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Intake Assessment of EPA/DHA Omega-3 Oils using Data from the European Union (EU)

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The opinions and comments formulated during this assessment are based on observations and information available at the time of the review. Exponent has no direct knowledge of, and offers no warranty regarding, the condition or conditions beyond what was available during our review. Observations and conclusions have been derived in accordance with current standards of professional practice based on our regulatory experience and judgment. Exponent has exercised the usual and customary care in the conduct of this assessment. No guarantee or warranty is express or implied regarding questions that were out of the scope of this compliance investigation or conditions that may be impacted by future regulation.

Executive Summary

The Global Organization for EPA and DHA Omega-3s (GOED) has requested that Exponent undertake an intake assessment for eicosapentaenoic acid (EPA)/docosahexaenoic acid (DHA) omega-3 oils using data from relevant populations in the European Union (EU). The present assessment concerns the use of EPA/DHA omega-3 oils as ingredients in foods, *i.e.* in food supplements or when they are used to fortify foods. In order to assess the potential intake of EPA/DHA omega-3 oils in the EU by consumers of food supplements and of fortified foods and beverages, a number of sources of data were used, including data provided to Exponent by GOED, along with a review of data on the levels of EPA/DHA omega-3 oils in food supplements and in fortified foods on the market in the EU. Based on the volume of EPA/DHA omega-3 oils used for human consumption in Europe, the major use of EPA/DHA omega-3 oils in the EU is for food supplements (82.5%), while the use in fortified foods and beverages is much lower at 5.7%. Other uses include infant formula (5.8%), clinical nutrition (3.4%) and pharmaceuticals (2.7%).

The typical amount of EPA/DHA omega-3 oils in food supplements sold on the UK and Irish market were reviewed as an example of likely amounts present in products sold in all European countries. The results were considered on a population group basis in relation to their target markets. There was only one product identified that was suitable for infants, and this product provided 500 mg/day total fish/marine oil. In the small number of child supplements on the market, the range of total EPA/DHA omega-3 oils was 400 to 2500 mg/day (median 800 mg/day). Supplements designed for adolescents contained EPA/DHA omega-3 oils in the range of 540 to 1906 mg/day (median 770 mg oil/day). For adults, food supplements containing total EPA/DHA omega-3 oils provided 270 to 5500 mg/day (median 800 mg/day).

Given that 82.5% of the volume of EPA/DHA omega-3 oils is used in food supplements, and 5.7% is used in food and beverages, along with a median content of EPA/DHA omega-3 oils of 800 mg/day for adults observed from the survey of food supplement products on the UK and Irish market, the estimated intake of EPA/DHA omega-3 oils for EU adults from fortified foods and beverages is approximately 55 mg/day. These intake estimates are based on users of food supplements and fortified foods and do not represent an average intake value for the entire EU population. Based on the compilation of estimated total intake of EPA/DHA omega-3 oils, the most likely or typical intakes are in the region of 0.85 g per day for most population groups, and 1.79 g per day for infants (who consume a DHA-fortified infant / follow-on formula).

Introduction

The Global Organization for EPA and DHA Omega-3s (GOED) has requested that Exponent undertake an intake assessment for EPA/DHA omega-3 oils from the diet of European consumers using data from relevant populations in the European Union (EU). In addition to fish oil, the scope of the current intake assessment includes omega-3 concentrates, along with other marine oils such as krill oil, and microalgal oils¹, among others. Dietary supplementation with EPA/DHA omega-3 oils is a widespread practice intended to supplement the diet with the critical nutrients EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). EPA and DHA are long-chain omega-3 polyunsaturated fatty acids that are abundant in fish, shellfish, and some microalgae. Food supplements containing EPA/DHA omega-3 oils usually contain well-refined fish oils from whole fish (e.g. anchovies, sardines etc), cod liver oil and concentrates (reconfigured oils in the form of concentrated ethyl esters and triglycerides). Omega-3 oils are also sourced in smaller amounts from squid, krill, microalgae and other marine sources.

Background

Part of GOED's mission is to monitor and analyse the body of science related to the intake and benefits of EPA and DHA omega-3s. The background for this report is that GOED wishes to have a better understanding of EPA/DHA omega-3 oil intake that can help support any consideration of changes to the setting of maximum contaminant levels for EPA/DHA omega-3 oil in the EU under Regulation (EC) No 1881/2006² on contaminants in food. Under the Regulation, maximum levels of various contaminants have been established for different foodstuffs. Maximum limits for EPA/DHA omega-3 oils may be set at levels equal to those for vegetable oils, while the intake levels of these types of oils can be very different. For example, currently, there are maximum levels for the process contaminants glycidyl fatty acid esters and 3-MCPD fatty acid esters for the group 'fish oils and oils from other marine organisms' that are the same or similar to those for vegetable oils and fats (and "other" vegetable oils).² Therefore, one of the aims of the present report is to assess the potential exposure of the EU population to this category 'fish oils and oils from other marine organisms'. In addition, the intake of EPA/DHA omega-3 oils from other sources, such as those from microalgae, and an analysis of intake by different age groups, has been evaluated in the present report.

Methods

The present assessment concerns the use of EPA/DHA omega-3 oils as ingredients in foods (i.e. in food supplements or when they are used to fortify foods). In order to assess the intake of EPA/DHA omega-3 oils by EU consumers of food supplements and of fortified foods and

¹ Any reference to omega-3 oil in this report means oils containing EPA and DHA, not alpha-linolenic acid.

² Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs - <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1881-20230101>

beverages, and infant formula a number of approaches were used employing various sources of data.

