Superior Health Council

ADVANTAGES AND DISADVANTAGES OF EATING FISH AND SEAFOOD

PART 1 : MERCURY AND METHYLMERCURY IN FISH

DECEMBER 2022

SHC № 9343

JOINT REPORT WITH SciCom

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Federal Public Service Health, Food Chain Safety
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Please cite this document as follows:
Superior Health Council. Advantages and disadvantages of eating fish and seafood. Part 1 : Mercury and methylmercury in fish. Brussels: SHC; 2022. Report 9343.

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SCIENTIFIC COMMITTEE ESTABLISHED AT THE FEDERAL AGENCY FOR THE SAFETY OF THE FOOD CHAIN

PUBLICATION OF
THE SUPERIOR HEALTH COUNCIL
AND OF
THE SCIENTIFIC COMMITTEE ESTABLISHED AT THE FASFC
SHC No. 9343 and SciCom 17-2022

Advantages and disadvantages of eating fish and seafood
Part 1 : Mercury and methylmercury in fish

Common advisory report approved by the Scientific Committee established at the FASFC
on 25 November 2022
and validated by the Board of the Superior Health Council (SHC)
on 7 December 2022

The Superior Health Council and the Scientific Committee provide the following common advisory report.

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Keywords and MeSH *descriptor terms*[1]

MeSH terms*	**Keywords**	***Sleutelwoorden***	***Mots clés***	***Schlüsselwörter***
Diet	Nutrition	*Voeding*	*Nutrition*	*Ernährung*
Nutrition policy	Recommendations	*Aanbevelingen*	*Recommandations*	*Empfehlungen*
Risk assessment	Risk assessment	*Risico-evaluatie*	*Evaluation du risque*	*Risiko-Bewertung*
Food safety	Food safety	*Voedselveiligheid*	*Sécurité alimentaire*	*Ernährungssicherheit*
Dietary exposure	Dietary exposure	*Voedingsblootstelling*	*Exposition alimentaire*	*Ernährungsbedingte Exposition*
Mercury	Mercury	*Kwik*	*Mercure*	*Quecksilber*
Methylmercury compounds	Methylmercury	*Methylkwik*	*Méthylmercure*	*Methylquecksilber*
Fishes	Fish	*Vis*	*Poisson*	*Fisch*

MeSH (Medical Subject Headings) is the NLM (National Library of Medicine) controlled vocabulary thesaurus used for indexing articles for PubMed *http://www.ncbi.nlm.nih.gov/mesh*.

[1] The Council wishes to clarify that the MeSH terms and keywords are used for referencing purposes as well as to provide an easy definition of the scope of the advisory report. For more information, see the section entitled "methodology".

ABBREVIATIONS AND SYMBOLS

Bod	Burden of disease
ADHD	Attention deficit hyperactivity disorder
ASD	Autism spectrum disorder
b.w.	Body weight
CHD	Coronary heart disease
CVD	Cardiovascular disease
DALY	Disability-adjusted life years
DGAPF	Directorate General Animals, Plants and Foodstuffs
DHA	Docosahexaenoic acid
DL-PCB	Dioxin-like Polychlorinated biphenyls
EC	European Commission
EFSA	European Food Safety Authority
EPA	Eicosapentaenoic acid
EU	European Union
FA	Fatty acid
FAO	Food and Agriculture Organization of the United Nations
FASFC (Be)	Federal Agency for the Safety of the Food Chain
FBDG	Food Based Dietary Guidelines
FCS	Food Consumption Survey
FFQ	Food Frequency Questionary
GBD	Global Burden of Disease
Hg	Mercury
inHg	Inorganic mercury
JECFA	Joint FAO/WHO Expert Committee on Food Additives
LB	Lower bound
LCPUFA	Long Chain Polyunsaturated Fatty Acid
LOD	Limit of detection
LOQ	Limit of quantification
MAC	Maximum analytical concentration
MB	Middle bound
MeAC	Mean analytical concentration
MeHg	Methylmercury
NHFS	Nutrition and Health, Including Food Safety
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NVT	*Niet van toepassing*
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzodioxins
PCDF	Polychlorinated dibenzofurans
PFAS	Per- and polyfluoroalkyl substances
PTWI	Provisional Tolerable Weekly Intake
PUFA	Polyunsaturated Fatty Acid
RASFF	Rapid Alert System for Food and Feed
RB	Risk vs Benefit
RIVM	*Rijksinstituut voor Volksgezondheid en Milieu*
SciCom	Scientific Committee established at the FASFC
SHC	Superior Health Council
SPADE	Statistical Program to Assess Dietary Exposure
TEQ	Toxic equivalency
TRV	Toxicological reference value

TWI	Tolerable weekly intake
UB	Upper bound
VLAM	*Vlaams Centrum voor Agro- en Visserijmarketing* Flemish Centre for Agriculture and Fish production
WHO	World Health Organization

1. REFERENCE TERMS

1.1. Question

DGAPF addressed a first request for an advisory report on 15 February 2016 regarding "Advantages and disadvantages of fish and seafood consumption for the Belgian population, including specific risk groups".
The objective was to update the advisory report "Fish and health in adults" of the SHC from 2004 (SHC, 2004) by taking into account the evolutions.

As EFSA was working on the same subject, it was decided, in agreement with the DGAPF, to wait for the results and methodology in order to work continuously and draw up an advisory report focusing on Belgium.

In December 2019, DGAPF reports that EFSA is behind schedule and therefore asks the SHC to no longer wait and to start the project.
This is formalised in the letter of 8 January 2020 from the DGAPF to the SHC:
The DGAPF asks the Superior Health Council to give its opinion on the following points, taking into account the Belgian surveys on food consumption in different age groups, the data of the FASFC, the Belgian human biomonitoring, the data collected in contract research projects and the scientific literature:

- Are there groups of the Belgian population exposed to a risk of excessive ingestion of contaminants (mercury, but also dioxins, PCBs, etc.) due to their current consumption habits of fish and other seafood, given their positive effects?

  If so, which are these population groups and which fish and seafood species in particular contribute to this overexposure? Please also divide the fish species as far as possible, e.g. by further subdividing the tuna group.

- Is there a need to continue and/or modify the consumption advices for these population groups? If so, what specific dietary recommendations could the Council make (e.g. restricting or avoiding certain fish and seafood species for certain population groups)? Please communicate as much as possible in a "positive" way and thus make recommendations for species and frequencies of fish suitable for consumption by these population groups. For example, it may be decided in this context to examine the problems of fish and seafood in a broader context, e.g. in comparison with meat consumption, etc.

In 2018, EFSA published a new opinion on dioxins, a set of 29 compounds including 7 polychlorinated dibenzodioxins (PCDDs), 10 polychlorinated dibenzofurans (PCDFs) and 12 dioxin-like PCBs (DL-PCBs). The Tolerable Weekly Intake (TWI) has been revised to 2 pg TEQ/kg b.w./week. This revision follows the evaluation of new data. The risk assessment is based on the new epidemiological data, supported by animal studies. The critical point is the reduced sperm concentration, following pre- and post-natal exposure. The studies showed a no-observed-adverse-effect level (NOAEL) of 7.0 pg PCDD/F TEQ/g fat (blood sample from 9-year-old boys), which allowed the derivation of the above mentioned TWI. Based on new occurrence data provided by the Member States and consumption data, the estimated intake of dioxins and dioxin-like PCBs for the all age population far exceeds the TWI. Fish and seafood products are considered the main contributors to exposure. This estimate is rather conservative due to the uncertainties of the impact of PCB126 (the most important contributor to the exposure of the 29 congeners). In its recommendations, EFSA points to the need to update the risk-benefit assessment of fish consumption that takes into account exposure to PCDD/Fs and DL-PCBs.

On 17 May 2022, DGAPF sent an amended request for an advisory report to the SHC:
Following the latest discussions on mercury, in which DGAPF participates at European level, namely:

> 1) the Commission Regulation amending Regulation (EU) No 1881/2006 as regards maximum levels of mercury in fish and salt, and
> 2) the draft Commission Recommendation on the monitoring of mercury in fish, crustaceans and seafood.

This proposal for a recommendation (which has meanwhile been approved by the *ad hoc* European Regulatory Committee in June 2022) requires Member States to actively develop and disseminate advices on fish and seafood consumption to the public and professionals:
"Where needed for the protection of consumer health, Member States develop specific national consumption advice related to the consumption of fish, crustaceans and molluscs to fully achieve the beneficial effects of fish and seafood consumption, whilst limiting the risks of mercury toxicity. When developing this consumption advice, Member States shall especially include the frequency of the consumption of fish, crustaceans and molluscs and the species consumed.".
In addition, EFSA is responsible for evaluating the effectiveness of these consumption advice. To this end, EFSA asks Member States to send their consumption advice before 1 October 2022. This deadline has been extended to 1 December 2022.

Belgium is making every effort to meet its European obligations by responding to the above-mentioned requests regarding mercury. On the other hand, this will ensure that Belgian consumers receive appropriate and scientifically based recommendations on the consumption of fish and seafood to minimize the risks related to the ingestion of mercury.

Therefore, DGAPF requests that the efforts of the working group focus at this stage on the problem of mercury in fish, crustaceans and seafood, and requests that the SHC finalize an advisory report on this contaminant in time for Belgium to be able to respond to the requests referred to in the above-mentioned European recommendation.

The delivery of the full advisory report, i.e. on all relevant contaminants, will be delayed. In view of the recent importance of the PFAS issue, DGAPF requests that the full advisory report also takes into account this contaminant.

1.2. <u>Legal context</u>

Commission Regulation (EC) No 1881/2006 (European Commission, 2006) sets maximum levels for certain contaminants, including mercury, in foodstuffs. Since mercury is mainly present in fish (mainly in the form of methylmercury), Europe has opted for maximum levels for mercury in fish and fishery products.

In its scientific opinion of 2012, the European Food Safety Authority (EFSA) 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. The opinion concluded that the mean dietary exposure across age groups does not exceed the TWI for methylmercury, with the exception of toddlers and other children in some surveys. The 95th percentile dietary exposure is close to or above the TWI for all age groups. High fish consumers may exceed the TWI by up to approximately six-fold and unborn children constitute the most vulnerable group. However EFSA advised taking into account the beneficial effects of fish consumption, if measures to reduce methylmercury exposure were considered.

In 2014, EFSA published a scientific opinion on health benefits of seafood (fish and shellfish) consumption in relation to health risks associated with exposure to methylmercury. This scientific opinion takes into account the important nutrients, including the long-chain omega-3 polyunsaturated fatty acids that fish contains. These benefits are weighed against the disadvantages, such as mercury. On 2015, EFSA published a statement on the benefits of fish/seafood consumption compared to the risks of methylmercury in fish/seafood, where it concluded that, to achieve the benefits of fish consumption associated with 1 to 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.

Taking into account the outcome of the EFSA's scientific opinions, the maximum levels for mercury were reviewed, to reduce further the dietary exposure to mercury in food. Therefore on 3 May 2022, Commission Regulation (EU) 2022/617 entered into force (EUa, 2022). This Regulation amends Regulation (EC) No 1881/2006 as regards maximum levels of mercury in different types of fish, crustaceans, molluscs and salt.

In parallel, Commission Recommendation (EU) 2022/1342 on the monitoring of mercury in fish, crustaceans and molluscs was published on 28 July 2022 (EUb, 2022). Member States should perform during the years 2022, 2023, 2024 and 2025 monitoring on the presence of methylmercury and total mercury in fish, crustaceans and molluscs with the aim of gathering detailed occurrence data and information on the effective impact of the lowered maximum levels for certain fish species on the overall consumer exposure to mercury. Recommendation 2022/1342 also indicates the consumption advice for fish as an important risk management instrument in view of fully achieving the beneficial effects of fish consumption whilst limiting the risks of mercury toxicity and recommends the development of national consumption advice by Member State competent authorities as well as an active communication of such an advice.

1.3. Methodology

After analysing the advisory requests to the SHC and the Scientific Committee established at the FASFC, it was decided to provide a common advice. An *ad hoc* working group was then set up which included experts in areas of expertise.
The experts of this working group provided a general and an *ad hoc* declaration of interests and the Committee on Deontology of the SHC assessed the potential risk of conflicts of interest.

This advisory report is based on a review of the scientific literature published in both scientific journals and reports from national and international organisations competent in this field (peer-reviewed), as well as on the opinion of the experts. Specifically for this report, the dietary exposure was estimated based on the nationally available occurrence and consumption data.

The advisory report was endorsed by the *ad hoc* working group, by the standing working group NHFS, by the Scientific Committee established at the FASFC and by the Board of the SHC.

2. INTRODUCTION

2.1. Introduction and issue

Mercury (Hg) is a metal that is released into the environment from both natural and anthropogenic sources. After release into the environment, it undergoes complex transformations and cycles between atmosphere, land and aquatic systems. During this biogeochemical cycle, humans, plants, and animals are exposed to mercury, potentially resulting in a variety of health impacts (EFSA, 2012).

The three chemical forms of mercury are:

(i) elemental or metallic mercury (Hg^0),

(ii) inorganic mercury (mercurous (Hg_2^{2+}) and mercuric (Hg^{2+}) cations) and

(iii) organic mercury (methylmercury being the most common).

In general, elemental mercury is the predominant form of mercury in the atmosphere (Selin, 2009). Inorganic mercury (inHg) compounds are used in several industrial processes and can be found in batteries, fungicides, antiseptics or disinfectants. Organic mercury compounds have at least one carbon atom covalently bound to the mercury atom. Methylmercury (MeHg) is by far the most common form in the food chain. After oral intake, methylmercury is much more extensively and rapidly absorbed than mercuric and mercurous mercury. In contrast to mercuric mercury, methylmercury is able to enter the hair follicle, and to cross the placenta as well as the blood-brain and blood-cerebrospinal fluid barriers, allowing accumulation in hair, the fetus and the brain. Mercuric mercury in the brain is generally the result of either in situ demethylation of organic mercury species or oxidation of elemental mercury (EFSA, 2012).

Developmental studies of rats and mice indicated that **methylmercury** leads to immunotoxicity and effects on body weight gain, locomotor function and auditory function. In children, it was shown on a Faroe Islands Cohort that the association between prenatal exposure and neurological auditory function was still present at 14 years, but with a smaller impact than at seven years. In another children cohort (Nutrition Cohort in the Seychelles Child Developmental Study), an association was found between prenatal mercury exposure and decreased scores on neurodevelopmental indices at 9 and 30 months after adjustment for prenatal blood maternal n-3 long-chain polyunsaturated fatty acids (n-3 LCPUFAs). The EFSA CONTAM Panel concluded that associations between methylmercury exposure and neurodevelopmental outcomes after prenatal exposure still form the best basis for derivation of a health-based guidance value for methylmercury (EFSA, 2012).

For **inorganic mercury**, the critical target for toxicity is the kidney. The EFSA CONTAM Panel used the kidney weight changes in male rats as the pivotal effect to set a health-based guidance value (EFSA, 2012).

The largest source of mercury exposure for most people in developed countries is inhalation of mercury vapour due to the continuous release of elemental mercury from dental amalgam. Exposure to methylmercury mostly occurs via the diet. Methylmercury collects and concentrates especially in the aquatic food chain, making populations with a high intake of fish and seafood particularly vulnerable (EFSA, 2012).

The amount of mercury in fish is related to the age of the fish and the position of the fish species within the food chain; predatory fish and older fish having higher concentrations than others. Unlike some other contaminants, mercury content is not related to the fat content of the fish and, as such, mercury is not considered a problem associated especially with oily fish (EFSA, 2012).

Regarding fish intake in Belgium, in 2019, the Superior Health Council published Dietary Guidelines for the Belgian adult population (SHC, 2019). Fish is a food group to focus on. Due to long chain polyunsaturated omega 3 fatty acids content in some fish, it was recommended to eat fish, seafood, or shellfish once to twice a week, including oily fish once a week, varying the species and origin. Indeed, according to the GBD study, in order to prevent health problems, it is desirable to consume at least 12 % of energy intake in the form of PUFAs, with particular attention to omega-3 fatty acids (GBD, 2017).

In its advisory report on the vegetarian diet, the SHC also discusses the advantages and disadvantages of fish consumption (SHC, 2021). For pesco-vegetarians, regular consumption of oily fish with a fat content of more than 2 % (sardines, mackerel, salmon, etc.) and/or fish oil can provide sufficient quantities of EPA and DHA. Regarding toxicological aspects, the advisory report states that exposure to mercury is mainly due to the consumption of fish and much less to other foods. This is also reported in the EFSA opinion of 2012, which states that in most of the foods analysed (excluding fish), mercury is not detected. Therefore, one should not expect problems among vegetarians and vegans, except for pesco-vegetarians who should avoid continuous consumption of fish.

The objectives of this advisory report are to update previous fish intake recommendations from the SHC for the Belgian population, considering both nutritional benefits and risks linked to mercury (including inorganic and methylmercury) exposure.

To achieve this goal, on one hand, the main fish species consumed by the Belgian population as well as their nutritional composition was assessed, and, on another hand, a risk assessment related to mercury exposure through fish consumption in Belgium was performed.

2.2. Study description

For the purpose of this advice, first of all, the consumption data available from the Belgian National Food Consumption Survey were assessed and the variety of the reported consumption events related to fish and fish products were listed. The most consumed items were ranked. Based on this, the possible consumption scenarios were discussed and proposed.
Subsequently, the occurrence data of mercury in fish from the annual Food Control Programs of FASFC were used to assess inorganic and methylmercury intake.
Based on exposure scenarios, the exposure assessment for methylmercury and inorganic mercury was performed for Belgian population (3-64 years). On this basis, the risk was characterized.
In addition to this, the beneficial role of fish consumption was reviewed and an attempt of risk-benefit analysis of fish consumption was performed.
Finally, recommendations about fish consumption were proposed, based on both nutritional benefits and health risks.

3. ADVISORY REPORT

3.1. Data sources and methodology

3.1.1. Occurrence of methylmercury and inorganic mercury in fish

3.1.1.1 *Occurrence data definition*

In order to perform the intake and risk assessment, the data on dietary intake and analytical concentration levels had to be coupled. The latter are referred as occurrence data.

3.1.1.2 *Origin of the occurrence data*

The occurrence data of methylmercury and total mercury in fish were obtained from the Food Control Program (period 2014-2021) of the Federal Agency for Safety in Food Chain (FASFC), which is annually updated based on the risk (Maudoux et al., 2006).

The occurrence data provided by FASFC were analytical concentrations for total mercury (number of results = 1139[2]) and methyl mercury (number of results = 878). Following the procedure, a first screening is performed, and in case of determined levels of total mercury, a speciation method is performed to determine Hg species, including methylmercury. However, no method is available to determine inorganic mercury alone. In fish, the contribution of methylmercury to total mercury generally ranged between 30 % and 100 %, depending on fish species, size, age and diet (EFSA, 2012). EFSA (2012) proposed that, to ensure that dietary exposure to inorganic mercury was not underestimated, 20 % of total mercury in fish was assumed to be inorganic mercury. In this study, the measured total mercury was converted to inorganic mercury by applying a conversion factor of 20 % in case of fish. For crustaceans and shellfish, a conversion factor of 50 % was applied to total mercury concentration to estimate inorganic mercury levels (EFSA, 2012).

The number of results per fish species is illustrated in figures 1, 2 and 3. These figures show that tuna, cod and swordfish were constantly sampled each year and these are the fish species most often sampled for the analysis. Similarly, scallops were also constantly sampled but in lower amount.

[2] Only data obtained in the scope of control were considered. Data obtained for the purpose of the contra analysis (confirmation) and RASFF confirmations were excluded.

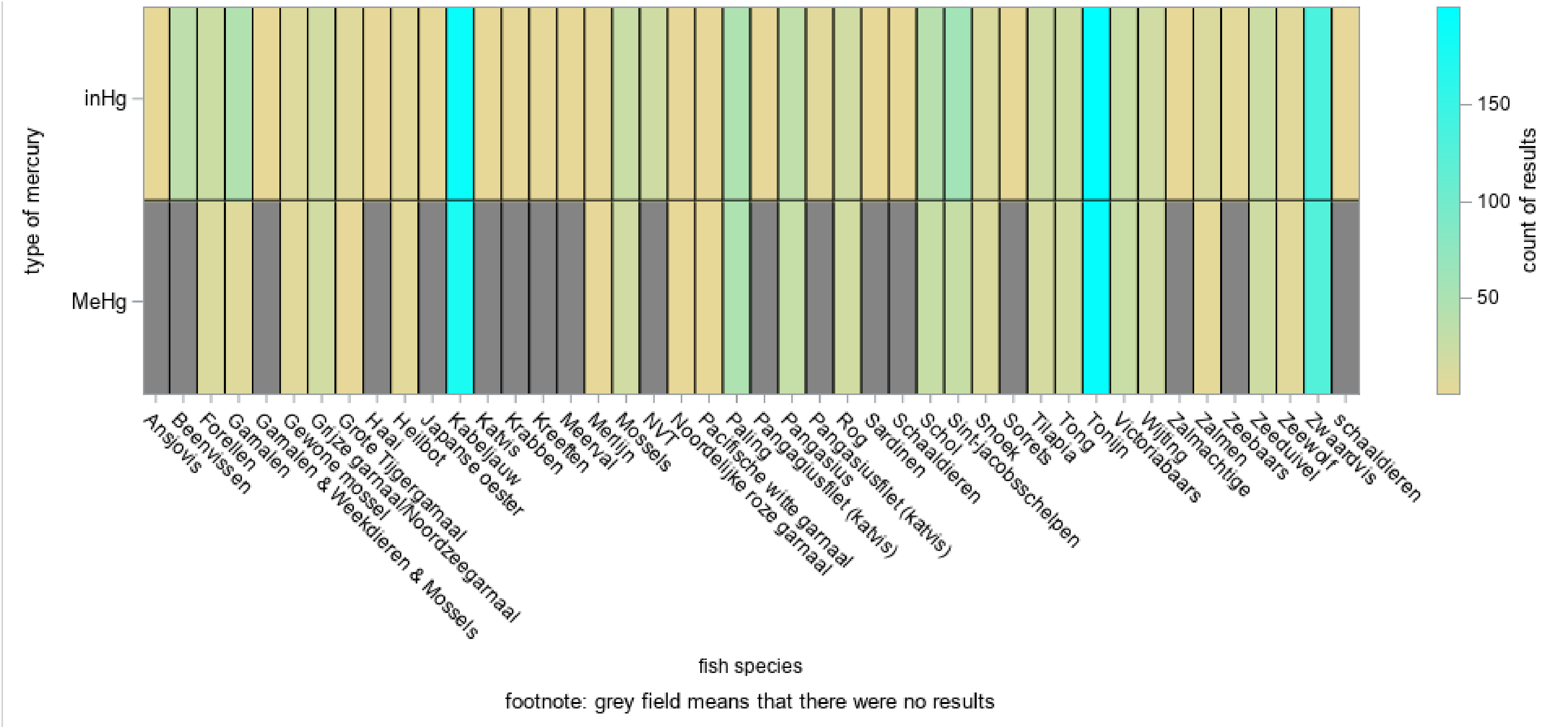

Figure 1. Comparative overview of the number of analytical results (2014-2021 data collection) per fish species and per type of mercury used in the study.
*grey colour stands for “no results”

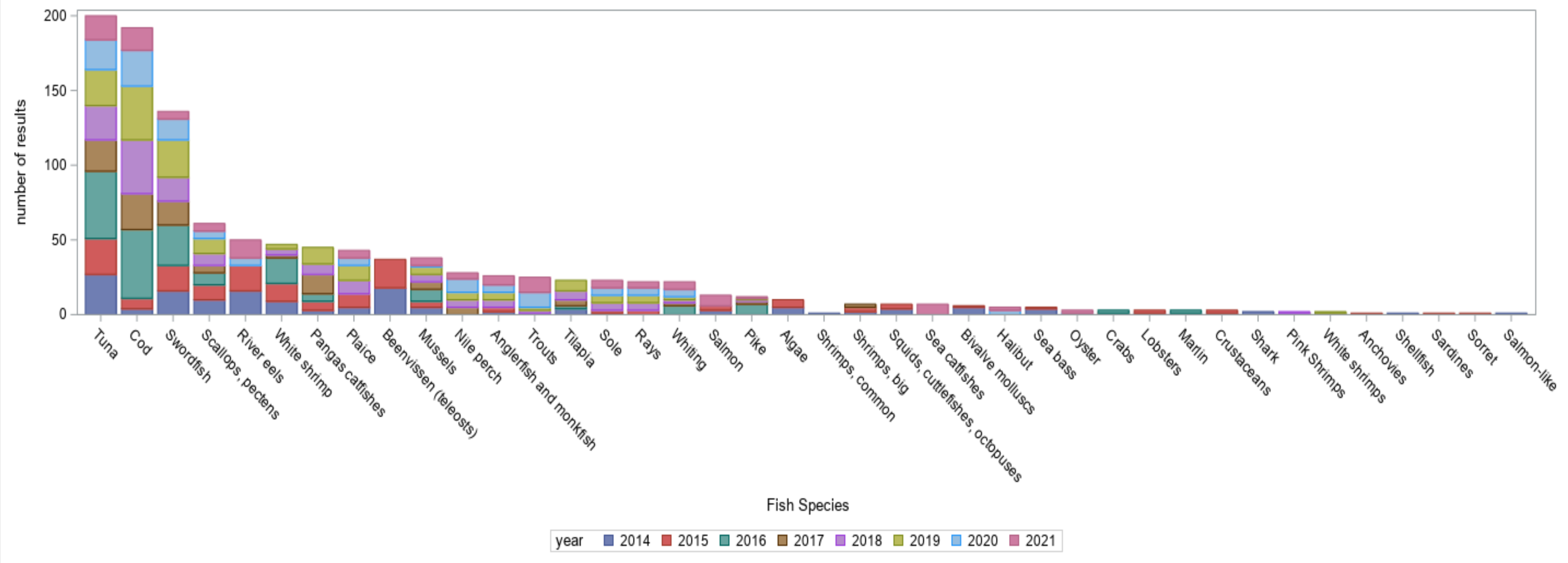

Figure 2. Total number of results used for inorganic mercury, reported per fish species, obtained from Federal Agency for Safety in Food Chain (FASFC) in the scope of the Food Control Program (2014-2021).

