), was included.

A total of four segmentation solutions for both FPS and SPS were generated using a Latent class clustering analysis. Latent class segmentation is a distance-based, non-hierarchical clustering method (Hagenaars & McCutcheon, 2002). It aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean (cluster centres or cluster centroids). Latent class clustering takes into account that there is uncertainty about an object's segment membership. An instance is assigned a probability to belong to each of the segments, i.e. a probabilistic approach.

Once the four solutions were retrieved, a discriminant analysis model was run to evaluate the robustness of each solution. These analyses confirmed that the allocation accuracy to the different segments for the four solutions presented was very high. These findings also ensure that the allocation algorithm that predicts to which segment respondents belong in any future studies, will be equally robust.

To select the optimal segmentation solution, a series of quality standards was followed:

- Segments needed to be mutually distinguishable;
- Each one of the defined segments needed to include at least 10% of the survey respondents;
- The segmentation solution needed to be stable, meaning that patterns that are found in the data can be reproduced when different indicators of a same construct are included in the segmentation;
- Segments needed to be actionable, meaning that they are meaningful for targeting communications about fish and other seafood consumption and the risks and benefits of this consumption.

2.8 | Overview of total sample

An overview of the total unweighted sample of the FPS and SPS by country, ML category, population group and consumption frequency equal to two or more times per week is presented in Tables 1 and 2, respectively. The frequencies presented in these tables are estimated for the total survey sample, i.e., individuals recruited through the RDD and boost sampling designs. As expected, the adolescents and adults RDD sample include also pregant women. Furthermore, it is worth noting that from the ~500 individuals per country participating in both surveys, around 60% of them identified themselves as fish and seafood consumers (Appendix E).

TABLE 1 Overview (N. %) of total unweighted sample of the FPS by country, ML category and population subgroup.

		Adolescents	Adults	Pregnant	Adolescents (N)	Adults (N)	Pregnant (N)
Country	ML category	Total N (% consumers)	Total N (% consumers)	Total N (% consumers)	consumers 2+	consumers 2+	consumers 2+
AT	1	126 (50%)	283 (49%)	122 (52%)	9	36	11
AT	0.5				6	13	3
AT	0.3				8	33	15
BE	1	129 (49%)	273 (55%)	131 (55%)	3	33	15
BE	0.5				2	22	15
BE	0.3				16	31	17
BG	1	126/ (51%)	293 (68%)	132 (70%)	11	42	19
BG	0.5				8	23	8
BG	0.3				16	60	22
CY	1	130 (80%)	283 (78%)	118 (67%)	24	52	13
CY	0.5				9	24	4
CY	0.3				25	55	14
CZ	1	134 (48%)	275 (58%)	122 (54%)	6	41	9
CZ	0.5				4	16	3
CZ	0.3				14	46	19
DE	1	137 (44%)	280 (52%)	124 (65%)	3	37	31
DE	0.5				1	28	17
DE	0.3				11	43	21
DK	1	129 (47%)	278 (63%)	122 (56%)	11	37	20
DK	0.5				3	25	15
DK	0.3				15	55	28
EE	1	132 (48%)	278 (64%)	125 (44%)	6	26	2
EE	0.5				5	21	2
EE	0.3				6	54	5
EL	1	126 (58%)	279 (82%)	114 (68%)	19	58	22
EL	0.5				13	26	7
EL	0.3				29	67	16
ES	1	140 (53%)	278 (72%)	124 (57%)	19	106	31
ES	0.5				11	53	15
ES	0.3				21	109	30
FI	1	125 (47%)	290 (82%)	111 (66%)	14	30	8
FI	0.5				7	13	2
FI	0.3				24	49	17
FR	1	121 (47%)	288 (63%)	127 (66%)	8	42	18
FR	0.5				2	14	7
FR	0.3				14	56	28
HR	1	124 (45%)	286 (59%)	115 (49%)	17	48	10
HR	0.5				7	19	5
HR	0.3				17	59	10
HU	1	124 (43%)	290 (54%)	118 (57%)	7	35	10
HU	0.5				2	12	0
HU	0.3				9	50	11
IE	1	130 (51%)	275 (57%)	128 (62%)	10	39	20
IE	0.5				10	13	9
IE	0.3				21	48	24

(Continues)

TABLE 1 (Continued)

Country	ML category	Adolescents Total N (% consumers)	Adults Total N (% consumers)	Pregnant Total N (% consumers)	Adolescents (N) consumers 2+	Adults (N) consumers 2+	Pregnant (N) consumers 2+
IS	1	125 (48%)	286 (82%)	127 (73%)	4	85	18
IS	0.5				5	46	8
IS	0.3				12	100	25
IT	1	126 (66%)	286 (70%)	123 (80%)	36	84	51
IT	0.5				24	30	24
IT	0.3				34	85	41
LT	1	133 (37%)	280 (55%)	122 (54%)	7	30	27
LT	0.5				5	15	3
LT	0.3				10	52	30
LU	1	129 (50%)	282 (70%)	134 (59%)	7	52	21
LU	0.5				1	32	8
LU	0.3				6	77	26
LV	1	129 (40%)	287 (56%)	121 (55%)	14	40	22
LV	0.5				5	24	7
LV	0.3				15	43	15
MT	1	122 (53%)	281 (58%)	128 (62%)	14	54	24
MT	0.5				7	25	8
MT	0.3				17	53	25
NL	1	130 (45%)	273 (57%)	124 (61%)	14	34	21
NL	0.5				2	25	8
NL	0.3				13	61	29
NO	1	134 (45%)	284 (65%)	129 (60%)	9	25	20
NO	0.5				4	17	4
NO	0.3				19	68	35
PL	1	120 (52%)	281 (60%)	120 (62%)	13	40	16
PL	0.5				2	14	3
PL	0.3				38	99	26
PT	1	122 (59%)	288 (72%)	126 (57%)	22	62	14
PT	0.5				6	22	1
PT	0.3				17	47	24
RO	1	122 (48%)	289 (61%)	113 (54%)	6	42	8
RO	0.5				3	18	1
RO	0.3				7	64	9
SE	1	129 (55%)	277 (68%)	125 (64%)	15	55	20
SE	0.5				7	28	11
SE	0.3				20	59	20
SI	1	126 (46%)	278 (53%)	124 (66%)	13	28	12
SI	0.5				4	8	4
SI	0.3				11	29	20
SK	1	121 (50%)	294 (55%)	116 (52%)	11	51	19
SK	0.5				1	7	3
SK	0.3				10	63	23

Note: 'Total' equals to the unweighted sample size of all respondents (Q4 = yes or no) and 'Consumers' equals to the unweighted sample size of fish/seafood consumers (Q4 = yes), 'Consumers 2+' equals to consumers with two or more times per week.

TABLE 2 Overview (N, %) of total unweighted sample of the SPS by country for the 10 + 5 countries, ML category and population subgroup.

Country	ML category	Adolescents Total N (% consumers)	Adults Total N (% consumers)	Pregnant Total N (% consumers)	Adolescents (N) consumers 2+	Adults (N) consumers 2+	Pregnant women (N) consumers 2+
AT	1	131 (46%)	289 (56%)	131 (48%)	29	95	36
AT	0.5				12	47	14
AT	0.3				32	75	26
BE	1	131 (53%)	268 (58%)	135 (56%)	30	86	44
BE	0.5				13	32	15
BE	0.3				28	80	36
CY	1	135 (77%)	275 (78%)	130 (68%)	56	109	54
CY	0.5				21	38	19
CY	0.3				44	78	36
CZ	1	131 (51%)	277 (59%)	131 (55%)	30	94	34
CZ	0.5				9	59	12
CZ	0.3				32	92	27
DE	1	133 (54%)	272 (53%)	131 (62%)	34	80	54
DE	0.5				9	44	26
DE	0.3				32	81	49
DK	1	131 (40%)	282 (55%)	130 (55%)	27	89	32
DK	0.5				8	44	21
DK	0.3				18	78	33
EL	1.0	145 (57%)	251 (77%)	131 (63%)	57	111	47
EL	0.5				22	58	20
EL	0.3				42	89	45
ES	1	130 (53%)	265 (69%)	132 (60%)	36	129	56
ES	0.5				16	65	21
ES	0.3				37	118	46
FI	1	132 (53%)	277 (74%)	132 (59%)	35	92	43
FI	0.5				11	41	14
FI	0.3				43	92	44
FR	1	131 (46%)	277 (59%)	131 (56%)	33	84	43
FR	0.5				10	35	23
FR	0.3				30	75	43
IS	1	131 (56%)	277 (79%)	131 (69%)	37	131	38
IS	0.5				12	73	20
IS	0.3				41	121	42
LT	1	132 (40%)	262 (59%)	132 (57%)	31	94	50
LT	0.5				10	27	14
LT	0.3				26	95	40
NO	1	133 (45%)	279 (64%)	132 (51%)	34	90	39
NO	0.5				9	42	10
NO	0.3				26	98	40
PT	1.0	130 (48%)	297 (70%)	135 (59%)	32	119	42
PT	0.5				7	45	15
PT	0.3				23	103	34
SE	1	133 (49%)	278 (64%)	132 (61%)	28	100	46
SE	0.5				12	61	19
SE	0.3				33	84	41

Note: 'Total' equals to the unweighted sample size of all respondents (Q4 = yes or no) and 'Consumers' equals to the unweighted sample size of fish/seafood consumers (Q4 = yes), 'Consumers 2+' equals to consumers with two or more times per week.

3 | ASSESSMENT

3.1 | Consumption frequency of different fish, crustacean and mollusc species

This section examines the frequency of different fish and seafood consumption among individuals aged 10+ and pregnant women, focusing on species categorised by their MLs of mercury. Only respondents[8] who generally consume fish or seafood were included and for each ML of mercury category, a computed variable (see Section 2.7.3) measured consumption frequency over the past 12 months. The analysis compares trends between the FPS and SPS, highlighting changes in countries with and without updated consumption advice. Findings for all countries and survey points combined are also presented.

3.1.1 | Influencing factors for fish and seafood consumption

Fish and seafood consumption is shaped by a complex interplay of personal, cultural, economic, environmental and safety-related factors (Govzman et al., 2021). Health considerations are among the strongest motivators for fish and seafood consumption as fish is widely recognised for its benefits, including high-quality protein and omega-3 fatty acids (Noreen et al., 2025). However, concerns about contaminants can counterbalance these benefits and influence consumer choices. Knowledge and cooking skills also matter (Ekpenyong et al., 2025); consumers who lack confidence in preparing fish and seafood dishes are less likely to include them in their diets.

Cultural traditions and culinary heritage strongly shape fish and seafood consumption patterns (Almeida et al., 2015). In some regions, fish is a dietary staple, while in others it is consumed occasionally or seasonally. Religious practices can also influence intake, for example during fasting periods.

Price and affordability are also critical determinants. Fish and seafood are often perceived as more expensive than other protein sources, making income level and household budgets influential (Marinac Pupavac et al., 2022). Availability and accessibility such as proximity to coastal areas or reliable infrastructure also play a role (Bostic et al., 2017; Hilger et al., 2017). Taste preferences are equally important: consumers who enjoy the flavour and texture of fish are more likely to include it regularly in their diets (Lebiedzińska et al., 2006).

EFSA's survey results, specifically the answers to Q6 (To what extent do each of the following factors influence your consumption or no consumption of fish or other seafood, if at all?) and Q8 (Do any of the following reasons explain why you increased/decreased your consumption of fish/seafood in the last 12 months?) of the questionnaire are in line with the above-mentioned factors found in the literature.

Based on data collected during both the FPS and SPS (cumulatively), fish and seafood consumers in the 10+ population and pregnant women samples reported that taste is the first influencing factor for fish and seafood consumption to a large or to some extent (answer to Q6). Price and desire to have a healthy/nutritious diet follow for the 10+ population, instead desire to have a healthy/nutritious diet and food safety concerns like environmental contaminants were indicated by pregnant women, as seen in Figures 1 and 2.

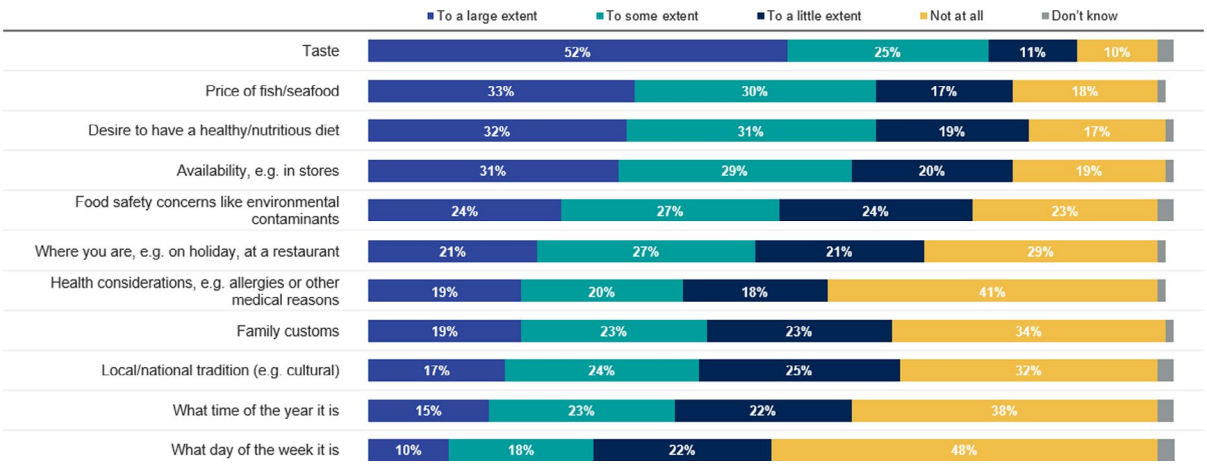

FIGURE 1 Influencing factors of fish and other seafood consumption among consumers in the 10+ population sample in all countries combined FPS and SPS. *(Question: Q6. To what extent do each of the following factors influence your consumption or no consumption of fish or other seafood, if at all?).* (Base: 10+ population both surveys (N=18011)

[8]Question Q4. We would now like to ask you about your own individual consumption of fish and other seafood (like mussels and squid, or shrimp and lobster). Would you say, in general, that you eat fish and/or other seafood? [YES/NO]

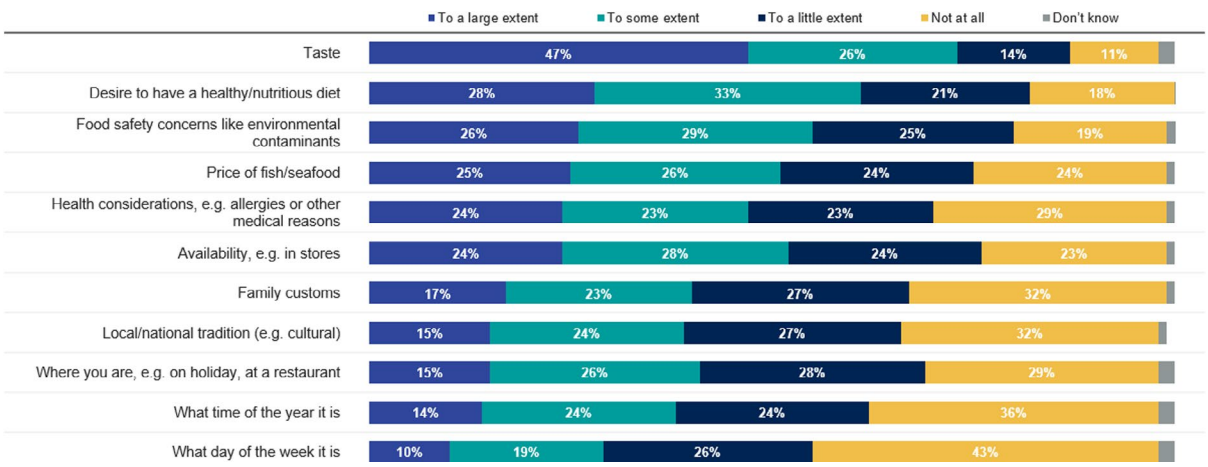

FIGURE 2 Influencing factors of fish and other seafood consumption among pregnant women who reported fish and seafood consumption in all countries combined FPS and SPS. *(Question: Q6. To what extent do each of the following factors influence your consumption or no consumption of fish or other seafood, if at all?).* (Base: pregnant women both surveys (N=5541)

In Q8 on reasons to explain the increase or decrease of fish and seafood consumption in the last 12 months, participants could select more that one of the available answers. Looking at the answers provided by consumers in the 10+ population sample, the main reasons for increased consumption of fish were the wish to have more proteins and fish oil in their diet and have a more varied diet . Consumers in the pregnant women sample increased consumption also because of their wish to have more proteins and fish oil in their diet but also because of dietary requirements and seek of a more balanced diet (Figure 3).

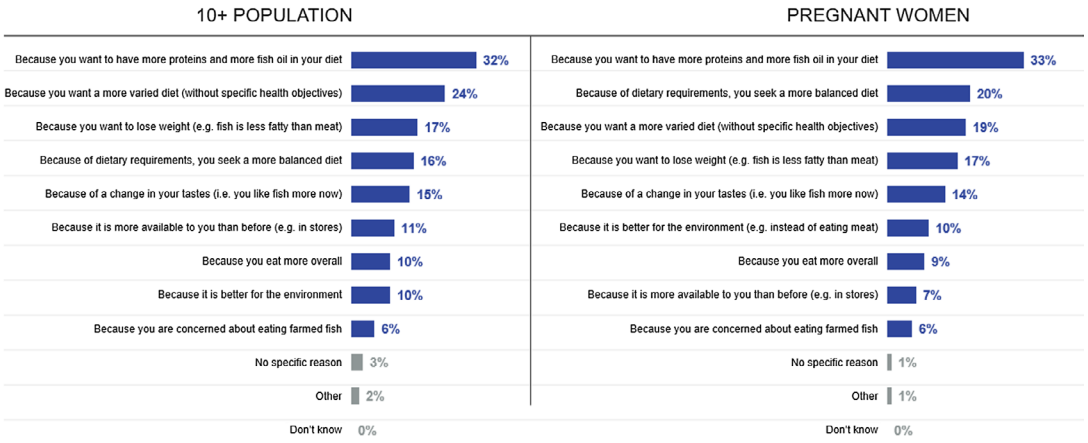

FIGURE 3 Reasons for increased consumption of fish in the past 12 months among 10+ population and pregnant women in all countries combined FPS and SPS. (Base: Respondents who reported having increased their consumption of fish in the past year ($n = 4.162$). Question: Q8.1.3. Do any of the following reasons explain why you increased your consumption of fish in the last 12 months?).

The main reasons for decreased consumption among consumers in the 10+ population sample were a change in their tastes (i.e., they like fish less) and that they eat less overall . Instead for consumers in the pregnant women sample were dietary requirements for a more balanced diet and change in their taste (Figure 4).

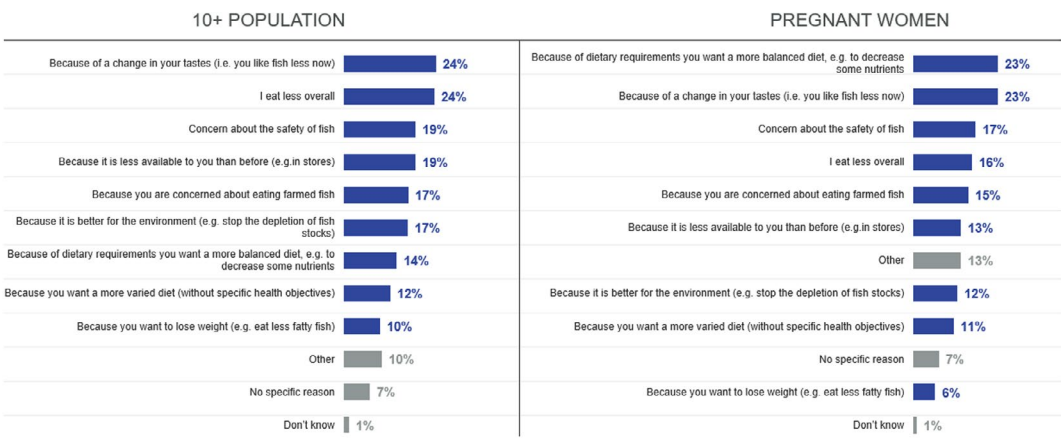

FIGURE 4 Reasons for decreased consumption of fish in the past 12 months among 10+ population and pregnant women in all countries combined FPS and SPS. *(Base: Respondents who reported having decreased their consumption of fish in the past year (n = 2.275). Question: Q8.2.3. Do any of the following reasons explain why you decreased your consumption of fish in the last 12 months?).*

Among the main reasons for increasing their consumption of seafood, consumers in the 10+ population sample reported dietary requirements in a more balanced diet, and a wish to have a more varied diet. Consumers in the pregnant women sample reported dietary requirements and a change in their taste (Figure 5).

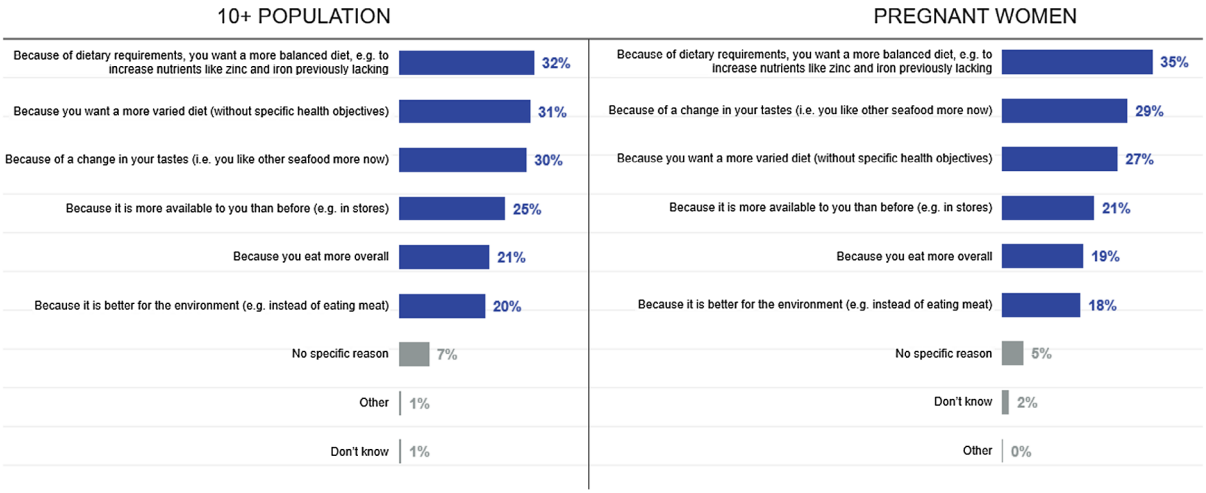

FIGURE 5 Reasons for increased consumption of seafood in the past 12 months among 10+ population and pregnant women in all countries combined FPS and SPS. *(Base: Respondents who reported having increased their consumption of seafood in the past year (n = 2.262). Question: Q8.3.3. Do any of the following reasons explain why you increased your consumption of seafood in the last 12 months?).*

Finally, the main reasons indicated for a decreased consumption of seafood among consumers in the 10+ population sample were a change in their taste and concern about the safety of other seafood. Pregnant women who reported fish and seafood consumption instead reported dietary requirements and concern about the safety of other seafood (Figure 6).