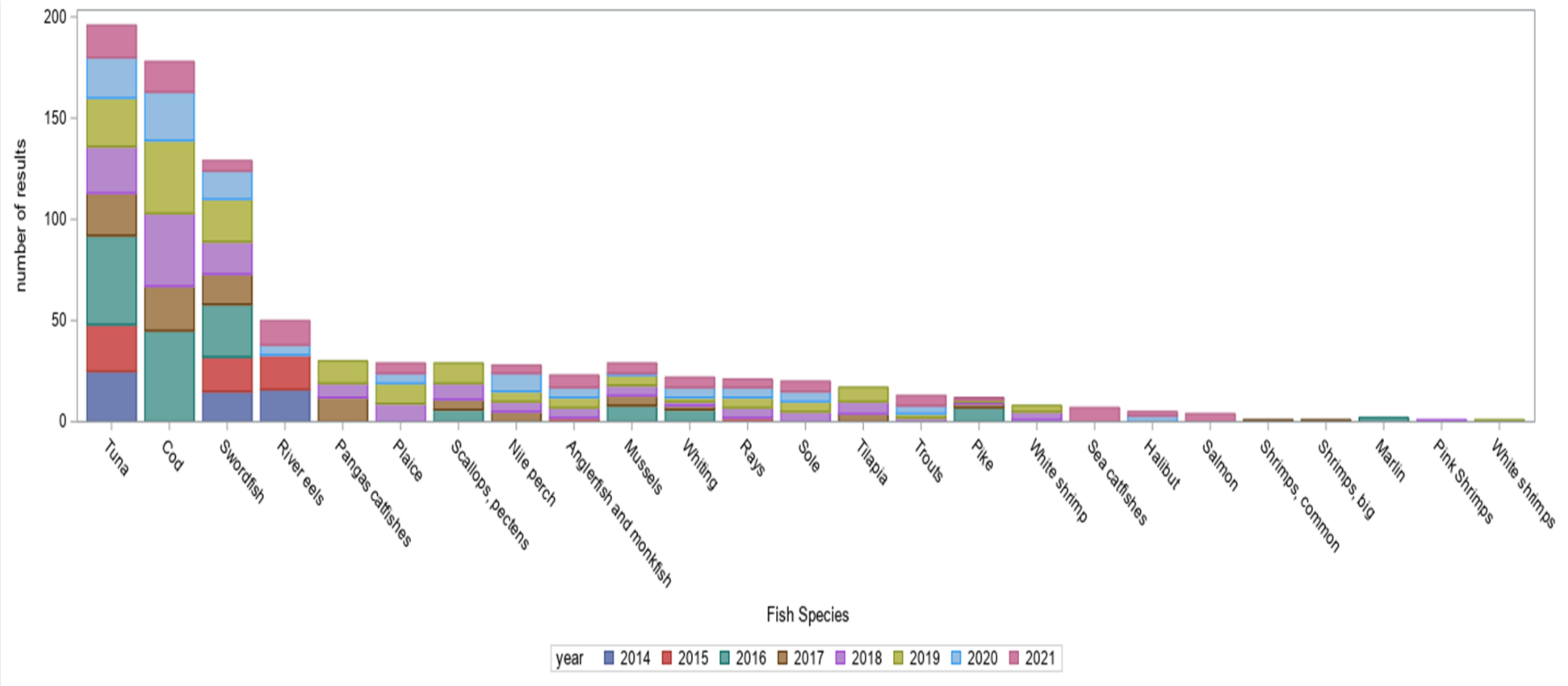

Figure 3. Total number of results for methylmercury reported per fish species, obtained from Federal Agency for Safety in Food Chain (FASFC) in the scope of the Food Control Program (2014-2021).

3.1.1.3 *Data analysis and validation*

The data were carefully selected to provide as much as possible information (analytical results and descriptive information). Finally, the parameters with the highest level of detail and relevance were used; these were: data collection period (“year”), categorisation of the matrix on different levels[3] (“matrix level 3”, “matrix level 4”, “matrix level 5”), description of the matrix, fish species, analytical result, units, country of origin of the sample, reason for analysis, fish treatment, packaging, sample code, sample mission number

The input data sets were cleaned, refined, and validated prior to perform the exposure assessment. There were no duplicates, and the data were validated for further use by the expert group. The left data were treated as recommended in international guidelines (WHO/IPCS, 2009; EFSA, 2010b) and substitution method was used for the treatment of results below the LOD/LOQ. Occurrence values below the LOD/LOQ were set equal to the LOD/LOQ (upper bound). The LOD/LOQ in the dataset originated from the monitoring data and were assigned according to the reported values. Lower bound[4] was not used since there is a low number of data reported as <LOQ/LOD.

3.1.1.4 *Distribution of analytical results across fish species*

Provided occurrence data were classified according to the FASFC classification system. For further analysis, the name of a fish species was used as a distinctive variable to make further selections. Further grouping was necessary to have a sufficient and reliable number of results per each species/group. The overview of the number of the analytical results per matrix group (matrix level 5) is given in Figure 4.

There were three major groups: fish (“aquaculture fish", "river fish", "fish in general", "fish rich in histidine", "sea fish”), shellfish (“Cooked bivalves", "Live bivalves” and "Bivalves”) and crustaceans (“Frozen peeled crustaceans", "Crustaceans", "Crustaceans cooked on board”), with an additional fourth group of other species, like algae and squid (Figure 4).

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[3] The FASFC system includes a five subsequent levels categorisation of a matrix (food item, eg) where each subsequent level describes the matrix with more details, therefore matrix level 1 is the highest level (the general group like fish) and the matrix level 5 is the lowest level (the most detailed level).

[4] The lower bound (LB) was obtained by assigning a value of zero to all the samples reported as less than the LOQ/LOD level, the middle bound (MB) may be obtained by assigning half of the LOQ/LOD limit as the sample result.

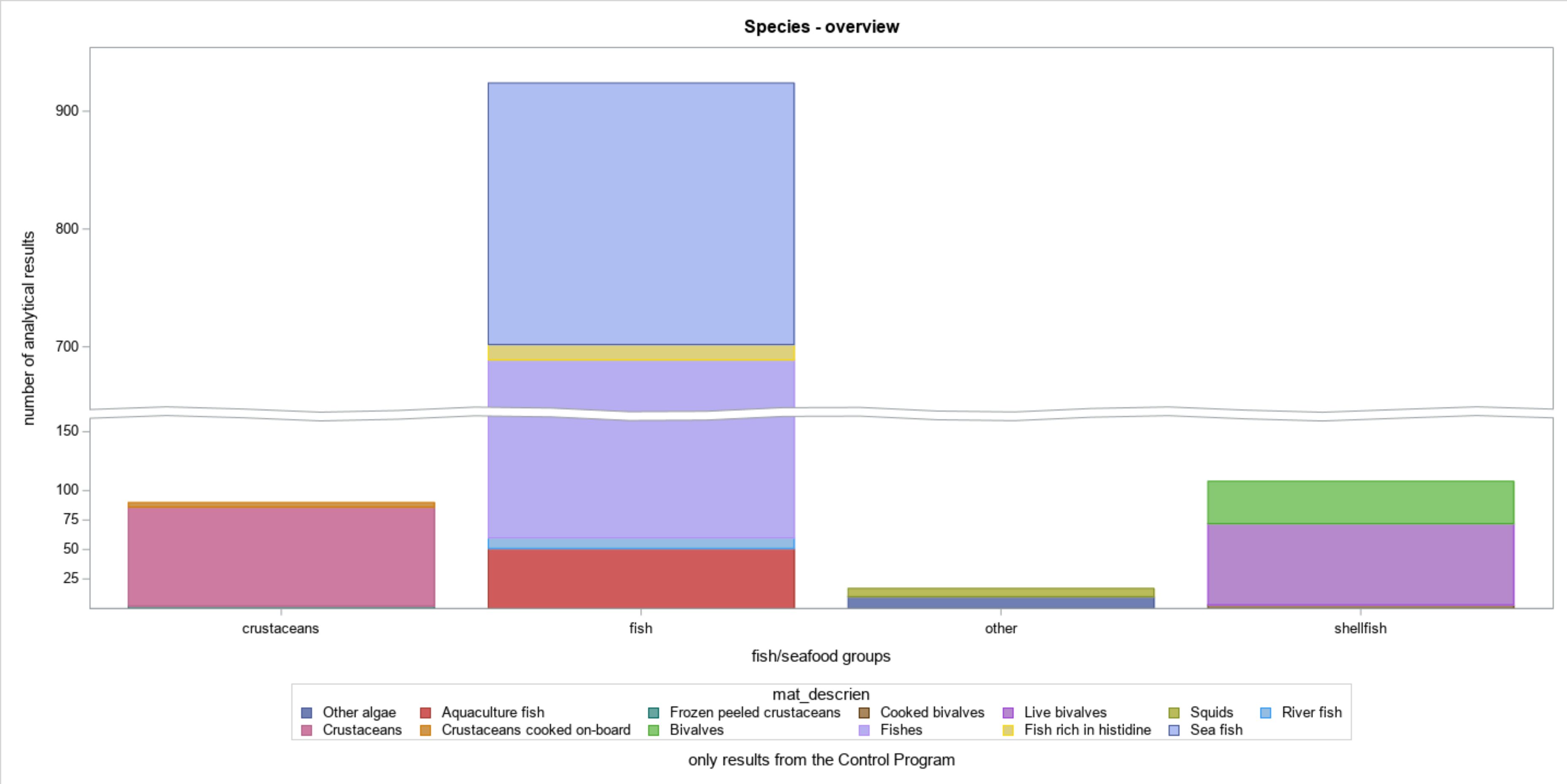


Figure 4. Number of analytical results for total mercury reported per matrix group (matrix level 5) obtained from Federal Agency for Safety in Food Chain (FASFC) in the scope of the Food Control Program (2014-2021).

3.1.2. Fish consumption

3.1.2.1 *Fish consumption data origin*

The evaluation of the exposure has been realized using Belgian national representative food consumption data of the FCS_2014 (for ages between 3 and 64 years). The objectives, concept and methodology of the food consumption survey have been described elsewhere (Bel et al., 2016).

3.1.2.2 *Fish consumption data description*

Dietary assessment in adolescents and adults (> 10 years) was performed by the 24-h dietary recall method, carried out on two non-consecutive days, using GloboDiet© (former EPIC-Soft), a computerised 24-h recall program. Dietary assessment in children (3 to 9 years old) was done using two self-administered non-consecutive one-day food diaries followed by a GloboDiet© completion interview with a proxy respondent. Pre-defined coded lists of foods, recipes, facets and descriptors are used in Globodiet©. Facets and descriptors describe foods and recipes in more details. Facets characterize different aspects of the dietary item such as the cooking method used, brand name and preservation method. Descriptors are pre-defined answers for the facets, e.g. grilled, fried or boiled for the facet ‘cooking method’ (Crispim et al., 2014).

3.1.3. Exposure assessment

3.1.3.1 *Fish categorization in the project*

The classification of analytical data was performed according to five subsequent levels where each higher level describes with more details the fish matrix. As described above, there were three major groups: fish, shellfish, and crustaceans, with an additional fourth group of other species.
The consumption data were grouped into fish as end product (directly consumed items) and fish as ingredient (fish part consumed as a part of a fish based meal, eg. tuna in tuna salad).

3.1.3.2 *Matching of analytical results to fish consumption data*

To facilitate the grouping, the FoodEx classification system was used. The system was introduced by EFSA (EFSA, 2011) and consists of a large number of individual food items aggregated into food groups and broader food categories in a hierarchical parent-child relationship. It contains 20 main food groups (first level), which are further divided into subgroups having 140 items at the second level, 1,261 items at the third level and reaching about 1,800 items (food names or generic food names) at the fourth level.

Each fish according to the name of the species (NL translation to English, but also using Latin species names) was matched to Foodex classification[5] and a coded number was assigned (cf. annex 4). The codification was performed at the lowest possible level (eg. fourth) avoiding the aggregation of fish that have dissimilar consumption patterns. Finally, 73 Foodex codes matching the occurrence data were identified at level 2-6 The main groups at level 2 were “Fish

[5] FoodEx classification system classifies foods in 20 main food categories where each food category is divided further horizontally and vertically into subcategories and the maximum level of vertical subcategories per one category is 6. The food description (name) at the 7th (last) level of classification is very specific and might even stand for a specific food product. https://www.efsa.europa.eu/en/data/data-standardisation.

(meat)", "Crustaceans" and "Molluscs"). Additionally, facets (descriptors) were also evaluated and used where necessary.

Based on this, occurrence data were matched to the FCS_2014 consumption data. Occurrence data of 31 fish species were directly matched to the consumption data representing 80 % of all fish reported consumption. For around 17 % of the fish, a best possible match was sought. Practically consumption of Pollock was matched with the analytical results of cod. Both fish belong to the same family. This aggregation of analytical results was necessary to account as much as possible consumptions data. To match consumptions reported as salmon mousse, fish mousse, fish schnitzel filled with sauce and surimi, a correction factor was used to take into account of the percentage of the main ingredient (salmon in salmon mousse, eg). However, for 3 % of fish related consumption, it was not possible to find the best match and they were not used in the exposure estimation.

Facets and descriptors were not taken into account to ensure sufficient number of consumptions per each fish species.

3.1.3.3 *Intake assessment*

The intake and risk assessments were performed for the Belgian population aged 3-64 years (children, adolescents, and adults) using the FCS_2014 food consumption database. Only respondents with two completed 24-h dietary recalls and available measured body weight were included in the exposure assessments (FCS_2014: n=3096; 1529 men and 1567 women).

To assess the long-term average intake from these short-term measurements, the data required statistical modelling to take into account between-person and within-person variations. The daily usual intake distributions were estimated by the Statistical Program to Assess Dietary Exposure (SPADE) (RIVM; 2014). SPADE is freely available as an R package called SPADE.RIVM. The usual intake distribution is modelled as a function of age. Uncertainty in the usual intake distribution was quantified with ready for use bootstrap (a technique that allows estimation of the sampling distribution using random sampling methods; n=1000), which provided confidence intervals with the required confidence level (Dekkers et al., 2014). The 2-part model for episodical-consumed food components was used because fish was not consumed daily by all the subjects. SPADE program allows semi-probabilistic approach to dietary exposure estimation where distribution of daily consumption figures are multiplied with food specific fixed contaminant concentrations and these products are summed over all foods consumed by an individual per day.

To ensure representative results for the Belgian population and for the different seasons and interview days (week versus weekend days) weighting factors were used. The usual intake distribution was weighted for age, sex, province, season, and day of the week.

The frequency of fish consumption was collected from the FCS_2014. The database contains the result of the Food Frequency Questionnary (FFQ). The consumption frequency is necessary to assess mercury exposure through fish consumption and to characterize the risk using tolerable weekly intake (TWI) as a reference value.

3.1.3.4 *Exposure scenario's*

The exposure scenario describes the circumstances of the exposure. In defining the exposure, possible consumption patterns regarding the food selected in the project were considered (high consumers and average consumer). Furthermore, to estimate the risk from specific fish species with a higher content of either inorganic mercury or methylmercury, some hypothetical exposure scenarios were developed.

a) Baseline exposure scenario's

To estimate and evaluate dietary exposure three baseline exposure scenarios were considered. In each scenario, fixed contaminant concentrations (inHg and MeHg) were defined (mean, 95th percentile and maximum). This allowed to use of semi-probabilistic approach by SPADE.

Scenario 1: Exposure scenario using mean analytical concentrations (mean scenario)

In the first exposure scenario, mean analytical concentrations of inorganic mercury and methyl mercury in all considered fish products were used to assess dietary intake in the Belgian population. It was performed using actual total fish consumption data combined with the mean analytical concentrations for each fish category. This scenario is a more realistic scenario for the chronic intake of both inorganic mercury and methylmercury.

The individual intake of a compound was estimated using the following equation:

$$Y_i = \sum_{k=1}^{n} \frac{X_{k,i} \times C_k}{bw_i}$$

> *where: Yi is the daily inorganic or methylmercury intake of a given individual i (µg (kg bw)$^{-1}$ day^{-1}; n is the number of fish items containing the inorganic or methylmercury, bw_i is the measured body weight of a given individual i (kg); $X_{k,i}$ is the amount of the food k consumed on that day (g day^{-1}); Ck is the mean analytical concentration of inorganic or methylmercury in the food item k (mg kg^{-1}).*

Scenario 2: Exposure scenario using the 95th percentile analytical concentration (high exposure)

A P95 analytical concentration exposure assessment scenario was performed using actual total fish consumption data combined with the 95th percentile analytical concentration of either inorganic mercury or methylmercury. This scenario represents the high exposure as it assumes that the consumer will be continuously (over a lifetime) exposed to these contaminants present in fish at the P95th observed level. This scenario excludes possible outlier analytical concentrations and is also used by EFSA.

The equation as described above has been used, with *Ck* being the P95 analytical concentration.

Scenario 3: Exposure scenario using the maximum analytical concentration (worst case)

In the third exposure scenario, a maximum analytical concentration of either inorganic mercury or methylmercury was combined with actual total fish consumption data. This scenario is the most conservative scenario as it assumes that the consumer will be continuously (over a lifetime) exposed to these contaminants present in fish at the maximum observed level.

The equation as described above has been used, with *Ck* being the maximum analytical concentration.

b) Risk vs Benefit exposure scenario

Fatty fish are a rich source of omega 3 polyunsaturated fatty acids and should be consumed for beneficial health effect of these essential fatty acids. To be able to quantify this trade off, beneficial effect versus risk due to the presence of toxic compounds like methylmercury, an additional estimation of the exposure is proposed. This calculation is based on the recommendation for the optimal intake of omega 3 fatty acids via fish for adults and children. Using a deterministic approach, the estimated dietary intake of inHg and MeHg in these conditions is calculated.

3.1.3.5 *Fish species contributing to the total mercury exposure of the general population*

The contribution of the different fish species based on the FoodEx2 hierarchy to the estimated total exposure was calculated.

These calculations included only information from the first 24-h dietary recall. For each consumer, the proportion between the ingested quantity of the contaminant for a specific fish group and the total ingested quantity on that day was determined. A weighted mean was calculated to estimate the mean contribution of fish categories to the total exposure for the whole Belgian population.

3.1.4. Risk assessment

Inorganic mercury and methylmercury intakes were compared to toxicological reference values. The CONTAM Panel from EFSA established a tolerable weekly intake (TWI) for inorganic mercury of 4 µg (kg b.w.)$^{-1}$, expressed as mercury (based on kidney weight changes in male rats as the pivotal effect). For methylmercury, the health-based guidance value was determined based on an association between human prenatal exposure to methylmercury and neurodevelopmental endpoints. A TWI of 1.3 µg (kg b.w.)$^{-1}$, expressed as mercury, was calculated (EFSA, 2012).

3.1.5. Benefits of fish consumption

Fish as a food group are a unique source of nutrients with metabolic and hormonal importance including omega-3 fatty acids, iodine, selenium, vitamin D, taurine and carnitine. Fish are also a source of high quality protein and have in general low caloric density.
The impact of these nutrients on cardiovascular risk has been extensively reviewed. More recently, the impact of fish on the broader field of endocrine and metabolic health, conditions like the metabolic syndrome, obesity, diabetes, hypothyroidism, polycystic ovary syndrome and the menopausal transition has been reported (Mendivil, 2021).

3.1.6. Nutritional value data

3.1.6.1 *Data sources*

The nutritional data come from the Belgian Nubel composition table (Nubel, 2022). Nubel's mission is to manage a scientific database of nutrients in foodstuffs for Belgium. Its table offers data for hundreds of fish, molluscs and crustaceans.
The tables of neighbouring countries Nevo (Netherlands) (RIVM/Nevo, 2021) and Ciqual (France) (ANSES/Ciqual, 2020) were also used.

Recommended nutrient intakes are based on:

- Nutritional recommendations for Belgium (SHC, 2016);
- EU Nutrient Reference Values (EFSA, 2019);
- Food Based Dietary Guidelines (SHC, 2019).

3.1.6.2 *Selection of nutrients*

In order to evaluate the benefits of consuming fish, it is important to select the nutrients that may beneficially contribute to the consumer’s health. Five nutritional characteristics are used to assess the nutritional quality of different fish:

- Omega 3 fatty acids
- Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)
- Iodine
- Selenium
- Vitamin D

These are the nutrients identified in the literature as providing health benefits through fish consumption (Thomsen et al., 2021).

FCS_2014 was reviewed and the available mean contribution from fish and fish products to the total intake of the nutrient were extracted. It was also envisaged to include specific nutrients based on literature data. Those were EPA, DHA, vitamin D, selenium.

3.1.6.3 *Processing and presentation of the data*

For each of the five nutrients mentioned above, a sorting of the fish in the Nubel table is carried out in order of decreasing content, as some values remain unknown. The aim is to be able to quickly identify the fish with the highest level of a nutrient.

It will then be possible to cross-reference this information with consumption or contamination data.

3.1.7. Uncertainties

The inherent uncertainties in the risk assessment on inorganic mercury and methylmercury have been noted and listed. Their evaluation was done according to EFSA guidelines (EFSA, 2007). The uncertainties were evaluated according to their source (the assessment objectives, the exposure scenario(s), the exposure model, the model inputs, and the performance of the assessment) and their type (vague or imprecise description, measurement uncertainty, sampling uncertainty due to limited sample sizes), default value uncertainty, extrapolation uncertainty, uncertainty about model structure, uncertainty about correlations or dependencies between inputs, differences in expert opinion, excluded factors, and ignorance which reflects the possibility that unknown factors may influence exposure.

3.2. Results

3.2.1. Occurrence data

In EFSA (2012) it has already been stated that the amount of mercury is related to the age of the fish and the position of the fish species within the food chain; predatory fish and older fish having higher concentrations than others. Unlike some contaminants, mercury content is not related to the fat content of the fish and, as such, mercury is not considered a problem associated especially with oily fish. Some fish species that usually have higher concentrations of mercury include shark, swordfish and marlin. Predatory freshwater fish may also be a source of mercury dietary exposure.

The results obtained for this advice were a collection representing the selection of fish according to the continuous annual risk analysis performed by FASFC to establish his annual food control program. As said above, swordfish (predator fish) was analysed the most frequently whereas some species were not even considered in the analysis like turbot, which is just occasionally consumed. In general, there were 43 fish species analysed for the presence of total mercury and 26 fish species were specifically analysed for methylmercury in the period 2014-2021. Inorganic mercury concentrations in fish were calculated from total mercury concentrations (see below).

3.2.1.1 *Analytical results of total mercury and calculation of inorganic mercury levels*

The results show the highest occurrence of total mercury in swordfish with mean (UB) values of 1.03 mg/kg (years 2016 and 2017) and 1.61 mg/kg (year 2021), and maximum levels (UB) of 1.89 mg/kg (year 2017) and 4.27 mg/kg (year 2021). The more consumed fish like tuna, is the second Hg-contaminated species. The measured mean (UB) concentrations in tuna were 0.19 mg/kg (year 2016) and 0.28 mg/kg (year 2021), and the maximum levels (UB) were 0.70 mg/kg (year 2018) – 1.07 mg/kg (year 2019). As mentioned above, according to EFSA (2022), 20 % of these concentrations are to be considered as inorganic mercury. Figure 5 illustrates the average annual calculated concentrations of inorganic mercury for each species over the years (2014-2021).

Similarly to total mercury, the highest levels of methylmercury were found in swordfish. The results show the highest occurrence with mean (UB) values from 0.82 mg/kg (year 2020) to 1.34 mg/kg (year 2021), and maximum levels (UB) from 1.68 mg/kg (year 2020) to 3.35 mg/kg (year 2021). The most consumed fish like tuna, is the second MeHg-contaminated species. The measured mean (UB) concentrations in tuna were from 0.17 mg/kg (year 2016) to 0.35 mg/kg (year 2014) and the maximum levels (UB) were 0.58 mg/kg (year 2018) and 0.91 mg/kg (year 2019). The average annual concentrations of methylmercury for each species over the years (2014-2021) are illustrated in Figure 6. Table 1 gives an overview of inorganic mercury calculated levels and methylmercury measured levels in fish for the whole period 2014 to 2021.

Table 1. Overview of inorganic mercury calculated levels and methylmercury measured levels in fish for the whole period 2014 to 2021 (mg/kg).

fish_species	inHg (UB, mean, mg/kg)	inHg (UB, P95, mg/kg)	inHg (UB, max, mg/kg)	MeHg (UB, mean, mg/kg)	MeHg (UB, P95, mg/kg)	MeHg (UB, max, mg/kg)
Algen	0,010	0,010	0,010	*	*	*
Ansjovis	0,010	0,010	0,010	*	*	*
Beenvissen	0,022	0,068	0,068	*	*	*
Forellen	0,004	0,008	0,009	0,025	0,036	0,036
Garnalen	0,007	0,018	0,051	0,022	0,033	0,033
Garnalen & Weekdieren & Mossels	0,006	0,006	0,006	*	*	*
Gewone mossel	0,010	0,015	0,015	0,019	0,023	0,023
Grijze garnaal/Noordzeegarnaal	0,036	0,046	0,049	0,056	0,078	0,078
Grote Tijgergarnaal	0,005	0,006	0,006	0,020	0,020	0,020
Haai	0,067	0,100	0,100	*	*	*
Heilbot	0,017	0,032	0,032	0,072	0,120	0,120
Inktvis	0,013	0,023	0,023	*	*	*
Japanse oester	0,014	0,015	0,015	*	*	*
Kabeljauw	0,014	0,032	0,084	0,061	0,130	0,320
Krabben	0,060	0,135	0,135	*	*	*
Kreeften	0,052	0,075	0,075	*	*	*
Meerval	0,005	0,005	0,005	*	*	*
Merlijn	0,020	0,024	0,024	0,091	0,110	0,110
Mossels	0,011	0,016	0,018	0,020	0,022	0,022
Noordelijke roze garnaal	0,005	0,005	0,005	0,020	0,020	0,020
Pacifische witte garnaal	0,005	0,005	0,005	0,020	0,020	0,020
Paling	0,021	0,062	0,082	0,091	0,290	0,390
Pangasius	0,004	0,003	0,068	0,036	0,190	0,330
Rog	0,026	0,076	0,096	0,120	0,420	0,420
Sardinen	0,012	0,012	0,012	*	*	*
Schaaldieren	0,013	0,030	0,030	*	*	*
Schol	0,024	0,066	0,074	0,108	0,300	0,380
Sint-jacobsschelpen	0,006	0,009	0,015	0,021	0,026	0,032
Snoek	0,042	0,108	0,108	0,176	0,570	0,570
Sorrets	0,020	0,020	0,020	*	*	*
Tilapia	0,003	0,002	0,017	0,020	0,020	0,020
Tong	0,014	0,026	0,028	0,060	0,096	0,100
Tonijn	0,059	0,145	0,214	0,251	0,600	0,910
Tweekleppige weekdieren	0,005	0,008	0,008	*	*	*
Victoriabaars	0,021	0,040	0,050	0,090	0,170	0,230

Wijting	0,020	0,036	0,038	0,079	0,120	0,140
Zalmachtige	0,002	0,002	0,002	*	*	*
Zalmen	0,004	0,014	0,014	0,028	0,053	0,053
Zeebaars	0,026	0,044	0,044	*	*	*
Zeeduivel	0,018	0,030	0,036	0,077	0,130	0,160
Zeewolf	0,034	0,086	0,086	0,157	0,410	0,410
Zwaardvis	0,229	0,486	0,854	0,974	1,970	3,350

* MeHg content was not measured in this foodstuff but, when needed to assess the cost (risk) vs benefit exposure of the sardines consumers, was derived from the measured total Hg content (see 3.2.6.).

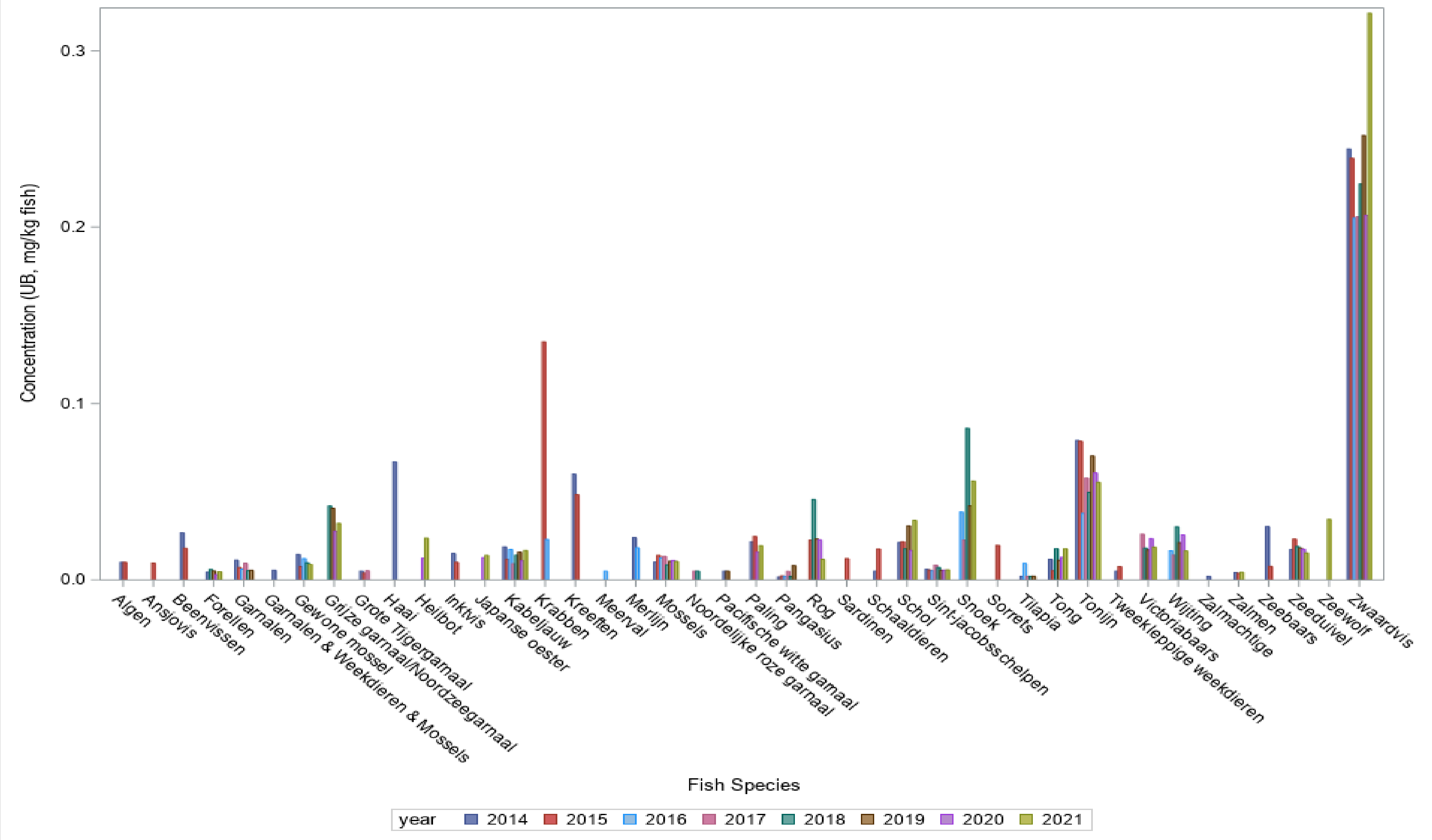


Figure 5. Average annual calculated concentrations of inorganic mercury for each species over the years (2014-2021).

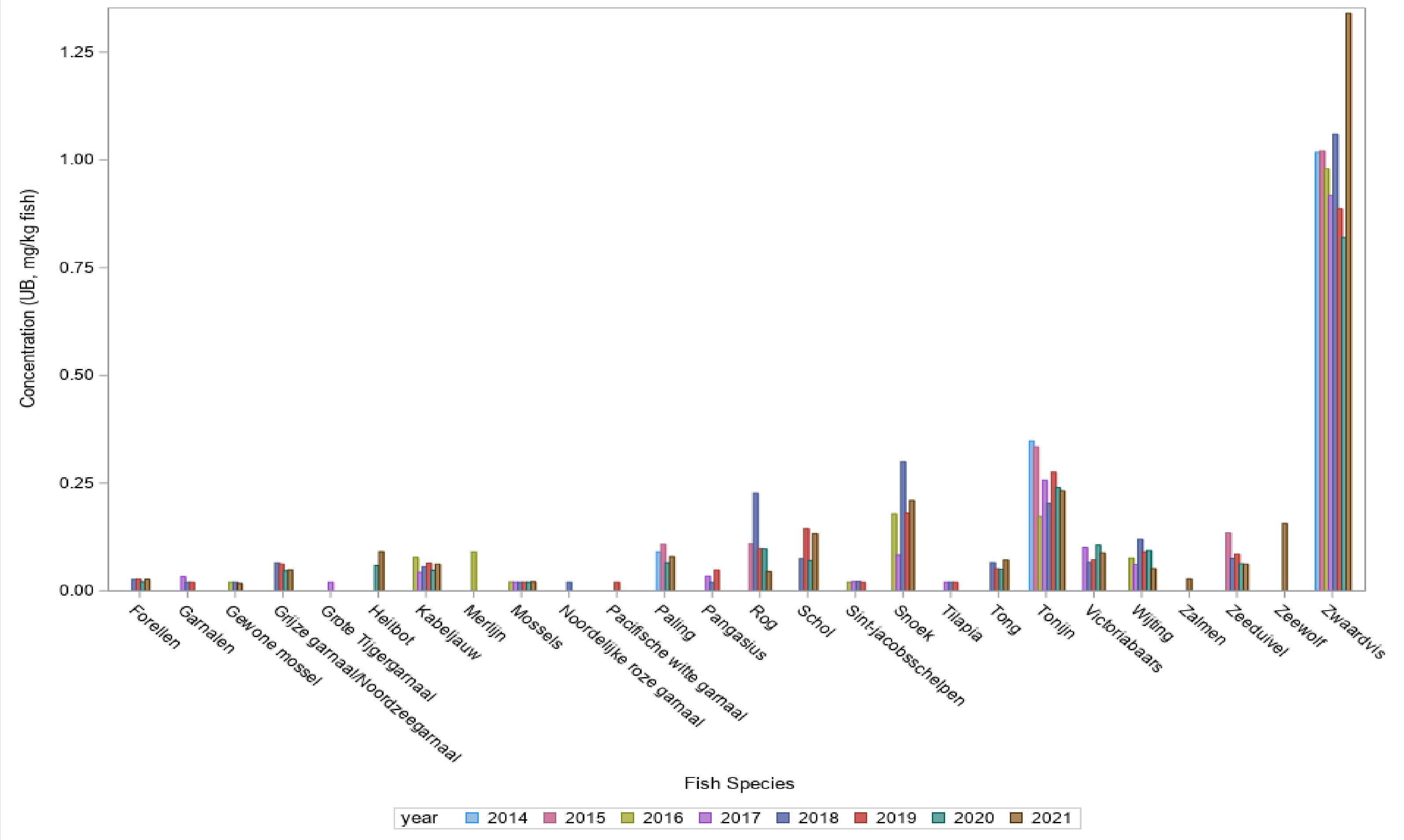


Figure 6. Average annual concentration of methylmercury for each species over the years (2014-2021) for the most contaminated fish species

3.2.1.2 *Fish categorization in the study*

Matching the analytical results to FoodEx allowed grouping of fish species into 28 various groups. Out of those, sardines, shrimps (rose), shark and crabs have not more than 3 valid results. Consumption of fatty fish, flatfish, dorade, carp, tubfish, spiering, smoked herring, Burgundy snail, fish terrine, tarama, fish eggs, rolled pickled herring fillets and frog eggs was not matched to any of the analytical results. This represented 44 consumptions or 3 % of all reported fish consumption. Consumption of “fatty fish”, “marine fish” and “white fish” was reported in FCS_2014. To estimate exposure to inHg and MeHg via these groups, fish were aggregated to these three groups.

The average concentration was calculated per formed group (according to the FCS code). The percentage of non-detected results for both inorganic mercury and methylmercury was below 20 %. Due to these low level of non-detected results, the results of UB and LB approach were comparable and only UB approach was applied in the estimations of the exposure to both inorganic mercury and methylmercury in this advice. However, values of MB and LB approach reported by EFSA were presented where necessary.

3.2.2. Fish consumption

FCS_2014 provides national information on food consumption at the individual level. The consumption of food items identified after coding the analytical results was evaluated per food code (foodnums).

Based on this consumption, Superior Health Council has issued the Food Based Dietary Guidelines in 2019 (SHC, 2019). Fish is a food group to focus on. Due to long chain polyunsaturated omega 3 fatty acids levels in some fish, it was recommended to eat fish, seafood, or shellfish once to twice a week, including oily fish once a week, varying the species and origin.

As stated in SHC (2019), *"the 2014 FCS revealed that the average usual consumption of (preparations with) fish, shellfish and seafood in the Belgian population was 23 g/day with a sharp rise in the older age groups. This food category is considered even as a source of proteins comparable to meat, eggs, vegetarian meat substitutes and legumes, with a recommended daily amount of 100 g. It was the second most important source of proteins, even though its contribution to the protein intake remains well below that from meat. Seven percent of the Belgian population stated that they never ate fish; 23 % never ate shellfish or seafood. Furthermore, fish is a good source of omega-3 fatty acids, iodine and vitamins. Its consumption as an alternative to meat should therefore be further encouraged.”*

3.2.2.1 *Fish consumption – description*

Fish is consumed both as food item and fish ingredient in a dish. In general fish as an item is the most consumed food class related to fish, crustaceans and breaded fish products are the following most often consumed fish classes (Figure 7).
Figure 8 shows that salmon is mostly consumed as a food product (raw or smoked salmon) whereas tuna is mostly consumed as an ingredient (eg tuna in tuna salad).

Salmon is the most consumed in general (8% of all fish related consumptions) followed by tuna and then cod. Adults are the most frequent consumers of these fish. They also consumed crab and crabsticks more often than adolescents and children. However, children consumed fish sticks the most frequently. Furthermore, tuna salad is the composite dish which is mostly consumed by all population groups (2-3.5% of all fish related consumption per age group). The second is crab salad for which the adults are the most frequent consumers. A low percentage of fish is consumed as part of sauces and broths. Similarly, adults consumed it more often. Whereas the number of registered consumptions is given in Figure 8, the detailed proportional consumption of each fish item is given in annexes (annexe 1, annexe 2, annexe 3).

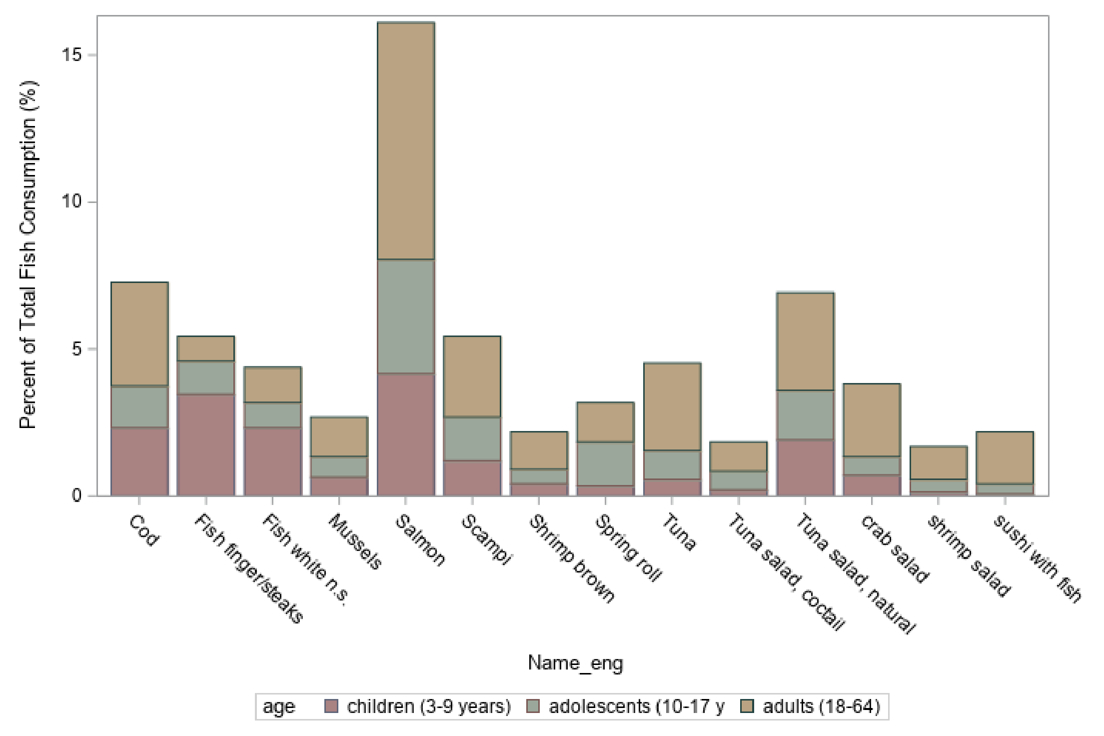


Figure 7. Proportion of consumption of fish related products categorized according to Belgian National food consumption database[6]

Figure 9 use the heatmap to represent the magnitude of consumption (expressed as the serving quantity) by colour codes. This map allows to screen the most consumed fish species/fish related dishes. For all population groups, these are (in alphabetical order) cod, crab, crabsticks, fish fingers, so called white fish, salmon, scampi, shrimp (brown), tuna and tuna salad.

The servings are varying per fish species (Figure 9). The average mussel portion (with sauce) is the biggest (average 550 g and max 1000 g) for adults while adolescents consumed the biggest portion of frozen fish with sauce (415 g).

Additionally, the data in Belgian National Food Consumption database contains facets which described how the food was prepared for the consumption. Although this has a limited reliability due to missing data, an attempt to evaluate the way of preparation was made. From the available data, it is possible to see that salmon is consumed “in pieces” which mostly refers to smoked salmon slices.

From the above results, it can be observed that adults consumed salmon the most (average serving of 87 g), followed by cod (average serving of 144 g) and tuna (average serving of 98 g). This means that although salmon and tuna are the most common prepared and consumed, it is cod that is eaten in the biggest servings on average. Additionally, tuna is consumed as part

[6] only proportions above 2% are presented

of “tuna salad” (“mayonnaise based preparation with tuna”) where the serving is on average 54 g (with all ingredients included). In this kind of preparation, tuna represents around 41 % of the total amount. This proportion was used for conversion into tuna as “ingredient” for intake calculation (Figure 8).

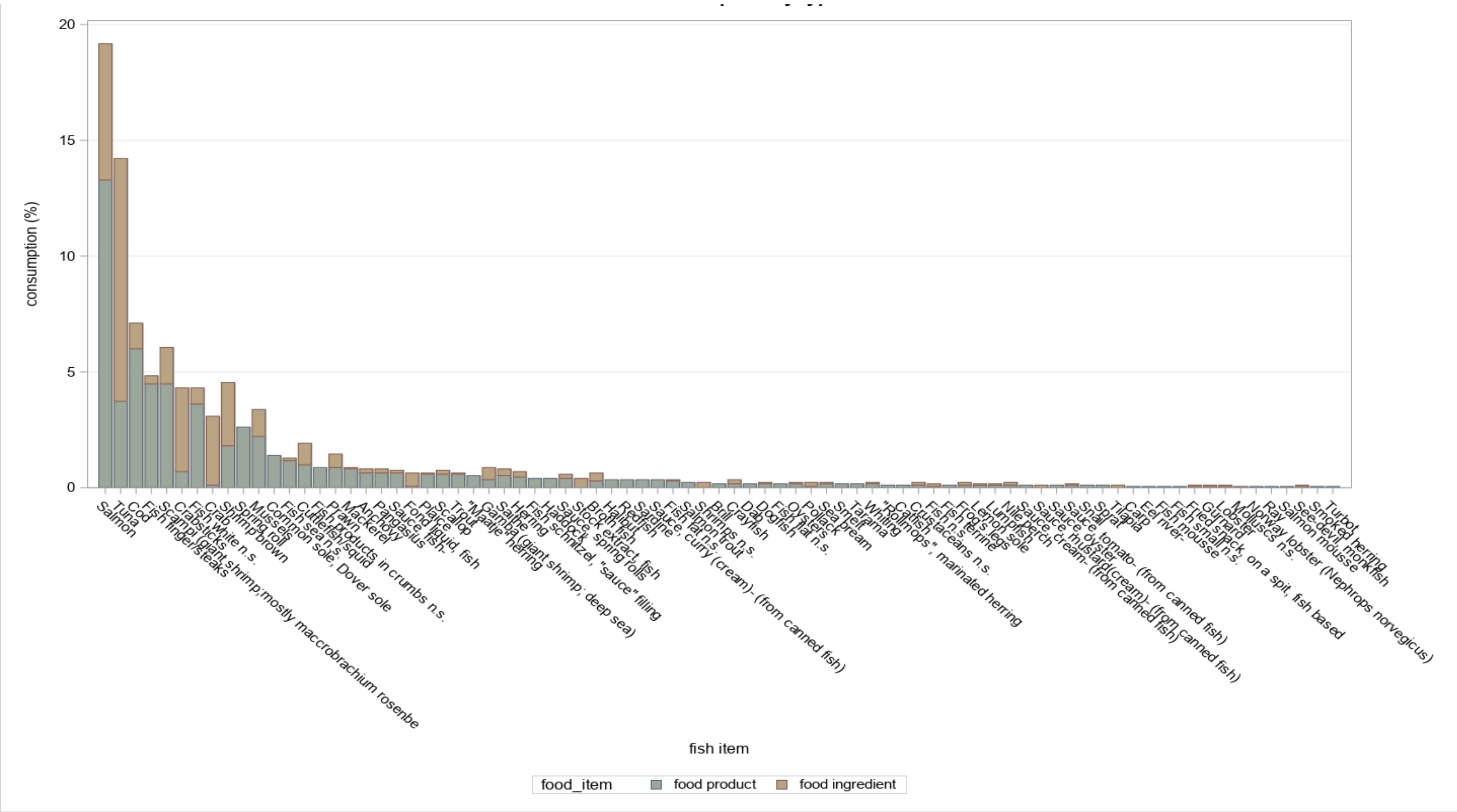


Figure 8. Proportion of fish consumption as a product vs as an ingredient in a dish expressed in percentages per each consumed fish.