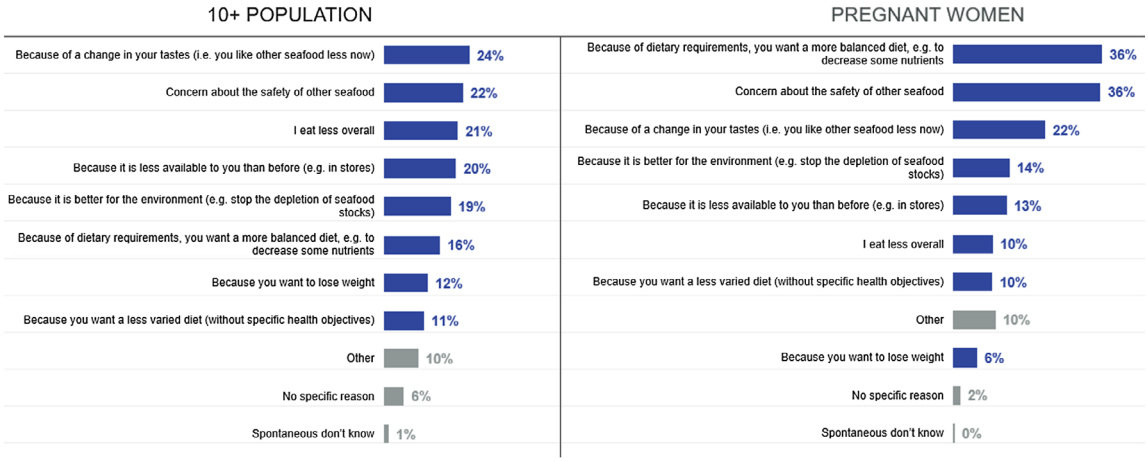

FIGURE 6 Reasons for decreased consumption of seafood in the past 12 months among 10+ population and pregnant women in all countries among FPS and SPS. *(Base: Respondents who reported having decreased their consumption of seafood in the past year (n = 2.405). Question: Q8.4.3. Do any of the following reasons explain why you decreased your consumption of seafood in the last 12 months?).*

All the above-mentioned reasons could have played a role in the consumption patterns observed during this survey, which are detailed in the following sections.

3.1.2 | Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg)

When comparing the consumption of fish and other seafood species with a mercury ML of 1.0 mg/kg of wet weight in countries with updated consumption advice between the FPS and the SPS, a decrease was noted in the proportion of 10+ population consumers that say they have consumed this category of fish and other seafood species never or less than once per week or once per week as shown in Table 3. Conversely, an increase was recorded in higher consumption frequencies, with more individuals reporting consumption two times per week or three or more times per week. By the SPS, half of the 10+ population consumers reported consuming fish and other seafood species with a mercury ML of 1.0 mg/kg of wet weight three or more times per week.

A similar trend was observed between the FPS and the SPS in the countries with no updated advice. The proportion of 10+ population consumers that say they have consumed fish and other seafood species with a mercury ML of 1.0 mg/kg of wet weight never or less than once per week or once per week decreased between the FPS and the SPS. Notably, the

percentage reporting consumption of fish and other seafood species from this ML category three or more times per week rose sharply from 26% in the FPS to 50% in the SPS.

TABLE 3 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among consumers in 10+ population including pregnant women recruited via the RDD sampling design, in countries with updated advice and with no updated advice during the FPS & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	42%	18%	38%	19%
Once per week	21%	16%	22%	17%
Two times per week	11%	15%	14%	15%
Three+ times per week	26%	51%	26%	50%

Pregnant women who reported fish and seafood consumption in countries with updated advice reported similar changes. The proportion of consumers with never or less than once per week consumption occasions fell from 41% during FPS to 25% during SPS, while high-frequency consumption, particularly three or more times per week increased. The same pattern was observed in countries without updated advice. The percentage of pregnant women consuming this fish and seafood category rarely (never/less than once per week or once per week) decreased, whereas those that declared to have consumed this ML category of fish and other seafood species three or more times a week increased, as seen in Table 4, below.

TABLE 4 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among pregnant women who reported fish and seafood consumption in countries with updated advice and with no updated advice during the FPS & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	41%	25%	40%	21%
Once per week	24%	12%	25%	14%
Two times per week	11%	12%	13%	13%
Three+ times per week	23%	51%	23%	51%

When considering consumers only in all surveyed countries together from both FPS and SPS (and thus covering time periods in 2023 and 2024), approximately one-third of the population aged 10+ (32%) and pregnant women (36%) report never consuming any fish or seafood species with a mercury ML of 1.0 mg/kg over the past 12 months or consuming it less than once a week. Equally, a similar proportion of consumers in both groups say they consumed fish and other seafood species from the 1.0 mg/kg mercury ML category three or more times per week in the last 12 months, as displayed in Figure 7.

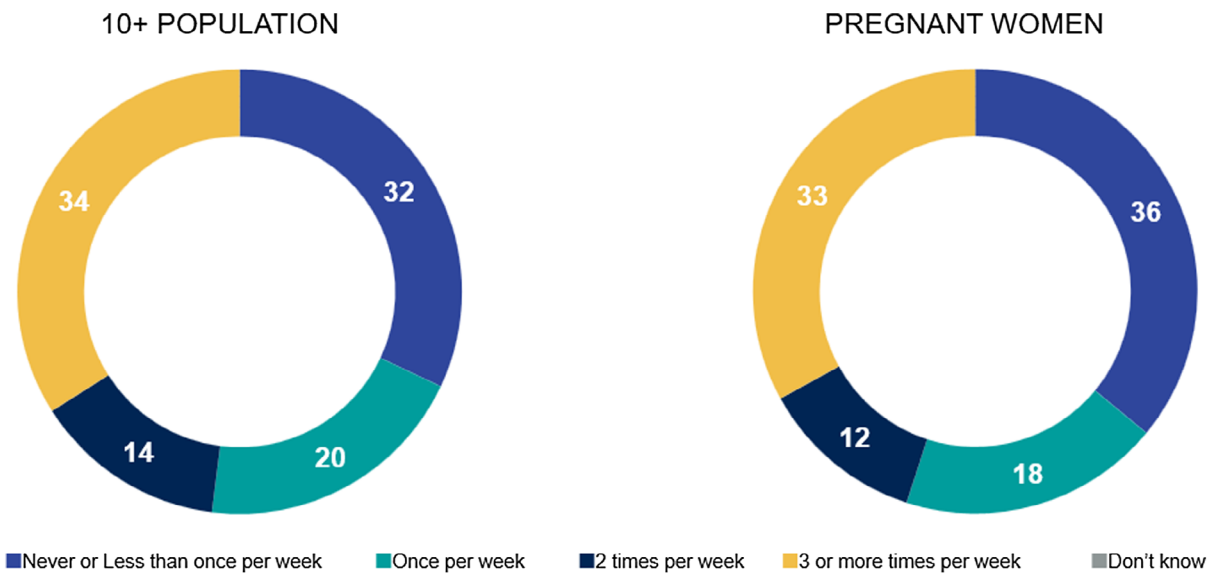

FIGURE 7 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among consumers in the 10 + population & pregnant women sample in all countries across the FPS (% - EU27 + Iceland & Norway) + SPS (% - EU13 + Iceland & Norway) *(Base: 10+ population both surveys (N = 10,761), Pregnant women both surveys (N = 3315) Question Q5.1 Derived variable for fish and other seafood species with mercury ML 1 mg/kg of wet weight as described in Section 2.7.3).*

3.1.2.1 | *Consumption frequency of shark and swordfish*

Shark and swordfish are important sources of methylmercury intake as they are large, long-lived predatory fish, positioned high in the marine food chain (EFSA, 2015). For these species a ML of 1.0 mg/kg is established under Regulation (EC) No 1881/2006.

The surveys showed that more than 80% of the 10+ population consumers and pregnant women who reported fish and seafood consumption across all countries of the FPS and SPS never consumed shark over the preceding 12 months. Slightly less than one in every 10 reported they had done so less than once per week (Figure 8). Similarly, less than seven in every 10 of the 10+ population and pregnant women consumers reported never consuming swordfish over the last 12 months and one in every five reported they have done so less than once per week (Figure 9).

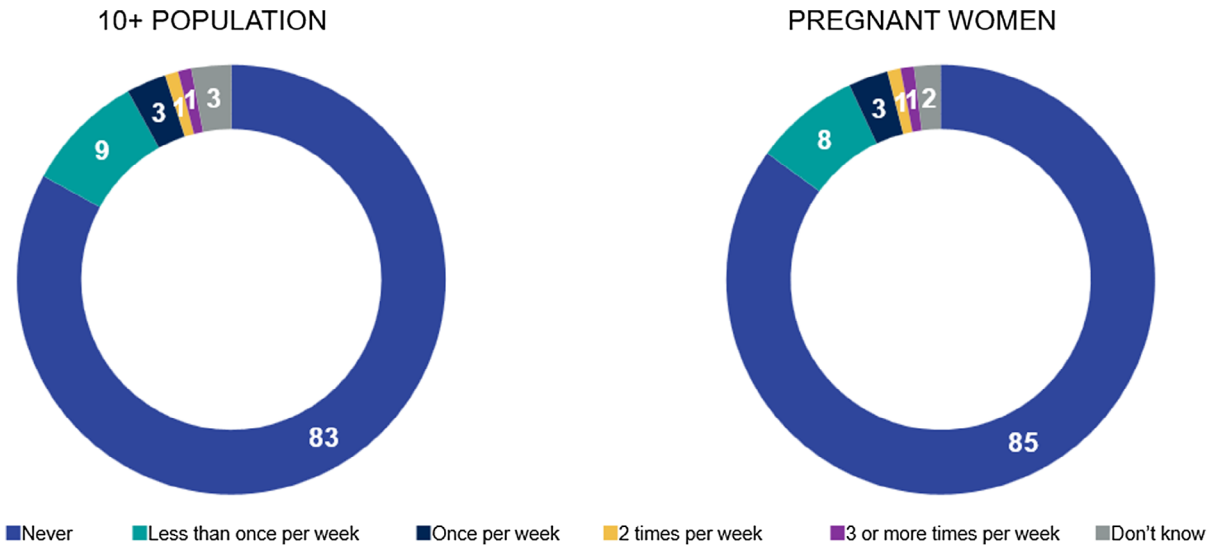

FIGURE 8 Consumption frequency of shark among consumers in the 10 + population & pregnant women sample in all countries across the FPS and SPS *(Base: 10+ population all waves (N = 10,761), Pregnant women all waves (N = 3315) Question: Q5_1_16 Consumption – Shark).*

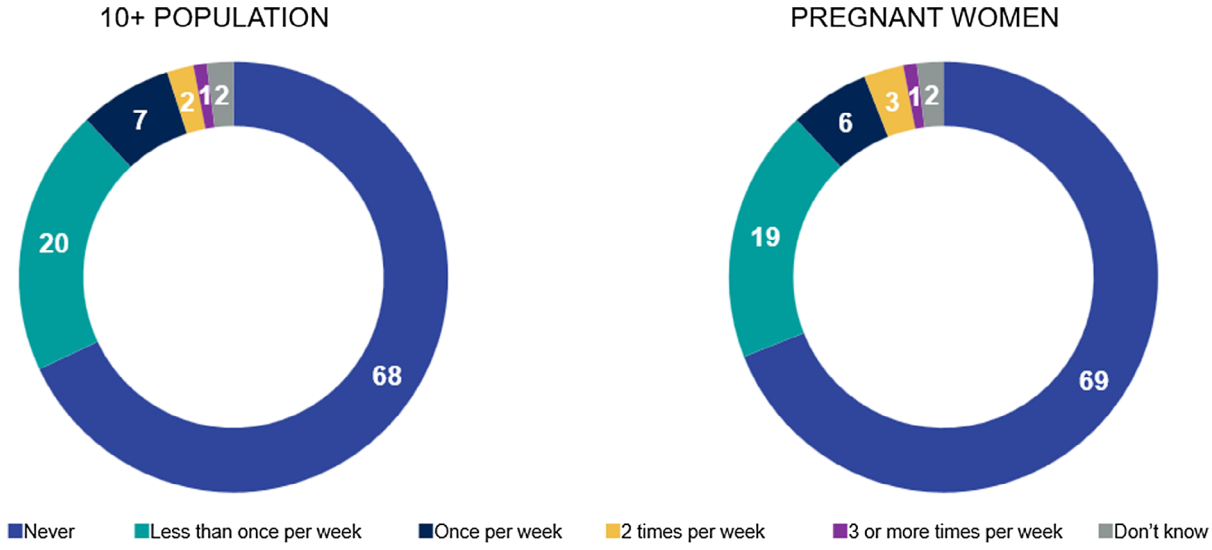

FIGURE 9 Consumption frequency of swordfish among consumers in the 10 + population & pregnant women sample in all countries across the FPS and SPS (*Base: 10+ population all waves (N10761), Pregnant women all waves (N = 3315) Question: Q5_1_20 Consumption – Swordfish*).

3.1.3 | Consumption frequency of fish and other seafood species (mercury ML 0.5 mg/kg)

In countries with updated consumption advice, consumption of fish and other seafood species with a mercury ML of 0.5 mg/kg of wet weight shifted to a lower frequency between the FPS and the SPS. The proportion of 10+ population consumers who reported low-frequency consumption (never or less than once per week) decreased in the last 12 months, while the proportion consuming this category for two or more times per week increased, as well as for three or more times per week, as presented in Table 5.

A similar trend was observed in countries without updated advice. There was a decline in low-frequency consumption among the 10+, while the consumers of fish and other seafood species with a mercury ML of 0.5 mg/kg of wet weight for two or more times per week increased between the two surveys.

TABLE 5 Consumption frequency of fish and other seafood species (mercury ML 0.5 mg/kg) among consumers in the10+ population, including pregnant women recruited via the RDD sampling design, in countries with updated advice and with no updated advice during the FPS & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	64%	56%	59%	49%
Once per week	19%	18%	22%	19%
Two times per week	8%	11%	9%	13%
Three+ times per week	8%	15%	10%	19%

Patterns were similar among pregnant women who reported fish and seafood consumption in countries with updated advice. Individuals reporting consumption never or less than once per week fell from 75% to 66%, whereas those reporting two times per week increased similarly to those reporting three or more times per week. Pregnant women with low-frequency consumption in countries without updated advice also shifted towards a decrease, though those with higher-frequency consumption (two times per week or more) increased, as shown in Table 6.

TABLE 6 Consumption frequency of fish and other seafood species (mercury ML 0.5 mg/kg) among pregnant women who reported fish and seafood consumption in countries with updated advice and with no updated advice during the FPS & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	75%	66%	67%	55%
Once per week	14%	12%	18%	17%
Two times per week	4%	9%	7%	12%
Three+ times per week	6%	13%	9%	16%

Overall, when considering consumers only in all countries in both survey points, nearly two-thirds of the 10+ population consumers and around seven in 10 pregnant women who reported fish and seafood consumption reported never consuming any of these fish and seafood species, or that they have done so less than once a week. Conversely, approximately 1 in 10 of the consumers in the 10+ population (11%) and the pregnant women (10%) sample stated that they consumed fish and other seafood species in the 0.5 mg/kg mercury ML category three or more times per week in the past 12 months (Figure 10).

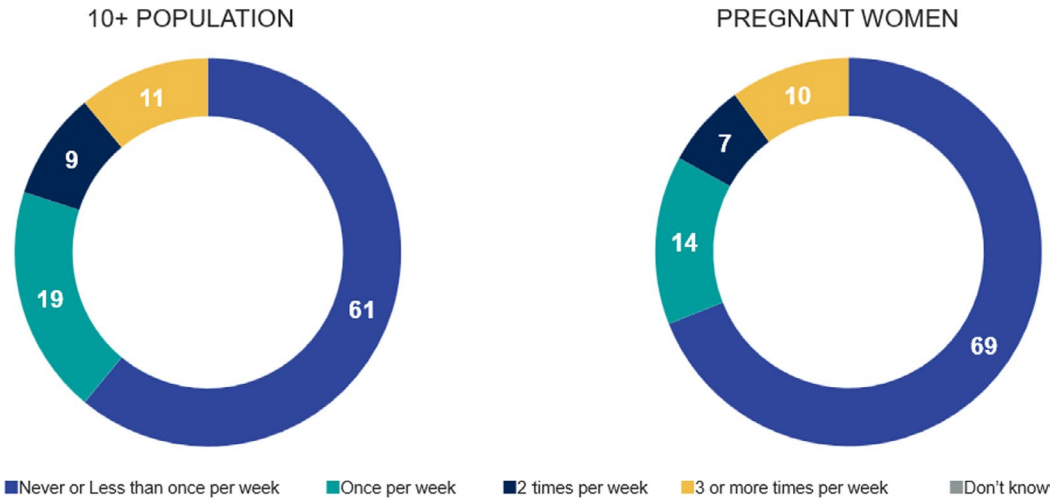

FIGURE 10 Consumption frequency of fish and other seafood species (mercury ML 0.5 mg/kg) among consumers in the 10+population and pregnant women sample in all countries across the FSP+*SPS (Base: 10+ population both surveys (N=10,761), Pregnant women both surveys (N=3315). Question: Q5.1 Derived variable for fish and seafood species with mercury ML 0,5 mg/kg of wet weight as described in Section 2.7.3).*

3.1.4 | Consumption frequency of fish and other seafood species (mercury ML 0.3 mg/kg)

Across countries with updated advice, consumption of fish and other seafood species with a mercury ML of 0.3 mg/kg for the 10+ population consumers reporting low-frequency consumption (never or less than once per week) decreased, while for those reporting consumption three or more times per week increased.

A similar trend was observed in countries without updated advice. Low-frequency consumption among the 10+ population consumers (never or less than once per week) decreased, while high-frequency consumption (three or more times per week) increased from 37% to 51% between the FPS and the SPS, as seen in Table 7.

TABLE 7 Consumption frequency of fish and other seafood species (mercury ML 0.3 mg/kg) among consumers in the 10+ population, including pregnant women recruited via the RDD sampling design, in countries with updated advice and with no updated advice during the FPS & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	28%	16%	28%	19%
Once per week	21%	19%	19%	18%
Two times per week	16%	16%	16%	13%
Three+ times per week	35%	50%	37%	51%

Among pregnant women who reported fish and seafood consumption in countries with updated advice, the proportion reporting consumption of fish and other seafood species with a mercury ML of 0.3 mg/kg of wet weight never or less than once per week in the last 12 months decreased, while the percentage consuming three or more times per week increased, as shown in Table 8. A similar trend appeared in countries without updated advice, where the proportion of pregnant women who reported fish and seafood consumption with low-frequency consumption decreased, whereas the percentage for consumption frequency of three or more times a week in the last 12 months increased.

TABLE 8 Consumption frequency of fish and other seafood species (mercury ML 0.3 mg/kg) among pregnant women who reported fish and seafood consumption in countries with updated advice and with no updated advice during the FSP & SPS.

Frequency category	Updated advice – FPS	Updated advice – SPS	No updated advice – FPS	No updated advice – SPS
Never or less than once/week	28%	18%	37%	19%
Once per week	21%	21%	24%	16%
Two times per week	18%	17%	12%	17%
Three+ times per week	33%	43%	27%	49%

Overall, when considering consumers only across all countries participating in both survey points, one in every four approximately of the 10+ population and pregnant women reported consuming fish and seafood species with a mercury ML of 0.3 mg/kg never or less than once per week in the last 12 months. Conversely, around 4 in every 10 of the 10+ population and pregnant women reported consuming these species three or more times per week in the last 12 months (Figure 11).

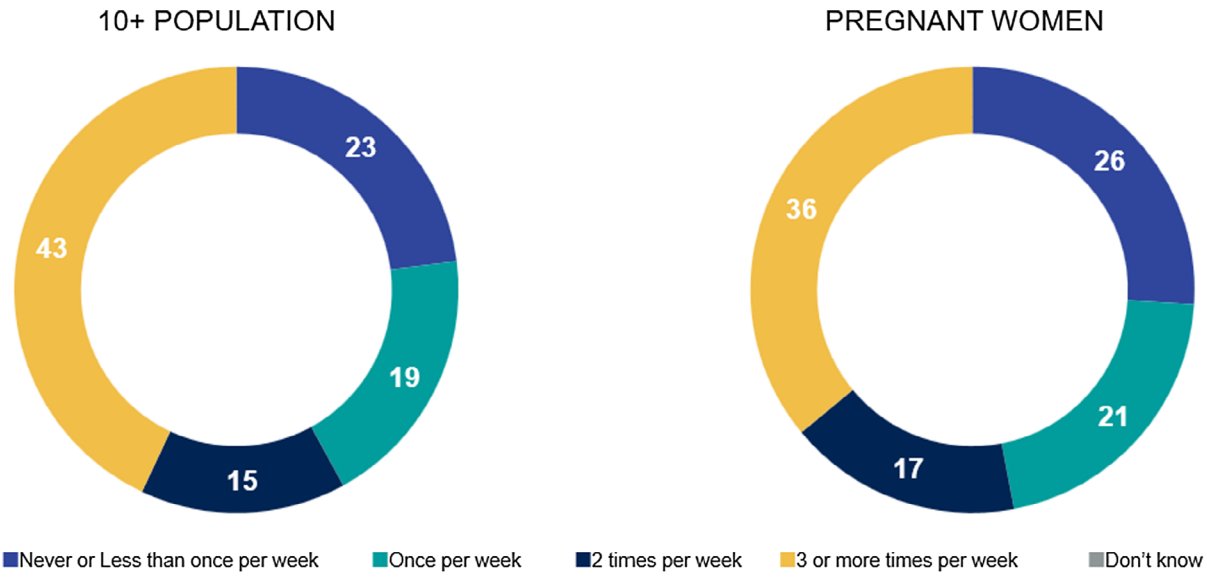

FIGURE 11 Consumption frequency of fish and other seafood species (mercury ML 0.3 mg/kg) among consumers in the 10 + population & pregnant women sample in all countries across the FPS & SPS *(Base: 10+ population both surveys (N = 10,761), Pregnant women both surveys (N = 3315). Question: Q5.1 Derived variable for fish and seafood species with mercury ML 0,3 mg/kg of wet weight as described in Section 2.7.3).*

3.1.5 | Season in which fish and other seafood are consumed the most

When consumers from the 10+ population and pregnant women were asked in the FPS and SPS about the season in which they consumed fish and other seafood species the most in the last 12 months, they commonly replied 'all year round', followed by 'the summer'. It is notable that a sizeable proportion of consumers indicated not knowing in which season they consumed specific fish/other seafood species the most (Figure 12).

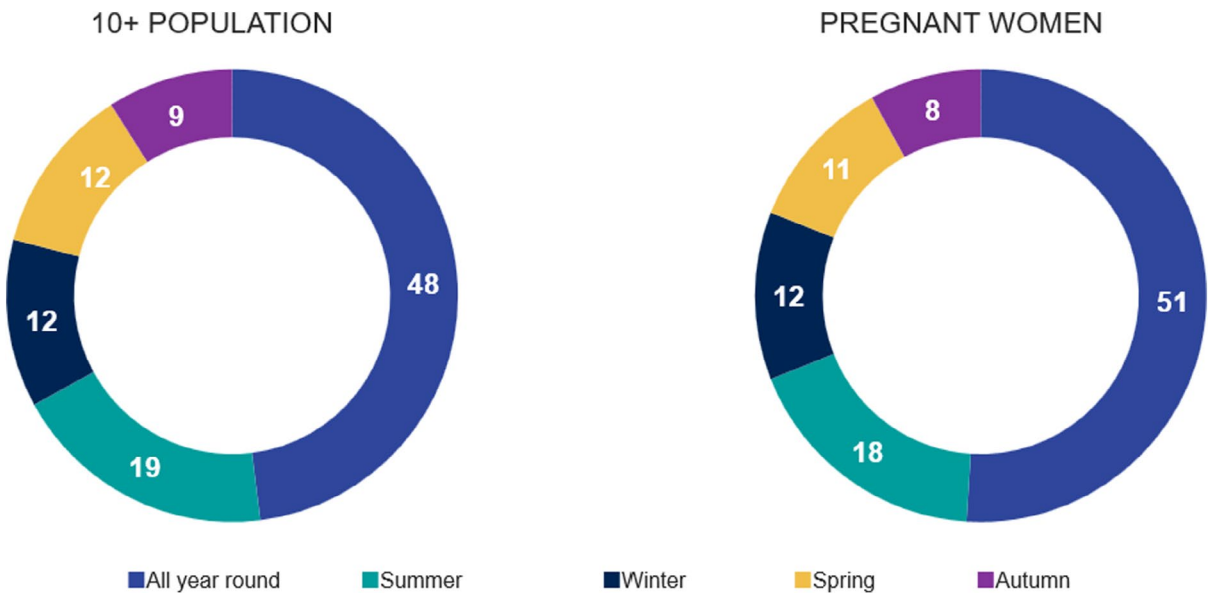

FIGURE 12 Season in which fish and other seafood species are consumed the most among consumers in the 10+ population and pregnant women samples in all countries across FPS and SPS *(Consumers indicating not knowing the season are excluded from this graph and those indicating consumption in multiple season are considered as 'all year round') (Base: 10+ population both surveys (N=10761), Pregnant women both surveys (N=3315). Question: Q5.2 When did you consume this fish/seafood species the most?).*

3.1.6 | Comparison of consumption frequency to relevant national advice

Recommendations for fish consumption can be retrieved from the evidence-based recommendations for healthy eating provided for all European counties in the European Commission's Health Promotion Knowledge Gate[9] page. In particular, most countries recommend two to three servings of fish per week, often specifying at least one serving of oily fish (rich in omega-3 fatty acids). Portion sizes vary from 100 to 200 g cooked fish per serving and emphasis is placed on variety, sustainability and limiting salted or smoked fish.

Before launching the SPS, EFSA reached out to all 27 EU MSs, Iceland and Norway to enquire about communication actions carried out prior to the upcoming survey to decide which countries to propose for inclusion. Ten countries, namely Austria, Belgium, Czechia, Cyprus, Denmark, Finland, Lithuania, Norway, Portugal and Spain replied positively, and the majority also shared further details and links. Most of the national advice targeted children and pregnant women. Predatory fish like shark, swordfish, tuna etc. were proposed to be avoided or consumed in limited quantities. Instead fish and seafood with a low mercury ML such as anchovies, sardines, salmon, etc. were suggested to be consumed more often. A reference to contamination with methylmercury was almost always made and a qualitative (portions per week) or quantitative (portion sizes) recommendation was given. More details and sources of information can be found in Appendix F.

Overall, although a decrease in consumption of fish and seafood species (and particularly of those targeted more through communication) may have been expected after the implementation of national advice strategies, the SPS did not provide evidence to support this. Instead, and based on comparisons of findings from the two-point surveys, all European consumers only populations taking part in these surveys reported an increase in all categories of fish and seafood consumption, irrespective of national strategies to inform consumers that were implemented between the survey periods.

3.2 | Consumer awareness of contaminants in certain fish species and shellfish

To answer the question whether consumers are aware of the presence of contaminants in specific fish, crustacean and mollusc species, and if yes, which contaminants, a targeted review was conducted focusing on keywords such as consumers, awareness, contaminants and fish, crustacean, mollusc. Literature from the past 5 years in Europe was initially prioritised. However, because few relevant papers were retrieved it was expanded to older and non-European literature, where relevant. Both peer-reviewed papers and grey literature were considered. The majority of the literature retrieved focuses on fish consumption, while crustacean and mollusc species are rarely investigated.

[9]https://knowledge4policy.ec.europa.eu/health-promotion-knowledge-gateway/food-based-dietary-guidelines-europe-table-9_en.

3.2.1 | Consumer awareness of contaminants generally

Overall, the reviewed literature showed that consumers generally have low awareness of contaminants. As mentioned above, regardless of awareness, people tend to eat or not eat fish and seafood for other reasons, e.g. cost, taste, availability and food preparation knowledge (see findings from the systematic review by Govzman et al., 2021).

For example, results from the Eurobarometer survey on EU consumer habits concerning fishery and aquaculture products (European Commission, 2025) indicate that health concerns, including allergies and metal contamination, account only for 9% of non-consumption reasons. The primary reasons for avoiding these products are taste, smell and appearance (41%). Cost is another significant factor, mentioned by 26% of respondents. Earlier qualitative research (Brunsø et al., 2009) indicated that consumers may experience (especially fresh) fish and seafood as costly not only owing to its price, but also because of experiencing the overall meal acquisition process (including among others planning, purchasing and preparation) as requiring more effort (i.e. being less convenient), and because of experiencing its consumption as providing less satiety and therefore requiring larger portions. Recent research by Spagnolo et al. (2025) in Italy revealed that approximately one-third of respondents (37.4%) perceive fish consumption as potentially hazardous due to contaminants, whereas 39.5% do not associate fish consumption with any risks.

Several studies investigated the potential differences in perception between farmed and wild fish. López-Mas et al. (2021) found that consumers in five European countries (France, Germany, Italy, Spain and the UK) perceive wild fish as more susceptible to marine pollution, heavy metals and parasites compared to farmed fish. A study by Pieniak et al. (2013) among European consumers (Czechia, Germany, Greece, Italy, Portugal, Romania, Sweden and the UK) showed similar results. Respondents most commonly knew that wild fish does not contain more mercury than farmed fish (68.5% correct answers in the total sample). The level of objective knowledge about fish was low and varied significantly between countries, with Southern European consumers generally displaying higher awareness. An earlier study with consumers in Belgium, Norway and Spain (Vanhonacker et al., 2011) and using the same objective knowledge statement about mercury in farmed vs. wild fish reported awareness levels in the same range as Pieniak et al. (2013), while underscoring that this stated awareness was associated with a low level of certainty about the response provided.

Govzman et al. (2021) conducted a systematic review of factors influencing seafood consumption in Europe, USA, Canada, Australia and New Zealand. Of 37 articles reviewed, five identified concerns about harmful contaminants in fish and seafood as a barrier to consuming fish and seafood. For pregnant women, belief about harmfulness was a notable barrier during pregnancy.

3.2.2 | Consumer awareness of specific contaminants

Overall, the majority of the reviewed literature on awareness of contaminants focuses on mercury and methylmercury. This is revealed also by the systematic review (Govzman et al., 2021) which reports that studies conducted on pregnant women identified concern for mercury content in fish as the most commonly reported barrier to consumption.

The recent study by Spagnolo et al. (2025) in Italy found that, among respondents acknowledging potential risks from fish consumption, 50.3% identified specific concerns, with chemical pollutants (such as methylmercury and other contaminants) being the most mentioned concern (81%), followed by the presence of pathogens (bacteria, viruses and parasites) (20%), the presence of antibiotics or bad preservation (6%) and generic risks linked to the consumption of raw fish alone (4%). Focusing on specific populations, a qualitative study on pregnant and breastfeeding women in Spain (Fontalba-Navas et al., 2020) showed that the discourses of participants reflected a lack of knowledge and a lack of adequate information on the subject. In the discourses analysed, exposure to pollutants like lead and mercury was mentioned and this exposure was related to direct health consequences.

Several studies in the United States (US) have focused on consumer awareness of contaminants in fish. For example, Lando and Zhang (2011) conducted trend analysis of food safety surveys that ran between 2001 and 2006 in the US and found that the population's awareness of mercury as a potential problem in fish increased from 69% to 80%. Knowledge of the information from national fish advisories also increased, as indicated by the increase in the percentage who could name a targeted at-risk group or fish listed in the national fish advisories. As compared to the non-target populations (not at risk), the target risk group of women of childbearing age did not have greater awareness and knowledge than the rest of the population. Consumers who prepared fish at home, who had experienced a foodborne illness in the household, or who were more alert on food safety issues, were more aware of mercury as a problem in fish and more knowledgeable about the information in the national advisories than others. A review focusing on consumers by Lando and Lo (2014) revealed that overall, consumers, including pregnant women, are generally aware of problems related to mercury contamination in some fish, but many do not know the specifics of the Federal government's national consumption advice for pregnant and lactating women (Frithsen & Goodnight, 2009; Lando & Zhang, 2011). Turaga et al. (2014) showed that mercury in fish was perceived to be a greater risk than air pollution, climate change and ecological degradation, but a lower risk than the risk from pollution of rivers and lakes.

A study by Burger and Gochfeld (2009) among fishermen and other recreationists in the north-eastern United States, reported that less than 25% of interviewees mentioned mercury, and less than 5% mentioned Polyclorinated Biphenyls (PCBs), the two contaminants of concern for fish.

Finally, a study from Japan (Murakami et al., 2017) revealed a link between consumption frequency and dread risk perception, i.e. high consumers of tuna-type fish were more concerned about mercury as they felt more exposed.

EFSA's survey results are in line with these findings in the literature. Results of the current survey revealed low awareness of chemical contaminants in seafood among European consumers, reflected by the low percentage of correct answers provided to questions assessing awareness and knowledge levels. When asked about awareness of the presence of chemical contaminants in fish and seafood, about two-thirds of the 10+ general population (65%) and about 6 out of 10 pregnant women (63%) answered none to three of the 12 questions correctly. A third of the 10+ population (33%) and the pregnant women (34%) answered four to eight of the questions correctly. Just 2% in each case gave 9 to 12 correct answers, showing very low awareness among the European population. As reported in the figure below from the SPS, the best-known contaminant is mercury (54% of respondents correctly saying that it is present in fish and seafood), followed by dioxins (29% of respondents). Furthermore, it is noteworthy that compared to other contaminants, mercury received the lowest share of 'don't know' answers, which underscores its position as the best-known contaminant in fish and other seafood among European consumers (Figure 13).

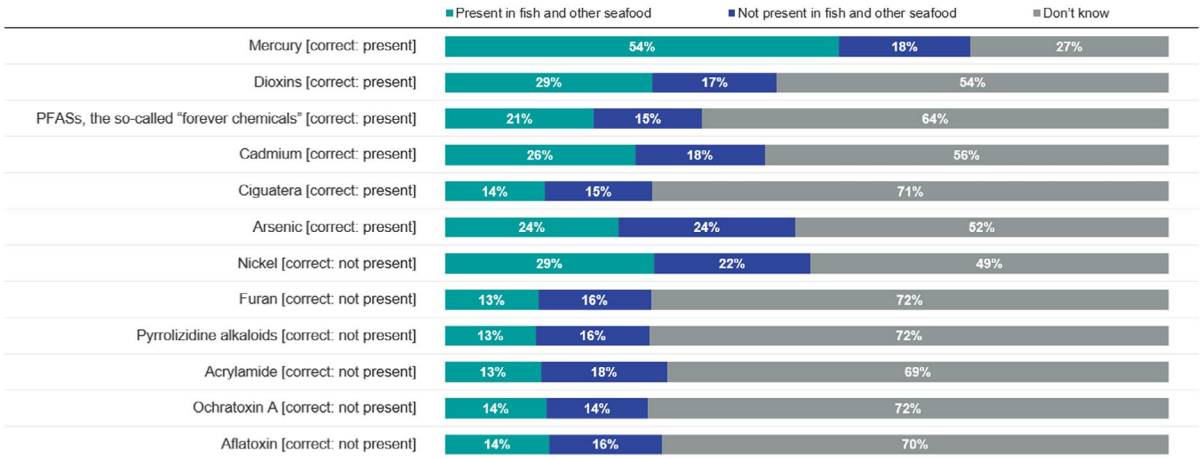

FIGURE 13 Awareness levels of presence of contaminants *(Base: All 10+ population (n = 6115). Question: Q12. For each of the following chemical contaminants, do you think they are present or not present in fish and other seafood?).*

Looking at cross-country differences in the SPS in the countries with updated advice, the proportion of 10+ population consumers who gave correct answers for only three or fewer of the chemical contaminants rose to over 70% in Portugal (76%), Norway (72%), Denmark (72%) and Cyprus (72%), and was lowest in Spain (58%), where 40% of respondents gave at least four correct answers. The proportion of pregnant women consumers who gave correct answers for only three or fewer of the chemical contaminants shows a greater degree of variation by country compared to the 10+ population consumers. It ranged from a high of 70% or more in Norway (72%), Denmark (71%) and Portugal (70%), to a low of around 40% in Czechia (41%) and Lithuania (40%) – where over half of respondents (54% and 56% respectively) gave at least four correct answers.

In the countries with no updated advice, the proportion of 10+ population consumers who gave correct answers for only three or fewer of the chemical contaminants was over 70% in Iceland (72%) and France (71%), and was lowest in Greece (61%), where 38% of respondents gave at least four correct answers. The proportion of pregnant women consumers who gave correct answers for only three or fewer of the chemical contaminants ranged from over 70% in Sweden (76%) and France (73%) to about 60% in Germany (61%) and Greece (60%).

Looking at the awareness findings for the second question about which contaminants are found in different types of fish, crustaceans and molluscs across all countries and both survey points, only 3% gave 7 to 10 correct answers, confirming low awareness in general about chemical contaminants in fish and other seafood. About 7 in 10 of the 10+ population (69%) and almost two-thirds of the pregnant women (64%) answered none to three of the statements correctly. Roughly 3 in 10 of the 10+ population (28%) and a third of the pregnant women (32%) answered four to six of the questions correctly (Figure 14).

As reported in the figure below from the SPS, the highest levels of knowledge were recorded for the statement 'Some toxins produced by algae can contaminate molluscs and crustaceans' (41% of correct answers) and 'Predator fish like tuna, swordfish, cod, whiting and pike, are a major source of mercury in the diet' (37% of correct answers). Importantly, 31% of respondents incorrectly believed that 'Fatty/oily fish such as salmon and trout are the highest contributors to mercury in the diet'.

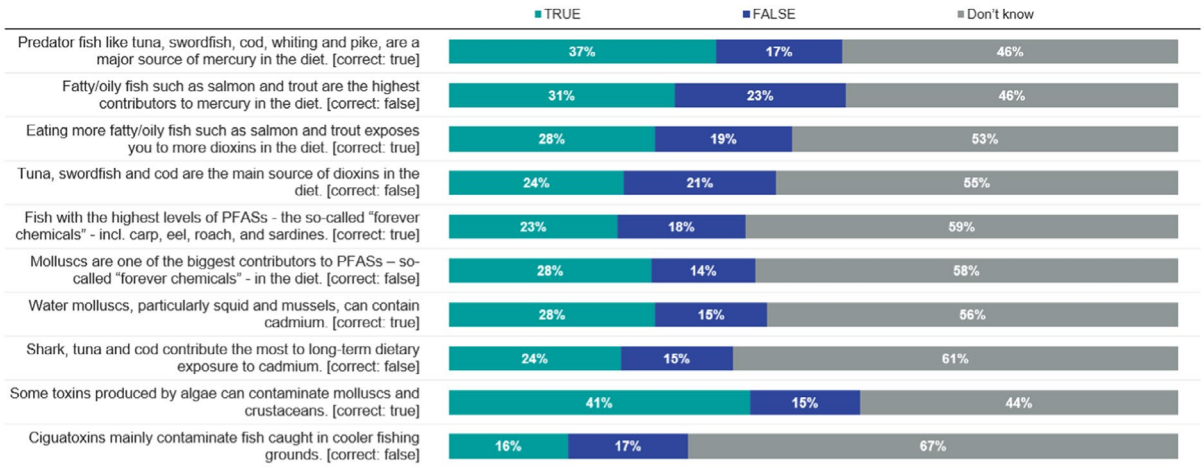

FIGURE 14 Awareness levels of presence of contaminants in fish and/or other seafood. *(Base: All 10+ population (n = 6115). Question: Q13. Which of the following statements about chemical contaminants in fish and/or other seafood do you think are correct?).*

The proportion of 10+ population consumers in the countries with updated advice who correctly answered only three or fewer of the statements remained at or above the 60% mark in all countries. It was highest in Cyprus, Portugal and Norway (79%, 75% and 75% respectively), and lowest in Spain (68%), Belgium (64%) and Austria (62%), where about a third of consumers answered at least four or more of the statements correctly. The proportion of pregnant women consumers who correctly answered only three or fewer of the statements rose to over 70% in Finland (74%), Cyprus (72%) and Portugal (71%), and was lowest in Czechia (56%), Belgium (55%) and Spain (53%).

In the countries with no updated advice, the proportion of 10+ population consumers who correctly answered only three or fewer of the statements was highest in Greece (75%) and Iceland (74%) and lowest in Germany (66%). The proportion of pregnant women consumers who correctly answered only three or fewer of the statements was higher than 70% in France and Ireland (72% in each case) and was lowest in Germany (58%), where 40% of pregnant women consumers answered at least four of the statements correctly.

Considering all consumers, across all countries and both survey points, 9 in 10 (90%) of the 10+ population and almost all pregnant women (96%) who said they had decreased their consumption of fish/other seafood in the last year, reported that they specifically decreased their consumption of fish/other seafood contaminated with mercury or other contaminants. It is important to note that no differences were found between countries with updated advice and countries without updated advice (see Figures 15 and 16 below for mercury and 16 for contaminants).

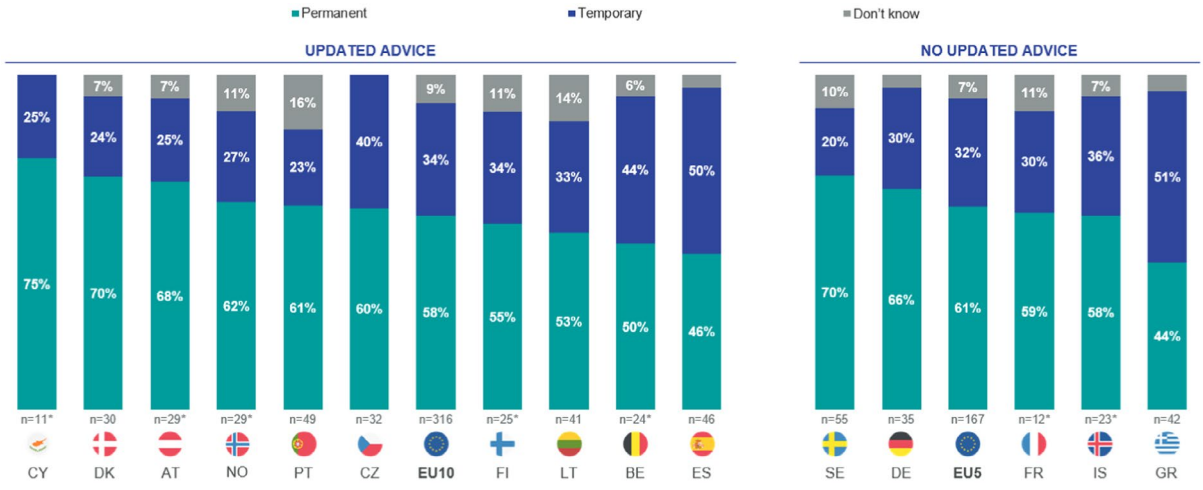

FIGURE 15 Overview of respondents who state they decreased their consumption of seafood species contaminated with mercury *(Base: Respondents who reported having decreased their consumption of other seafood in the past year: Countries with updated advice (n = 316), Countries with no updated advice (n = 157). Question: Q8.4.2. Do you intend this change in consumption to be permanent or is it temporary (for example, a few months)?)*

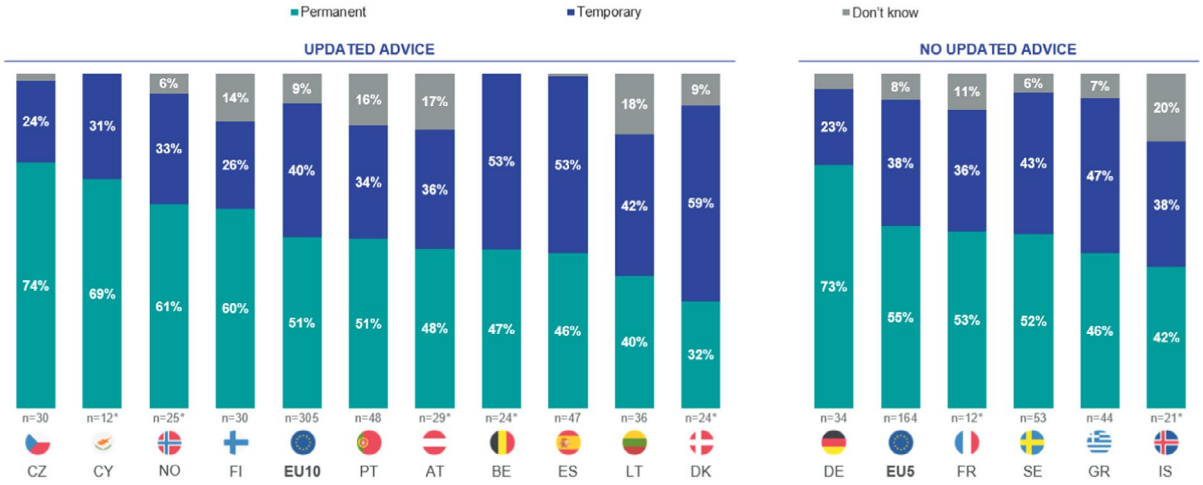

FIGURE 16 Overview of respondents who state they decreases their consumption of seafood species with contaminants *Base: Respondents who reported having decreased their consumption of other seafood in the past year: Countries with updated advice (n = 305), Countries with no updated advice (n = 164). Question: Q8.4.2. Do you intend this change in consumption to be permanent or is it temporary (for example, a few months)?*

In both groups of countries – those with updated advice and those without – decreased consumption of fish/seafood contaminated with mercury/other contaminants was reported by at least 9 out of 10 of the relevant 10+ population consumers in all countries. In the countries with updated advice, the highest figures were recorded in Lithuania (100%), Czechia (98%) and Portugal (97%), while comparatively lower figures were recorded in Finland (91%) and Denmark (90%).