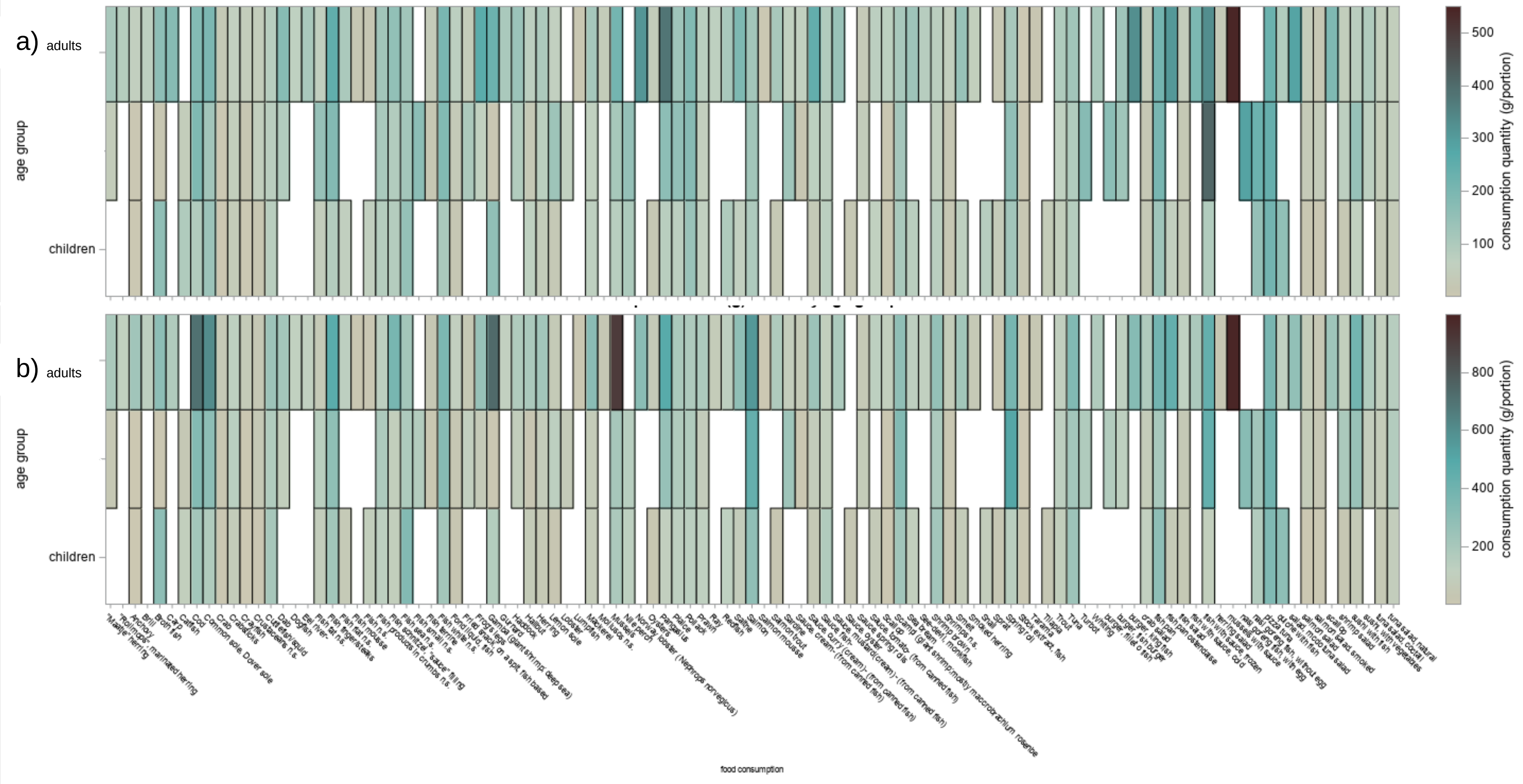
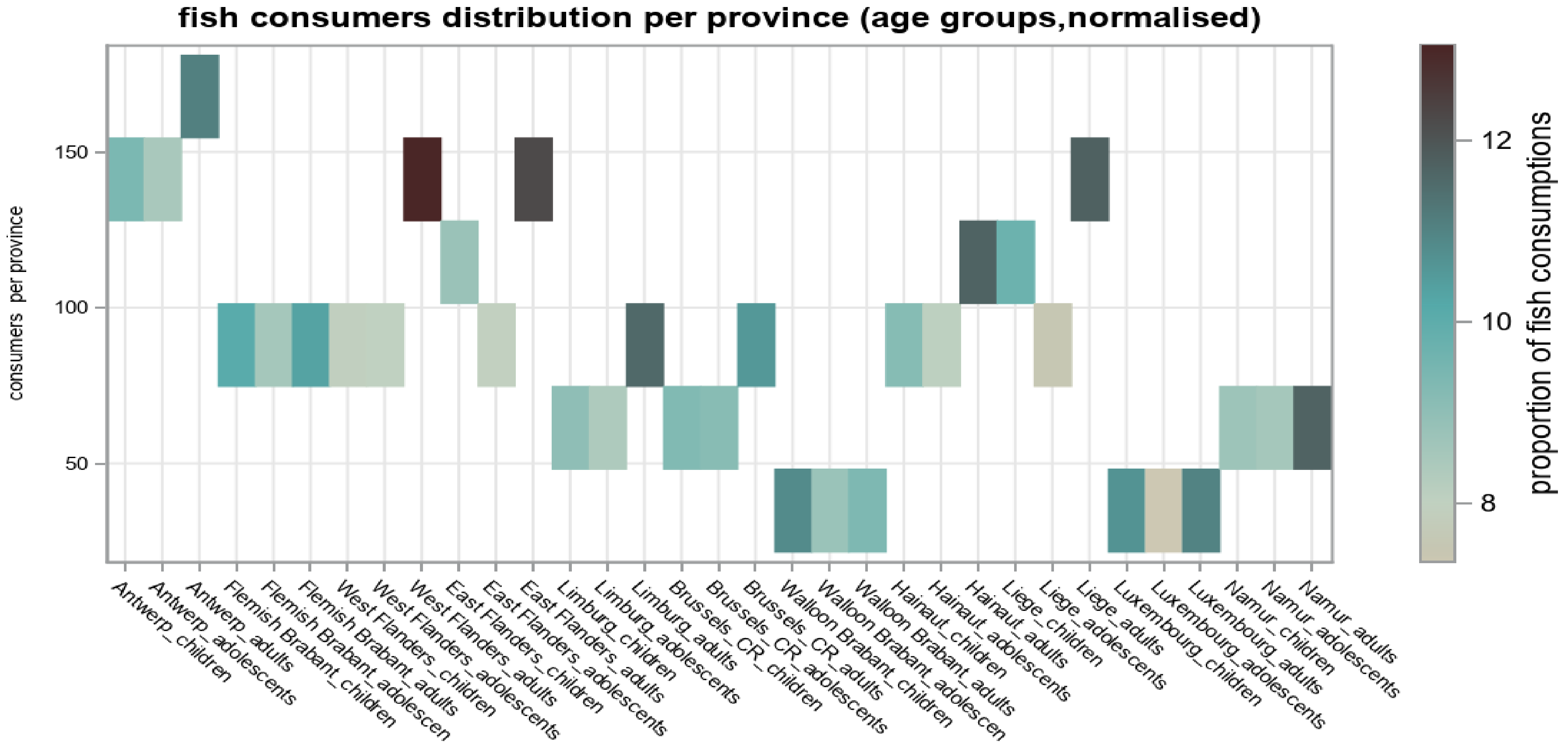


Figure 9. Mean (a) and maximum (b) consumption quantity (g) per serving (portion size) for each age group and fish species.



*Number of Consumers that claimed to consume fish among number of participants per province which was representative of the province size

Figure 10. Distribution of fish consumers per age group (children 3-9 years, adolescents 10-17 and adults 18-64 years) and province.

3.2.2.2 *Fish consumers – per province*

Participants of FCS_2014 that have reported consumption of fish were located in all provinces. However, a slight variation was observed. In general, adolescents across all provinces consumed fish and seafood the least. Figure 10 shows the proportion of each population group in each province of the total fish consumers, corrected for the representative number of participants. Whereas y-axis shows the number of consumers which is relatively the highest in the province of Antwerp. Proportionally to the number of residents per province and the size of each province, the adults in West Flanders are the most frequent consumers of fish. followed by the adults in East Flanders. In all provinces the most consumptions are reported by adults. Among adolescents, the most consumptions proportionally to the number of adolescents are registered in Brussels capital regions, while most children in Walloon-Brabant consumed fish/fish related products.

Other recent reports, like Flemish Centre for Agriculture and Fish production (VLAM) in 2019 pointed out that salmon and cod together accounted for half of all sold fish on the Belgian market. Additionally, it was stated that in 2021 a Belgian person bought 9,2 kg fish, and shellfish (fresh, frozen, and processed where fish salads and fish cans are included) for a total value of 125€, half of this purchases were fresh fish.

3.2.3. <u>Intake assessment</u>

3.2.3.1 *Previous intake assessments by EFSA (2012)*

Table 2. Lower, middle and upper bound mean and 95th percentile inorganic mercury exposure in µg (kg body weight)$^{-1}$ per week as reported by EFSA in 2012.

EFSA, 2012			Mean			P95		
Survey	**age group**	**N**	**LB**	**MB**	**UB**	**LB**	**MB**	**UB**
Regional Flanders Survey	toddlers	36	0,56	1,36	2,16	*	*	*
	children	624	0,39	0,99	1,60	0,82	1,69	2,66
FCS_2004	adolescents	584	0,19	0,39	0,60	0,53	0,83	1,17
	adults	304	0,19	0,35	0,51	0,52	0,72	1,01
	elderly	518	0,18	0,30	0,43	0,46	0,63	0,84

* P95 was not calculated for this small sample size of 36 individuals.

Table 3. Lower, middle and upper bound mean and 95th percentile methylmercury exposure in µg (kg body weight)$^{-1}$ per week as reported by EFSA in 2012.

EFSA, 2012			Mean			P95		
Survey	**age group**	**N**	**LB**	**MB**	**UB**	**LB**	**MB**	**UB**
Regional Flanders Survey	toddlers	36	0,2	0,21	0,21	*	*	*
	children	624	0,28	0,29	0,29	1,59	1,6	1,62
FCS_2004	adolescents	584	0,19	0,2	0,2	1,15	1,16	1,19
	adults	304	0,24	0;24	0,25	1;34	1,35	1,38
	elderly	518	0,25	0,26	0,26	1,24	1,27	1,3

* P95 was not calculated for this small sample size of 36 individuals.

3.2.3.2 *Exposure estimations to inorganic mercury*

The chronic intake assessment was calculated using the mean, P95 and max analytical concentrations representing the estimation of the exposure to the mean, P95 and max, respectively, of all inorganic mercury occurrences over the years. This estimation for three population groups (children, adolescents and adults) is presented in table 4.

Mean exposure estimate was from 0.03 to 0.16 µg $(kg\ bw)^{-1}$ $week^{-1}$. Children and adolescents are more exposed than adults. In all exposure scenarios, the exposure estimates were below TWI (4 µg $(kg\ bw)^{-1}$ $week^{-1}$)

Table 4. Estimated weekly exposure to inorganic mercury (µg $(kg\ bw)^{-1}$ $week^{-1}$) in the Belgian population

Age (years)	N	baseline (mean concentrations scenario)		high exposure (P95 concentrations scenario)		worst case (max concentrations scenario)	
		Mean	P95	Mean	P95	Mean	P95
3-9 years	516	0,05	0,15	0,09	0,29	0,16	0,58
10-17 years	461	0,03	0,09	0,08	0,26	0,14	0,52
18-64 years	1085	0,04	0,11	0,09	0,29	0,16	0,57

The exposure estimates per percentile are presented in figure 11, for children, adolescents and adults, for the mean exposure in the worst case scenario. The TWI (4 µg $(kg\ bw)^{-1}$ $week^{-1}$), corresponding to the upper limit of the y-axis, is far above the predicted exposure.

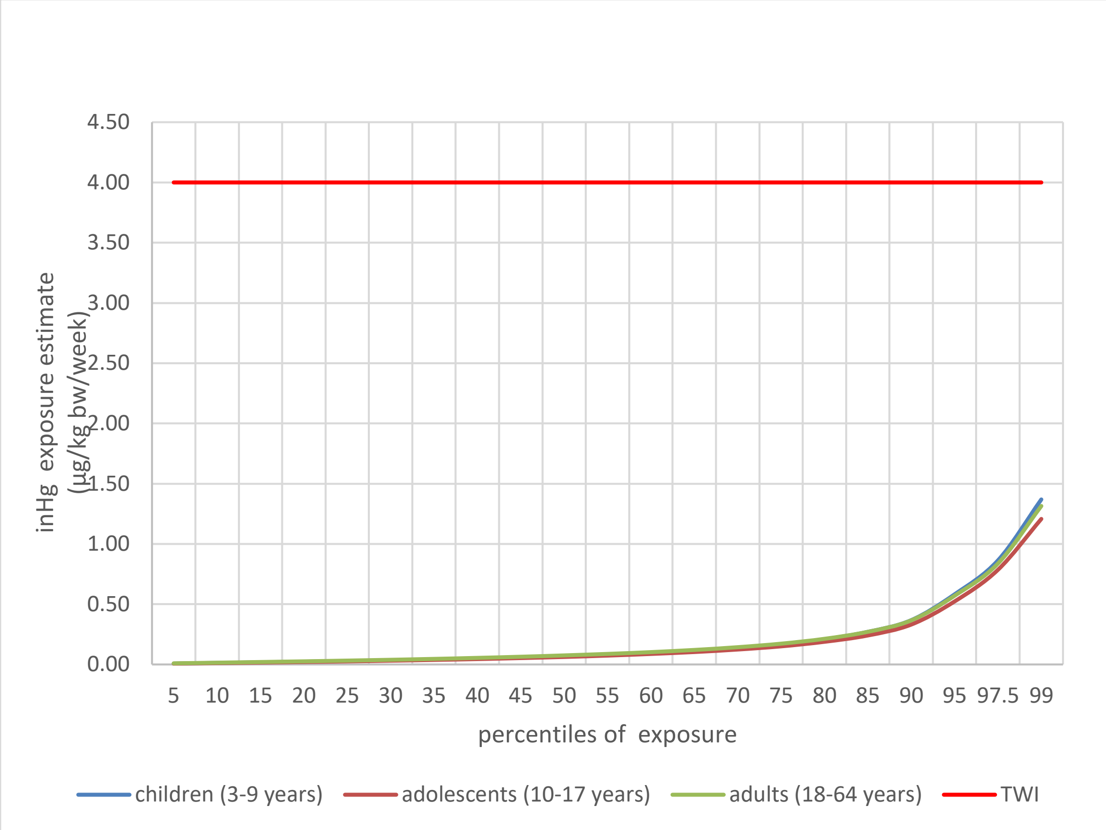


Figure 11. Estimated weekly exposure to inorganic mercury (UB approach) in the Belgian population (3-64 years), for the worst case scenario (taking into account of the maximum concentration of inorganic mercury found in fish).

3.2.3.3 *Exposure estimations to methylmercury*

Table 5 gives the overview of the estimated exposures.

In the scenario using the mean concentration of methylmercury, the mean dietary exposure varied from 0.13 µg (kg bw)$^{-1}$ week^{-1} in adolescents to 0.20 µg (kg bw)$^{-1}$ week^{-1} in children. The mean exposure estimates are higher than what was previously estimated by EFSA in 2012 using other consumption data.

Exposure estimates for the high exposure scenario (the 95th percentile of exposure, using P95 concentrations per each fish group) were 1.18 and 1.23 µg (kg bw)$^{-1}$ week^{-1} for adolescents and adults, respectively, and 1,30 µg (kg bw)$^{-1}$ week^{-1} for children).

Exposure estimates for the worst case exposure scenario (the 95th percentile of exposure, using maximum concentrations per each fish group) were 2,39 and 2,48 µg (kg bw)$^{-1}$ week^{-1} for adolescents and adults, respectively, and 2,67 µg (kg bw)$^{-1}$ week^{-1} for children.

Table 5. Estimated weekly exposure to methylmercury (µg $(kg\ bw)^{-1}$ $week^{-1}$) in the Belgian population.

Age (years)	Baseline (mean concentrations scenario)		High exposure (P95 concentrations scenario)		Worst case (max concentrations scenario)	
	Mean	P95	Mean	P95	Mean	P95
3-9	0,20	0,65	0,37	1,30	0,71	2,67
10-17	0,13	0,42	0,33	1,18	0,64	2,39
18-64	0,14	0,44	0,35	1,23	0,66	2,48

The exposure estimates for each exposure scenario are illustrated in figure 12, where it can be seen that the TWI value for methylmercury can be exceeded for percentiles 95, 90 or 85, depending on the exposure scenario. The worst case scenario assumes long-term exposures to the highest measured concentrations, which is very unlikely to occur. In a more realistic scenario using mean concentration exposure scenario, some children may be exposed to methyl mercury above the TWI.

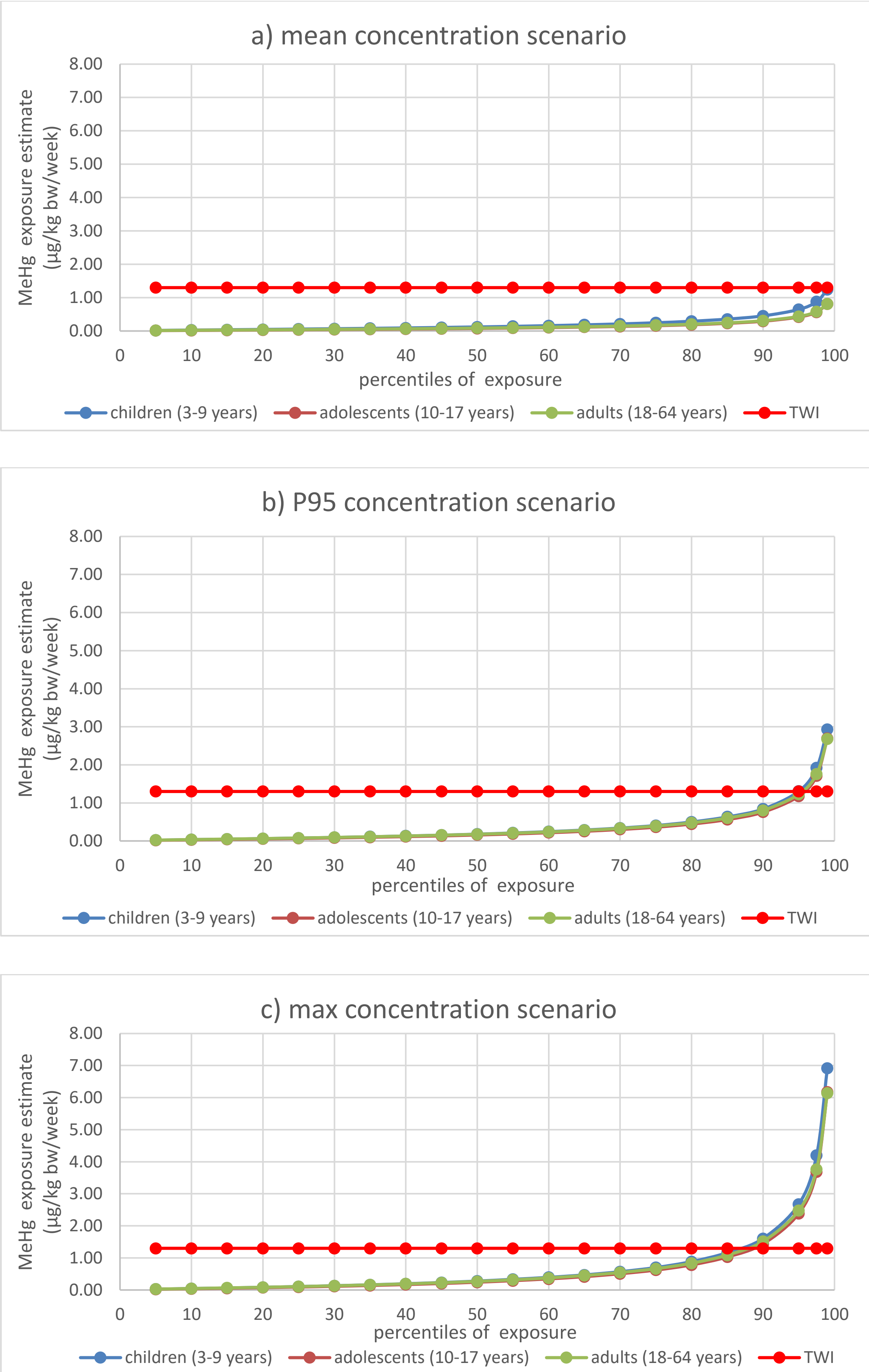


Figure 12. Estimated exposure to methylmercury in the Belgian population (3-64 years) using the mean (a), 95th percentile (b) and maximum (c) analytical concentration per fish group.

3.2.3.4 *Identification of the main fish species contributors*

The percentage contribution of the different fish categories to the total exposure to methylmercury were calculated for each age class based on the fish groups defined earlier for the intake assessment. For this, P95 concentrations exposure scenario was used. The results are illustrated in figure 13.

Swordfish was not reported as consumed in the last Belgian National Food Consumption Survey. To account for this, the concentration found in swordfish were included in the aggregated group of marine fish. Salmon, tuna and cod are the main contributors in all age groups. Fish fingers are important contributors for children and adolescents. As no methylmercury data were available for fish fingers, fish fingers contribution to methylmercury exposure was extrapolated from cod contamination data, assuming that fish fingers are made of 60% cod. For an easier graphical presentation, contributions of some fish species were aggregated into medium consumed fish (pangasius, plaice, gambas, anchovy, scallop, trout) and low consumed fish (sardine, nile perch, oysters, whiting).

The analysis of the exposure estimates for children whose intake was exceeding TWI for methylmercury (P95 exposure scenario) shows a high consumption of some fish species contributing to exposure. Next to tuna, some high consumption of marine fish, with servings of more than 100 g, resulted in high individual intake. Also, cod, plaice, catfish and white fish can occasionally be consumed in high amount and consequently lead to high intakes. The individual intakes for those high consumer children are shown in figure 14.

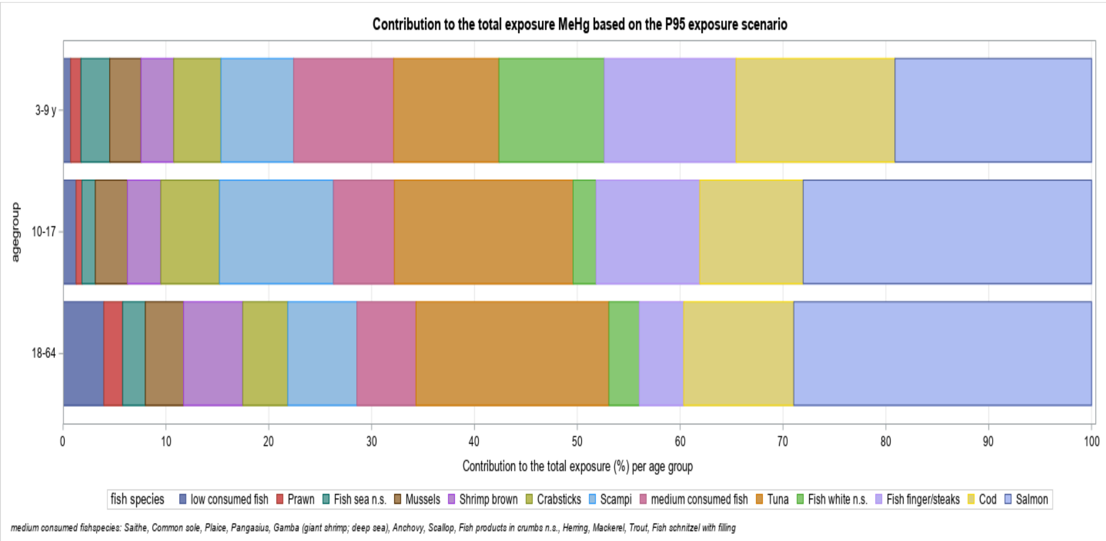


Figure 13. Contribution to the total exposure to methylmercury from each fish species and expressed for three population groups (children, adolescents and adults)

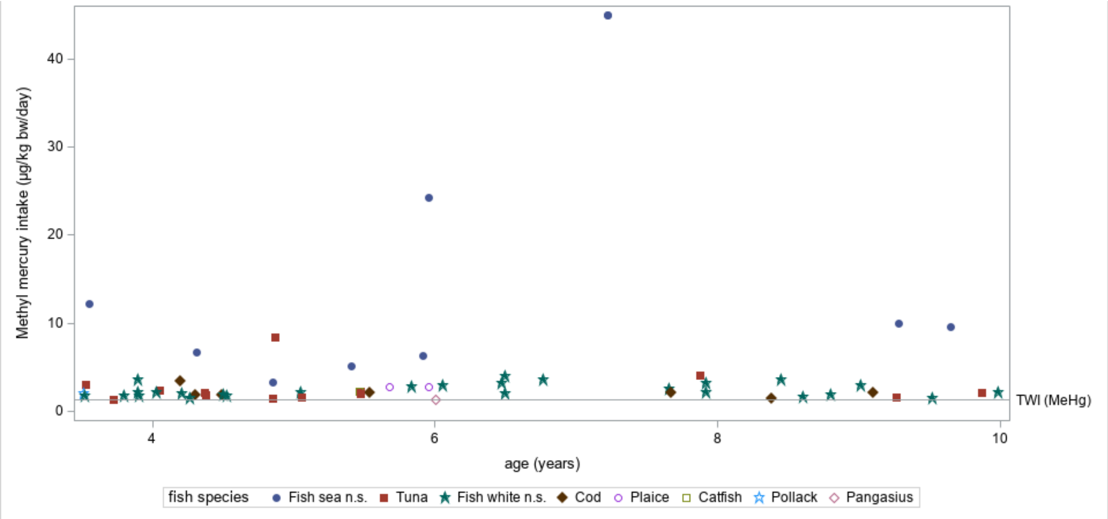


Figure 14. Individual children intakes exceeding TWI in P95 concentration exposure scenario (high exposure)

3.2.4. Risk assessment

3.2.4.1 *Risk characterization of inorganic mercury*

Regarding inorganic mercury, the calculated mean intakes (i.e. the average value of the estimated exposure for all percentiles) were below the tolerable weekly intake established by EFSA of 4 µg per kg b.w., expressed as mercury (Figure 15).

Based on the estimations in this advisory report; dietary inorganic mercury exposure in Belgium via fish does not exceed the TWI in the considered scenarios.

3.2.4.2 *Risk characterization of methylmercury*

Regarding methylmercury, the EFSA established a tolerable weekly intake (TWI) of 1.3 µg per kg b.w. expressed as mercury.

Children were in general more exposed than adolescents and adults. Whereas mean dietary exposure across all age groups and scenarios does not exceeds the TWI, the 95th percentile dietary exposure in both high exposure scenario (using P95 concentrations) and worst case exposure scenario (using maximum concentrations) were very close or above TWI for all age groups. This means that high fish consumers may exceed the TWI and their exposure is of concern (Figure 15).