In the countries with no updated advice, the highest figures were recorded in Iceland and Greece (100% in both cases), while the lowest figures were found in Sweden (93%) and France (89%).

Decreased consumption of fish/seafood contaminated with mercury/other contaminants was reported by even larger proportions of the relevant pregnant women consumers across the countries with both updated and no updated advice. In nine of the countries with updated advice – Belgium, Czechia, Denmark, Spain, Lithuania, Austria, Portugal, Finland and Norway – all of the pregnant women who had reduced their fish/seafood consumption over the last 12 months had specifically chosen to eat less contaminated fish/seafood.

Similarly, in four of the countries with no updated advice – Germany, Greece, France and Iceland – all of the pregnant women who had reduced their fish/seafood consumption over the last 12 months had specifically chosen to eat less contaminated fish/seafood.

3.2.2.1 | *Conclusions on consumer awareness of contaminants in certain fish species and shellfish*

- European consumers generally have low awareness of contaminants in fish, crustaceans and molluscs
- Within the studies that explored awareness of various contaminants, mercury and methylmercury are the most recognised among consumers, particularly pregnant women
- The literature reviewed shows that detailed knowledge about national consumption advice of the countries in which studies were conducted remains limited
- The findings from EFSA's survey reveal lack of differences in consumption and awareness between countries with updated advice and those without updated advice, while some cross-country differences emerge.

3.3 | Consumer awareness of consumption advice and their information sources for such advice

This section aims to address 'whether the consumers are aware of the existence of consumption advice for limiting the consumption of specific fish, crustacean and mollusc species due to the occurrence of mercury and, if yes, whether this concerns advice from the national competent authorities or from other sources'.

To answer these questions, a targeted review focusing on keywords such as consumers, awareness, 'consumption advice', national, institutional, contaminants and fish, food was conducted. Literature from the past 5 years in Europe was initially prioritised, however older and non-European literature, where highly relevant, was also included. Both peer-reviewed papers and grey literature were considered.

3.3.1 | Consumer awareness of consumption advice

Overall, there is limited evidence from the literature on consumers' awareness of consumption advice, with studies often focusing on specific contexts/guidance as reported next. In a US study comprising a survey focusing on fish consumption

habits and awareness of state and EPA/FDA fish consumption advisories among Great Lakes basin residents, He et al. (2022) found that while half of the fish consumers were aware of fish advisories, there was less awareness among non-white and female consumers. More recently, Petali et al. (2024) carried out a review of challenges, knowledge gaps and needs associated with fish consumption advisories, with a focus on PFAS-related fish advisories/guidance for safer consumption. As noted by the authors and prior research (Burger & Gochfeld, 2009; Engelberth et al., 2013; as cited by Petali et al., 2024), adoption of recommended official guidance by the respective population depends on a number of factors, such as their risk perceptions about PFAS, guidance understanding and trust in the associated authorities, all of which can affect the populations' willingness to change its habits to comply with the advice. In a recent scoping review, Minnens et al. (2025) assessed 40 tools that aim at assisting consumers in making seafood consumption choices that align with their health, environmental and social interests. One quarter of the identified tools provide an option to estimate mercury intake from fish and seafood consumption. In some of these tools, the outcome is compared with consumption advice and eventually also an alert or warning is provided, and a possible alternative is suggested. The review neither assessed the validity and reliability of the content of the tools, nor the accuracy of eventual resulting advice and concludes among others that the increasing availability of tools offering consumption advice presents a challenge for consumers.

EFSA's survey and, in particular, its results on national advice on the health benefits and/or risks of eating fish and seafood from the public health authority in their country extend these findings. The survey revealed that, overall (i.e. across all countries and both survey points), 32% of respondents belonging to the 10+ population claimed to have heard of national advice. Contrasting the FPS and the SPS, results showed an increase in the proportion of 10+ population consumers who were aware of this advice (36% in SPS vs. 31% in FSP; see Figure 17). Among pregnant women, 37% of respondents had heard of national advice, but there were no significant differences between survey points.

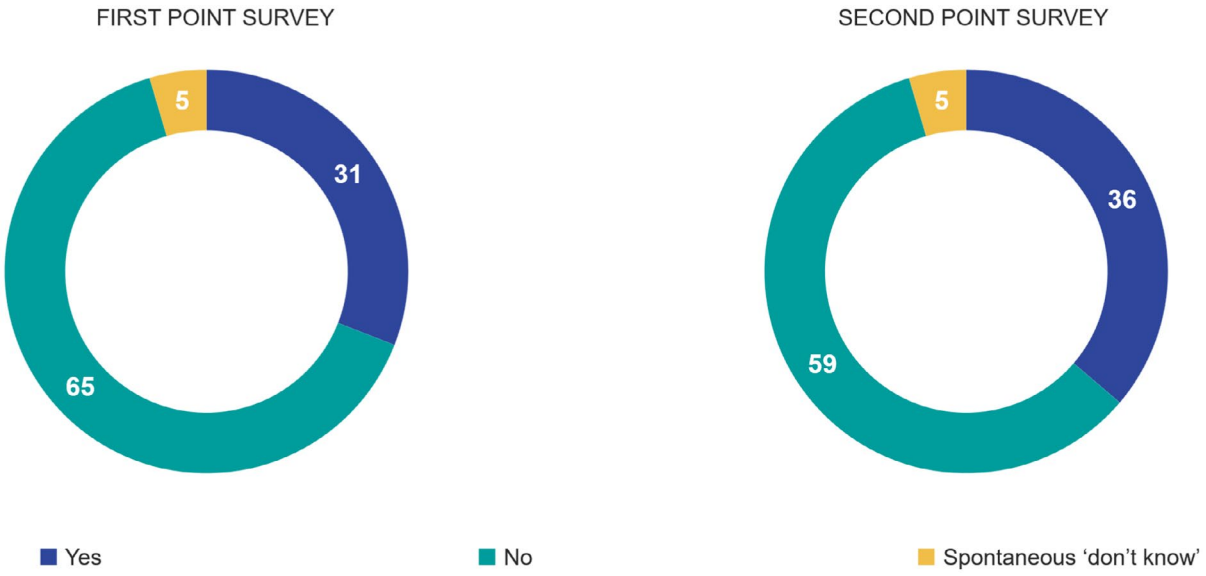

FIGURE 17 Awareness of national advice among 10+ population consumers in FPS (% - EU27 + Iceland & Norway) and SPS (% - EU13 + Iceland & Norway). (Base: 10+ population FPS (*N* = 11,896) and SPS (*N* = 6115). Question: *Q10. Have you heard of any national advice on the health benefits and/or risks of eating fish and seafood from the public health authority in [your country]?).*

As indicated earlier, the SPS was carried out both in the 10 countries (nine EU MSs and Norway) that had issued updated advice on fish consumption prior to FPS, and five countries (four EU MSs and Iceland) that had not, i.e. as a control. Accordingly, respondents in countries which issued updated advice were also asked whether they had heard of this updated advice. Results revealed that around 4 in 10 of the 10+ population consumers (36%) and of the pregnant women consumers (40%) had heard of it (Figure 18).

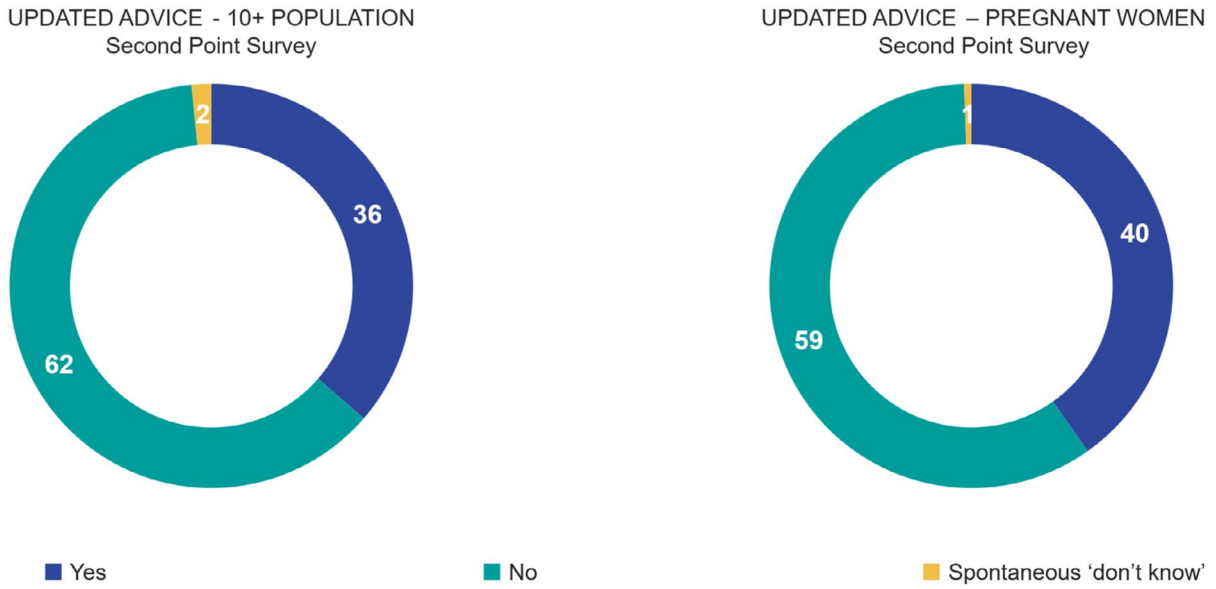

FIGURE 18 Awareness of recently updated advice among 10+ population and pregnant women consumers in countries with updated advice, in SPS (% - EU9 + Norway). (Base: 10+ population SPS (*N* = 4067) and pregnant women SPS (*N* = 1320). Question: *Q10.1. The public health authority in [your country] has recently updated its advice on the health benefits and/or risks of eating fish and seafood consumption. Have you heard of it?)*

The EFSA survey also asked respondents about certain health risks and benefits associated with fish and other seafood consumption to explore their objective knowledge of the topic. Respondents were required to indicate whether a series of 12 health outcomes are benefits or risks of fish and other seafood consumption, or neither. The health outcomes, whether the effects from fish and seafood consumption are beneficial or potentially harmful, and an explanation are presented in Table 9.

TABLE 9 Risks and benefits associated with fish and other seafood consumption.

Health effect	Type	Explanation
Thyroid function in adults	Benefit	Iodine (cod, tuna, crustaceans) for thyroid hormone synthesis; Omega-3 Fatty Acids (oily fish especially salmon) help manage autoimmune thyroid conditions; Selenium (tuna, shrimp) protects thyroid cells, supporting immune function; and Zinc (crustaceans) immune health and thyroid function.
Teeth and bone health at all ages	Benefit	Calcium and Phosphorus (sardines, salmon) build strong bones and teeth; Vitamin D (oily fish) for calcium absorption.
Bones and muscle function in adults	Benefit	Protein (all fish/other seafood) for building, repairing, maintaining muscle tissue and strong bones; vitamin D (oily fish e.g. salmon, mackerel) for calcium absorption and bone health, helping prevent osteoporosis; Phosphorus, calcium, zinc, magnesium and iron, supporting bone density and muscle function; Omega-3 Fatty Acids: Anti-inflammatory properties, protecting skeletal muscle and improving muscle performance, especially beneficial in older adults.
Brain function and vision in unborn children	Benefit	Omega-3 Fatty Acids (oily fish especially salmon) essential for fetal brain and retina development, crucial for neural connections, vision, memory and cognitive function.
Hearing development of unborn children	Risk	Harm to an unborn child's hearing development from mercury in predator and white fish and other seafood (consumed by pregnant women).
Semen quality of unborn male children	Risk	Reduced semen quality in males from dioxins and PCBs in oily fish (consumed by pregnant women)
Liver function in adults	Risk	Dioxins and dioxin-like PCBs (oily fish) increase the risk of liver disease and disorders in adults
Antibody response to vaccination in adults	Risk	Per- and Polyfluoroalkyl Substances (PFAS) (found in fish meat) impair immune function reducing vaccine antibody responses in adults
Reproductive system of unborn female children	Neither/Nor	Not strongly associated with fish/other seafood intake
Taste development of unborn children	Neither/Nor	Not strongly associated with fish/other seafood intake
Sense of touch in adults	Neither/Nor	Not strongly associated with fish/other seafood intake
Skin sensitivity in adults	Neither/nor	Not strongly associated with fish/other seafood intake

Figure 19 shows the overall results from the FPS among the 10+ population. Awareness (or more accurately objective knowledge) that fish and seafood consumption are associated with beneficial 'Bone and muscle function in adults' and with

'Teeth and bone health at all ages' were answered correctly by over half of respondents with 60% and 58% correct responses, respectively. 'Brain function and vision in unborn children' – a benefit referenced in relation to consumption of fish and other seafood during pregnancy – was answered correctly by almost half of the total sample (49%). The other benefit, 'Thyroid function in adults', was answered correctly by over one-third of respondents (38%). Conversely, the percentages of correct responses to the four 'risks' on the list of health effects were low, ranging from 10% to 14%. Some 44% incorrectly indicated 'Liver function in adults' as a benefit of fish and other seafood consumption, while it is a risk associated with exposure to dioxins and dioxin-like PCBs in oily fish (also in animal meat). Approximately one in four respondents (from 23% to 28%) answered all four of the neither/nor outcomes correctly and the share of 'Don't know' replies was over one-third of respondents for most of the risks and all of the neither/nor statements. Among pregnant women in the FPS, correct answers mirrored those for the 10+ population with only minor differences. Similarly, there were no significant differences in the shares of correct replies among either the 10+ population or pregnant women between the FPS and the SPS.

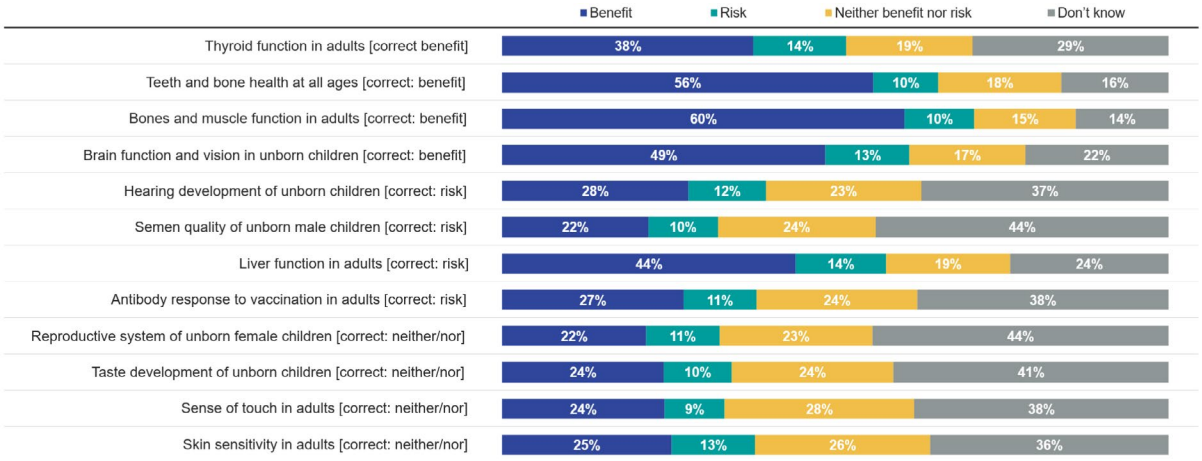

FIGURE 19 Knowledge of selected benefits and selected risks from fish and other seafood consumption among the 10+ population ($n = 11,765$) in the 27 EU Member States, Iceland and Norway, FPS. *Question: Q11. Consumption of fish and other seafood can be beneficial for some aspects of our health but can also have health risks. For each of the following health aspects, can you each time say whether you think fish and other seafood consumption is a benefit, a risk or neither of those?*

More differences in knowledge of the benefits and risks were visible when comparing the results across countries. The results from the FPS which included all 27 EU MS plus Iceland and Norway follow. Figure 20 (10+ population) and Figure 21 (pregnant women) report the responses across countries for a benefit ('Brain function and vision in unborn children') linked to consumption of fish/other seafood by pregnant women. Figure 22 (10+ population) and Figure 23 (pregnant women) report the results across countries for a risk ('Hearing development of unborn children') associated with the related exposure to mercury of the fetus.

Among the 10+ population (Figure 20), compared to the EU27 + 2 average of 49%, correct responses to the benefit 'Brain function and vision in unborn children' ranged widely from 62% in PT and IE (with IS, RO, PL, EE, ES and IT close behind them) to 30% in AT and 31% in DE at the other end of the scale.

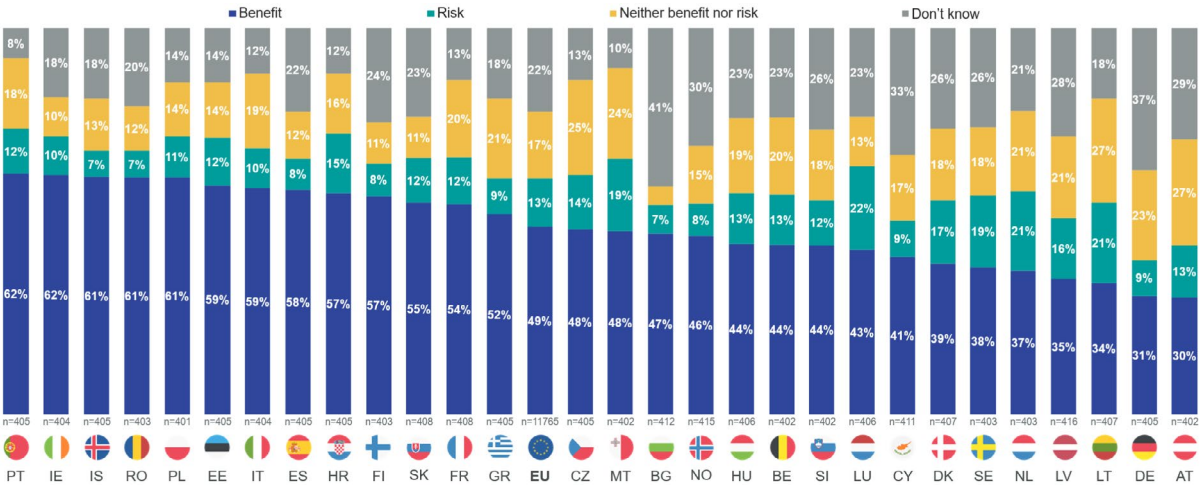

FIGURE 20 Knowledge that 'Brain function and vision in unborn children' is a benefit of fish and other seafood consumption, among the 10+ population in the 27 EU Member States, Iceland and Norway, FPS *Question: Q11. Consumption of fish and other seafood can be beneficial for some aspects of our health but can also have health risks. For each of the following health aspects, can you each time say whether you think fish and other seafood consumption is a benefit, a risk or neither of those?*

Knowledge among pregnant women (Figure 21) differed in some cases to the 10+ population. In particular, 74% of pregnant women in GR responded correctly, compared to 52% of the 10+ population in GR. Major differences were also visible in LT (51% pregnant women vs. 34% 10+ population) and LV (49% vs. 35%). Significant differences in other countries included: DE (39% vs. 31%), HR (64% vs. 57%) and PL (66% vs. 61%). The results in IS indicated lower knowledge of this health benefit among pregnant women (43%) than in the 10+ population (61%), a similar effect also emerged in SE (27% vs. 38%).

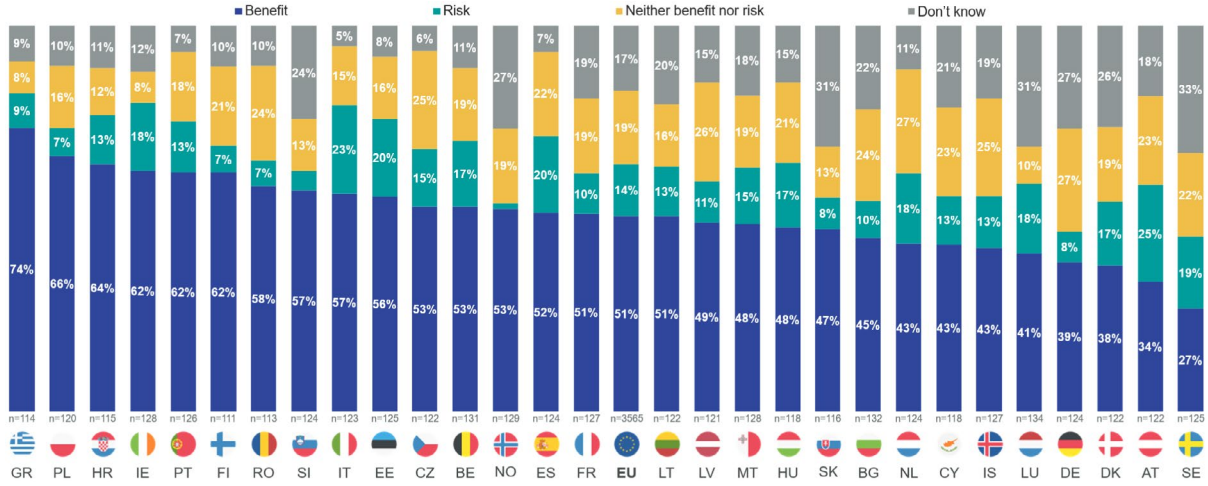

FIGURE 21 Knowledge that 'Brain function and vision in unborn children' is a benefit of fish and other seafood consumption, among pregnant women in the 27 EU Member States, Iceland and Norway, FPS *Question: Q11. Consumption of fish and other seafood can be beneficial for some aspects of our health, but can also have health risks. For each of the following health aspects, can you each time say whether you think fish and other seafood consumption is a benefit, a risk or neither of those?*

As noted above, objective knowledge of all four 'risks' included in the list was low. While the EU27 + 2 average for the 10+ population (Figure 22) for 'Hearing development of unborn children' was 12%, there were cross-country differences with knowledge of this 'risk' somewhat higher in LU (22%), NL (21%), LT (21%), MT and SE (both 19%).

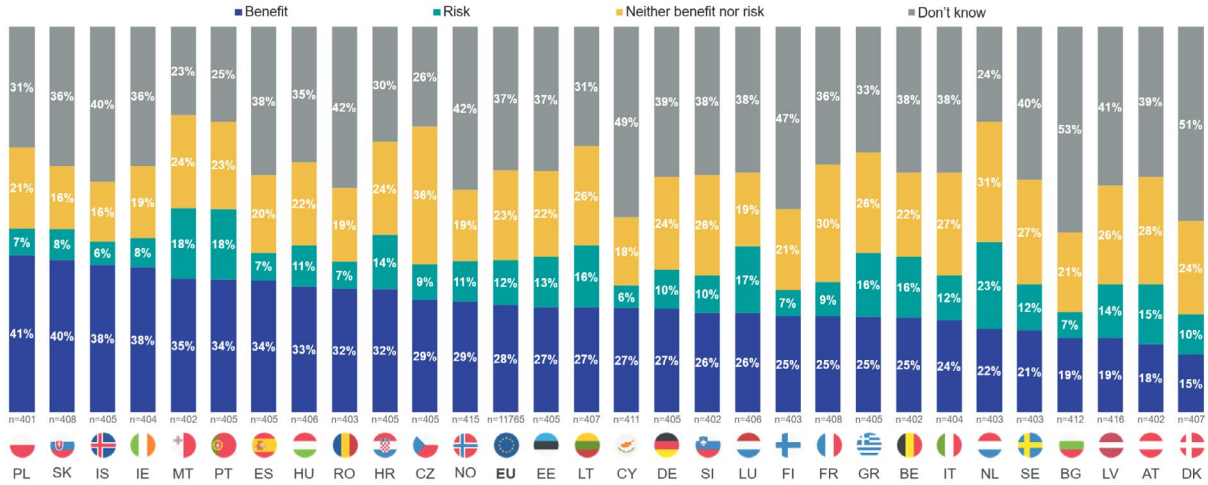

FIGURE 22 Knowledge that 'Hearing development in unborn children' is a risk from fish and other seafood consumption, among the 10+ population in the 27 EU Member States, Iceland and Norway, FPS.

Among pregnant women (Figure 23), the EU27 + 2 average was slightly higher than the 10+ population at 14%. Pregnant women in SE and AT were more likely to answer correctly than in other countries with 33% and 26%, respectively.

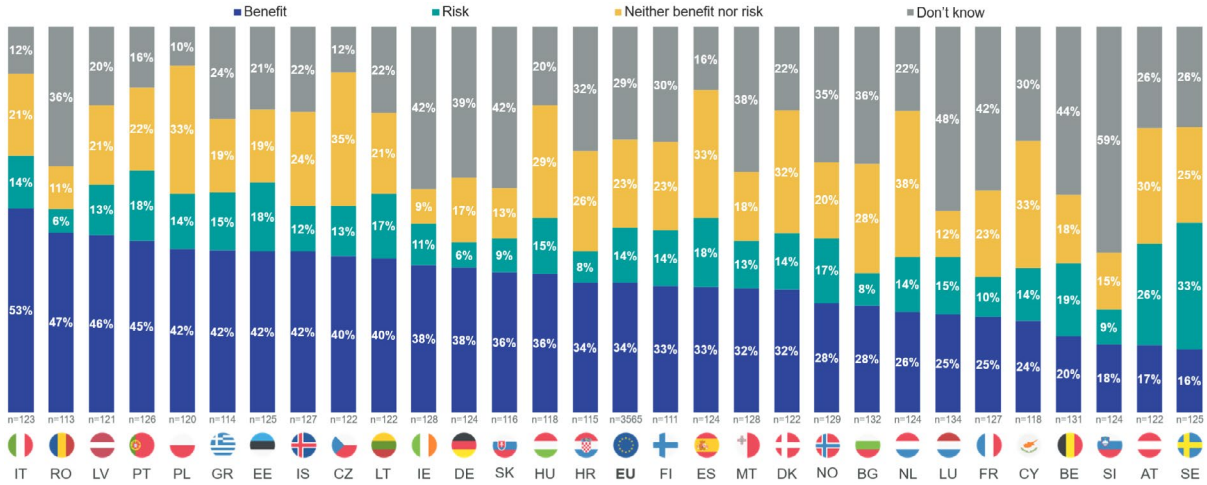

FIGURE 23 Knowledge that 'Hearing development in unborn children' is a risk from fish and other seafood consumption, among pregnant women in the 27 EU Member States, Iceland and Norway, FPS *Question: Q11. Consumption of fish and other seafood can be beneficial for some aspects of our health, but can also have health risks. For each of the following health aspects, can you each time say whether you think fish and other seafood consumption is a benefit, a risk or neither of those?*

3.3.1.1 | *Conclusions on consumer awareness of consumption advice*

- There is limited evidence from the literature on consumers' awareness of consumption advice, with studies often focusing instead on specific contexts/guidance (e.g. Minnens et al., 2025).
- The findings from EFSA's survey reveal that around 4 in 10 of the 10+ population consumers and of the pregnant women consumers in the 10 countries that had issued updated advice had heard of the advice.
- Objective knowledge of human health benefits associated with fish and other seafood consumption is significantly higher among consumers (with correct responses ranging from 38% to 60% for four health benefits tested) than objective knowledge of risks (ranging from 10% to 14% correct responses for the four health risks tested) from exposure to contaminants in fish and other seafood.
- There are significant differences across countries and at national level (between the 10+ population and pregnant women) for objective knowledge of specific human health benefits associated with fish and other seafood consumption and risks from mercury exposure, which national authorities may find useful for their communication on this topic.

3.3.2 | Information sources used by consumers

By means of a consumer survey in eight European countries (Germany, Sweden, Italy, Greece, Romania, Portugal, Czechia and the UK), Pieniak et al. (2013) investigated consumers' interest in information cues about fish products and their use of information sources. The strongest interest in information cues was recorded for a label indicating quality and/or safety, followed by nutritional information and information about the product being farmed of fished in a sustainable manner. With respect to information sources, claimed use was the highest for the product label, followed by sellers, the internet and television. Information from non-governmental organisations, institutional campaigns and consumer associations were mentioned as the three least used sources of information. This study did not focus specifically on interest in consumption advice or on sources providing such advice. The recent Eurobarometer survey on food safety in the EU27 (EFSA, 2025) provides European and country-level data on the extent to which consumers use different sources of information. Results indicate that television (on a TV set or via the internet) (55%), followed by exchanges with family, friends, neighbours or colleagues (42%) and internet search engines (38%) are the main sources of information about food risks. By contrast, only around 2 in 10 (8%) indicated relying on institutional websites (e.g. from public authorities). Results also indicated that preferences about food information sources varied as a function of some socio-demographics such as age, education or awareness of food risks. For example, younger age groups were more likely to indicate online sources: internet search engine (50% of those aged 15–24, compared with 27% of those aged 55 or older), online social networks and blogs (48%, compared with 13%) and institutional websites (23%, compared with 12%). Further, respondents with higher levels of awareness of food risks were more likely to rely on a broader range of information sources. Specifically, among others, they tended to select exchanges with family, friends, neighbours or colleagues (44%–46% of those with a high or very high awareness level, compared with 27% of those with a very low level) or institutional websites (20%–23%, compared with 13%) more frequently. Focusing on a different, but related topic, Connelly et al. (2022) examined how to effectively communicate seafood consumption guidelines to pregnant women in the US. Among others, their results suggested the importance of distribution of guidance through health care professionals (e.g. Obstetrics/Gynaecology offices) as these were often trusted sources.

In EFSA's survey, respondents who indicated that they had changed (i.e. increased or decreased) their consumption of fish/other seafood in the last 12 months, were presented with a list of different sources of information and asked to indicate, for each, the extent to which it had led them to change their consumption or not. The corresponding results are reported below, starting with findings for respondents from countries with updated advice and then for respondents from countries without, while providing a breakdown by type of population (10+ population consumers vs. pregnant women consumers) in each case.

Across the 10 countries that had issued updated advice, SPS results for the 10+ population who had changed their consumption revealed that more than one-third reported that institutional websites (e.g. from public authorities such as the national government) or other websites (e.g. from consumer organisations) (35% and 38%, respectively) had led them to change their consumption behaviour to a large/to some extent. Notably, there was a significant increase between the FPS and the SPS in the percentage who indicated that these sources had led them to change their fish/other seafood consumption 'to a large extent' (12% in FSP vs. 15% in SPS for institutional websites; and 12% in FSP vs. 16% in SPS for other websites). Additionally, results showed a significant decrease between FPS and SPS in the percentage indicating that institutional websites (39% vs. 34%), did 'not at all' lead them to change their consumption.[10] SPS data also revealed that family, friends, neighbours or colleagues, as well as TV (on a TV set or via the internet) were the top sources. Specifically, in both cases, about half (49%) indicated that it had led them to change their consumption of fish/other seafood to a large/to some extent, and these results were similar to those observed in the FSP (see Figure 24).

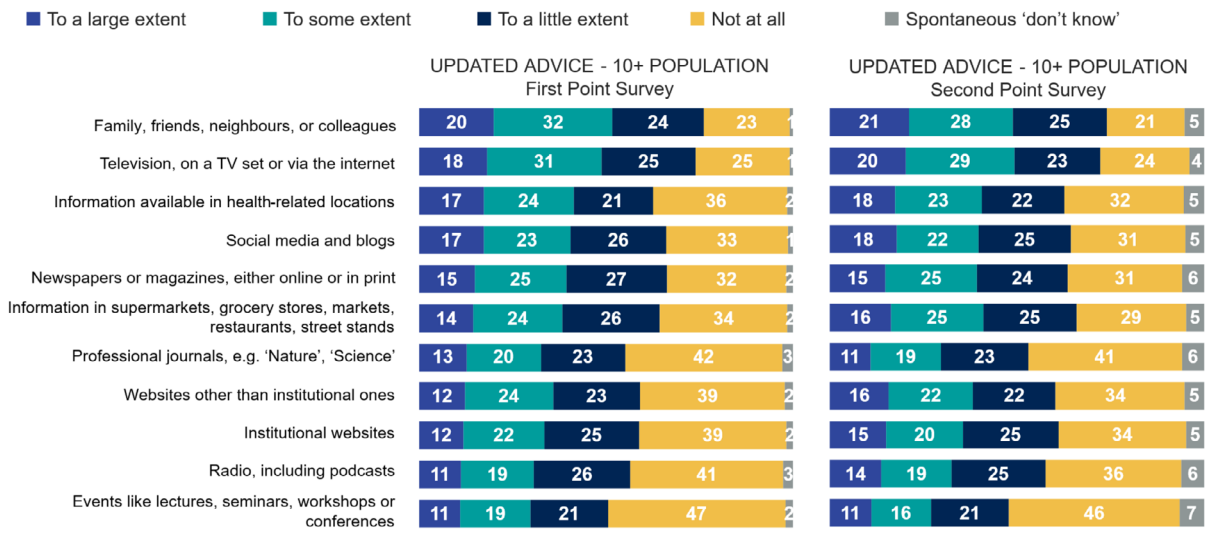

FIGURE 24 Extent to which sources/types of information led to change in fish/other seafood consumption among 10+ population consumers in countries with updated advice, for FPS (left) and SPS (right) (% - EU 9 + Norway). (Base: 10+ population FPS ($N = 1368$) and SPS ($N = 1424$). Question: *Q9.1. To what extent, if at all, did any of the following sources or types of information lead you to change your consumption of fish and other seafood?)*

Results for pregnant women consumers from the 10 countries with updated advice were largely similar to those for the 10+ population consumers. SPS results revealed that more than one-third of pregnant women respondents who had changed their consumption reported that institutional websites (e.g. from public authorities such as the national government) or other websites (e.g. from consumer organisations) (34% and 37%, respectively), had led them to change their consumption to a large/to some extent. Moreover, also in line with what was found for the 10+ population consumers, SPS data for pregnant women consumers revealed that family, friends, neighbours or colleagues (52%), as well as TV (on a TV set or via the internet) (49%) were the top sources. Information available in health-related locations was another common information source, with 45% indicating that it had led then to change their consumption of fish/other seafood to a large/to some extent. Results showed no significant differences between FPS and SPS, except for a decrease in the share who indicated that lectures, seminars, workshops or conferences did 'not at all' lead them to change their consumption of fish/other seafood (46% in FPS vs. 38% in SPS) (see Figure 25).

[10]Regarding the 10+ population consumers from countries with updated advice, a significant decrease between FPS and SPS was also observed in the percentage that indicated that information in supermarkets, grocery stores, markets, restaurants and street stands (34% FPS vs. 29% SPS), and radio, including podcasts (41% FPS vs. 36% SPS) did 'not at all' lead them to change their consumption of fish/other seafood.

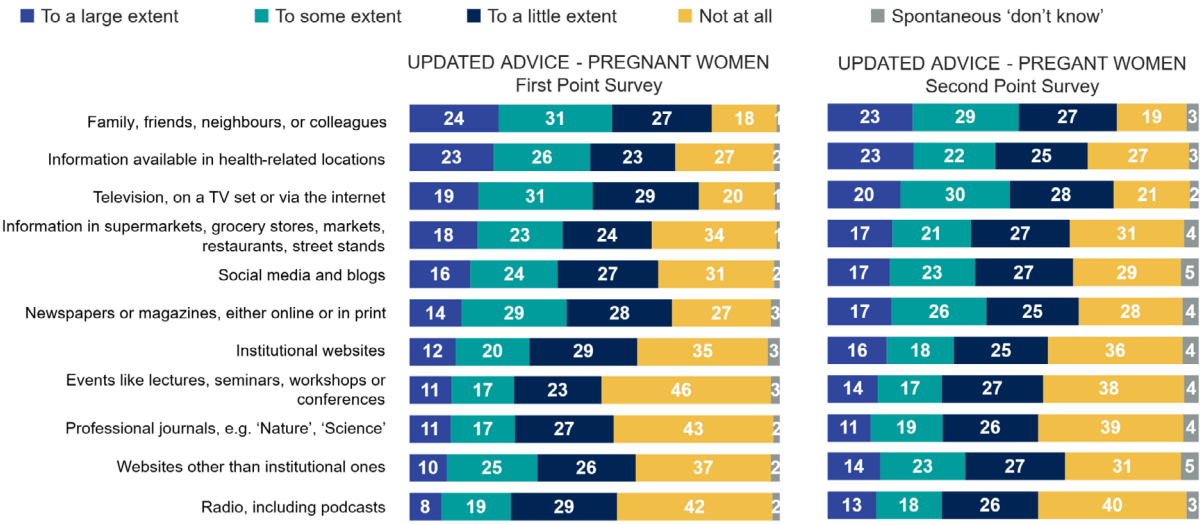

FIGURE 25 Extent to which sources/types of information led to change in fish/other seafood consumption among pregnant women consumers in countries with updated advice, FPS (left) and SPS (right) (% - EU 9+Norway). *(B*ase: Pregnant women FPS (*N* = 418) and SPS (*N* = 445). Question: *Q9.1. To what extent, if at all, did any of the following sources or types of information lead you to change your consumption of fish and other seafood?).*

Finally, turning to results for 10+ population consumers in countries with no updated advice SPS results showed largely similar results to those observed for this population in countries with updated advice. Namely, around one-third indicated that institutional websites (e.g. from public authorities such as the national government) or other websites (e.g. from consumer organisations) (33% and 38%, respectively), had led them to change their consumption of fish/other seafood to a large/to some extent. Moreover, family, friends, neighbours or colleagues (52%), as well as TV (on a TV set or via the internet) (46%) were also the top sources leading them to change their consumption to a large/some extent.

By contrast, SPS results for pregnant women consumers in countries with no updated advice, were slightly different compared to the other subgroups (i.e. 10+ population consumers in countries with/without updated advice, and the pregnant women consumers in countries with updated advice). Specifically, slightly less than one-third indicated that institutional websites (e.g. from public authorities such as the national government) (31%) had led them to change their consumption behaviour to a large/to some extent. Moreover, while around half of pregnant women consumers in countries with no updated advice also reported that family, friends, neighbours or colleagues had led them to change their consumption of fish/other seafood to a large/some extent (49%), this was followed by influence from information in supermarkets, grocery stores, markets, restaurants and street stands (46%). By contrast only 4 in 10 indicated that TV (on a TV set or via the internet) (40%) had influenced them, and this was similar to the effect on their consumption of social media and blogs, e.g. YouTube, Facebook, Instagram, TikTok (41%) and information in health-related locations (40%). Although there were some fluctuations between FPS and SPS, no significant differences were found for these or other sources/types of information (see Figure 26).

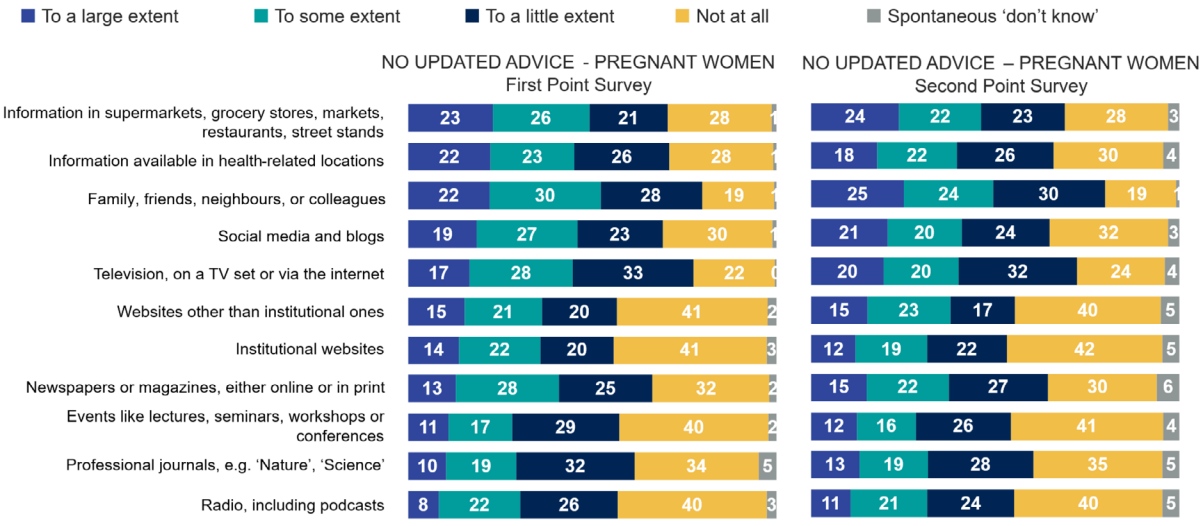

FIGURE 26 Extent to which sources/types of information led to change in fish/other seafood consumption among pregnant women consumers in countries with no updated advice, FPS (left) and SPS (right) (% - EU 4+Iceland). (Base: Pregnant women FPS (*N* = 214) and SPS (*N* = 284). *Question: Q9.1. To what extent, if at all, did any of the following sources or types of information lead you to change your consumption of fish and other seafood?).*

3.4 | Impact of national consumption advice on consumers

This section aims to address the question of 'whether the consumers take into account the MSs' advice or not, or to a limited extent' in their fish and other seafood consumption behaviours.

To answer this question, a targeted review focusing on keywords such as advice, policy, 'consumption advice', contaminants, fish and seafood was conducted. Literature from the past 10 years in Europe was prioritised, however older and non-European literature, where highly relevant, was also included. Both peer-reviewed papers and grey literature were considered. Overall, the literature on behaviour change in response to national dietary advice on fish and seafood consumption in European countries is scarce.

Government policies are only one of many factors influencing food consumption behaviour alongside other factors such as cost and taste (see e.g. 'Determinants Of Nutrition and Eating' (DONE) framework (Stok et al., 2017); and empirical studies e.g. EFSA's Eurobarometer on food safety (EFSA, 2025)). A review of policies that promote healthy eating in Europe, mainly aimed at increasing fruit and vegetable consumption, but also in some cases eating fish, concluded there is evidence that public information campaigns promoting increased consumption of healthy foods, which are assumed to be in line with dietary guidelines, can significantly impact attitudes and intentions but are limited in their potential to change behaviour (Capacci et al., 2012). The first report of the EU-funded PLAN'EAT Project (Grant et al., 2023) includes a comparison of national dietary recommendations to food consumption trends. The authors conducted a systematic review to collect evidence for effective behavioural change strategies currently employed in 11 EU MSs. In the 'fish' category in countries with the most recent available dietary surveys up to 2018–2021, France and Italy witnessed an increase in fish consumption while Netherlands, Poland and Spain saw a decrease, and fish consumption in Hungary remained steady. As indicated, the national food-based dietary guidelines – which include advice on fish consumption aimed both at healthy eating, avoiding food waste and, in some countries, more sustainable foods, may have played a role, but a direct association is not substantiated.

An experimental study on the impact of communicating risks and benefits of fish consumption to Belgian consumers (Verbeke et al., 2008), also tested whether message content (risk vs. benefit vs. balanced information) and information source influenced consumers' intentions. The study indicated intentions to change fish consumption – with a 21% increase when receiving benefit-only information, and an 8% decrease when receiving risk-only information. Balanced information (risk followed by benefit or benefit followed by risk information) did not yield a significant change in behavioural intention to eat fish. The information source, whether 'government', 'consumer organisation' or 'fish and food industry', made no significant difference, suggesting official information sources can be as impactful as other sources if consumers are exposed to them. In a two-point survey on attitudinal determinants of fish consumption in Spain and Poland (Pérez-Cueto et al., 2011), public information and healthy eating campaigns conducted in Poland between 2004 and 2008 were positively associated with an increase in objective knowledge about the health benefits of fish consumption and with concomitant growth of fish consumption in the population. In Spain, where fish consumption was already high, healthy eating campaigns may have influenced some changes in choice of the source of fish, e.g. caught in the wild vs. bred in aquaculture. In Jacobs et al. (2018) the authors explored consumer responses in Belgium and Portugal to the communication of advice that includes environmental sustainability goals alongside human health risks and benefits and, in particular, whether this information can influence adherence to 'the general advice to consume seafood twice per week'. Most participants (60%) saw no need to change their intended behaviour having heard the combined advice, but of the remainder 14% intended to increase seafood consumption to twice per week (having learnt of the health benefits) and 17% found the sustainability information appealing but this would not necessarily change their intended consumption. The study by Minnens et al. (2020) looked at intended behaviour after using FishChoice, an online search tool that allows consumers to search and receive tailored advice in 30 European countries on benefits, risks and species of fish and other seafood drawing on official sources such as risk assessments and dietary advice. Just over two-thirds of participants indicated they would re-use the tool to receive advice on choosing seafood species, portion size or frequency of consumption. However, changes to diet were less likely and varied by country and frequency of consumption, e.g. consumers eating seafood more than three times per week were more likely to adjust their diet to the tailored advice.