3.2.4.3 *Comparison with previous risk assessments*

The EFSA CONTAM Panel performed a risk characterization of inorganic mercury and methyl mercury in 2012 (EFSA, 2012). In this assessment, the consumption data obtained in 2004 or 2008 (children and toddlers) were used.

The assessment for both forms of mercury in this study shows a limited reduction since the latest assessment done by EFSA (Figure 15). In order to compare these results, it is necessary to note that the concentrations used in the estimations performed by EFSA were in general 1,5 times higher than those used in this advice.

In their risk assessment, EFSA (2012) also pointed out the contribution of inorganic mercury to total mercury in human milk, and outgassing from dental amalgam fillings was noted as a possible source of total mercury exposure. The other sources, like ambient air and mercury containing skin products were considered as negligible sources.

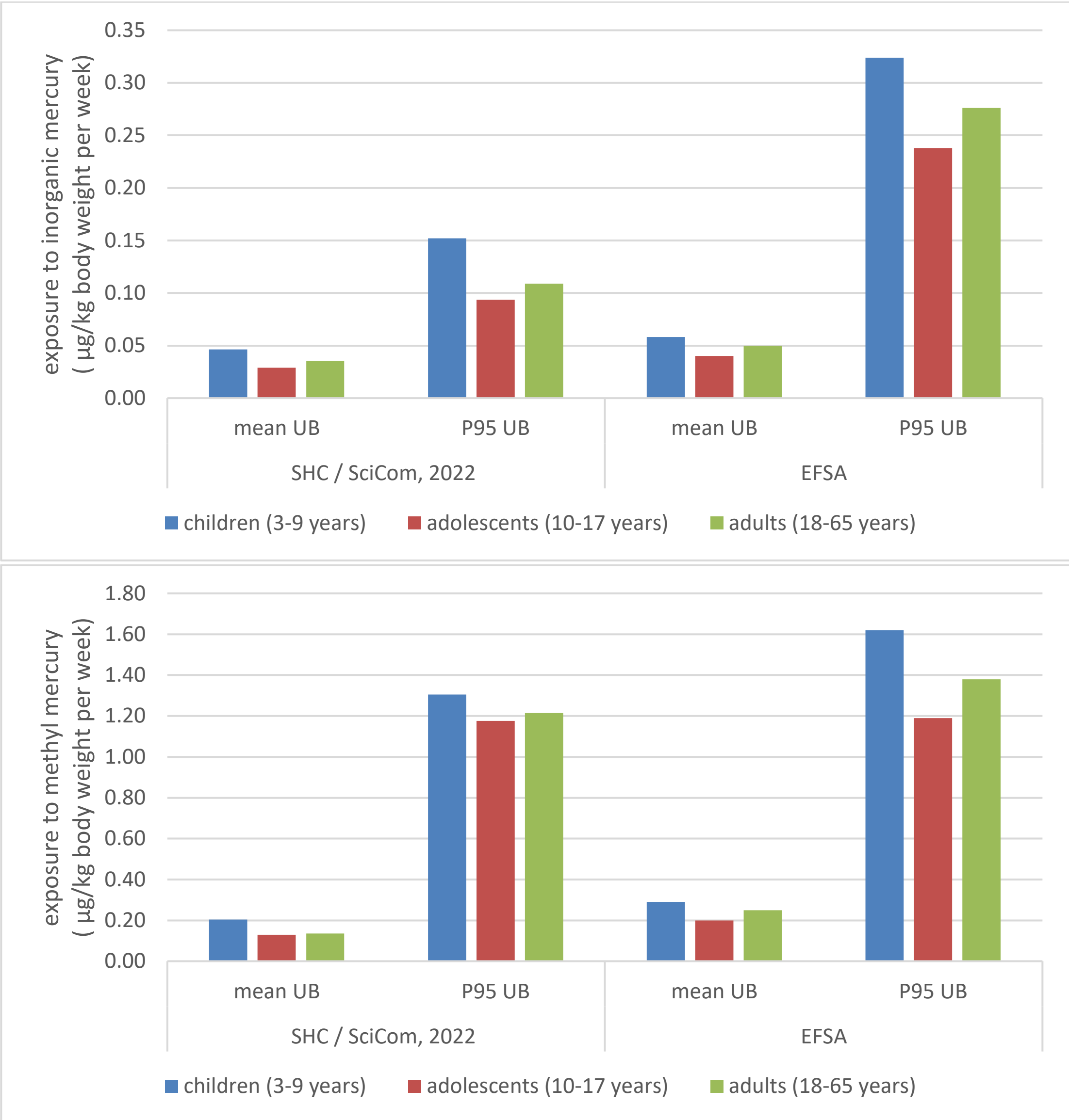


Figure 15. Comparison of estimated exposure to inorganic mercury and methylmercury in Belgian population by EFSA, 2012, and by the Superior Health Council / SciCom, 2022[7].

[7] The consumption data used in SHC / SciCom calculation are from 2014 whereas for the other calculation from 2004.

3.2.5. Benefit assessment

3.2.5.1 *Nutritional and dietary aspects of fish consumption*

Fish and seafood are valuable sources of key nutrients, such as protein, long-chain omega-3 polyunsaturated fatty acids EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), iodine, selenium and vitamin D. The nutritional content may vary according to the species, their diet, their environment, their maturity, etc.

A global table of nutritional data from the Nubel table for approximately a hundred fish is available in annex 5.

3.2.5.2 *Nutritional dietary intake*

The most important nutrients were evaluated in the FCS, 2014 report (Lebacq and Vetten, 2016).

The intake of nutrients was evaluated per age group and per gender with a description of various demographic factors (like level of education). For the selection, only the contribution from fish and fish products was evaluated.

Table 6. Overview of mean contribution in percent from fish and fish products to the total dietary intake of nutrients (FCS, 2014)

Nutrient	Contribution (%)	95% CI
Total fat	1,9	1,5-2,2
Saturated fat	1,3	1,1-1,6
Monounsaturated fat	2,0	1,6-2,4
Polyunsaturated fat	2,6	2,2-3,1
Vitamin D	8,7	7,4-9,9
Iodine	6,5	5,6-7,4

CI= confidence interval

Table 7. Usual intake of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) expressed in mg per day, for the Belgian population (FCS, 2014)

Age group	Mean intake	P95	n[8] (consumers)
Children (3-9 years)	75-125	215-354	918
Adolescents (10-17 years)	154-169	444-477	579
Adults (18-64 years)	196-213	562-608	1528
Total (mean)	190	549	2325

[8] n: number of people that consumed EPA or DHA at least on one of the interview days in FCS, 2014

3.2.5.2.1 Nutritional characteristics of fish

As the populations particularly targeted by this advisory report are small children, adolescents, women of childbearing age, pregnant women and breastfeeding women, the recommended nutrient intakes have been specified for these groups.

a) Omega 3 fatty acids

Table 8. Recommended intake of omega-3 fatty acids (% energy) (SHC, 2016)

	Children > 1-year-old	Adolescents	Adults	Pregnant/Breastfeeding women
SHC, 2016	1	1-2	1-2	1-2
EFSA	0,5	0,5	1,5	0,5

Usual intake in the Belgian population

The FCS shows that the intake of omega-3 fatty acids in the Belgian population (3-64 years old) contributes on average to 0.7 % of energy intake, which is less than the recommended minimum of 1 in %. This intake tends to increase with age: approximately 0.60 in % for children (3 to 9 years old) and adolescents (10 to 17 years old), then 0.71 in % for adults aged 18 to 39 years and 0.84 in % for adults aged 40 to 64 years.

Omega-3 FA levels in fish

Table 9. Decreasing omega 3 fatty acids levels in fish with "high" content in omega 3 fatty acids, expressed as g per 100g (NUBEL)[9]

Caviar en conserve	**6,80**	Saumon au naturel en conserve	**1,60**
Maquereau, fumé	**6,60**	Anguille de mer, fumée	**1,50**
Anguille de rivière, fumée	**5,00**	Salade, surimi/crabe	**1,50**
Sardines à la sauce tomate en conserve	**3,40**	Anguille de mer	**1,40**
Sprat, fumé	**3,20**	Poisson, gras, cru	**1,40**
Maquereau sauce tomate en conserve	**2,70**	Flétan du Groenland, fumé	**1,40**
Saumon, cru	**2,70**	Sardines	**1,30**
Salade, saumon	**2,70**	Moules, cuites	**1,20**
Hareng	**2,60**	Hareng, maatje	**1,20**
Caviar, imitation	**2,50**	Moules au vinaigre	**1,10**
Salade, thon	**2,50**	Pilchard a la sauce tomate en conserve	**1,00**
Saumon, fumé	**2,40**	Truite, fumée	**1,00**
Salade, mollusques et crustacés	**2,30**	Anchois à l'huile en conserve	**1,00**
Saumon, cuit	**2,20**	Anguille de rivière	**0,90**
Hareng, fumé	**2,10**	Barbue sans peau	**0,80**
Escolier noir	**1,80**	Rollmops au vinaigre	**0,80**
Maquereau a l'huile en conserve	**1,70**	Truite saumonée	**0,70**
Grondin perlon	**1,70**	Maquereau au naturel en conserve	**0,60**
Sardines a l'huile en conserve	**1,70**	Homard	**0,60**
Maquereau	**1,60**	Thon a l'huile en conserve	**0,60**

[9] Not available in English

b) EPA+DHA

Table 10. Recommended intake of EPA+DHA (mg/day) (SHC, 2016)

	Children > 1-year-old	Adolescents	Adults	Pregnant/Breastfeeding women
SHC, 2016	100-500	250-500	250-500	/
EFSA	100-250	250	250	250 + 100-200

<u>Usual intake in the Belgian population</u>
In Belgium, in 2014, the population (aged 3 to 64) consumed, on average, 190 mg of EPA and DHA per day.

<u>EPA+DHA levels in fish</u>
The vast majority of fish is rich in EPA+DHA, according to the authorised nutritional claim (> 80 mg EPA+DHA per 100g, or 0.08g).

Table 11. Decreasing EPA+DHA levels of fish with "high" content in EPA+DHA, expressed as g per 100g (NUBEL)[10]

Caviar en conserve	**6,54**	Homard	**0,52**
Anguille de rivière, fumée	**4,91**	Anchois	**0,50**
Maquereau, fumé	**4,37**	Huître, creuse	**0,48**
Caviar, imitation	**2,34**	Anguille de rivière	**0,48**
Sardines à la sauce tomate en conserve	**2,44**	Anchois à l'huile en conserve	**0,43**
Saumon, fumé	**2,16**	Cabillaud, cuit	**0,41**
Sprat, fumé	**2,20**	Thon a l'huile en conserve	**0,40**
Maquereau sauce tomate en conserve	**1,80**	Langoustine	**0,37**
Hareng	**2,02**	Dorade royale	**0,36**
Flétan, du Groenland	**1,48**	Chair de coques, cuites	**0,32**
Hareng, fumé	**1,41**	Seiche	**0,31**
Grondin perlon	**1,35**	Flétan du Groenland, fumé	**0,30**
Anguille de mer	**1,26**	Brochet	**0,26**
Maquereau	**1,25**	Poisson, mi-gras, cru	**0,24**
Saumon au naturel en conserve	**1,25**	Praire	**0,23**
Anguille de mer, fumée	**1,17**	Lieu noir, cuit	**0,22**
Sardines	**1,06**	Espadon	**0,18**
Moules, cuites	**1,06**	Salade, thon	**0,18**
Saumon, cru	**0,99**	Crabe, Alaska King, cuit	**0,16**
Poisson, gras, cru	**0,99**	Coquille Saint-Jacques	**0,15**
Sardines a l'huile en conserve	**0,98**	Limande-sole	**0,14**
Moules au vinaigre	**0,97**	Cabillaud	**0,14**
Saumon, cuit	**0,93**	Fish stick, pané, précuit, frit	**0,14**
Pilchard à la sauce tomate en conserve	**0,85**	Homard, cuit	**0,13**
Hareng, maatje	**0,81**	Thon au naturel en conserve	**0,12**

[10] Not available in English

Escolier noir	**0,69**	Carpe	**0,12**
Truite, fumée	**0,61**	Roussette	**0,10**
Truite saumonée	**0,61**	Salade, saumon	**0,09**
Barbue sans peau	**0,58**	Truite, poêlée	**0,09**
Rollmops au vinaigre	**0,54**	Loup de mer	**0,08**

Contribution of fish consumption to the coverage of the recommended intake
According to the **average values** proposed by the NUBEL table,

- By consuming 100g of fatty fish per week, the average daily intake of EPA+DHA would be 141 mg.
- By consuming 100g of medium-fatty fish per week, the average daily intake of EPA+DHA would be 34 mg.

To reach the SHC recommendations, the ideal intake would be 150g of fatty fish and 150g of medium-fatty fish per week, or 200g of fatty fish per week.

The following fish species are among the richest **unprepared fish** regarding EPA+DHA contain: herring, halibut, gurnard, eel, mackerel, sardines, salmon (from 2.02 to 0.99 g/100g). By consuming 100g of mackerel or sardines per week, the average daily intake of EPA+DHA would be 179 or 151 mg.
A suggestion would be 100g of salmon and 80g of sardines per week = 263 mg EPA+DHA on average per day.

The richest **smoked fish** regarding EPA+DHA contain are: see eel, mackerel, salmon, sprat, herring. They have very interesting EPA+DHA values (from 4.91 to 1.17 g/100g), which must be balanced out by their high salt content.

Canned fish such as sardines, mackerel, salmon, pilchard, herring, mussels, rollmops can significantly contribute to the nutritional intake.

c) Iodine

Table 12. Recommended Iodine Intake (µg per day)

	Children > 1-year-old	Adolescents	Adults	Pregnant/Breastfeeding women
SHC, 2016	90	120-130	150	200
EFSA	90	120-130	150	200

Usual intake in the Belgian population
In Belgium, in 2014, the population (aged 3 to 64) consumed an average of 144 µg of iodine per day through their diet. Fish consumption contributes an average of 6.5 % of this intake.

Iodine levels in fish
All seafood products contribute to the nutritional intake of iodine.
To be considered "rich in iodine", a foodstuff must contain more than 45 µg per 100g.

Table 13. Decreasing iodine levels of fish with “high” content in iodine, expressed as µg per 100g (NUBEL)[11]

Anguille de mer, fumée	**840,0**	Lieu noir	**85,0**
Crevette, grise, cuite	**260,0**	Lingue	**80,0**
Églefin	**243,0**	Saumon, cuit	**73,9**
Cabillaud, cuit	**243,0**	Colin d'Alaska	**70,0**
Langoustine	**240,0**	Merlan	**67,0**
Moules au vinaigre	**197,0**	Huître	**60,0**
Homard, cuit	**130,0**	Huître, creuse	**60,0**
Moules, cuites	**124,7**	Loup de mer	**60,0**
Cabillaud	**116,0**	Flétan, blanc	**52,0**
Caviar en conserve	**103,0**	Maquereau	**50,0**
Homard	**100,0**	Rondelles de calamars, précuites	**49,7**
Grand sébaste	**99,0**	Écrevisse d'eau douce	**45,0**
Limande-sole	**94,0**		

d) Selenium

Tableau 14. Recommended Selenium Intake (µg/day)

	Children > 1-year-old	Adolescents	Adults	Pregnant/Breastfeeding women
SHC, 2016	15-30	50-65	70	85
EFSA	15-35	55-70	70	85

<u>Selenium levels in fish</u>
All seafood products contribute to the nutritional intake of selenium.
To be considered "rich in selenium", a foodstuff must contain more than 16.5 µg/100g.

Table 15. Decreasing selenium levels in fish with “high” content in selenium, expressed as µg per 100g (NUBEL)[12]

Thon	**200**	Anchois	**37**
Homard	**130**	Escolier noir	**37**
Sardines	**85**	Flétan, blanc	**37**
Moules, cuites	**78**	Lotte	**37**
Limande-sole	**75**	Loup de mer	**37**
Maquereau a l'huile en conserve	**70**	Poisson, maigre, cru	**37**
Thon a l'huile en conserve	**68**	Maquereau sauce tomate en conserve	**37**
Thon au naturel en conserve	**68**	Crabe, Alaska King, cru	**36**
Seiche	**66**	Huître	**36**
Caviar en conserve	**66**	Rondelles de calamars, précuites	**35**
Huître, creuse	**64**	Saumon au naturel en conserve	**33**
Anguille de mer	**57**	Écrevisse d'eau douce	**32**

[11] Not available in English
[12] Not available in English

Langoustine	**55**	Lieu noir	**32**
Limande	**55**	Crabe au naturel en conserve	**32**
Maquereau au naturel en conserve	**54**	Saumon, fumé	**32**
Anguille de mer, fumée	**54**	Perche du Nil	**31**
Flétan du Groenland, fumé	**53**	Églefin	**30**
Flétan, du Groenland	**52**	Plie	**30**
Caviar, imitation	**52**	Sole	**30**
Crevette, rose, cuite	**52**	Turbot	**30**
Homard, cuit	**52**	Cabillaud	**28**
Moules au vinaigre	**52**	Pilchard a la sauce tomate en conserve	**28**
Grand sébaste	**50**	Anguille de rivière, fumée	**28**
Hareng	**50**	Salade, mollusques et crustacés	**28**
Chair de coques, cuites	**49**	Anguille de rivière	**27**
Espadon	**48**	Escargot	**27**
Hareng, fumé	**48**	Merlan	**25**
Anchois a l'huile en conserve	**47**	Sprat, fumé	**25**
Maquereau, fumé	**47**	Praire	**24**
Dorade royale	**45**	Lieu noir, cuit	**24**
Poisson, mi-gras, cru	**45**	Sole meunière, poêlée	**24**
Lingue	**42**	Sandre	**23**
Salade, thon	**41**	Saumon avec peau	**23**
Raie	**40**	Cabillaud, cuit	**23**
Raie, ailes	**40**	Truite, fumée	**23**
Crabe, Alaska King, cuit	**40**	Coquille Saint-Jacques	**22**
Crevette, grise, cuite	**40**	Surimi	**22**
Maquereau	**39**	Brochet	**21**
Poisson, gras, cru	**39**	Colin d'Alaska	**20**
Sardines a la sauce tomate en conserve	**39**	Pangasius cru	**18**
Hareng, maatje	**38**	Fish stick, pané, précuit, frit	**17**
Sardines a l'huile en conserve	**38**	Salade, saumon	**17**
Rollmops au vinaigre	**38**		

e) Vitamin D

Table 16. Recommended intake of vitamin D (µg/day)

	Children > 1 year old	Adolescents	Adults	Pregnant/Breastfeeding women
SHC, 2016	10	10-15	10-15	20
EFSA	15	15	15	15

<u>Usual intake in the Belgian population</u>
In Belgium in 2014, the average intake of vitamin D from food is 3.76 µg per day for the Belgian population aged 3-64 years. While still below the recommendations, they tend to increase with age. “Fish, shellfish and crustaceans" contributes to this with 8.7 %.

Vitamin D levels in fish

To be considered rich in vitamin D, a product must contain at least 1.5 µg/100g.

Table 17. Decreasing levels of vitamin D in fish with "high" content in vitamin D, expressed as µg per 100g (NUBEL)[13]

Saumon avec peau	**17,5**	Saumon, fumé	**5**
Rollmops au vinaigre	**15,6**	Poisson, mi-gras, cru	**4,7**
Hareng	**13,1**	Maquereau	**4**
Truite saumonée	**12,3**	Anguille de rivière, fumée	**4**
Truite	**12,2**	Carpe	**3,8**
Poisson, gras, cru	**11**	Caviar, imitation	**3,8**
Sardines	**11**	Fish stick, pané, précuit, congelé	**3,8**
Truite, poêlée	**10,9**	Sardines à l'huile en conserve	**3,4**
Merlan	**10,9**	Barbue sans peau	**2,9**
Truite, fumée	**9,4**	Thon au naturel en conserve	**2,9**
Saumon, cru	**8,5**	Fish stick, pané, précuit, frit	**2,9**
Anguille de rivière	**8,4**	Thon à l'huile en conserve	**2,8**
Huître, creuse	**8**	Maquereau sauce tomate en conserve	**2,7**
Sole	**8**	Anguille de mer, fumée	**2,7**
Flétan, blanc	**7,3**	Dorade	**2,3**
Espadon	**7,2**	Rondelles de calamars, précuites	**2,3**
Maquereau, fumé	**7**	Sprat, fumé	**2,1**
Saumon au naturel en conserve	**6,7**	Maquereau au naturel en conserve	**1,9**
Sole meunière, poêlée	**6,3**	Flétan, du Groenland	**1,8**
Salade, mollusques et crustacés	**6,2**	Turbot	**1,7**
Hareng, maatje	**6,1**	Grondin perlon	**1,6**
Plie	**6**	Tacaud	**1,6**
Caviar en conserve	**5,8**	Thon	**1,6**
Hareng, fumé	**5,7**	Limande	**1,5**
Dorade royale	**5,5**	Anchois à l'huile en conserve	**1,5**
Saumon, cuit	**5,5**	Salade, thon	**1,5**
Pilchard a la sauce tomate en conserve	**5,3**		

[13] Not available in English

3.2.6. Risk vs benefit exposure scenario's

The impact of fish consumption on health can be estimated as the product of exposure to the contaminant by evaluating the daily intake of MeHg, intake of omega 3 fatty acid and servings per week of fish. Here above, the recommendation is given that 100 g of salmon and 80 g of sardines per week would allow an intake of 263 mg EPA+DHA per day, which meet the recommendation of a daily intake of EPA+DHA of 100 to 250 mg. SHC recommended a weekly consumption of 150g fatty fish and 150g medium fat fish, or 200g fatty fish. The recommended minimal daily intake of EPA+DHA is 100 mg. To attain that, the weekly consumption of a child could be either 70g of fatty fish, or 70 g salmon, or combination of 30 g salmon and 30 g sardines.

Exposure to mercury was calculated based on the mean (UB) and P95 (UB) concentrations for both inHg and MeHg in salmon, sardines, fatty fish (Halibot, Eel, Tuna, Salmon and Seabass)[14] and medium fat fish (cod was used as a proxy) and the assumption that weekly intake for an adult person (70 kg) or a child (15 kg) are as recommended here above. The estimated weekly intake for both inHg and MeHg would be below their respective TWI when mean concentrations are considered. Depending on the Risk vs Benefit scenario (RB), the coverage of TWI would be 9-76 %. However, if the P95 (UB) concentrations would be considered, then consumption of fatty fish at the recommended intake level to attain benefits of omega fatty acids may be of concern in particular for children in relation to methyl mercury. This is due to the concentrations found in Halibot, Eel, Tuna, Salmon and Seabass which were aggregated into the group of fatty fish.

Note that for this estimation, no occurrence data for MeHg in sardines were available, but only occurrences for total mercury. Sardines are mostly recognized as a fish species in which no high levels of MeHg are found and therefore it is not frequently included in the monitoring. If we assume that the concentration of methyl mercury is 100 % that of the total mercury (as recommended by EFSA, 2012), then the calculation would still indicate no exceedance of TWI neither for inorganic nor for methyl mercury when sardines are consumed.

[14] For "fatty fish", to calculate the mean (UB) and P95 (UB) concentrations, individual concentrations determined in Halibot, Eel, Tuna, Salmon and Seabass were used

Table 18. Dietary weekly intake estimation of inorganic mercury and methyl mercury for a proposed fish consumption based on the benefits of omega-3 fatty acids intake from fish

Population/ RB scenario	fish species	mean concentration (UB) (mg/kg)		Proposed Weekly Consumption (g)	Hg intake (µg/kg bw)		%TWI
		inHg	*MeHg*		*inHg*	*MeHg*	*MeHg*
mean concentrations							
Adult (70 kg)							
RB[15] scenario 1	Salmon	0,003	0,037	100	0,00	0,05	9,29%
	Sardines	0,012	**0,060**	80	0,01	0,07	
RB scenario 2	fatty fish[16]	0,013	0,214	150	0,03	0,46	43,43%
	semi-fatty fish[17]	0,024	0,050	150	0,05	0,11	
Children (15 kg)							
RB scenario 1	Salmon	0,003	0,037	30	0,01	0,07	14,85%
	Sardines	0,012	**0,060**	30	0,02	0,12	
RB scenario 2	fatty fish	0,013	0,214	70	0,06	1,00	76,64%
RB scenario 3	salmon	0,003	0,037	70	0,01	0,17	13,10%
P95 concentrations							
Adult (70 kg)							
RB scenario 1	salmon	0,005	0,053	100	0,01	0,08	11,10%
	sardines	0,012	**0,060**	80	0,01	0,07	
RB scenario 2	fatty fish	0,028	0,690	150	0,06	1,48	123,46%
	semi-fatty fish	0,032	0,059	150	0,07	0,13	
Children (15 kg)							
RB scenario 1	salmon	0,005	0,053	30	0,01	0,11	17,38%
	sardines	0,012	**0,060**	30	0,02	0,12	
RB scenario 2	fatty fish	0,028	0,690	70	0,13	3,22	247,69%
RB scenario 3	salmon	0,005	0,053	70	0,02	0,25	19,03%

[15] RB, risk vs benefit exposure scenario

[16] Fish species considered as fatty fish: Halibot, Eel, Tuna, Salmon and Seabass. The average concentration of methyl mercury was used

[17] Cod used as a proxy for semi-fat fish

3.2.7. DALYs and fish consumption/mercury consumption

Disability adjusted life years (DALY) is a metric developed for the World Health Organization in the 1990'ies and have been applied since then, as a metric to estimate the public health impact of diseases, injuries and risk factors in the Global Burden of Disease Study (GBD) (Arnesen & Nord, 1999). This metric integrates information on disease incidence, mortality, duration, and severity. Practically, DALY expresses how many healthy life years are lost due to a given disease in a population by estimating how many years are lived with the disease of a given severity and add them to the number of years lost due to death earlier than expected. The severity of a given disease (or health outcome) is expressed by a disability weight.
DALYs were initially introduced as an incidence-based metric, where the morbidity impact was calculated by multiplying health state incidence with the corresponding duration and disability weight. Over the time, two additionally approaches, the pure prevalence-based approach, and the hybrid approach were developed and accepted. The selection of a suitable approach may vary by the purpose of the study.