3.4.1 | EFSA survey results on the impact of advice on consumption

In the EFSA survey, respondents in countries with recently updated national advice who indicated they had heard of the advice were asked in Question 10.2 'To what extent did the advice about the health benefits and/or risks of fish and seafood consumption lead you to change your consumption of them?'. In the FPS Question 10.2 was asked only to respondents in Cyprus and Portugal as they were the only two countries that had informed EFSA that they had recently updated their fish and other seafood consumption advice prior to the start of fieldwork. In both countries, over half (55%) of the 10+ population consumers indicated that the recently updated advice from the public health authority in their country had led them to change their consumption of fish/seafood 'to a large extent' or 'to some extent'. This figure was just below 6 in 10 (59%) for pregnant women.

The frequency of fish/other seafood consumption by respondents who had heard of the updated advice vs. those who had not, provides further potential insights about its possible impact. The following focuses on the results for species with a mercury ML of 1.0 mg/kg as the species of higher concern.

Among the 10+ population (Figure 27) those who had heard about the updated national advice were somewhat more likely to consume fish and other seafood species with a mercury ML of 1.0 mg/kg three or more times per week than those who had not heard of the advice. The shares in Cyprus and Portugal were 26% and 42%, respectively, among consumers who had heard of the advice, while for those who had not heard of the advice, they were 22% and 34%, respectively. For those who consume these species two times per week, there was a larger difference in Cyprus between those who had heard advice (24%) vs. those who had not (10%), while the opposite was seen in Portugal (14% vs. 18%).

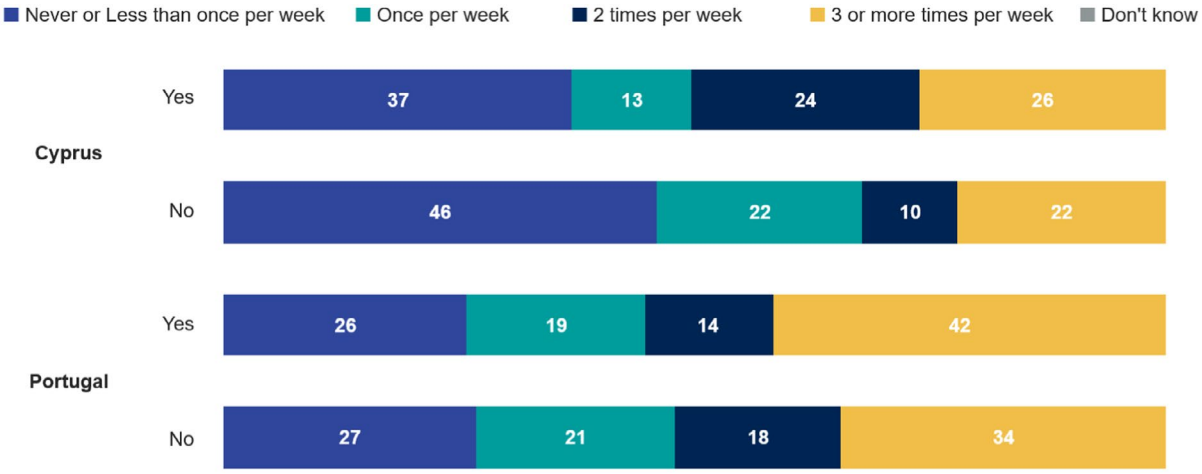

FIGURE 27 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among 10+ population by awareness of updated national advice (% - by country), FPS *[Base: 10+ population (n = 603) Questions: Q5.1 Derived variable for fish and other seafood species with mercury ML of 1.0 mg/kg wet weight; Q10.1. The public health authority in [your country] has recently updated its advice on health benefits and/or risks of fish and other seafood consumption. Have you heard of it?].*

Looking at Figure 28, fewer pregnant women consumed these species two times or three or more times per week, overall compared to the 10+ population. Also, consumption among pregnant women who consumed these species three or more times per week was somewhat lower when they reported hearing the updated national advice (13% in Cyprus, 18% in Portugal) than among those respondents who were not aware of the national advice (18% in Cyprus, 19% in Portugal). For those who consumed these species two times per week, awareness of the national advice made little impact in Cyprus (13% of those who had heard of the advice vs. 14% for those who had not) but was significantly lower in Portugal for those who had heard the advice (15%) than those who had not (25%).

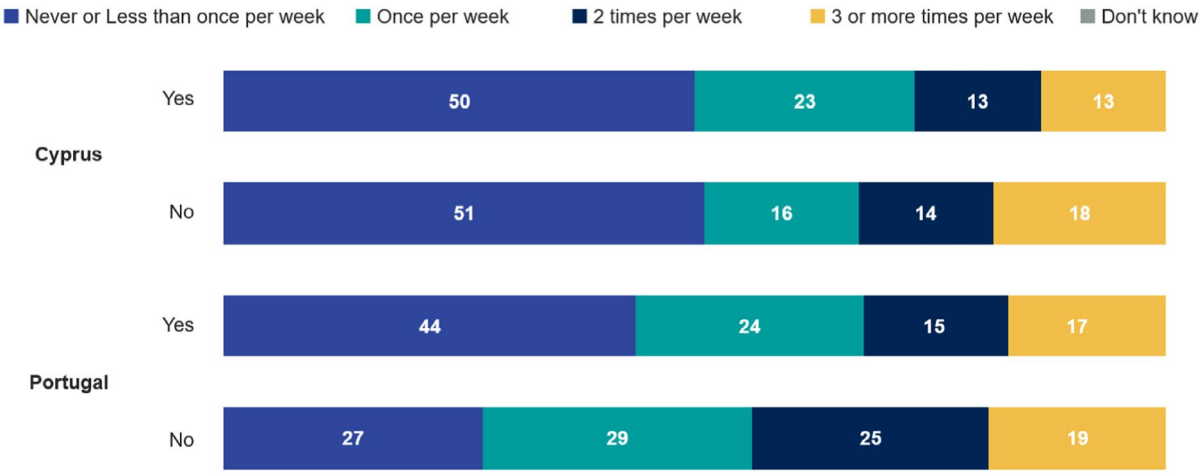

FIGURE 28 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among pregnant women by awareness of updated national advice (% - by country), FPS *[Base: Pregnant women (n = 151) Questions: Q5.1 Derived variable for fish and other seafood species with mercury ML of 1.0 mg/kg wet weight; Q10.1. The public health authority in [your country] has recently updated its advice on health benefits and/or risks of fish and other seafood consumption. Have you heard of it?].*

In the SPS, responses to Question 10.2 'To what extent did the advice about the health benefits and/or risks of fish and seafood consumption lead you to change your consumption of them?' were collected from the 9 MSs and Norway who had indicated that they had updated their national advice between the FPS and the SPS. Among the 10+ population respondents who had heard of the updated advice some 6 in 10 (62%) indicated that the advice had led them to change their consumption of fish and other seafood 'to a large extent' (17%) or 'to some extent' (45%). A slightly higher proportion

(65%) of pregnant women indicated that the advice had led them to change their consumption 'to a large extent' (19%) or 'to some extent' (46%).

Cross-country differences were noticeable ranging from 78% in Spain to 52% in Belgium among the 10+ population (Figure 29), while among pregnant women in countries with updated advice, the figures were highest in Belgium (70%) and Denmark (70%) and lowest in Portugal (56%) (Figure 30).

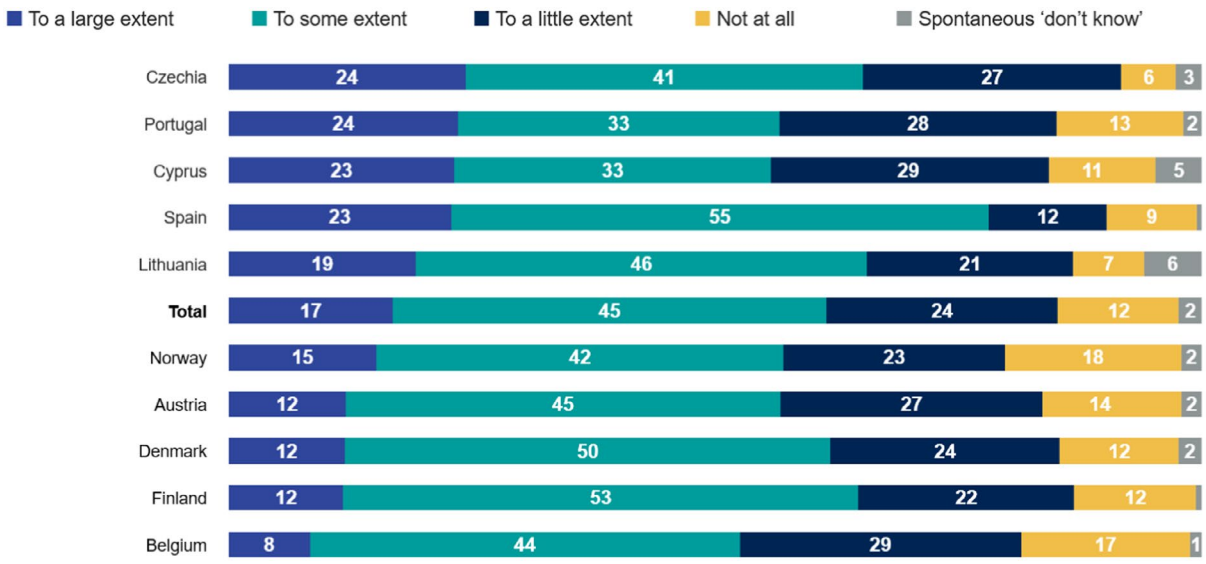

FIGURE 29 Extent to which updated national advice led to change in fish/other seafood consumption among 10+ population consumers (% – by country), SPS. *[Base: 10+ population (N = 1431) Question 10.2 'To what extent did the advice about the health benefits and/or risks of fish and seafood consumption lead you to change your consumption of them?']*.

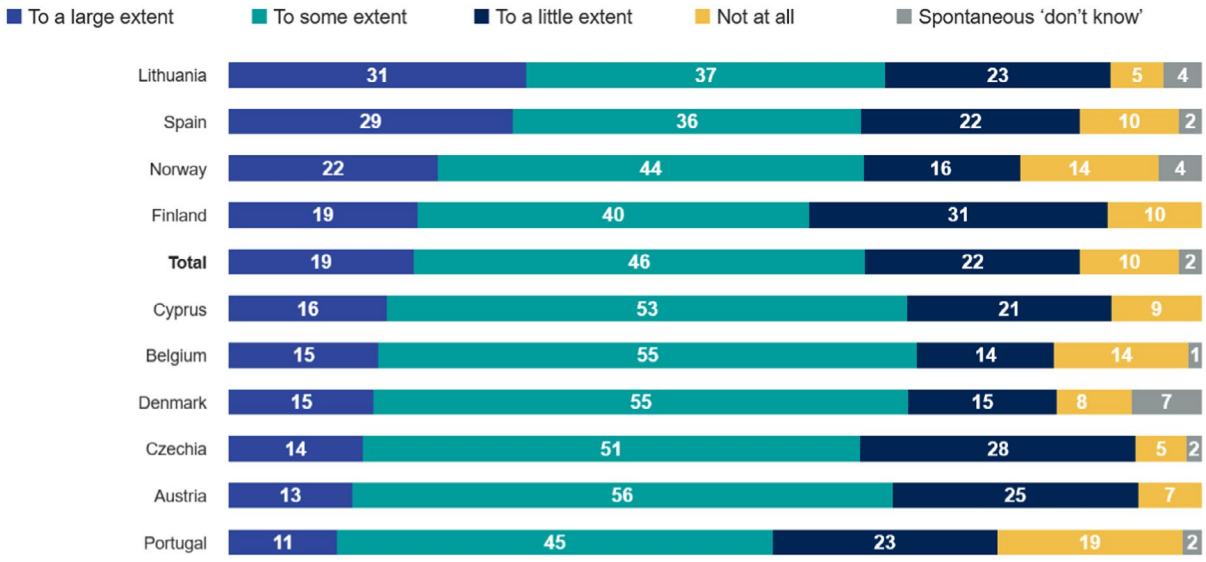

FIGURE 30 Extent to which updated national advice led to change in fish/other seafood consumption among pregnant women consumers (% – by country), SPS. *[Base: Pregnant women (N = 527) Question 10.2 'To what extent did the advice about the health benefits and/or risks of fish and seafood consumption lead you to change your consumption of them?']*.

The frequency of consumption of fish and other seafood species with a mercury ML of 1.0 mg/kg among respondents who had heard vs. those who had not heard of the updated national advice was also analysed during the SPS (Figure 31). As reported above (Section 3.2.1), the general large increase in consumption across all 15 countries in SPS, whether they had updated their advice or had not, makes trend analysis challenging. However, any differences between those who had heard of the advice and those who had not can still be seen. As with the FPS, among the 10+ population in the EU9 countries plus Norway, those who had heard about the updated national advice (54%) were somewhat more likely to consume fish and other seafood species with a mercury ML of 1.0 mg/kg three or more times per week than those who had not heard of the advice (49%). For those who consumed these species two times per week, there was almost no difference (14% vs. 15%). Among pregnant women who consume these species three or more times per week, awareness of the advice made no difference with response rates of 51% in either case and almost no difference for those consuming them two times per week (12% vs. 13%).

At a country level, among the 10+ population the proportion of consumers consuming these species three or more times per week who were aware of the national advice ranged from 71% in Denmark and Spain to 39% in Finland. The difference between those who had heard/not heard of the advice and changed their consumption was most prominent in Denmark at 71% (heard of the advice) vs. 43% (not heard of the advice) with the differences being less pronounced for the other countries. In Cyprus, the opposite effect is seen with awareness of the national advice associated with fewer three or more times per week consumers (37%) than those who were not aware of updated advice (44%). For consumption two times per week, awareness of national advice differences was associated with a 0%–4% difference in most countries except in Czechia and Lithuania where awareness advice decreased the likelihood of consuming the species two times per week from 17% to 9% and from 16% to 9%, respectively.

Overall, when combining the results for consumption of the 1.0 mg/kg ML species three or more times per week and two times per week, having heard of advice is associated with lower consumption in Czechia (57% vs. 64%), Lithuania (66% vs. 74%) and Cyprus (61% vs. 64%), while the opposite is seen in most other countries with the largest differences in Denmark (85% vs. 67%), Spain (89% vs. 78%) and Austria (69% vs. 59%).

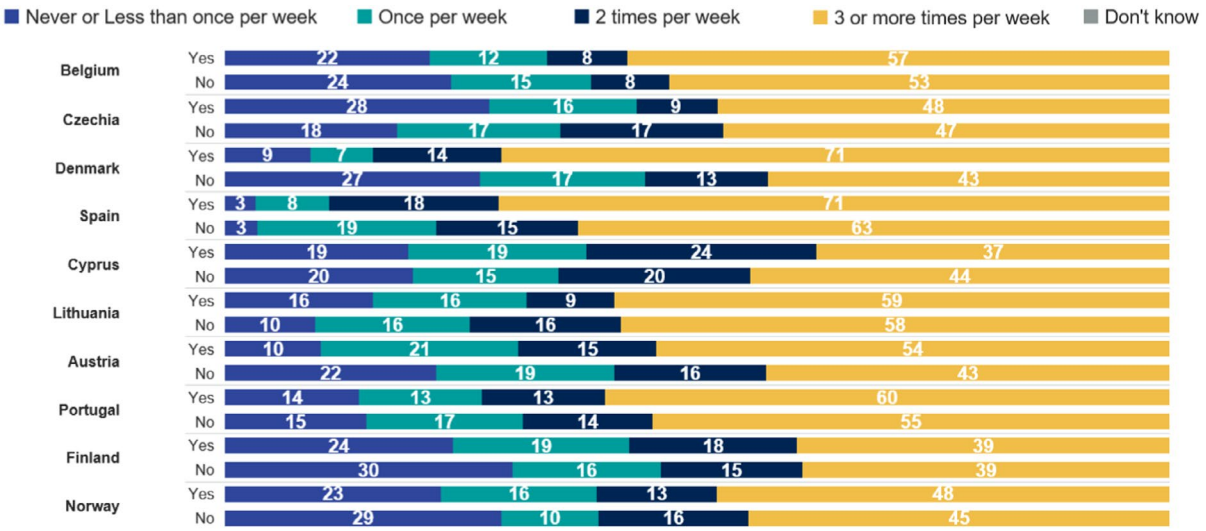

FIGURE 31 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among 10+ population by awareness of updated national advice (% - by country), SPS *[Base: 10+ population (n = 4087) Questions: Q5.1 Derived variable for fish and other seafood species with mercury ML of 1.0 mg/kg wet weight; Q10.1. The public health authority in [your country] has recently updated its advice on health benefits and/or risks of fish and other seafood consumption. Have you heard of it?].*

Some cross-country differences among pregnant women can also be seen in the results (Figure 32). Pregnant women who were aware of updated national advice were less likely to eat fish and other seafood species with a mercury ML of 1.0 mg/kg three or more times per week, than those who had not heard of the advice, in Portugal (36% vs. 54%), Finland (39% vs. 51%), Norway (49% vs. 58%) and Cyprus (53% vs. 58%). The opposite relationship could be seen in some other countries with the widest differences seen in Denmark (50% vs. 36%) and Belgium (61% vs. 48%). Consumption two times per week was less likely having heard of national advice than not in Denmark (0% vs. 12%), Austria (12% vs. 18%) and Czechia (12% vs. 19%), but more likely in other countries with the largest differences seen in Cyprus (24% vs. 15%), Norway (10% vs. 5%) and Finland (19% vs. 15%). Combing consumption of the species three or more times with two times per week reduces the differences between awareness and non-awareness of advice in some countries, e.g. Denmark (50% vs. 48%), Cyprus (77% vs. 73%) and Norway (59% vs. 63%).

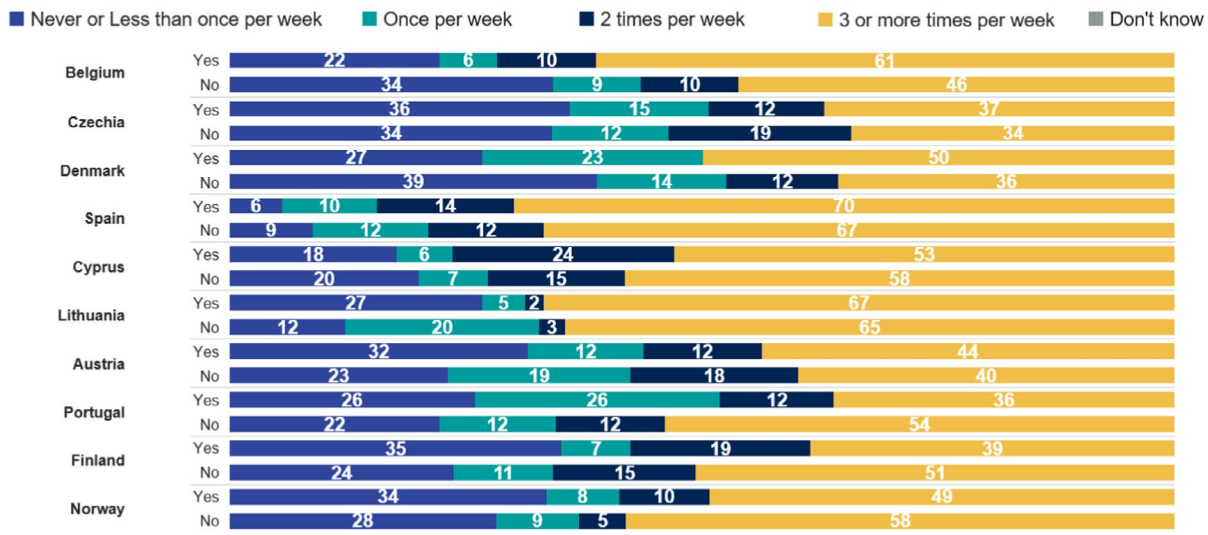

FIGURE 32 Consumption frequency of fish and other seafood species (mercury ML 1.0 mg/kg) among pregnant women by awareness of updated national advice (% - by country), SPS *Base: Pregnant women (n = 1320) Questions: Q5.1 Derived variable for fish and other seafood species with mercury ML of 1.0 mg/kg wet weight; Q10.1. The public health authority in [your country] has recently updated its advice on health benefits and/or risks of fish and other seafood consumption. Have you heard of it?].*

A comparison of FPS and SPS results from Cyprus and Portugal, the only two countries for which data are available in both surveys, was carried out to determine any noteworthy differences following the longer period of communication about the updated national advice in each country. However, due to the generally much higher consumption frequency reported in the SPS, as noted above (Section 3.2.1), no meaningful trends could be observed.

3.4.1.1 | *Conclusions on the impact of advice on consumption*

- In the EFSA Survey a majority of the 10+ population who stated they had heard the national advice and had recently changed their consumption of fish and other seafood, indicated that they had taken the advice into account 'to a large extent' or 'to some extent'.
- In most countries with updated national advice the consumption of species with a mercury ML of 1.0 mg/kg three or more times per week was either the same or higher among those who had heard the advice than those who had not heard the advice with the exception of Cyprus and Portugal in the FPS, and Cyprus only in the SPS.
- The EFSA Survey indicated that in the countries with updated advice pregnant women are more likely to be aware of the national advice and also more likely to indicate that they take the advice into account than the 10+ population. However, their consumption of species with a mercury ML of 1.0 mg/kg three or more times per week was higher among those who had heard the advice than among those who had not heard the advice with the exceptions of Cyprus and Portugal in the FPS, and Cyprus and Norway in the SPS.
- Overall, the long-term promotion of national advice, particularly on the health benefits of fish and other seafood consumption, may encourage consumers to eat more fish generally, however, other factors are important mitigating factors such as the existing consumption levels (e.g. impact is less likely in already high-consuming countries) and the range of personal preferences (outlined in Section 3.1.1.).
- Providing advice about health risks is less likely to lead to a change in fish/other seafood consumption (i.e. a decrease or replacement with other species) than advice about health benefits (i.e. an increase in fish/other seafood consumption).

3.5 | Communication insights for use by national authorities in MSs

This section provides insights for communication gathered through the research carried out to fulfil the Terms of Reference of this report. While this advice was not requested by the European Commission (see Section 1.1 Terms of Reference), the authors determined that the insights revealed by the EFSA Survey and supporting research could be of value to national public health authorities that provide dietary advice for consumers and communicate this advice in their country.