In the scope of this advice, it was seen advantageous to perform a DALY calculation analysis integrating positive and negative health impacts of fish consumption (i.e., a risk-benefit analysis). However, this was not possible within the timeframe of this opinion, but instead a literature overview was made.

Quantification of incidence, mortality, and DALY attributable to dietary exposure to chemical can be done as a part of a risk assessment approach. The modelling, mostly Monte Carlo simulations, may be used to estimate DALY leading to Burden of Disease associated with a contaminant. Thomsen et al. (2019) estimated, for the general Danish adult population, that methylmercury exposure from fish was the greatest contributor to overall burden (478 DALY), even 16 times higher than the second contributor, acrylamide from potato products. The health outcomes leading to highest burden were intellectual disability and cancer.

In the Scientific Opinion of the Steering Committee of the Norwegian Scientific Committee for Food and Environment (VKM, 2022), a quantitative approach was suggested to link the changes in intake of fish to changes in occurrence of specific health outcomes. However, it was seen that incidence, duration and mortality for specific age-groups needed to be collated to quantify the number of years lived with a given health effect and years of life lost to premature death. This process required a substantial amount of work and additionally DALY interpretation could be challenging. Practically, therefore, the Burden of disease (No Daly) was estimated. An extensive systematic literature review to evaluate the epidemiological evidence for associations between fish consumption and health outcomes in Norwegian population was performed. The scientist included non-communicable diseases or common conditions in the Norwegian population as health outcomes for which fish, or compounds in fish (nutrients or contaminants) have an established or hypothesized role. The reviewed health outcomes were CVD, CHD, myocardial infarction, stroke, heart failure, heart fibrillation, venous thrombosis, neurodevelopment in children, mental disorders in children (e.g., ASD and ADHD), cognition and cognitive decline in adults (including Alzheimer's and dementia), depression in adults, type 2 diabetes, weight/overweight in children and adults, bone health, birth outcomes such as preterm birth, small for gestational age, low birth weight, birth weight (continuous), birth length and head circumference (continuous), asthma and allergy (especially in children), multiple sclerosis, rheumatoid arthritis, cancer, vaccine response, and semen quality/male fertility. As a results of this exhaustive narrative review, it was indicated that there was a low exposure to methyl mercury in the population included in the reviewed studies. The delayed language development was indicated as a possible associated health outcome but would need more confirmation in a larger study group.

In another approach, Thomsen et al (2019) quantified the health impact of substituting red and processed meat with fish in the diet of the adult Danish population using DALYs as a common health metric. They have developed four alternative scenarios in which red and processed meat were substituted with fish and the consumption of different fish species was considered. General conclusion was that 80 or 150 DALYs/100,000 individuals could be averted each year if Danish adults consumed either only lean fish or 350 g of fish/week (fatty or mix of fatty and lean), respectively, while decreasing the consumption of red and processed meat. A scenario in which red meat is substituted only by tuna, was less beneficial. This finding results from the high concentration of MeHg in tuna which was particularly higher than other (smaller) predatory fish species consumed in Denmark with around a 10-fold higher MeHg concentration.

Monitoring data used in our study also show that tuna was one of the fish species highly contaminated with MeHg, Therefore, the interpretation of the conclusion from Thomson et al. study (2018) that high consumption of large predatory fish like tuna is less beneficial could also be applicable for Belgian population.

3.2.8. Uncertainty analysis

All various sources with their possible direction of the estimation (over or under estimation) are given in Table 19.

Table 19. Summary of qualitative evaluation of the impact of uncertainties on the exposure and risk assessment of the dietary exposure of inorganic and methyl mercury

Sources of uncertainty	Direction(a)[18]
ANALYTICAL RESULTS	
Measurement uncertainty of analytical results The analytical results were collected over the period of years, in which the analytical method could have been modified leading to various measurement uncertainties	-/+
Use of analytical data from targeted sampling Analytical results were obtained from the Food Control Program which is a risk based system to monitor contaminants in food available on the market or to be placed on the market.	++
Measurement were either for total mercury, either for methylmercury There was no direct measurement of inorganic mercury. The level of contamination of inorganic mercury was calculated from total mercury measurements, assuming that inorganic mercury represents 20% of total mercury in fish, according to EFSA, 2012, which is probably on overestimation.	+

[18] +:uncertainty with potential to cause over-estimation of exposure/risk; −:uncertainty with potential to cause under-estimation of exposure/risk

EXPOSURE MODELLING	
Matching the analytical results to the best possible consumption data The analytical results were matched using Foodex classification which increased the reliability. On the other side, matching to the consumption data was difficult for some fish specieswhich were vaguely defined in FCS, 2014. To match consumption of fatty fish, marine fish and whitefish aggregated groups were made. For fatty fish, fat percentage >5 % as registered in NUBEL was taken into account, namely these were: halibut, eel, tuna, salmon, see catfish. Marine fish was selected according to the indication on the concentration data (Anchovis, Teleosts, Shak, Halibot, Cod, Merlin, Eel, Pangasius, Rye, Plaice, Sole, Sea bass, Marine Catfish, Sea devil, Swardfish, Whiting. As white fish following fish species for which the analytical results were available, were considered: cod, Pangasius, Pike, Plaice, Tilapia, Tong, Nile Perch and Whiting.	--/++
Consumption of fish preparation ("fish dish") Several fish species are used for the preparation of fish based salads, the sauce based food preparation where in most of the cases canned fish would be used (eg tuna salad). General recipes are used for conversions of the concentrations in this kind of food (FCS, 2014 manual). However, it is challenging to find the real fish source in these foods which might underestimate the real concentration of either Hg or MeHg.	-
Exposure estimation from rarely consumed fish and/or in high consumers Swordfish was the most contaminated fish species, but it is less consumed. Nevertheless, this was also calculated.	-/+
Exposure estimation for derived fish products (eg surimi, fish sticks, salmon mousse) Fish products like surimi, or fish sticks which are consumed in Belgium could not be matched to the concentration data. In the case of fish sticks, an assumption was made that cod meat is used and the consumptions were matched to the concentration of cod with a correction factor 0.6 to account for weight of breading cover or sauce used in some breaded fish products. For surimi, based on the food products labels studies (previously performed in Belgium) white fish is used as basis and it may account for 40-60 % of a product. Concentration obtained in cod with a correction factor of 0.5 were matched to the consumptions. Fish products like salmon or fish mouse were matched to the reference fish with a correction factor 0.5.	+

RISK ASSESSMENT	
Expression of TWI based on the daily intake To perform the risk characterization, the daily intakes (results from 2X24H consumption recalls) were multiplied by seven. This may overestimate the consumption for many consumers.	+
Deduction of TWI value (inorganic mercury) Value of point of departure from the Seychelles and the Faroe Islands cohorts. These populations have specific diet with higher proportions of predatory fish that may contain higher levels of methyl mercury and inorganic mercury.	-/+

Provided all of this above, there might be a considerable impact on the estimation of the exposure (average exposure scenario). Therefore, the assessment is likely to be conservative.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

4.1.1. General conclusions

Children were in general more exposed than adolescents and adults.

The calculated mean intakes for inorganic mercury were below the tolerable weekly intakes established by EFSA in 2012 for Belgian population. Exposure to inorganic mercury through fish is unlikely to exceed the TWI for all age groups.

Regarding methylmercury, the EFSA established a TWI of 1.3 µg per kg b.w. expressed as mercury. Children were in general more exposed than adolescents and adults. Whereas mean and high dietary exposure across all age groups does not exceeds the TWI (even if the P95 exposure calculated using P95 concentrations is close to the TWI for all age groups), the worst case exposure scenario is above TWI for all age groups. Even if this scenario assumes long-term exposures to the highest measured concentrations, which is very unlikely to occur, we cannot exclude that high fish consumers may exceed the TWI and that their exposure could be of concern.

4.1.2. Data gaps

The experts identified data that were missing and that could lead to possible data misinterpretation. For these data gaps, some assumptions had to be made in the exposure assessment. Due to their importance on the data interpretation, they are listed here.

The amount of data was not sufficient to characterize exposure and keep uncertainties as low as possible. For instance, the swordfish was highly sampled but it is consumed only in very low level or even not consumed. It could be recommended to include other data sources (research, monitoring, eg) for similar analysis in the future. Additional chemical occurrence data are necessary.

The analytical data used to characterize the risk are i.e. targeted data, which means that are collected for the selected matrices which are result of the prior risk analysis. The impact of this was described in the uncertainty analysis.

Data did not include all potentially fish sources related to consumption. Hereby tuna salad can be one of the examples. Whereas there were multiple results of inorganic Hg and MeHg in tuna there were almost no results for their levels in other tuna related food products The consumption data were not sufficiently detailed. The number of consumptions reported as fish, but without specifying the species of fish was notable. The lack of details hampered the definition of several exposure scenarios, for example consumption of specific fish due to low number of reported consumptions. Additional assumptions were required as described in uncertainty analysis. It may be recommended to evaluate the awareness and knowledge of consumers related to fish in a separate study.

The occurrence data were submitted in a specific format and following the classification of the collector. On the other hand, the consumption data are classified differently but linked and verified to FoodEx classification; It would be important to address these discrepancies in future and to facilitate risk assessment.

The analytical data used for this type of analysis may include more than those from Food Control Program to increase the representativeness.

For the future risk-benefit analysis, sufficient attention must be given to understanding which diseases pose the greatest threat to health and wellbeing. Various data sources routinely generate partial information related to health and food consumption in Belgium. The Belgian national burden of disease study, conducted by Sciensano, currently generates estimates for various health outcomes, but does not yet produce estimates for risk factors such as dietary patterns or chemical exposures. Broadening the scope of this exercise to such risk factors would provide a basis for risk-benefit analyses, and would allow the necessary capacity to be built and maintained in the Belgian context.

Considering that this group could be especially susceptible to developmental *sequelae* following Hg exposure, fish and seafood consumption data were lacking for children younger than 3 years.

4.2 <u>Recommendations</u>

Based on the estimated risk of exposure to mercury through fish consumption and the nutritional benefits of fish consumption, the SHC/SciCom makes a series of preliminary recommendations, to be reviewed in a later advisory report, to take into account other contaminants in fish (whether environmental or related to processing, such as smoking), such as PCBs and dioxins, polycyclic aromatic hydrocarbons, perfluorinated products, etc.

About fish consumption,

- For the Belgian adult population, the SHC/SciCom recommends eating fish, seafood or shellfish once or twice a week, of which at least once is fatty fish. Fish and seafood are valuable sources of essential nutrients, such as protein, the long-chain omega-3 polyunsaturated fatty acids EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), iodine, selenium and vitamin D. They represent an interesting alternative to meat and meat products. Their regular consumption has a significant impact on good health.

- The fish to be favored for their richness in omega 3 are: mackerel, sardines, salmon, herring, halibut, mussels, trout, cod, etc. they can be chosen fresh, frozen, canned or smoked.

- However, fish can accumulate contaminants. Eat fish once or twice a week can be considered as safe regarding inorganic mercury and methyl mercury exposure. Ideally, origin and fish species should vary from week to week to limit mercury exposure. In Belgian data, swordfish and tuna appear to be the most contaminated with mercury.

- For children (3-9 years) and women of childbearing age, pregnant and breastfeeding women, it is also recommended to eat fish once or twice a week, including fatty fish. Their nutrients contribute, among other things, to the development of their nervous and cerebral systems. Due to the neurodevelopmental toxicity of methylmercury, those groups are particularly concerned by exposure to mercury. They should limit the consumption of predatory fish such as tuna, and avoid the consumption of swordfish. The fish rich in omega 3 proposed in the second bullet should be favored.

5. RECOMMENDATIONS FOR RESEARCH

The consumption data are sometimes not specific and are lacking a detail on the fish species. Consumers might not be aware of the whole fish production process, origin of fish, etc. Furthermore, it is difficult to report the origin of fish used in the breaded fish sticks. Therefore, it may be recommended to evaluate the awareness and knowledge of consumers related to fish in a separate study. Also, the specification and labelling of fish origin can be further improved. This reporting aspect is also correlated with the design of the consumption surveys which are collecting data of the previous consumption. Further developments in the data collection, like automated collections are being considered in Belgium. This might improve further estimation in the future, in particular for fish which is less frequently consumed in Belgium.

Fish and seafood consumption data should be collected for children younger than 3 years.

Regarding risk assessment, it could be refined if a larger number of data about fish mercury contamination were available, in particular for the most consumed fish species and related products in Belgium, as well as more specific information about fish species consumption.

Further research needs to focus on the exposure of the Belgian consumer to methyl mercury, thus requiring a further refinement of the integration of consumption data and concentration data. The subsequent application of the risk-benefit model in the Belgian context, will allow assessing the specific nett impact of methyl mercury exposure in Belgium, and the effects of possible mitigation scenarios.

Other contaminants such as persistent organic pollutants (dioxins, PCBs, brominated flame retardatants, perfluorcompounds, etc.) should be included in the risk benefit analysis of fish consumption. Analytical data for all these contaminants are needed, as well as toxicological data about the toxicity linked to the exposure to a cocktail of chemicals through fish consumption.

For the Scientific Committee,
The President,
Dr. Lieve Herman,

(Sgd.)

Brussels, 25/11/2022

For the Superior Health Council,
The President,
Prof. J. Nève

(Sgd.)

Brussels, 7/12/2022

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7. COMPOSITION OF THE WORKING GROUP

The following experts have cooperated in drawing up the advice in the framework of a common working group SciCom - SHC:

Andjelkovic M. (SHC)	Toxicology, chemical residues and contaminants	Sciensano
Bossier P. (SHC)	Aquaculture	UGent
De Henauw S. (SHC)	Public health nutrition	UGent
De Meulenaer B. (SciCom, SHC)	Food chemistry, quality and safety	UGent
Eppe G. (SHC)	Inorganic analytical chemistry	ULiège
Gabriel S. (SciCom)	Parasitological risks of fish	UGent
Herman L. (SciCom)	Microbiological risks	ILVO
Hoet P. (SciCom)	Toxicology	KULeuven
Jacxsens L. (SHC)	Quality management and risk analysis	UGent
Larondelle Y. (SHC)	Metabolic biochemistry, animal and human nutrition	UCL
Maindiaux V. (SHC)	Nutrition and dietetics,	HE Vinci
Pussemier L. (SHC)	Residues and contaminants, chemical risks	CODA-CERVA
Robbens J. (SciCom)	Aquatic environment and quality	ILVO
Scippo M.-L. (SciCom, SHC)	Residues and contaminants, food analysis	ULiège
Van Loco J. (SHC)	Chemistry, contaminants	Sciensano
Vleminckx C. (SHC)	Toxicology, zoological sciences	Sciensano

The administration was represented by:

Carletta A.	PFS Public health
Vinckx C.	PFS Public health
Vromman V.	FASFC

The presidency of the working group was assumed by Luc Pussemier and Marie-Louise Scippo and the scientific secretaries were Florence Bernardy (for the SHC), Wendie Claeys (for the SciCom), Michèle Ulens (for the SHC) and Olivier Wilmart (for the SciCom).

8. APPROVAL AND VALIDATION

The advice was approved in English by the Scientific Committee established at the FASFC during the plenary session of 25 November 2022 and by the permanent working group "Food and Health, including Food Safety" of the SHC during the session of 30 November 2022. It was validated by the Board of the SHC during the session of 7 December 2022.

The names of the experts of the SHC appointed by Royal decree as well as the members of the Board and College are available on the website of the SHC (link: composition and operation).

The Scientific Committee is composed of the following members (https://www.favv-afsca.be/scientificcommittee/operation/members/).

9. CONFLICT OF INTEREST

The experts of the working group have completed a general and an *ad hoc* declaration of interests. The potential risk of a conflict of interest was evaluated by the SHC's Deontological Committee and the Bureau of the Scientific Committee. No conflict of interest was established for the experts of the working group.

10. ACKNOWLEDGEMENTS

The Scientific Committee established at the FASFC as well as the SHC acknowledge Nadia Waegeneers from Sciensano for the support.

The SciCom and the SHC would also like to thank N. Gillard (SciCom) and Y. Vandenplas (SHC/SciCom) for the 'deep reading' of the opinion.

11. LEGAL FRAMEWORK OF THE ADVISORY REPORT

For the Scientific Committee:

- Law of 4 February 2000, on the creation of the Federal Agency for the Safety of the Food Chain, in particular article 8;

- The Royal Decree of 19 May 2000, on the composition and operating procedures of the Scientific Committee, as established at the Federal Agency for the Safety of the Food Chain;

- The Internal Rules as mentioned in Article 3 of the Royal Decree of 19 May 2000, on the composition and operating procedures of the Scientific Committee, as established at the Federal Agency for the Safety of the Food Chain, approved by the Minister on 9 June 2011.

The Scientific Committee is an advisory body established at the Belgian Federal Agency for the Safety of the Food Chain (FASFC) that provides independent scientific opinions on risk assessment and risk management in the food chain, and this at the request of the Chief Executive Officer of the FASFC, the Minister competent for food safety or at its own initiative. The Scientific Committee is administratively and scientifically supported by the Staff direction for Risk Assessment of the Agency.

The Scientific Committee consists of 22 members who are appointed by royal decree on the basis of their scientific expertise in areas related to the safety of the food chain. When preparing an opinion, the Scientific Committee can call on external experts who are not a member of the Scientific Committee. Similar to the members of the Scientific Committee, they must be able to work independently and impartially. To ensure the independence of the opinions, potential conflicts of interest are managed transparently.

The opinions are based on a scientific assessment of the question. They express the view of the Scientific Committee which is taken in consensus on the basis of a risk assessment and the existing knowledge on the subject.

The opinions of the Scientific Committee may contain recommendations for food chain control policy or for the stakeholders. The follow-up of these recommendations for control policy is the responsibility of the risk managers.

Questions on an opinion can be directed to the secretariat of the Scientific Committee: Secretariat.SciCom@afsca.be.

For the Superior Health Council (SHC):

The Superior Health Council is a federal service that is a part of the FPS Health, Food Chain Safety and Environment. The Council was established in 1849 and provides scientific advice on public health to the ministers of public health and environment, to their administrations and to some of their agencies. It provides this advice on demand or on its own initiative. The SHC does not take policy decisions, nor does it execute these decisions, but based on the most recent scientific knowledge it tries to provide a guideline for the policy on public health.

In addition to an internal secretariat of about 25 collaborators, the Council has an extensive network of more than 500 experts (university professors, collaborators of scientific institutions) at its disposal of which 300 have been appointed as Council Experts; the experts convene in multidisciplinary working groups to draw up advices.

As an official organ, the Superior Health Council believes it is essential to guarantee the neutrality and impartiality of the scientific advices it provides. To this end, it has worked out a structure, rules and procedures that allow to efficiently meet these needs at every step of the creation of the advices. Key moments in doing this are the preliminary analysis of the demand, the assignment of experts for the working groups, the putting into place of a system for managing possible conflicts of interest (based on the declaration of interest, investigations of possible conflicts of interest and a Deontological Commission and the eventual validation of the advices by the Committee (the final decision-making body). This coherent whole should allow for the delivery of advices that are based on the highest possible scientific expertise available within the highest degree of impartiality.

The advices of the working groups are submitted to the Committee. After being validated, they are sent to the applicant and to the minister of public health and the public advices are published on the website (www.hgr-css.be). In addition, a number of the advices are communicated to the press and to target groups among health care practitioners.

The SHC is also an active partner in the EuSANH network (*European Science Advisory Network for Health*) that is currently under construction and which is intended to elaborate advices on the European level.

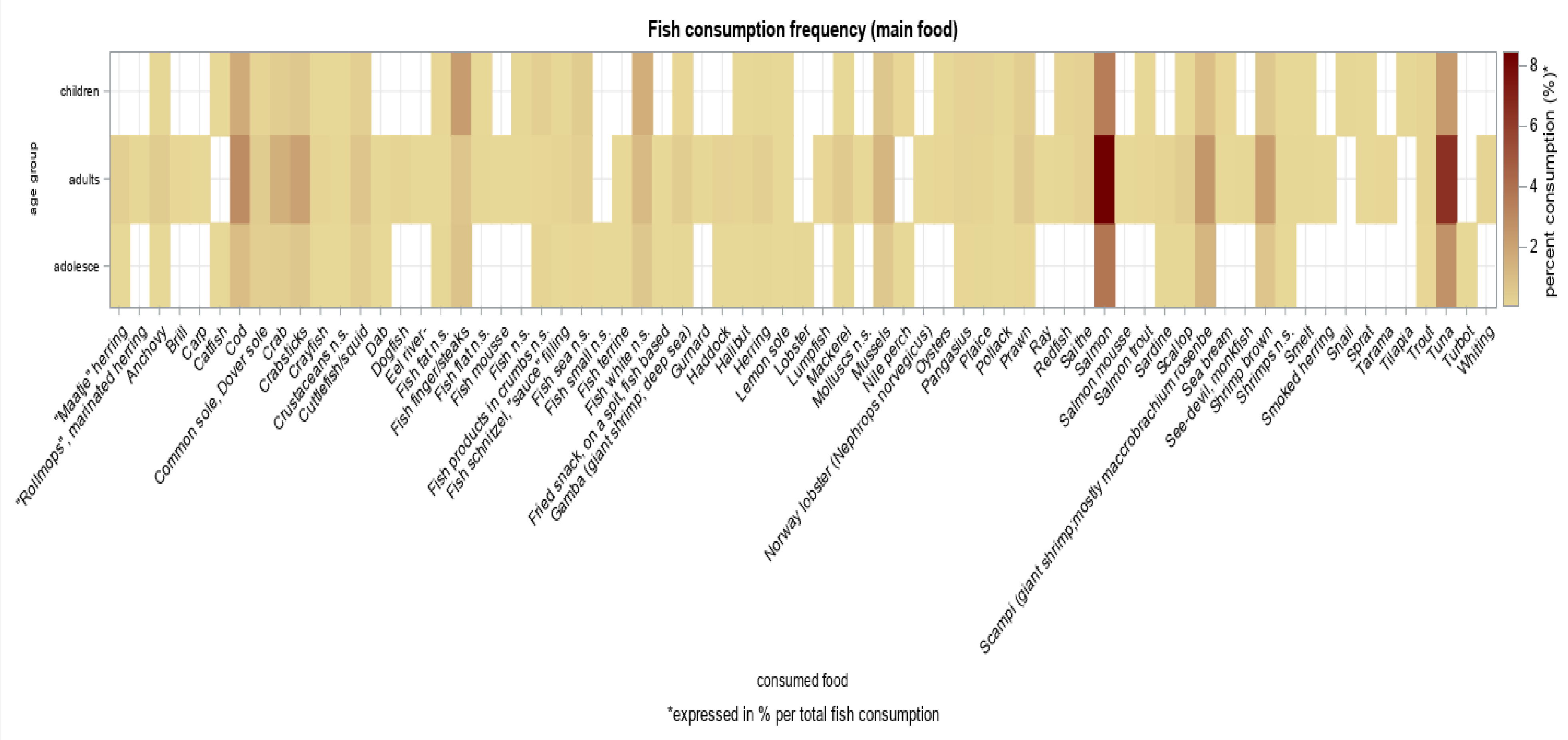
If you wish to stay informed on the activities and publications of the SHC, you can send an e-mail to info.hgr-css@health.belgium.be.

12. DISCLAIMER

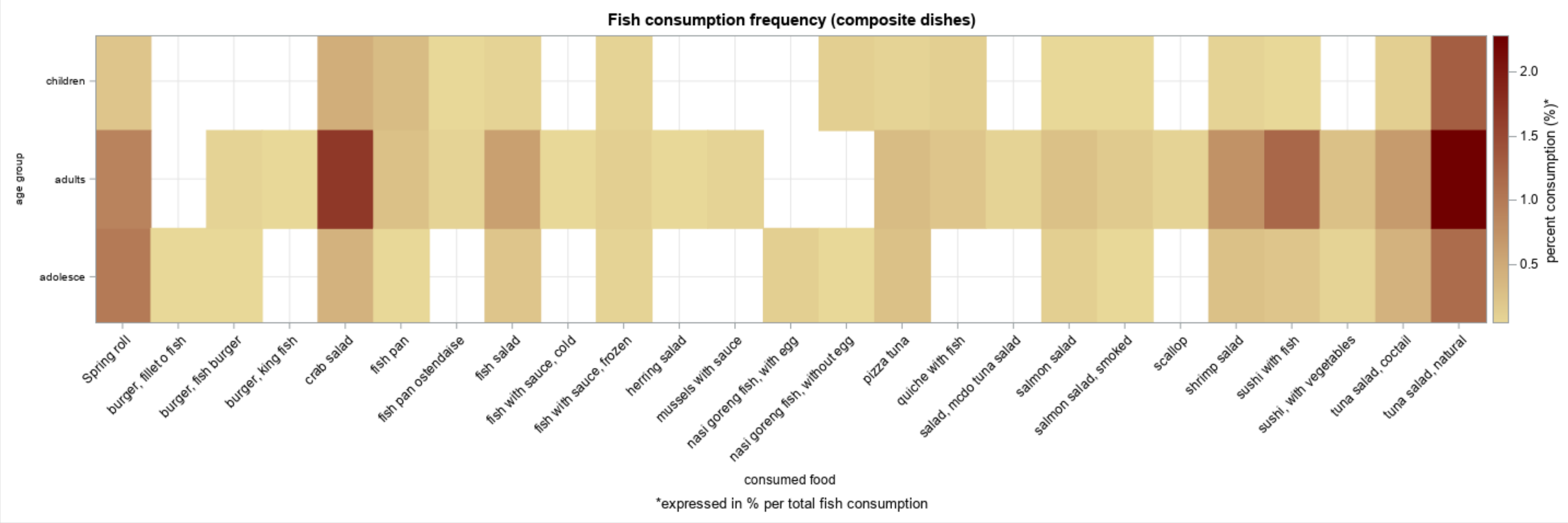
The Scientific Committee established at the FASFC and the Committee of the Superior Health Council (SHC) at all times reserve the right to modify the advice by mutual consent, should new information and data become available after the publication of this version.

13. ANNEXES

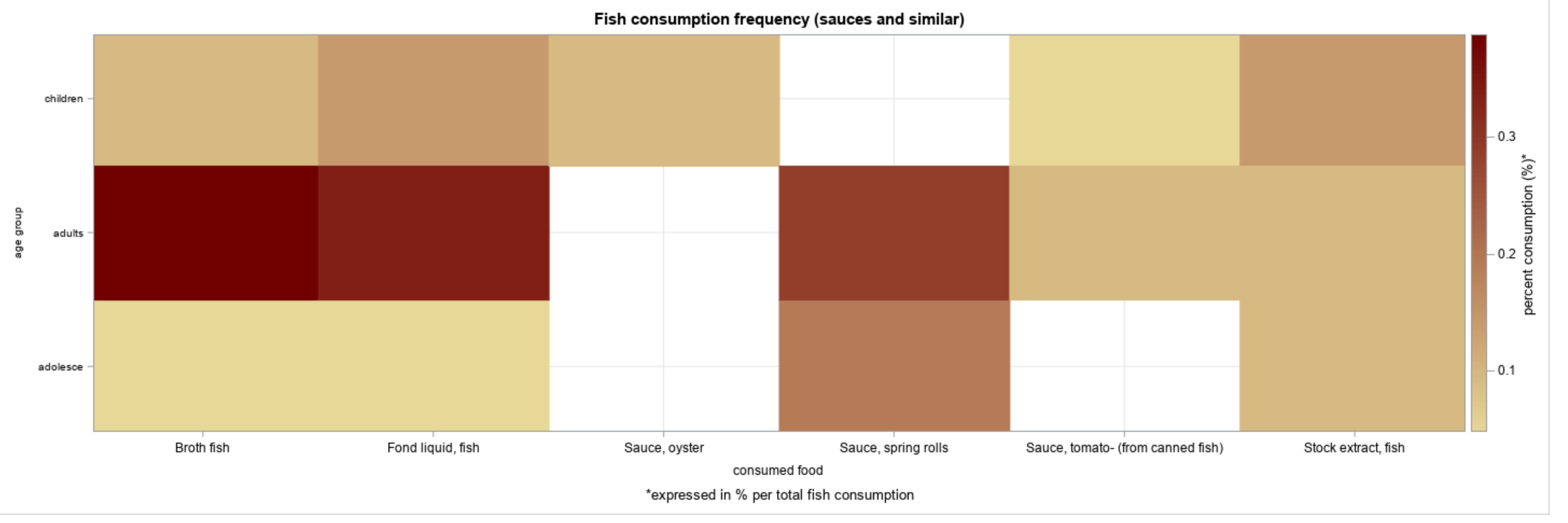
Annex 1. Proportion of consumption of fish as a main item.



Annex 2. Proportion of consumption of fish as a composite dish.



Annex 3. Proportion of consumption of fish as part of a sauce or broth.



Annex 4. Overview of the matched results to consumption per selected consumption code.

Nomenclature Belgian Food Consumption Database			Nomenclature FASFC		
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Fish finger/steaks	Fish stick/steack poisson pané	Vissticks/-steaks	Afgeleide producten van vis	Visstaafjes	NVT
Fish products in crumbs n.s.	Poisson/produits de poisson pané n.s.	Visprodukten gepaneerd n.s.	Afgeleide producten van vis	Visstaafjes	NVT
Fish schnitzel, "sauce" filling	Poisson fourré sauce et pané	Visschnitzel gevuld met "saus"	Afgeleide producten van vis	Visstaafjes	NVT
Fried snack, on a spit, fish based	Snack à frire, 'brochette', base de poisson	Snack frituur-, op stokje, basis vis	Afgeleide producten van vis	Visstaafjes	NVT
Cuttlefish/squid	Calamar	Inktvis	Pijlinkvis-Inktvis	Pijlinkvis-Inktvis	NVT
Crab	Crabe	Krab	Schaaldieren	Schaaldieren	Krabben
Crayfish	Ecrevisse de rivière	Rivierkreeft	Schaaldieren	Schaaldieren	Kreeften
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Garnalen
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Garnalen & Weekdieren & Mossels
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Grijze garnaal/Noordzeegarnaal
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Grote Tijgergarnaal

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Krabben
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Kreeften
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	NVT
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Noordelijke roze garnaal
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	Pacifische witte garnaal
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.	Schaaldieren	Schaaldieren	schaaldieren
Gamba (giant shrimp; deep sea)	Gambas	Gamba	Schaaldieren	Schaaldieren	Grote Tijgergarnaal
Lobster	Homard	Kreeft zee-	Schaaldieren	Schaaldieren	Kreeften
Molluscs n.s.	Mollusque n.s.	Weekdieren n.s.	Schaaldieren	Schaaldieren	Garnalen & Weekdieren & Mossels
Norway lobster (Nephrops norvegicus)	Langoustine (avec pince, plus petit que	Langoestine (met scharen, kleiner dan kreeft)	Schaaldieren	Schaaldieren	Kreeften
Prawn	Crevette, rose	Garnalen, roze	Schaaldieren	Schaaldieren	Noordelijke roze garnaal
Scampi (giant shrimp;mostly maccrobrachium rosenbe	Scampi	Scampi	Schaaldieren	Schaaldieren	Grote Tijgergarnaal
Shrimp brown	Crevette, grise	Garnalen, grijze	Schaaldieren	Schaaldieren	Grijze garnaal/Noordzeegarnaal

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Shrimps n.s.	Crevette n.s.	Garnalen n.s.	Schaaldieren	Schaaldieren	Garnalen
Anchovy	Anchois	Ansjovis	Vissen	Vissen	Ansjovis
Brill	Barbue	Griet	Vissen	Vissen	Tong
Catfish	Loup de mer	Zeewolf	Vissen	Vissen	Zeewolf
Cod	Cabillaud	Kabeljauw	Vissen	Vissen	Kabeljauw
Common sole, Dover sole	Sole	Tong zee-	Vissen	Vissen	Tong
Crabsticks	Surimi	Surimi	Vissen	Vissen	Kabeljauw**
Dab	Limande commune	Schar	Vissen	Vissen	Schol
Dogfish	Chien de mer (roussette)	Doornhaai	Vissen	Vissen	Haai
Dogfish	Roussette (chien de mer)	Doornhaai	Vissen	Vissen	Haai
Eel river-	Anguille de rivière	Paling rivier-	Vissen	Vissen	Paling
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.	Vissen	Vissen	Heilbot
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.	Vissen	Vissen	Paling
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.	Vissen	Vissen	Tonijn
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.	Vissen	Vissen	Zalmachtige
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.	Vissen	Vissen	Zeewolf
Fish flat n.s.	Poisson, plat n.s.	Vis plat- n.s.	Vissen	Vissen	Heilbot

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	Name (fre)	Name (Ned)	Matrix level 3*	Matrix level 4	Fish Species
Fish mousse	Mousse, base de poisson	Vismousse	Vissen	Vissen	Zalmen
Fish n.s.	Poisson n.s.	Vis n.s.	Vissen	Vissen	Beenvissen
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Ansjovis
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Beenvissen
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Haai
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Heilbot
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Kabeljauw
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Merlijn
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Paling
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Pangagiusfilet (katvis)
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Pangasius
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Pangasiusfilet (katvis)
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Rog
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Schol

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Tong
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Tonijn
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Wijting
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Zeebaars
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Zeeduivel
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Zeewolf
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.	Vissen	Vissen	Zwaardvis
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Kabeljauw
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Pangasius
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Schol
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Snoek
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Tilapia
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Tong
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Victoriabaars

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.	Vissen	Vissen	Wijting
Haddock	Aiglefin	Schelvis	Vissen	Vissen	Kabeljauw
Haddock	Eglefin	Schelvis	Vissen	Vissen	Kabeljauw
Halibut	Flétan	Heilbot	Vissen	Vissen	Heilbot
Lemon sole	Sole limande	Tongschar	Vissen	Vissen	Schol
Nile perch	Perche du Nil	Victoriabaars	Vissen	Vissen	Victoriabaars
Pangasius	Pangasius	Pangasius	Vissen	Vissen	Katvis
Pangasius	Pangasius	Pangasius	Vissen	Vissen	Pangagiusfilet (katvis)
Pangasius	Pangasius	Pangasius	Vissen	Vissen	Pangasius
Plaice	Plie	Pladijs	Vissen	Vissen	Schol
Pollack	Pollak	Pollak	Vissen	Vissen	Kabeljauw
Ray	Raie	Rog	Vissen	Vissen	Rog
Redfish	Sébaste	Roodbaars	Vissen	Vissen	Zeebaars
Saithe	Colin (lieu noir)	Koolvis	Vissen	Vissen	Kabeljauw
Saithe	Lieu noir (colin)	Koolvis	Vissen	Vissen	Kabeljauw
Salmon	Saumon	Zalm	Vissen	Vissen	Zalmachtige
Salmon	Saumon	Zalm	Vissen	Vissen	Zalmen
Salmon mousse	Mousse, base de saumon	Zalmmousse	Vissen	Vissen	Zalmen
Salmon trout	Truite saumonée	Zalmforel	Vissen	Vissen	Forellen
Sardine	Sardine	Sardien	Vissen	Vissen	Sardinen
See-devil, monkfish	Baudroie	Zeeduivel	Vissen	Vissen	Zeeduivel
See-devil, monkfish	Lotte	Zeeduivel	Vissen	Vissen	Meerval
Tilapia	Tilapia	Tilapia	Vissen	Vissen	Tilapia

Nomenclature Belgian Food Consumption Database				Nomenclature FASFC	
Name (eng)	**Name (fre)**	**Name (Ned)**	**Matrix level 3***	**Matrix level 4**	**Fish Species**
Trout	Truite	Forel	Vissen	Vissen	Forellen
Tuna	Thon	Tonijn	Vissen	Vissen	Tonijn
Turbot	Turbot	Tarbot	Vissen	Vissen	Tong
Whiting	Merlan	Wijting	Vissen	Vissen	Wijting
Mussels	Moule	Mosselen	Weekdieren	Tweekleppige weekdieren	Gewone mossel
Mussels	Moule	Mosselen	Weekdieren	Tweekleppige weekdieren	Mossels
Oysters	Huitre	Oesters	Weekdieren	Tweekleppige weekdieren	Japanse oester
Scallop	Coquille St. Jacques	Sint-Jacobsschelpen	Weekdieren	Tweekleppige weekdieren	Sint-jacobsschelpen

*"*Mat_Niveau_1 (Voedingsmiddelen)"* and *"Mat_Niveau_2 (Producten en bereidingen van de visserij of de aquacultuur)"* are the same for all items in the table and were excluded for an easier overview. **Cod was arbitrary chosen as a proxy concentration for surimi.

Annex 5. Extract from the NUBEL table.

Produit	g_Protéines	g_Matieres grasses	g_Acides gras saturés	g_Ac.gras mono-insat., total	g_Ac.gras poly-insat, total	g_Ac.gras Oméga 3, total	g_Ac.gras Oméga 6, total	g_AG C18:2 n-6 cis acide linoléique	g_AG C20:5 n-3 cis EPA	g_AG C22:6 n-3 cis DHA	mg_Cholestérol	g_Glucides	g_Fibres, total	mg_Sodium	mg_Potassium	mg_Calcium	mg_Phosphore	mg_Magnésium	mg_Fer	mg_Cuivre	mg_Zinc	µg_Iodure	µg_Sélénium	µg_Vit.A - Activité	mg_Vit.B1	mg_Vit.B2	µg_Vit.B12	µg_Folates	µg_Vit.D
Anchois	20.1	2.3	0.8	0.4	0.6	-	-	0.1	0.210	0.290	330	0.0	0.0	148	278	82	233	41	4.9	0.2	1.4	29.0	37	49	0.07	0.27	0.62	9.0	-
Anchois a l'huile en conserve	20.0	10.0	2.1	3.0	5.1	1.0	3.4	3.3	0.163	0.263	45	0.0	0.0	4562	184	138	174	55	2.8	0.2	1.5	8.7	47	60	0.02	0.83	8.56	18.8	1.5
Anguille de mer	19.0	8.7	2.7	4.0	1.7	1.4	0.1	0.1	0.583	0.679	71	0.0	0.0	173	278	27	187	22	0.2	0.0	1.3	24.4	57	239	0.05	0.14	0.41	9.3	<1.0
Anguille de mer, fumée	17.9	15.0	3.4	5.9	2.2	1.5	0.8	0.4	0.409	0.758	174	0.0	0.0	626	218	19	260	17	0.3	0.0	4.4	840.0	54	614	0.03	0.17	0.00	-	2.7
Anguille de riviere	15.0	20.8	6.6	11.4	2.1	0.9	0.9	0.9	0.333	0.146	89	0.0	0.0	41	281	96	234	20	0.5	0.0	1.7	5.3	27	980	0.18	0.32	3.19	24.6	8.4
Anguille de riviere, fumée	18.0	28.3	7.6	12.2	6.8	5.0	1.5	1.4	1,895	3,010	145	0.0	0.0	529	193	31	204	15	3.5	0.1	1.1	5.7	28	940	0.19	0.37	2.27	10.4	4.0
Barbue sans peau	20.0	2.0	0.6	0.6	0.8	0.8	0.1	0.0	0.152	0.430	-	<0.1	<0.5	90	357	16	180	27	0.3	-	-	-	-	<30	<0.10	0.10	-	-	2.9
Brochet	18.4	0.9	0.1	0.2	0.4	0.3	0.1	0.0	0.065	0.191	63	0.0	0.0	100	300	20	192	25	0.7	0.1	0.7	15.3	21	14	0.09	0.06	2.00	6.0	0.0
Cabillaud	16.4	0.6	0.1	0.1	0.3	0.1	0.1	0.0	-	0.139	38	0.0	0.0	67	380	16	180	30	0.4	0.0	0.4	116.0	28	11	0.12	0.15	1.00	12.0	0.0
Cabillaud, cuit	23.0	1.0	0.2	0.1	0.5	0.4	0.0	0.0	0.120	0.290	35	0.0	0.0	108	310	40	330	25	0.1	0.0	0.4	243.0	23	2	0.07	0.04	2.00	14.0	1.2

Carpe	18.0	4.8	1.3	2.4	1.0	0.3	0.5	0.5	0.063	0.055	75	0.0	0.0	100	306	29	216	15	1.1	0.1	0.9	1.7	13	44	0.07	0.05	1.53	15.0	3.8
Caviar en conserve	26.1	16.7	4.1	4.6	7.4	6.8	0.6	0.1	2,741	3.8	300	0.0	0.0	1940	181	51	300	22	1.4	0.1	1.0	103.0	66	271	0.19	0.62	20.00	50.0	5.8
Caviar, imitation	12.9	5.7	1.1	1.4	2.8	2.5	0.2	0.2	1,019	1,325	312	0.8	0.0	2160	77	20	125	4	0.5	0.0	1.2	27.0	52	9	0.04	0.07	19.50	22.0	3.8
Chair de coques, cuites	12.3	0.7	0.2	0.1	0.4	0.4	0.1	0.0	0.182	0.141	34	3.2	<0.5	999	248	70	110	30	26.0	<0.1	1.4	<0.1	49	40	0.05	0.11	24.00	-	-
Colin d'Alaska	16.8	0.6	0.2	0.1	0.2	0.1	0.0	0.0	0.027	0.032	31	0.0	0.0	220	216	12	376	30	0.2	0.0	0.4	70.0	20	0	0.17	0.09	1.20	3.0	0.0
Coquille Saint-Jacques	15.0	0.9	0.5	0.2	0.2	0.2	0.0	0.0	0.066	0.086	75	3.0	0.0	150	420	26	208	45	1.3	0.0	2.3	20.0	22	2	0.04	0.05	2.00	17.0	0.5
Crabe au naturel en conserve	17.0	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.040	0.020	66	0.0	0.0	482	9	220	140	28	0.9	0.7	4.1	-	32	37	0.01	0.05	0.00	43.0	0.0
Crabe, Alaska King, cru	18.3	0.6	0.1	0.1	0.1	-	-	0.0	-	-	42	0.0	0.0	836	204	46	219	49	0.6	0.9	6.0	-	36	7	0.04	0.04	9.00	44.0	0.0
Crabe, Alaska King, cuit	19.4	0.9	0.3	0.3	0.2	0.2	0.0	0.0	0.104	0.055	67	0.0	0.0	1072	262	59	280	63	0.8	1.2	7.6	-	40	9	0.05	0.06	11.50	51.0	0.0
Crevette, grise, cuite	22.6	1.6	0.8	0.6	0.2	0.1	0.1	0.1	-	0.010	165	0.4	0.0	1000	165	150	350	42	2.0	0.7	1.8	260.0	40	0	0.05	0.28	12.60	33.5	<0.3
Crevette, rose, cuite	22.6	1.0	0.4	0.3	0.2	0.1	0.1	0.1	-	0.061	120	0.0	0.0	138	207	81	203	54	0.8	0.3	2.0	40.9	52	<2	0.04	0.04	2.46	-	0.5
Croquette aux crevettes, panée, précuite, congelée	9.4	7.2	3.9	2.9	0.7	0.1	0.5	0.4	0.027	0.015	77	17.6	1.2	553	131	96	105	17	0.4	0.2	0.7	16.9	0	0	0.09	0.16	-	-	-
Cuisses de grenouilles	14.5	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.006	0.005	26	0.0	0.0	55	310	18	147	23	1.5	0.3	2.0	-	14	14	0.14	0.25	0.40	10.0	0.5
Dorade	18.7	2.8	0.4	1.0	1.2	-	-	-	-	-	60	0.0	0.0	81	307	141	223	26	0.8	0.1	0.7	-	-	35	0.11	0.10	3.08	-	2.3
Dorade royale	19.7	7.0	2.4	3.1	1.3	0.6	0.7	0.7	0.147	0.210	60	0.0	0.0	33	474	53	244	50	0.7	0.0	0.8	5.0	45	4	0.07	0.07	3.16	0.0	5.5
Ecrevisse d'eau douce	16.0	0.7	0.2	0.2	0.2	0.1	0.1	0.1	0.059	0.015	89	0.0	0.0	253	260	97	226	25	1.8	0.4	1.8	45.0	32	9	0.03	0.04	2.35	30.0	0.3
Eglefin	18.2	<0.2	<0.1	<0.0	<0.1	<0.0	<0.0	<0.0	<0.021	<0.019	<20	0.0	0.0	98	357	27	203	23	0.8	0.2	0.3	243.0	30	17	0.05	0.17	0.74	8.9	0.5

Escargot	16.0	1.3	0.4	0.4	0.4	0.1	0.2	0.2	0.040	0.021	160	2.0	0.0	70	382	10	272	250	3.5	0.4	2.5	6.0	27	30	0.01	0.12	0.50	6.0	-
Escolier noir	18.3	23.7	0.9	19.9	2.6	1.8	0.6	0.2	0.284	0.403	82	0.0	0.0	89	375	22	240	25	0.5	0.1	0.8	-	37	30	0.12	0.15	1.90	15.0	-
Espadon	18.1	4.9	1.6	2.7	0.3	0.3	0.0	0.0	0.029	0.152	66	0.0	0.0	87	486	4	506	27	0.4	0.0	0.5	2.0	48	0	0.13	0.09	0.60	2.0	7.2
Fishstick, pané, précuit, congelé	12.5	7.7	1.0	3.0	3.1	0.2	3.0	3.0	0.028	0.028	23	16.0	0.8	454	257	13	142	28	0.4	0.0	0.4	33.7	16	2	0.12	0.08	0.90	10.0	3.8
Fishstick, pané, précuit, frit	13.2	16.9	4.4	6.4	6.2	0.4	5.8	5.8	0.050	0.088	13	27.0	1.7	814	210	86	201	25	0.9	0.1	1.5	-	17	54	0.09	0.06	2.00	5.0	2.9
Flétan du Groenland, fumé	18.5	12.9	2.4	9.1	1.7	1.4	0.2	0.1	0.149	0.153	40	0.0	0.0	1565	326	11	171	20	0.1	0.0	0.3	3.7	53	157	0.03	0.07	0.61	7.3	1.0
Flétan, blanc	20.1	0.4	0.1	0.2	0.1	0.1	0.0	0.0	0.014	0.035	34	0.0	0.0	71	412	16	202	17	0.6	0.0	0.4	52.0	37	43	0.07	0.08	1.00	8.6	7.3
Flétan, du Groenland	13.2	12.7	2.3	7.2	1.9	-	-	0.2	0.800	0.680	46	0.0	0.0	40	308	5	187	22	0.0	0.0	0.3	3.8	52	11	0.07	0.06	0.50	8.1	1.8
Grand sébaste	18.2	2.0	0.7	0.9	0.3	0.2	0.1	0.0	-	0.146	30	0.0	0.0	81	300	26	200	32	1.0	0.1	0.4	99.0	50	3	0.10	0.11	1.00	5.0	0.0
Grondin perlon	19.3	7.2	2.2	3.1	1.9	1.7	0.2	0.1	0.533	0.821	-	0.1	<0.5	52	398	9	200	24	<0.3	-	-	-	-	64	0.11	<0.10	-	-	1.6
Hareng	18.0	16.0	3.3	7.6	2.9	2.6	0.3	0.2	0.93	1.09	80	0.0	0.0	594	381	63	284	35	0.6	0.0	0.5	4.8	50	36	0.10	0.25	11.90	28.5	13.1
Hareng, fumé	22.2	14.0	4.5	6.7	2.5	2.1	0.3	0.2	0.883	0.525	68	0.0	0.0	518	326	71	305	36	1.0	0.1	0.7	7.0	48	13	0.04	0.28	5.71	29.6	5.7
Hareng, maatje	18.0	11.3	3.6	4.9	1.6	1.2	0.2	0.1	0.576	0.235	53	0.0	0.0	1051	284	46	260	29	0.8	0.1	0.8	11.8	38	36	0.10	0.25	9.24	20.1	6.1
Homard	18.2	1.9	0.2	0.4	0.7	0.6	0.1	0.1	0.350	0.165	89	0.0	0.0	270	260	61	234	22	0.6	1.7	3.4	100.0	130	21	0.13	0.09	0.97	16.0	0.0
Homard, cuit	19.6	2.0	0.6	0.4	0.6	0.1	0.0	0.0	0.086	0.040	118	0.0	0.0	440	350	138	185	45	0.4	1.4	2.9	130.0	52	20	0.06	0.07	2.06	17.0	0.0
Huître	10.2	1.8	0.7	0.4	0.4	0.1	0.0	0.0	0.030	0.009	45	4.2	0.0	290	250	70	157	32	5.8	7.9	16.0	60.0	36	75	0.15	0.20	16.20	15.0	1.0
Huître, creuse	7.1	3.0	1.5	0.8	0.6	0.5	0.0	0.0	0.393	0.087	115	3.9	0.0	211	156	45	135	47	6.7	4.5	90.8	60.0	64	30	0.10	0.10	19.46	10.0	8.0