The insights are outlined below in line with the EFSA Scientific Committee Guidance on risk–benefit assessment (EFSA Scientific Committee, 2024), in which Annex G provides 'Risk-benefit communication guidance' for communicators. The guidance recommends consideration of 'Factors influencing risk and benefit perceptions', 'Information needs' and 'Information and behaviour' and suggests use of tools used by EFSA (i.e. Pre-assessment, Appraisal – Concern assessment). Several strands of the evidence collected for this report and detailed in the preceding sections contribute findings in these three areas, however, since this assessment was not conceived as a risk–benefit assessment, there are limitations. In particular, the EFSA Survey focused on consumption and awareness, therefore, the design did not include sufficient questions allowing a detailed understanding of consumer perceptions of risks and benefits related

to these foods. However, information was collected on the information sources consumers use (Section 3.2.2) and the factors influencing the respondents' consumption of the selected fish and other seafood species (Section 3.1.1), as well as some insights on the role played by prior knowledge of the associated health risks and benefits among respondents who reported changing their fish/other seafood consumption (Sections 3.2 and 3.3.1). Further insights were extracted from the targeted literature review. The following summary of these findings begins with an overview of the most relevant social science insights as advice for communication on risk and dietary advice in general. Second, it presents informative results from the EFSA survey through an audience segmentation (the methodology for which is described in Section 2.7.4). In conclusion, it reflects upon the relevance of these insights for use by national authorities across the countries covered by the report.

3.5.1 | Social science insights on communication of risk/benefits and dietary advice

Impactful risk–benefit communication and dietary advice that garners attention, increases risk–benefit awareness and leads to behavioural change, should consider what is known about consumers' risk and benefit perceptions, their desire for information, and which trade-offs and other mechanisms are involved in their food choices, such as the fundamental choice to consume a specific type of fish or frequent fish consumption behaviour (EFSA Scientific Committee, 2024).

First and foremost, risk and benefit perceptions can drive food choices in general. It is fair to assume that fish consumption may, in parts, be driven by the risk perception of contaminants and nutritional benefit perceptions. While risk perception and benefit perceptions have been shown to interact (e.g. Alhakami & Slovic, 1994; Bearth & Siegrist, 2016; Finucane et al., 2000; Sleboda & Lagerkvist, 2021) – in that a higher benefit perception is related to a lower risk perception and vice versa – they are not always related and could be formed in isolation, shaped by a wide range of individual factors (e.g. beliefs, personal values, prior knowledge, emotions, trust in institutions) and contextual factors (e.g. social context, (social) media coverage, cultural norms, policy environments) (e.g. Siegrist & Árvai, 2020; Ueland et al., 2012). For instance, perceptions of risks and benefits are shaped by complex interactions between correct or incorrect health-related (e.g. awareness of contaminants, knowledge of dietary benefits) and non-health-related beliefs (e.g. price, taste) about food and related contextual factors. It has also been theorised that risk messages may garner more attention if consumers are aware of a particular risk or if initial risk or benefit perceptions are high (Kasperson et al., 1988; Kasperson et al., 2022; Pidgeon et al., 2003). To communicate effectively, it is essential to take on the audience's perspective by considering the individual and contextual factors that may shape their decision making and mapping this onto the risk/benefit communication or dietary advice.

As people can process only a limited number of considerations, communications should focus on key factors of importance, instead of overwhelming audiences with complexity. For this, it can be informative to understanding the audience's knowledge about the issue at hand that may be made of informative and experiential information but also comprise false beliefs or misunderstandings (Morgan et al., 2002).

Consumers routinely make complex trade-offs among health, environmental, economic and social considerations when interpreting food information and making food-related decisions (e.g. purchases for self and others, general and situational dietary choices, citizen engagement in the form of voting, protesting or petitioning). However, increasing people's knowledge about health-related risks and benefits does not automatically lead to different choices or behaviours. This reflects the reality that decisions are shaped by more than information alone; they are influenced by the diverse individual and contextual factors described above. To address these challenges, communication strategies must first clarify the types of trade-offs consumers are likely to encounter. These may involve balancing personal health with pleasure (e.g. nutritional value vs. taste), economic constraints with product characteristics (e.g. price vs. quality, convenience or availability) or personal preferences with broader societal concerns (e.g. enjoyment vs. animal welfare, ethics or environmental impact).

3.5.2 | Segmentation analysis results

Identifying distinct consumer segments, meaning groups of consumers that exhibit similar consumption patterns (i.e. of fish/other seafood) and awareness (i.e. of the presence of contaminants in fish and other seafood, knowledge of the risks and benefits of eating fish and other seafood) is key to deliver targeted risk/benefit communication or dietary advice. Based on the factors presented in the Methodologies and data section, a segmentation solution with five consumer segments was selected based on the FPS data:

1. Infrequent consumers with awareness, including 31% of respondents
2. Infrequent consumers with little awareness, including 26% of respondents
3. Frequent consumers with little awareness, including 18% of respondents
4. Frequent consumers with awareness, including 15% of respondents
5. Very frequent consumers with moderate awareness, including 10% of respondents

The table below summarises the characteristics of each segment. It is important to note that segments are described in relative terms, with respect to how they contrast and compare relative to the other identified segments. In other words, if a segment is described as having high awareness of chemical contaminants in fish/other seafood, it does not mean they have high awareness in absolute terms, but that they have – in comparison with the other segments – a higher awareness of chemical contaminants in fish and higher knowledge of the risks and benefits of eating fish and other seafood (Table 10).

TABLE 10 Overview of segments characteristics identified in the FPS.

Segment	Consumption frequency	Awareness level	Demographics	Interest in food safety/healthy diets	Consumption changes	Influence of information sources	Awareness of National Advice
Segment 1: Infrequent consumers with awareness (31%)	Lower than average (95% say never or < 1/week vs. 65% average)	Higher than average (more likely to have more correct answers)	Skewed younger (18% aged 10–17 vs. 12% average)	Lower interest (11% not interested in food safety vs. 8% average, 10% not interested in healthy diets vs. 8% average)	Lower increase in consumption (Fish: 12% vs. 19% average, Seafood: 7% vs. 11% average)	Health locations (20% vs. 17% average), Social media (19% vs. 17% average), Supermarkets (18% vs. 15% average), Newspapers (17% vs. 14% average)	22% changed consumption based on national advice vs. 17% average
Segment 2: Infrequent consumers with little awareness (26%)	Lower than average (96% say never or < 1/week vs. 65% average)	Lower than average (more likely to give 0–1 correct answers out of 10–12)	Higher proportion of pregnant women (14% vs. 11% average)	Neutral interest (Food safety: 26% vs. 21% average, Healthy diets: 24% vs. 19% average)	Lower increase in consumption (Fish: 14% vs. 19% average, Seafood: 8% vs. 11% average)	Less influenced by information sources	Average awareness of national advice
Segment 3: Frequent consumers with little awareness (18%)	Higher than average (32% say 1–3 times/week vs. 20% average)	Lower than average (more likely to give 0–1 correct answers out of 10–12)	Lower adolescents (8% aged 10–17 vs. 12% average)	High importance and interest (Food safety: 36% vs. 28% average, Healthy diets: 36% vs. 30% average)	Higher increase in consumption (Fish: 27% vs. 19% average, Seafood: 14% vs. 11% average)	Average influence by information sources	Average awareness of national advice
Segment 4: Frequent consumers with awareness (15%)	Higher than average (41% say 1–3 or more times/week vs. 23% average)	Higher than average (more likely to give 4–6 correct answers out of 10–12)	Average demographics	Higher interest (Food safety: 32% vs. 28% average, Healthy diets: 35% vs. 30% average)	High proportion who increased fish consumption	Supermarkets (27% vs. 23% average), Health settings (25% vs. 22% average), Newspapers (26% vs. 23% average), Events (20% vs. 18% average), Institutional websites (22% vs. 20% average)	Higher awareness of national advice (37% vs. 31% average)
Segment 5: Very frequent consumers with moderate awareness (10%)	Much higher than average (79% say ≥3 times/week vs. 15% average)	Higher than average (more likely to give 4–6 correct answers out of 10–12), but less than segments 1 and 4	Lower adolescents (6% aged 10–17 vs. 12% average)	Highest interest (Food safety: 39% vs. 28% average, Healthy diets: 39% vs. 30% average)	Highest change in consumption (Fish: +35% vs. 19% average/−12% vs. 10% average, Seafood: +25% vs. 11% average/−17% vs. 11% average)	Institutional websites (20% vs. 13% average), Professional journals (20% vs. 13% average), Newspapers (18% vs. 14% average), Events (18% vs. 12% average), Radio (18% vs. 12% average)	Highest awareness of national advice (42% vs. 31% average)

Note: Consumption frequency: Consumption frequency of fish in the last 12 months, Awareness level: Awareness of presence of contaminants in fish and other seafood and knowledge of risks and benefits of eating fish and other seafood.

To better visualise the segments, consumption frequency and awareness were plotted in a diagram (Figure 33), assigning values ranging from 0 (lower than average consumption/awareness) to 1 (higher than average consumption/awareness). Specifically, for consumption, the following quantitative index was calculated: 0 × (% never) + 2 × (% 1–2 times/week) + 4 × (% ≥ 3 times/week). The result was then divided by 4 to normalise it. For calculating the level of awareness, the following quantitative index was used: 0.5 × (% 0–1 correct answers) + 2.5 × (% 2–3 correct answers) + 5 × (% 4–6 correct answers) + 8.5 * (% ≥ 7 correct answers). To normalise it, the following was calculated: (Resulting score − 0.5)/8.

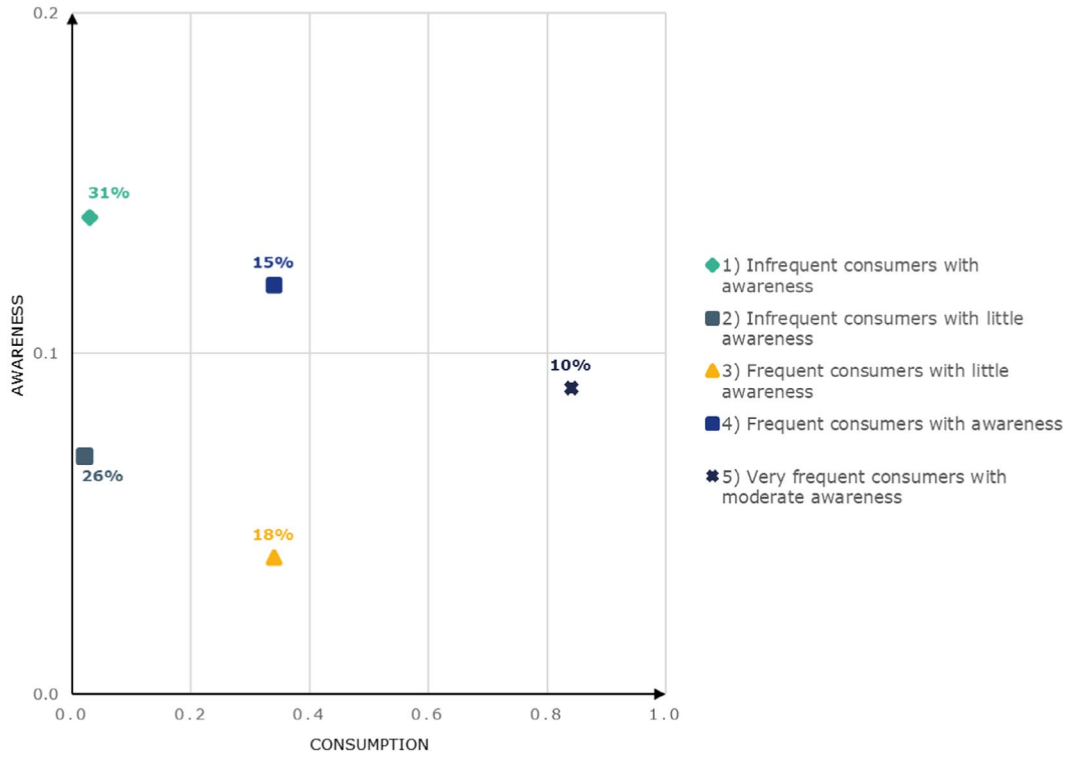

FIGURE 33 Diagram showing the relative high versus low levels of consumption and awareness for each segment of the FPS. *The coloured percentage indicates the size of the segment. As a result of the rather low degree of awareness in the study sample, the mean resulting index for all segments was lower than 0.2. To visualise the relative differences in awareness between the different segments, the awareness axis has been presented ranging from 0.0 to 0.2.*

Based on the SPS data, a segmentation solution with four segments was selected:

1. Very frequent consumers with little awareness, including 35% of respondents
2. Infrequent consumers with very little awareness, including 25% of respondents
3. Frequent consumers of fish/other seafood with a mercury ML of 0.3 mg/kg of wet weight, with awareness, including 21% of respondents
4. Infrequent consumers with awareness, including 19% of respondents

Table 11 below summarises the characteristics of each segment.

TABLE 11 Overview of segments characteristics identified in the SPS.

Segment	Consumption frequency	Awareness level	Demographics	Interest in food safety/ healthy diets	Consumption changes	Influence of information sources	Awareness of National advice
Segment 1: Very frequent consumers with little awareness (35%)	Much higher than average (56% say ≥ 3 times/ week vs. 39% average)	Lower than average (more likely to give 0–2 correct answers out of 10–12)	Lower adolescents (8% aged 10–17 vs. 12% average), Higher adults aged 35–44 (22% vs. 19% average), Higher live alone (22% vs. 19% average)	Highest importance (Food safety: 46% vs. 38% average, Healthy diets: 39% vs. 33% average), Higher interest (Food safety: 33% vs. 29% average, Healthy diets: 39% vs. 31% average)	Slightly higher increase (Fish: 23% vs. 19% average, Seafood: 10% vs. 8% average), Slightly higher decrease (Fish: 11% vs. 9% average, Seafood: 11% vs. 10% average)	Supermarkets (19% vs. 16% average), Lectures or seminars (13% vs. 11% average)	20% changed consumption based on national advice vs. 17% average
Segment 2: Infrequent consumers with little awareness (25%)	Lower than average (78% say never or < 1/ week vs. 30% average)	Lower than average (more likely to give 0–2 correct answers out of 10–12)	Higher pregnant women (14% vs. 12% average)	Neutral importance and interest (Food safety: 24% vs. 20% average, Healthy diets: 22% vs. 18% average)	Average consumption changes	Professional journals (14% vs. 11% average), Non-institutional websites (18% vs. 16% average)	Average awareness of national advice
Segment 3: Frequent consumers of fish/ seafood with mercury ML of 0.3 mg/ kg, with awareness (21%)	Higher than average for fish and other seafood with mercury ML 0.3 mg/ kg (37% say ≥ 2–3 times/ week vs. 33% average)	Higher than average (more likely to give 4–6 correct answers out of 10–12)	Slightly more adults aged 45–54 (22% vs. 20% average)	Somewhat interested (Food safety: 43% vs. 39% average)	Slightly higher increase (Fish: 21% vs. 19% average, Seafood: 10% vs. 8% average), Slightly higher decrease (Seafood: 11% vs. 10% average)	Health locations (22% vs. 18% average), Institutional websites (20% vs. 15% average), Radio/Podcasts (16% vs. 14% average)	Highest awareness (43% vs. 36% average), 50% changed consumption to some extent based on national advice vs. 45% average
Segment 4: Infrequent consumers with awareness (19%)	Lower than average (83% say never or < 1/ week vs. 30% average)	Higher than average (more likely to give 4–6 correct answers out of 10–12)	Skewed younger (19% aged 10–17 vs. 12% average), Larger households (28% vs. 22% average), Higher pregnant women (14% vs. 12% average)	Neutral or mild disinterest (Food safety: 24% neutral vs. 20% average, 9% not interested vs. 6% average; Healthy diets: 21% neutral vs. 18% average, 8% not interested vs. 6% average)	Lower increase (Fish: 12% vs. 19% average, Seafood: 5% vs. 8% average)	Family/Friends (27% vs. 21% average), Social media (21% vs. 18% average), Professional journals (13% vs. 11% average)	Average awareness, 16% not influenced at all by national advice for consumption behaviour vs. 12% average

Note: Consumption frequency: Consumption frequency of fish in the last 12 months, Awareness level: Awareness of presence of contaminants in fish and other seafood and knowledge of risks and benefits of eating fish and other seafood.

As done for the FPS, to visualise the segments, levels of consumptions and awareness were plotted in a diagram (Figure 34), assigning values ranging from 0 (lower than average consumption/awareness) to 1 (higher than average consumption/awareness).

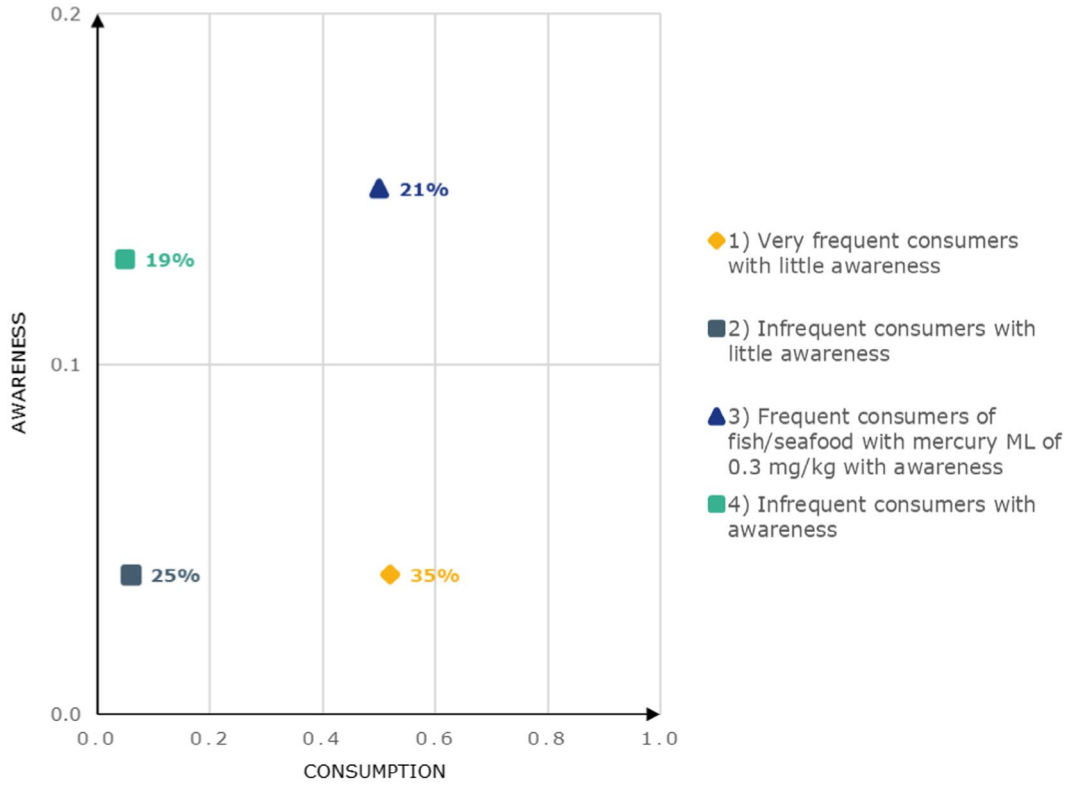

FIGURE 34 Diagram showing the relative high vs low levels of consumption and awareness for each segment of the SPS. The coloured percentage indicates the size of the segment. As a result of the rather low degree of awareness in the study sample, the mean resulting index for all segments was lower than 0.2. To visualise the relative differences in awareness between the different segments, the awareness axis has been presented ranging from 0.0 to 0.2.

3.5.3 | Potential use of insights by national authorities

The analysis of the findings and the segmentation provide insights for potential use to inform risk–benefit communication strategies related to dietary advice. These could focus on the following three key areas: (i) Benefits of fish/other seafood consumption for low consumers with low awareness, especially pregnant women, (ii) diversifying fish/other seafood species for high consumers, especially among pregnant women, (iii) strategies for accessing trusted sources of information and (iv) conducting concern assessments, and evaluating and monitoring the impact of communications. Communication by national public health authorities in the Member states, Iceland and Norway can further tailor these strategies, if they deem them useful, using data on their country from the EFSA Survey. Summaries of the key findings are available in national factsheets and EFSA supports national partners to analyse their data by providing online access to dashboards (Annex D).

Benefits of fish/other seafood consumption for low consumers with low awareness, especially pregnant women

Continued or reinforced health promotion should be used to reach consumers with low consumption frequency and comparatively low awareness of the benefits and risks of fish consumption. In designing the content of the messaging, it is important to consider the individual and contextual factors that may contribute to the low awareness and consumption. In practice, decisions to consume a type of fish and/or to consume it with a specified frequency typically involve weighing several factors simultaneously rather than choosing between two simple alternatives of eating or not eating fish. Thus, dietary advice should specifically focus on trade-offs that lead to choices that are not beneficial or suboptimal and highlight consumption choices that are. For instance, false beliefs about the beneficial effects of fish and seafood consumption for neurodevelopment of children, despite personally liking seafood and fish may lead pregnant women to avoid fish and seafood. In this case, clarifying the false beliefs and informing about the possible safe choices may be a useful communication strategy.

Content should combine informative messages with prescriptive guidance on behavioural choices. The informative messages should focus on the health benefits and safety of fish consumption in dependence of frequency, portion size. The prescriptive guidance should be explicit on what to eat and how often, while considering regional, culturally appropriate and affordable examples, dishes and recipes.

Diversifying fish/other seafood species for high consumers, especially among pregnant women

Communicating risk through risk messaging and dietary advice on diversifying fish and other seafood species consumption to high consumers may be challenging, particularly when paired with low risk awareness for contaminants or when risk information is perceived to be incongruent with a-priori beliefs. High consumers very likely perceive high health and non-health-related benefits (e.g. regarding nutritional value of fish, taste) or live in Member States where fish is highly embedded into the cultural and culinary context. In these cases, repeated messages that focus on diversifying consumption habits regarding the fish and other seafood species may be a more relevant strategy, as already adopted by some Member States (e.g. encouraging the use of the FishChoice[11] tool).

Strategies for accessing trusted sources of information

Consumers in the EU, Iceland and Norway differ widely in their desire for information about dietary advice regarding fish consumption. While some actively seek out detailed information, others may be more ignorant or require specially tailored communication approaches, particularly if they belong to vulnerable groups (e.g. pregnant women receiving guidance from health care professionals). Because audiences vary in their needs and expectations, dietary advice must be clear, concise and consistent, and go beyond simply providing facts. Communication approaches through trusted information sources and that acknowledge the previously mentioned individual and contextual factors can improve attention to the messages, support knowledge uptake, positively influence perceptions and, where appropriate, encourage behavioural change.

Source credibility is also critical in reaching consumers, holding their attention, changing their perceptions and attitudes, and promoting behaviour change as a goal of public health authorities. Regular and news media (i.e. television, internet search engines, online social networks and blogs) and social contacts (i.e. family, friends, neighbours, colleagues) are more regularly the passive or active source of food risk information than institutional websites from the authorities in the Member State. Consequently, collaborations with amplifiers (i.e. journalists, science communicators, influential communicators) should be evaluated and considered to enhance the spread, penetration and uptake of the dietary advice. This may already take place in many Member States (e.g. use of healthcare and nutrition professionals) but further creative solutions may be needed in an ever more competitive information environment. For example, collaborations with TV producers to include food-and-health-based narratives in TV shows popular among specific age groups deserve to be considered.

Conducting concern assessments, evaluating and monitoring the impact of communications

EFSA's concern assessment framework (see Vrbos et al., 2023 and EFSA Scientific Committee, 2024, for its adaptation to risk–benefit assessment), provides a structured approach for analysing and integrating insights on risk–benefit perceptions and awareness/knowledge related to fish/other seafood consumption that can be gathered from available primary research, targeted literature reviews, media and social media monitoring and social media listening. While a concern assessment per se was not carried out for this report, the insights that emerged from the EFSA study and the findings from the targeted research are translated into recommendations for potential use by national authorities in Section 3.5.3. EFSA will consider following up this report with concern assessments and further research linked to risk–benefit assessments requested by EU risk managers.[12]

Importantly, the impact of risk–benefit communication and/or dietary advice should be monitored and critically evaluated in terms of the following key performance indicators (KPIs):

- Awareness surveys, utilising established targets drawn from the EFSA survey,
- Self-reported or ideally, observed behaviour among specific target groups and vulnerable groups,
- Engagement with messages and information sources, e.g. through clicks and other forms of interactions.

3.6 | Uncertainties

The uncertainties identified in the organisation and administration of the EFSA survey are presented qualitatively below focusing on factors that might have influenced data accuracy and interpretation. While this report does not apply the full structured approaches recommended in EFSA's guidance on uncertainty analysis in scientific assessments (EFSA Scientific Commitee, 2018), it wishes to acknowledge limitations and their potential impact on conclusions.

Collecting dietary data through FPQ is subject to several limitations, notwithstanding the fact that respondents are asked to report their usual frequency of consumption only and not the associated quantity. Respondents often experience recall errors when trying to remember food consumed over extended periods and when answering it is inherently difficult to average within-person variation in intakes over an extended period of time. By design, FPQs provide descriptive data

[11] https://www.fishchoice.eu.

[12] For example, the European Commission requested EFSA to perform a human health risk-benefit assessment of fish and seven types of contaminants found in fish: https://open.efsa.europa.eu/question/EFSA-Q-2025-00746.

on frequency of consumption and thus, food-consumption patterns rather than estimates of food intake (Smiliotopoulos et al., 2020). Additionally, misinterpretation of frequency categories can lead to inconsistencies in reported intake.

Using a RDD sampling design can also introduce biases that affect representativeness and the data's external validity. Coverage bias occurs as individuals without access to a telephone are excluded, leading to underrepresentation of certain demographic groups. Similarly, older adults or individuals at home during the day are more likely to answer calls received through a landline. In addition, eligible participants may not respond to calls from unknown numbers or refuse to participate and without a non-response questionnaire the reasons lying behind refusals are not possible to be captured. Finally, social sampling recruitment involves a degree of self-selection, excluding individuals who are socially isolated or belong to less connected groups or are less health-conscious or motivated hindering representativeness of the sample. The latter may have been an issue especially for the boost sampling procedure used for the recruitment of adolescents and pregnant women. Lastly, the sample of pregnant women includes participants recruited through both the RDD and the boost sampling design, which may compromise the external validity of the estimates, given differences in selection probabilities between the two designs.

The FPS and SPS were run in different periods of the year and respondents were asked to recall their consumption over the past 12 months. Comparison of the results, therefore, might be subject to some seasonal bias as they may reflect seasonal shifts rather than actual changes in dietary behaviour. Summer for example, is a season where both availability is higher, and people tend to consume more fish and seafood meals. Therefore, the increase in consumption noted during the SPS, might be due to the fact that the most recent recall period for responders was summer and autumn compared with the FPS where the most recent recall period was winter and spring. Apart from seasonal effects, other events or micro- and macro-environmental influences (e.g. generic advertising campaigns for fish, seafood or substitute food products; adverse publicity about specific fish or seafood species; food price inflation) may have induced changes in fish and seafood consumption behaviour between both survey points.

Finally, the sample size required for both FPS and SPS was of 500 participants per country. As detailed under the section 'Overview of the total sample' around 60% of them identified themselves as fish and seafood consumers, yet many of them reported having consumed fish and seafood less than two or more times per week in the last 12 months. Therefore, a small percentage of the full sample drove the results for high-frequency consumption. This small subgroup introduces uncertainty as estimates based on such a limited proportion may not be representative of the country population.

4 | OVERALL CONCLUSIONS

Among fish and seafood consumers only, the findings from the FPS and the SPS indicate an increase in fish and seafood consumption frequency between the two survey points (and thus covering time periods in 2023 and 2024). This increase occurred in both countries with and without updated consumption advice and among both the general population (10+) and pregnant women samples. For species with a mercury ML of 1.0 mg/kg, high-frequency consumption (three or more times per week) nearly doubled, from 26% to about 50% in both country groups. Similar upward trends were observed for species with mercury MLs of 0.5 mg/kg and 0.3 mg/kg, though less pronounced. Pregnant women who reported fish and seafood consumption mirrored these patterns, showing increases across all fish and seafood mercury categories. Overall, when considering consumers only and combining all countries and both survey points, roughly one-third of both the general population (34%) and pregnant women (33%) samples reported consuming fish with a mercury ML of 1.0 mg/kg three or more times per week. These findings should be translated with caution given the uncertainties mentioned above.

The observed increases in consumption frequency, in countries with and without updated consumption advice, combined with the higher consumption frequency levels that were observed among those that are aware of recently updated advice vs. those that are not, suggest that factors other than awareness of consumption advice are driving changes in dietary habits. This underscores the importance of continued monitoring and targeted public health messaging to ensure that consumption is balanced with appropriate awareness of both the benefits and potential risks associated with fish and seafood intake.

European consumers generally have low awareness of contaminants in fish, crustaceans and molluscs, but of the contaminants reviewed mercury and methylmercury are the most recognised among consumers, particularly pregnant women.

The literature reviewed shows that detailed knowledge about national consumption advice of the countries in which studies were conducted is limited. EFSA's survey reveals that around 4 in 10 of the 10+ population consumers and of pregnant women in 10 countries that had issued updated advice reported that they had heard of the advice. Objective knowledge of human health benefits from fish and other seafood consumption is four to five times higher among consumers than objective knowledge of risks from exposure to contaminants in fish and other seafood. There are significant differences across countries and at national level (between the 10+ population and pregnant women) for objective knowledge of these benefits/risks, which national authorities may find useful for their communication on this topic.

Consumers use different sources of information about food risks, showing that television, followed by exchanges with family, friends, neighbours or colleagues and internet search engines are the main sources of information, though preferences vary to some extent as a function of socio-demographics (EFSA's, 2025 Eurobarometer survey). EFSA's survey revealed that institutional websites led around one-third of respondents (as self-reported by them) to change their consumption of fish/other seafood in the last 12 months to a large/some extent. This was generally consistent across both types of countries (with/without updated advice) and populations (10+ population/ pregnant women).

Overall, the long-term promotion of national advice, particularly on the health benefits of fish and other seafood consumption, may encourage consumers to eat more fish generally, however, other factors are more important. In the EFSA

Survey a majority of the 10+ population who stated they had heard the national advice and had recently changed their consumption of fish and other seafood, indicated that they had taken the advice into account to a large/some extent. However, there was a lack of differences in consumption and awareness between countries with updated advice and those without updated advice, while some cross-country differences emerge.

In most countries with updated national advice the consumption of species with a mercury ML of 1.0 mg/kg three or more times per week was either the same or higher among those who had heard the advice than those who had not. In the countries with updated advice pregnant women are more likely to be aware of the national advice and more likely to indicate that they take the advice into account than the 10+ population. However, their consumption of species with a mercury ML of 1.0 mg/kg three or more times per week was higher among those who had heard the advice than among those who had not heard the advice in almost all countries. Providing advice about health risks is less likely to lead to a change in fish/other seafood consumption (i.e. a decrease or replacement with other species) than advice about health benefits (i.e. an increase in fish/other seafood consumption).

Risk–benefit communication strategies related to dietary advice could focus on raising awareness of the health benefits of fish/other seafood consumption among low consumers with low awareness, especially pregnant women, diversifying fish/other seafood species for high consumers with low awareness, especially among pregnant women, and explore how to access trusted sources of information on these topics.

ABBREVIATIONS

AAPOR	American Association for Public Opinion Research
bw	body weight
CATI	computer-assisted telephone interview
CATI	computer-assisted telephone interview
CONTAM Panel	Panel on Contaminants in the Food Chain
FPQ	food propensity questionnaire
FPS	first point survey
KPIs	key performance indicators
ML	maximum level
MS	MS
PCBs	Polyclorinated Biphenyls
PFAS	polyfluoroalkyl substances
RDD	random digit dialling
RR3	response rate 3
SPS	second point survey
TWI	tolerable weekly intake
VoIP	voice over internet protocol

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A

Pre-defined fish and other seafood categories based on their ML of mercury

Fish/other seafood species	Mercury ML 1.0 mg/kg of wet weight	Mercury ML 0.5 mg/kg of wet weight	Mercury ML 0.3 mg/kg of wet weight
1. Bonito	X		
2. Cusk-eel (Pink cusk-eel)	X		
3. Emperor, Orange Roughy, Rosy Soldierfish	X		
4. Grenadier	X		
5. Halibut	X		
6. Kingklip	X		
7. Marlin	X		
8. Megrim	X		
9. Mullet (Red mullet, Surmullet)	X		
10. Pike	X		
11. Plain bonito	X		
12. Poor cod	X		
13. Sail fish	X		
14. Scabbard fish (Silver scabbard)	X		
15. Seabream (Axillary seabream, Blackspot seabream), Pandora/Common pandora	X		
16. Shark	X		
17. Snake mackerel, Oilfish, Butterfish or Escolars	X		
18. Sturgeon	X		
19. Swordfish	X		
20. Tuna (e.g. also in sushi) *Included only in the FPS*	X		
20. Canned tuna *Included only in the SPS*	X		
21. Fresh tuna (e.g. also in sushi) *Included only in the SPS*	X		
22. Crustaceans (prawns, shrimps, lobsters etc.)		X	
23. Eels		X	
24. Anglerfish		X	
25. Rays		X	
26. Redfish/Ocean perch		X	
27. Anchovy			X
28. Atlantic herring			X
29. Carp			X
30. Mackerel			X
31. European plaice			X
32. European sprat			X
33. Pollock			X
34. Saithe, Coalfish			X
35. Salmon			X
36. Trout			X
37. Sardine or Pilchard			X
38. Sole			X
39. Molluscs (mussel, squid, octopus etc.)			X

APPENDIX B

Unweighted sample size per country

TABLE B.1 Unweighted sample size of the FPS per country, split between adolescent, adult and pregnant women population groups.

Country	Adolescents (10–17 years) (RDD + boost sample)	Adults (18–64 years) RDD sample	Pregnant women (RDD + boost sample)	Total sample size (RDD + boost sample)
Austria	126	283	122	511
Belgium	129	273	131	503
Bulgaria	126	293	132	519
Croatia	124	286	115	510
Cyprus	130	283	118	515
Czech Republic	134	275	122	510
Denmark	129	278	122	507
Estonia	132	278	125	511
Finland	125	290	111	520
France	121	288	127	510
Germany	137	280	124	518
Greece	126	279	114	507
Hungary	124	290	118	514
Iceland	125	286	127	514
Ireland	130	275	128	509
Italy	126	286	123	512
Latvia	129	287	121	518
Lithuania	133	280	122	515
Luxembourg	129	282	134	514
Malta	122	281	128	505
Netherlands	130	273	124	504
Norway	134	284	129	520
Poland	120	281	120	502
Portugal	122	288	126	510
Romania	122	289	113	512
Slovakia	121	294	116	517
Slovenia	126	278	124	507
Spain	140	278	124	520
Sweden	129	277	125	509
Total	**3701**	**8195**	**3565**	**14843**

Note: Pregnant women from the boost sample are not included in the numbers that are reported for the adolescents/adults per country. The total sample size equals the adolescent's sample, the adults sample and the pregnant women boost sample but excluding the pregnant women recruited via the RDD sample (as these are already included in the adolescents/adults sample).

TABLE B.2 Unweighted sample size of the SPS per country, split between adolescent, adult and pregnant women population groups.

Country	Adolescents (10-17yo) (RDD + boost sample)	Adults (18-64yo) RDD sample	Pregnant women RDD + boost sample)	Total sample size (RDD + boost sample)
Austria	134	286	131	526
Belgium	131	268	135	504
Cyprus	135	275	130	525
Czech Republic	131	277	131	524
Denmark	131	282	130	520
Finland	132	277	132	530
France	131	277	131	513
Germany	133	272	131	517

TABLE B.2 (Continued)

Country	Adolescents (10-17yo) (RDD + boost sample)	Adults (18-64yo) RDD sample	Pregnant women RDD + boost sample)	Total sample size (RDD + boost sample)
Greece	145	251	131	516
Iceland	131	277	131	522
Lithuania	132	262	132	502
Norway	133	279	132	523
Portugal	130	297	135	530
Spain	130	265	132	511
Sweden	133	278	132	519
Total	**1992**	**4123**	**1976**	**7782**

Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, Lithuania, Portugal, Spain and Norway issued updated advice.

France, Germany, Greece, Sweden and Iceland were selected as control countries.

Pregnant women from the boost sample are not included in the numbers that are reported for the adolescents/adults per country.

The total sample size equals the adolescent's sample, the adults sample, and the pregnant women boost sample but excluding the pregnant women recruited via the RDD sample (as these are already included in the adolescents/adults sample).

APPENDIX C

TABLE C.1 Response rates by survey and country for RDD sample.

Country	Response rate – FPS	Response rate – SPS
Austria	9.1%	8.6%
Belgium	25.9%	12.5%
Bulgaria	12.3%	/
Czechia	8.8%	7.5%
Denmark	7.9%	7.8%
Germany	15.3%	13.7%
Estonia	11.7%	/
Ireland	8.8%	/
Greece	19.6%	9.5%
Spain	7.9%	7.6%
France	10.2%	16.6%
Croatia	5.3%	/
Italy	14.1%	/
Cyprus	20.8%	14.2%
Latvia	7.6%	/
Lithuania	5.6%	8.1%
Luxembourg	17.8%	/
Hungary	12.8%	/
Malta	11.3%	/
Netherlands	6.8%	/
Poland	10.2%	/
Portugal	5.0%	6.3%
Romania	7.3%	/
Slovenia	9.3%	/
Slovakia	11.6%	/
Finland	11.2%	12.0%
Sweden	5.8%	6.6%
Iceland	8.9%	10.0%
Norway	5.4%	7.5%
Overall average	**10.8%**	**9.9%**

APPENDIX D

Weighting approach and targets by sample target group

Adolescents (10–17 years)	Adults (18–64 years)	Total sample (10–64 years)	Pregnant women
• Booster sample (combined with any 10–17 years from telephone survey) • Weighting to correct for any imbalance in the **gender** (male/female) & **regional distribution** (NUTS1, NUTS2 or NUTS3 region, depending on country size)	• Random probability telephone survey • Weighting to correct for under/over-representation in terms of **gender, crossed by age** (18–24 years, 25–34 years, 35–44, 55–64 years) **and region** • Design weight used as base weight	• Random probability telephone survey, combined with booster sample of 10–17 years • Weighting as in adult sample (18–64 years), plus additional correction for over-representation by adding all 10–17 years (booster) • Design weight used as base weight for cases from telephone survey; booster sample cases have a base weight of 1 • Weighting targets: **gender, crossed by age** (10–17 years, 18–24 years, 25–34 years, 35–44, 55–64 years) **and region**	• Booster sample (combined with any pregnant women from telephone survey) • Weighting to correct for any imbalance in the regional distribution • *Note:* given that no official statistics are available for pregnant women, the population regional distribution for all women aged 14–48 was used

APPENDIX E

Fish and other seafood species consumersxx

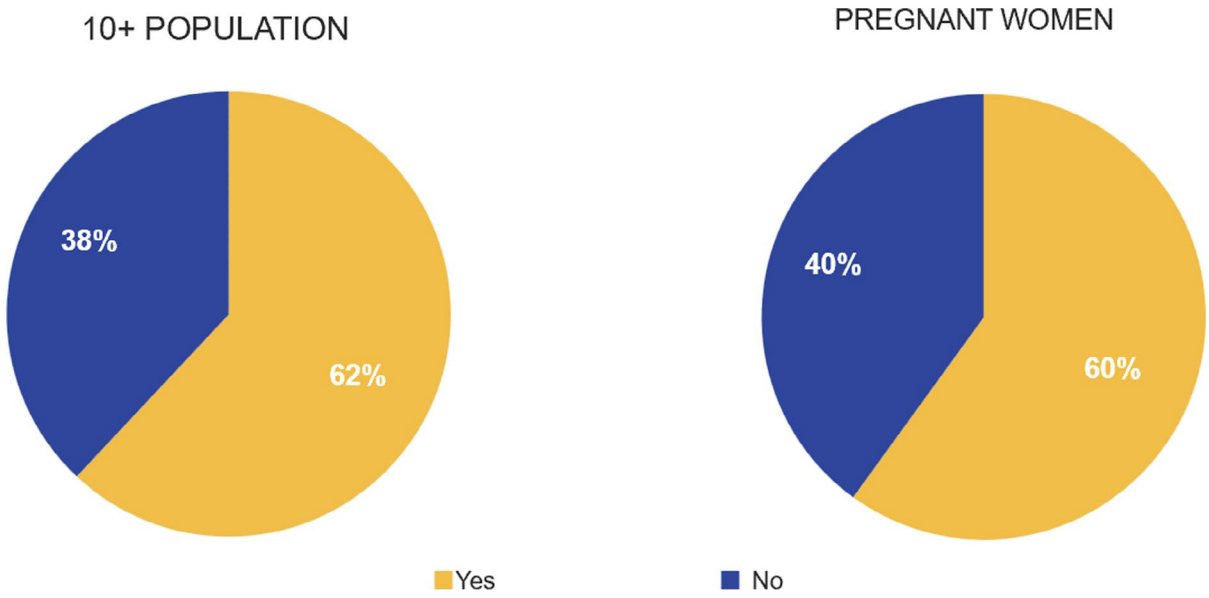

FIGURE 35 Consumers of fish and other seafood species among 10+ population & pregnant women in all countries across the FPS (% - EU27 + Iceland & Norway) and SPS (% - EU13 + Iceland & Norway). (Base: 10+ population FPS and SPS (N = 17780), pregnant women FPS and SPS (N = 5541))

APPENDIX F

Details on the content national communication actions from the 10 countries participating in the SPS and sources of information

Country	Target population	Does the advice recommend limiting consumption or avoiding specific fish or seafood?	Does the advice recommend preference for consumption of specific fish and seafood?	Quantitative or qualitative recommendation on fish or seafood consumption	Reference to contamination with methylmercury	Source
Austria	Babies, Young children Women who wish to conceive, Pregnant women, Lactating women	Yes	Yes	Qualitative and quantitative	Yes	https://www.ages.at/forschung/wissen-aktuell/detail/aufnahme-von-quecksilber-ueber-lebensmittel-zeitraum-2016-2022; https://www.ages.at/mensch/ernaehrung-lebensmittel/rueckstaende-kontaminanten-von-a-bis-z/quecksilber
Belgium	Pregnant Lactating women Children	Yes	Yes	Qualitative and quantitative	Yes	https://www.health.belgium.be/fr/professionnels/entreprises/alimentation/securite-alimentaire/contaminants-chimiques/methylmercure-poissons-fruits-mer
Czech Republic						**Information on the updated national advice was confirmed through personal communication. No additional sources are available**
Cyprus	Pregnant women Lactating women	Yes	Yes	Qualitative and quantitative	Yes	https://www.moh.gov.cy/Moh/SGL/sgl.nsf/All/5193C38672EB5795C225886300318F43?Opendocument
Denmark	Pregnant Lactating women Children < 14 years old	Yes	Yes	Qualitative and quantitative	Yes	https://foedevarestyrelsen.dk/kost-og-foedevarer/alt-om-mad/de-officielle-kostraad/kostraad-til-dig/gravid-eller-ammende; https://foedevarestyrelsen.dk/kost-og-foedevarer/alt-om-mad/kemi-i-maden/baby-og-boernemad#tun
Finland	Pregnant women, Lactating women Under school-age children General population	Yes	Yes	Qualitative	Yes	https://www.ruokavirasto.fi/en/foodstuffs/instructions-for-consumers/safe-use-of-foodstuffs/safe-use-of-fish/
Lithuania	Children Pregnant women Lactating women	Yes	Yes	Qualitative and quantitative	Yes	https://www.hi.lt/uploads/Sveikatos%20stiprinimo%20centras/Naujienoms/2017%20metai/Lankstukai/Mitybos_plakatas_Zuvis_2023.jpg
Norway	Pregnant women Lactating women Children < 5 years old	Yes	No		Yes	https://www.mattilsynet.no/mat-og-drikke/forbrukere/ferskvannsfisk-og-kvikksolvforurensing
Portugal	Young children, Pregnant women Lactating women General population*	Yes	Yes	Qualitative and quantitative	Yes	https://repositorio-aberto.up.pt/bitstream/10216/151299/2/635429.pdf
Spain	Children 0–10 years old Children 10–14 years old Pregnant women Lactating women Women who wish to conceive General population*	Yes	Yes	Qualitative and quantitative	Yes	https://www.aesan.gob.es/AECOSAN/docs/documentos/seguridad_alimentaria/gestion_riesgos/CONSUMPTION_ADVICE_FISH_MERCURY_SPAIN_AESAN.PDF

* For the general population there was no distinction between the different fish species to be restricted or avoided.

ANNEXES

Annex A – Fish and other seafood consumption and awareness questionnaire.

The fish and other seafood consumption and awareness questionnaire is available under the Supporting Information section on the online version of the scientific output

Annex B – Data model

The data model for collecting fish and other seafood and awareness data is available on EFSA's Knowledge Junction Community in Zenodo at: https://doi.org/10.5281/zenodo.18467800.

Annex C – Raw data published in EFSA Knowledge Junction

The raw food consumption and other seafood and awareness data are available on EFSA's Knowledge Junction Community in Zenodo at: https://doi.org/10.5281/zenodo.18467800.

Annex D – National factsheets from FPS and SPS

The national factsheets from FPS and SPS are available on EFSA's Knowledge Junction Community in Zenodo at: https://doi.org/10.5281/zenodo.18467800.