Langoustine	19.6	1.3	0.2	0.3	0.5	0.4	0.0	0.0	0.251	0.118	95	0.8	0.0	341	213	48	144	68	2.0	0.7	4.6	240.0	55	0	0.13	0.01	0.90	17.0	0.0
Lieu noir	17.2	0.5	0.2	0.2	0.1	0.1	0.0	0.0	0.016	0.034	24	0.0	0.0	40	440	8	170	14	0.2	0.0	0.3	85.0	32	3	0.05	0.05	1.30	10.0	0.8
Lieu noir, cuit	23.1	0.8	0.3	0.0	0.2	0.2	0.0	<0.0	0.044	0.180	105	0.0	0.0	102	224	38	152	36	0.4	0.1	0.6	12.0	24	11	0.06	0.08	2.10	15.2	<0.5
Limande	17.4	1.1	-	-	-	-	-	-	-	-	50	0.0	0.0	80	298	20	260	28	0.8	0.0	0.5	30.0	55	14	0.10	0.08	1.50	5.0	1.5
Limande-sole	17.4	2.9	1.1	1.4	0.2	0.2	0.0	0.0	0.084	0.058	49	0.0	0.0	95	230	17	200	17	0.5	0.1	0.5	94.0	75	0	0.09	0.08	1.00	11.0	0.0
Lingue	18.4	0.3	0.1	0.1	0.1	0.1	0.0	0.0	0.025	0.049	49	0.0	0.0	61	315	9	198	26	0.9	0.0	0.7	80.0	42	0	0.09	0.03	0.56	7.0	0.0
Lotte	15.5	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.013	0.020	24	0.0	0.0	180	297	19	225	27	1.5	0.1	0.4	-	37	12	0.03	0.06	0.90	7.0	-
Loup de mer	17.6	0.6	0.2	0.2	0.1	0.1	0.0	0.0	0.049	0.027	27	0.0	0.0	76	282	6	179	27	0.9	0.1	1.8	60.0	37	105	0.18	0.06	2.03	5.0	0.5
Maquereau	18.7	9.1	3.0	3.5	1.8	1.6	0.2	0.1	0.496	0.758	76	0.0	0.0	80	380	12	244	30	1.2	0.1	0.5	50.0	39	100	0.13	0.36	9.00	1.2	4.0
Maquereau a l'huile en conserve	20.5	16.7	3.8	6.9	4.8	1.7	1.5	0.8	-	-	68	0.0	0.1	386	279	17	162	23	1.0	0.1	0.6	12.2	70	45	0.04	0.24	7.52	9.2	1.2
Maquereau au naturel en conserve	21.0	5.7	1.4	1.5	1.7	0.6	0.1	0.1	-	-	43	0.2	0.1	229	250	15	166	23	0.9	0.1	0.6	18.6	54	37	0.03	0.27	10.17	7.7	1.9
Maquereau sauce tomate en conserve	15.0	10.6	2.4	3.9	3.1	2.7	0.3	0.3	0.635	1.162	56	3.0	1.0	425	288	21	150	18	0.9	0.1	0.8	6.7	37	59	0.07	0.20	10.30	18.9	2.7
Maquereau, fumé	19.5	24.8	5.7	10.1	7.5	6.6	0.6	0.5	1,632	2,740	56	0.0	0.0	449	317	25	240	25	1.2	0.1	1.0	9.7	47	50	0.13	0.30	12.35	10.8	7.0
Merlan	17.4	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.014	0.025	48	0.0	0.0	115	360	25	183	38	0.3	0.0	0.6	67.0	25	3	0.05	0.05	0.80	12.0	10.9
Moules au vinaigre	14.8	2.7	0.7	0.7	1.3	1.1	0.1	0.0	0.672	0.295	69	2.7	0.0	321	102	29	220	13	5.2	0.2	1.2	197.0	52	124	<0.10	<0.10	21.00	37.0	0.0
Moules, cuites	19.4	2.6	0.7	0.5	1.4	1.2	0.1	0.0	0.603	0.455	59	8.9	0.0	794	179	149	220	12	4.2	0.3	3.6	124.7	78	124	<0.10	<0.10	37.00	33.6	0.0
Pangasius cru	14.9	1.6	0.6	0.5	0.2	0.0	0.2	0.1	0.000	0.010	36	0.0	0.0	204	293	10	166	29	0.1	0.0	0.3	3.0	18	0	0.02	0.06	1.00	10.0	1.4
Perche du Nil	18.0	0.5	0.3	0.2	0.0	0.0	0.0	0.0	0.005	0.009	<20	0.0	0.0	58	308	5	156	27	0.3	0.1	0.4	6.5	31	6	0.07	0.04	1.17	-	0.5

Pilchard a la sauce tomate en conserve	16.0	12.0	3.3	0.9	1.9	1.0	0.1	0.0	0.725	0.120	40	0.7	0.2	500	272	271	248	43	2.0	0.1	1.1	36.2	28	7	0.01	0.33	6.95	13.8	5.3
Plie	13.4	1.0	0.4	0.4	0.2	0.1	0.1	0.0	-	0.065	30	0.0	0.0	120	326	39	200	22	0.9	0.0	0.5	31.0	30	12	0.09	0.15	1.20	11.0	6.0
Poisson, gras, cru	18.3	15.0	3.3	7.2	1.9	1.4	0.3	0.2	0.576	0.409	64	0.0	0.0	80	374	21	244	26	0.5	0.1	0.7	8.5	39	33	0.11	0.25	7.25	17.6	8,4
Poisson, maigre, cru	17.4	0.6	0.2	0.2	0.2	0.1	0.0	0.0	0.025	0.043	42	0.0	0.0	80	307	19	200	27	0.8	0.0	0.6	32.5	37	10	0.07	0.08	1.20	8.9	0.5
Poisson, mi-gras, cru	18.1	4.4	1.4	2.4	1.0	0.3	0.3	0.3	0.084	0.152	60	0.0	0.0	81	351	41	234	27	0.6	0.1	0.6	2.0	45	20	0.10	0.09	1.52	11.0	4.7
Praire	9.2	1.0	0.2	0.2	0.6	-	-	0.0	0.024	0.206	40	2.8	0.0	56	314	49	107	9	2.8	0.3	2.3	-	24	90	0.01	0.11	49.44	16.0	0.1
Raie	20.7	0.7	0.2	0.1	0.3	0.1	0.2	0.0	-	0.060	48	0.0	0.0	100	300	20	240	24	1.0	0.1	0.9	0.0	40	3	0.02	0.01	6.00	3.0	0.0
Raie, ailes	22.0	0.6	0.2	0.1	0.3	0.1	0.2	0.0	-	0.051	45	0.0	0.0	100	300	20	240	24	1.0	0.1	0.9	0.0	40	3	0.02	0.01	6.00	3.0	0.0
Rollmops au vinaigre	13.4	12.4	4.0	9.3	1.0	0.8	0.2	0.2	0.250	0.290	90	1.0	0.6	1120	60	16	89	8	0.6	0.1	0.3	8.0	38	13	0.05	0.21	3.32	6.4	15.6
Rondelles de calamars, précuites	9.6	9.7	1.6	2.3	6.1	0.3	5.8	5.8	-	-	64	19.0	0.8	194	230	81	160	23	0.7	0.5	0.9	49.7	35	47	0.10	0.13	1.10	15.0	2.3
Roussette	21.4	0.8	0.2	0.4	0.2	0.1	0.1	0.0	0.011	0.084	-	0.2	<0.5	120	223	15	150	18	0.4	-	-	-	-	<30	<0.10	<0.10	-	-	<0.3
Salade, mollusques et crustacés	8.2	25.5	2.3	15.8	7.4	2.3	5.1	5.0	-	-	74	6.9	0.2	479	188	78	149	15	0.7	0.0	0.3	-	28	48	0.04	0.11	1.90	11.0	6.2
Salade, saumon	10.7	34.6	2.6	22.1	9.5	2.7	5.8	5.8	0.031	0.062	46	5.8	0.5	562	110	11	100	10	< 0.3	<0.1	<0.4	6.6	17	24	0.10	0.07	1.19	7.9	-
Salade, surimi/crabe	6.5	24.1	2.1	14.1	6.0	1.5	4.2	4.2	0.022	0.022	70	8.8	0.1	600	78	28	66	10	0.3	0.1	0.4	17.0	13	25	0.03	0.03	0.60	7.0	0.3
Salade, thon	10.9	31.9	2.2	18.4	7.9	2.5	5.4	5.4	0.029	0.149	62	4.5	0.5	520	158	20	101	16	0.7	<0.1	0.7	2.8	41	28	0.06	0.08	1.95	5.6	1.5
Sandre	19.2	0.4	0.1	0.2	0.1	0.1	0.0	0.0	0.030	0.037	34	0.0	0.0	24	391	53	194	50	0.6	0.1	0.6	21.5	23	0	0.04	0.09	1.55	14.0	0.7
Sardines	19.4	12.2	5.7	4.3	1.5	1.3	0.1	0.1	0.647	0.415	51	0.0	0.0	100	375	20	258	24	1.2	0.1	4.1	32.0	85	20	0.02	0.22	11.00	4.0	11.0
Sardines a la sauce tomate en conserve	18.0	12.0	3.5	2.6	4.8	3.4	1.3	1.2	1.54	0.9	18	0.5	0.0	333	335	766	417	40	5.6	0.1	0.8	26.0	39	56	0.03	0.22	10.00	4.0	1.1

Sardines a l'huile en conserve	24.0	13.7	2.3	5.4	3.6	1.7	0.8	0.7	0.499	0.477	59	0.0	0.0	221	382	73	347	29	1.8	0.1	0.8	9.8	38	49	0.04	0.30	17.70	9.4	3.4
Saumon au naturel en conserve	19.5	7.2	1.7	2.9	2.8	1.6	0.1	0.1	0.490	0.760	25	0.0	0.0	470	332	118	292	25	0.5	0.1	0.6	9.7	33	7	0.03	0.21	6.40	11.5	6.7
Saumon avec peau	18.4	16.5	7.1	8.7	0.5	0.2	0.3	0.2	-	0.149	45	0.0	0.0	45	372	5	268	28	0.3	0.0	0.4	4.0	23	11	0.16	0.28	7.25	23.9	17.5
Saumon, cru	18.0	17.4	2.4	9.6	5.4	2.7	2.7	2.5	0.442	0.548	-	0.0	0.0	34	374	7	211	24	< 0.8	<0.2	<0.8	27.0	0	16	0.21	0.09	5.60	22.0	8.85
Saumon, cuit	19.2	16.3	2.4	8.9	4.9	2.2	2.7	2.3	0.408	0.522	55	0.7	0.0	265	199	9	230	16	< 0.3	<0.1	<0.4	73.9	8	5	0.20	0.12	4.09	12.7	5.5
Saumon, fumé	22.0	11.0	2.3	3.5	3.6	2.4	0.7	0.4	0.643	1,519	36	0.0	0.0	1240	417	10	254	26	0.3	0.0	0.4	3.5	32	54	0.32	0.18	5.64	3.7	5.0
Seiche	16.0	2.4	1.0	1.0	0.4	0.3	0.1	0.1	0.120	0.190	230	0.0	0.0	110	273	27	143	28	0.6	1.0	1.1	20.0	66	9	0.12	0.11	2.00	13.0	0.0
Sole	17.5	0.5	0.1	0.3	0.1	0.1	0.1	0.0	-	0.053	53	0.0	0.0	98	353	20	200	29	0.1	0.0	0.4	17.0	30	0	0.06	0.10	0.80	11.0	8.0
Sole meuniere, poelée	14.3	6.2	3.6	2.3	0.4	0.1	0.2	0.1	0.000	0.040	59	2.0	0.4	92	327	21	171	25	0.5	0.0	0.4	13.8	24	80	0.06	0.10	0.65	17.2	6.3
Sprat, fumé	19.4	16.0	4.5	3.8	3.6	3.2	0.5	0.3	0.7885	1,413	78	0.0	0.0	1079	408	79	230	38	1.5	0.1	1.2	23.0	25	150	0.25	0.40	10.50	42.2	2.1
Surimi	7.4	0.5	0.2	0.1	0.0	<0.0	<0.0	0.1	<0.000	0.097	26	9.8	0.0	604	97	16	282	15	0.4	0.1	0.3	-	22	0	0.02	0.02	0.57	0.0	-
Tacaud	17.8	0.4	0.0	0.2	0.1	0.1	0.0	0.0	0.016	0.033	-	0.2	<0.5	95	339	13	160	28	0.4	-	-	-	-	<30	<0.10	<0.10	-	-	1.6
Tanche	18.0	0.4	-	-	-	-	-	-	-	-	70	0.0	0.0	33	400	58	207	51	0.8	0.1	1.1	-	-	1	0.08	0.18	-	-	-
Thon	27.4	0.4	0.2	0.2	0.1	0.0	0.0	0.0	0.009	0.037	44	0.0	0.0	46	425	12	200	31	0.8	0.0	0.5	16.8	200	372	0.12	0.02	4.80	15.0	1.6
Thon a l'huile en conserve	25.5	13.0	2.0	11.7	1.7	0.6	1.1	1.1	0.086	0.318	51	0.0	-	350	288	10	294	35	1.4	0.1	1.2	12.0	68	6	0.03	0.10	2.20	15.0	2.8
Thon au naturel en conserve	24.2	0.8	0.2	0.3	0.2	0.1	0.0	0.0	0.026	0.098	58	0.0	0.0	363	316	6	308	26	0.7	0.0	0.5	11.2	68	542	0.08	0.09	2.82	15.0	2.9
Truite	18.4	2.7	1.1	1.3	0.2	0.1	0.1	0.0	-	0.103	33	0.0	0.0	50	365	16	226	26	0.2	0.0	0.4	1.8	16	18	0.07	0.26	1.26	19.1	12.2

Truite saumonée	21.4	5.4	1.8	2.4	1.0	0.7	0.3	0.3	0.205	0.400	53	0.0	0.0	42	394	145	311	27	0.2	0.0	0.5	1.5	12	49	0.31	0.30	1.50	20.4	12.3
Truite, fumée	20.3	4.6	1.4	1.2	1.3	1.0	0.2	0.2	0.174	0.432	52	0.0	0.0	840	355	35	235	23	0.4	0.0	0.5	2.6	23	77	0.13	0.19	5.74	10.7	9.4
Truite, poelée	16.7	6.4	2.6	2.8	0.8	0.2	0.6	0.6	0.000	0.090	28	6.2	0.3	74	342	15	203	24	0.3	0.0	0.4	1.6	14	56	0.08	0.23	1.09	18.6	10.9
Turbot	16.7	2.6	1.1	1.2	0.1	0.1	0.0	0.0	0.021	0.029	25	0.0	0.0	114	290	17	159	20	0.5	0.0	0.6	35.0	30	4	0.04	0.08	0.80	16.0	1.7

Annex 6. Glossaries of fish from an English, Dutch or French starting point (source: the Belgian Food Consumption Database)

1) In Dutch, alphabetical order

Name (Dutch)	Name (French)	Name (English)
Ansjovis	Anchois	Anchovy
Doornhaai	Roussette / chien de mer	Dogfish
Forel	Truite	Trout
Gamba	Gambas	Gamba (giant shrimp; deep sea)
Garnalen n.s.	Crevette n.s.	Shrimps n.s.
Garnalen, grijze	Crevette, grise	Shrimp brown
Garnalen, roze	Crevette, rose	Prawn
Griet	Barbue	Brill
Heilbot	Flétan	Halibut
Inktvis	Calamar	Cuttlefish/squid
Kabeljauw	Cabillaud	Cod
Koolvis	Colin /lieu noir	Saithe
Krab	Crabe	Crab
Kreeft zee-	Homard	Lobster
Langoestine (met scharen, kleiner dan kreeft)	Langoustine (avec pince, plus petit que homard)	Norway lobster (Nephrops norvegicus)
Mosselen	Moule	Mussels
Oesters	Huitre	Oysters
Paling rivier-	Anguille de rivière	Eel river-
Pangasius	Pangasius	Pangasius
Pladijs	Plie	Plaice
Pollak	Pollak	Pollack
Rivierkreeft	Ecrevisse de rivière	Crayfish
Rog	Raie	Ray
Roodbaars	Sébaste	Redfish
Sardien	Sardine	Sardine
Scampi	Scampi	Scampi (giant shrimp;mostly maccrobrachium rosenbe
Schaaldieren n.s.	Crustacés n.s.	Crustaceans n.s.
Schar	Limande commune	Dab
Schelvis	Aiglefin / Eglefin	Haddock
Sint-Jacobsschelpen	Coquille St. Jacques	Scallop
Snack frituur-, op stokje, basis vis	Snack à frire, 'brochette', base de poisson	Fried snack, on a spit, fish based
Surimi	Surimi	Crabsticks
Tarbot	Turbot	Turbot
Tilapia	Tilapia	Tilapia
Tong, zee-	Sole	Common sole, Dover sole
Tongschar	Sole limande	Lemon sole
Tonijn	Thon	Tuna
Victoriabaars	Perche du Nil	Nile perch
Vis n.s.	Poisson n.s.	Fish n.s.

Name (Dutch)	Name (French)	Name (English)
Vis vet n.s.	Poisson, gras n.s.	Fish fat n.s.
Vis zee n.s.	Poisson, de mer n.s.	Fish sea n.s.
Vismousse	Mousse, base de poisson	Fish mousse
Visprodukten gepaneerd n.s.	Poisson / Produits de poisson pané n.s.	Fish products in crumbs n.s.
Visschnitzel gevuld met "saus"	Poisson fourré sauce et pané	Fish schnitzel, "sauce" filling
Vissticks/-steaks	Fish stick / Steak poisson pané	Fish finger/-steaks
Weekdieren n.s.	Mollusque n.s.	Molluscs n.s.
Wijting	Merlan	Whiting
Zalm	Saumon	Salmon
Zalmforel	Truite saumonée	Salmon trout
Zalmmousse	Mousse, base de saumon	Salmon mousse
Zeeduivel	Lotte/ Baudroie	See-devil, monkfish
Zeewolf	Loup de mer	Catfish

2) In French, alphabetical order

Name (French)	Name (Dutch)	Name (English)
Aiglefin / Eglefin	Schelvis	Haddock
Anchois	Ansjovis	Anchovy
Anguille de rivière	Paling rivier-	Eel river-
Barbue	Griet	Brill
Baudroie	Zeeduivel	See-devil, monkfish
Cabillaud	Kabeljauw	Cod
Calamar	Inktvis	Cuttlefish/squid
Chien de mer / Roussette	Doornhaai	Dogfish
Colin / Lieu noir	Koolvis	Saithe
Coquille St. Jacques	Sint-Jacobsschelpen	Scallop
Crabe	Krab	Crab
Crevette n.s.	Garnalen n.s.	Shrimps n.s.
Crevette, grise	Garnalen, grijze	Shrimp brown
Crevette, rose	Garnalen, roze	Prawn
Crustacés n.s.	Schaaldieren n.s.	Crustaceans n.s.
Ecrevisse de rivière	Rivierkreeft	Crayfish
Eglefin / Aiglefin	Schelvis	Haddock
Fish stick/steak poisson pané	Vissticks/-steaks	Fish finger/steaks
Flétan	Heilbot	Halibut
Gambas	Gamba	Gamba (giant shrimp; deep sea)
Homard	Kreeft zee-	Lobster
Huitre	Oesters	Oysters
Langoustine (avec pince, plus petit que homard)	Langoestine (met scharen, kleiner dan kreeft)	Norway lobster (Nephrops norvegicus)
Lieu noir / Colin	Koolvis	Saithe
Limande commune	Schar	Dab
Lotte	Zeeduivel	See-devil, monkfish
Loup de mer	Zeewolf	Catfish
Merlan	Wijting	Whiting
Mollusque n.s.	Weekdieren n.s.	Molluscs n.s.
Moule	Mosselen	Mussels
Mousse, base de poisson	Vismousse	Fish mousse
Mousse, base de saumon	Zalmmousse	Salmon mousse
Pangasius	Pangasius	Pangasius
Perche du Nil	Victoriabaars	Nile perch
Plie	Pladijs	Plaice
Poisson fourré sauce et pané	Visschnitzel gevuld met "saus"	Fish schnitzel, "sauce" filling
Poisson n.s.	Vis n.s.	Fish n.s.
Poisson, blanc n.s.	Vis wit n.s.	Fish white n.s.
Poisson, de mer n.s.	Vis zee n.s.	Fish sea n.s.
Poisson, gras n.s.	Vis vet n.s.	Fish fat n.s.
Poisson, plat n.s.	Vis plat- n.s.	Fish flat n.s.

Name (French)	Name (Dutch)	Name (English)
Poisson/produits de poisson pané n.s.	Visprodukten gepaneerd n.s.	Fish products in crumbs n.s.
Pollak	Pollak	Pollack
Raie	Rog	Ray
Roussette / Chien de mer	Doornhaai	Dogfish
Sardine	Sardien	Sardine
Saumon	Zalm	Salmon
Scampi	Scampi	Scampi (giant shrimp;mostly maccrobrachium rosenbe
Sébaste	Roodbaars	Redfish
Snack à frire, 'brochette', base de poisson	Snack frituur-, op stokje, basis vis	Fried snack, on a spit, fish based
Sole	Tong zee-	Common sole, Dover sole
Sole limande	Tongschar	Lemon sole
Surimi	Surimi	Crabsticks
Steak poisson pané / Fish stick	Vissticks/-steaks	Fish finger/steaks
Thon	Tonijn	Tuna
Tilapia	Tilapia	Tilapia
Truite	Forel	Trout
Truite saumonée	Zalmforel	Salmon trout
Turbot	Tarbot	Turbot

3) In English, alphabetical order

Name (English)	Name (French)	Name (Dutch)
Anchovy	Anchois	Ansjovis
Brill	Barbue	Griet
Catfish	Loup de mer	Zeewolf
Cod	Cabillaud	Kabeljauw
Common sole / Dover sole	Sole	Tong zee-
Crab	Crabe	Krab
Crabsticks	Surimi	Surimi
Crayfish	Ecrevisse de rivière	Rivierkreeft
Crustaceans n.s.	Crustacés n.s.	Schaaldieren n.s.
Cuttlefish / Squid	Calamar	Inktvis
Dab	Limande commune	Schar
Dogfish	Roussette / Chien de mer	Doornhaai
Dover sole / Common sole	Sole	Tong zee-
Eel river-	Anguille de rivière	Paling rivier-
Fish fat n.s.	Poisson, gras n.s.	Vis vet n.s.
Fish finger/steaks	Fish stick / Steak poisson pané	Vissticks/-steaks
Fish flat n.s.	Poisson, plat n.s.	Vis plat- n.s.
Fish mousse	Mousse, base de poisson	Vismousse
Fish n.s.	Poisson n.s.	Vis n.s.
Fish products in crumbs n.s.	Poisson / Produits de poisson pané n.s.	Visprodukten gepaneerd n.s.
Fish schnitzel, "sauce" filling	Poisson fourré sauce et pané	Visschnitzel gevuld met "saus"
Fish sea n.s.	Poisson, de mer n.s.	Vis zee n.s.
Fish white n.s.	Poisson, blanc n.s.	Vis wit n.s.
Fried snack, on a spit, fish based	Snack à frire, 'brochette', base de poisson	Snack frituur-, op stokje, basis vis
Gamba (giant shrimp; deep sea)	Gambas	Gamba
Haddock	Aiglefin / Eglefin	Schelvis
Halibut	Flétan	Heilbot
Lemon sole	Sole limande	Tongschar
Lobster	Homard	Kreeft zee-
Molluscs n.s.	Mollusque n.s.	Weekdieren n.s.
Monkfish / See-devil	Baudroie / Lotte	Zeeduivel
Mussels	Moule	Mosselen
Nile perch	Perche du Nil	Victoriabaars
Norway lobster (Nephrops norvegicus)	Langoustine (avec pince, plus petit que homard)	Langoestine (met scharen, kleiner dan kreeft)
Oysters	Huitre	Oesters
Pangasius	Pangasius	Pangasius
Plaice	Plie	Pladijs
Pollack	Pollak	Pollak
Prawn	Crevette, rose	Garnalen, roze
Ray	Raie	Rog
Redfish	Sébaste	Roodbaars

Name (English)	Name (French)	Name (Dutch)
Saithe	Colin / Lieu noir	Koolvis
Salmon	Saumon	Zalm
Salmon mousse	Mousse, base de saumon	Zalmmousse
Salmon trout	Truite saumonée	Zalmforel
Sardine	Sardine	Sardien
Scallop	Coquille St. Jacques	Sint-Jacobsschelpen
Scampi (giant shrimp;mostly maccrobrachium rosenbe	Scampi	Scampi
See-devil / Monkfish	Baudroie / Lotte	Zeeduivel
Shrimp brown	Crevette, grise	Garnalen, grijze
Shrimps n.s.	Crevette n.s.	Garnalen n.s.
Squid / Cuttlefish	Calamar	Inktvis
Tilapia	Tilapia	Tilapia
Trout	Truite	Forel
Tuna	Thon	Tonijn
Turbot	Turbot	Tarbot
Whiting	Merlan	Wijting

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