1. Volume of EPA/DHA omega-3 oils used for human consumption in Europe

Estimates of the volume (metric tonnes) of EPA/DHA omega-3 oils used for human consumption in Europe was collated by GOED and provided to Exponent (please refer to Table 1, below).

2. EPA/DHA omega-3 oils from food supplements

EPA/DHA omega-3 oil-containing food supplements are generally formulated to provide EPA and DHA in amounts recommended by expert bodies; for example, the report from the European Food Safety Authority (EFSA) in 2009 on reference intake values for n-3 and n-6 polyunsaturated fatty acids (EFSA, 2009). To understand the typical concentrations of fish oils and oils from other marine organisms that are present in food supplements sold in the EU market, a review of information from the product label on supplements on sale in the market in Ireland and the United Kingdom (UK) was conducted through an online search of these products in a popular supplement retailer (Holland and Barrett³) – refer to Appendix I.

3. Use of food supplements among European consumers

GOED has also shared data with Exponent on consumer surveys in adults conducted in several European countries which have reported on the use of food supplements and fortified foods (Exponent did not have access to the actual / raw survey data for this review). GOED also shared some data on trends and developments in European EPA & DHA food supplement products based on the Mintel Global New Product database (GNPD)

In addition, a review of the published literature on the reported use of food supplements containing fish oil and other EPA/DHA omega-3 oils in the EU was undertaken.

4. EPA/DHA omega-3 oils from fortified foods and beverages

As part of a previous report in 2012, GOED collected data on current and potential future foods fortified with their respective levels of EPA and DHA (GOED, 2012). The then “current fortified foods” covered 5 main foods categories - bread, eggs, margarine/spreads, milk and yogurt. The data gathered by GOED on market share of these fortified products along with actual use levels were used to assess exposure to long chain PUFA (LCPUFA) in the EU. Assumptions on market share of fortified foods within each food category for the EU were incorporated into the exposure assessments to try and achieve a realistic overview of exposure to EPA and DHA from fortified foods. As accurate market share data on LCPUFA fortified foods in the EU for all food categories was not readily available, a conservative assumption was made by GOED members on the upper range of market share of foods fortified with EPA and DHA per food category with the following

³ <https://www.hollandandbarrett.ie/>

values used for these 5 food categories: bread = 3%, eggs = 8%, margarine/spreads = 5%, milk = 8% and yogurt = 3%.

5. EPA/DHA omega-3 oils from infant formula and follow-on formula

According to GOED, infant formula accounts for 5.8% of the volume of EPA/DHA omega-3 oils used in the EU (Table 1). To estimate the intake of EPA/DHA omega-3 oils in infants and young children who exclusively consume an infant formula or a follow-on formula containing EPA/DHA omega-3 oils as a source of DHA, levels stipulated by Commission Delegated Regulation (EU) 2016/127⁴ regarding specific compositional and information requirements for infant formula and follow-on formula were used.

6. Estimates of intake of EPA/DHA omega-3 oils across Europe

To further support the estimate of intake of EPA/DHA omega-3 oils in the EU, GOED also provided Exponent with estimates of the ranges of EPA/DHA omega-3 intake from all sources (expressed in mg per person per day) by European country. Estimates were developed by GOED using a statistical model that combined the results of surveys and economic indicators and validates against GOED market estimates.

Results and Discussion

1. Volume of EPA/DHA omega-3 oils used for human consumption in Europe

Estimates of the volume, in metric tonnes, of EPA/DHA omega-3 oils used for human consumption in Europe was collated by GOED and is presented in Table 1⁵. From these data, it is clear that the major use of EPA/DHA omega-3 oils in the EU is for food supplements (82.5%), while the use in fortified foods and beverages is much lower at 5.7%.

Table 1. Estimated use of the volume, in metric tonnes, of EPA/DHA Omega-3 Oils used for human consumption in Europe (data provided by GOED).

Category	Sum of 2021 Tonnage (mT)	% total
Dietary supplements	13,811	82.5
Infant formula	965	5.8
Food & Beverage	953	5.7
Clinical Nutrition / Medical foods	571	3.4
Pharmaceuticals	449	2.7
<i>Total</i>	<i>16,750</i>	<i>100</i>

⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02016R0127-20220401>

⁵ These data are available in the 2020-2021 Global EPA and DHA Ingredient Market Report (2022 Edition) <https://goedomega3.com/purchase/ingredient-market-report>

2. EPA/DHA omega-3 oils from food supplements

As described in the Methods section, a review of information from the product label on supplements on sale in the UK and Irish market was conducted through an online search (refer to Appendix I). A description of the findings is now presented per population target group for these products.

Supplements for infants

From the review of food supplement products containing fish and marine oils on sale in the retailer in the UK and Ireland, there was only one product identified that was suitable for infants. This product provided 500 mg/day total fish oils and oils from other marine organisms (from here on such products will be referred to as ‘total fish/marine oil’) containing 100 mg/day EPA and 350 mg/day DHA.

Supplements for children

In the small number of child supplements on the market, the range of total fish/marine oil was 400 to 2500 mg/day (median 800 mg/day), with EPA in the range of 36 – 279 mg/day and DHA in the range of 58 to 236 mg/day. While the range of total fish/marine oil in supplements designed for children was up to 2500 mg/day, from the five products identified for children on the UK and Irish market, three of these contained <1000 mg/day.

Supplements for adolescents

Supplements designed for adolescents (12+ years) contained total fish/marine oil in the range of 540 to 1906 mg oil/day (median 770 mg oil/day) with EPA in the range of 170 – 180 mg/day and DHA in the range of 120 to 800 mg/day. For products designed for adolescents, out of the four products identified on the UK and Irish market, three of these contained ≤ 1000 mg total fish/marine oil /day.

Supplements for adults.

For adults, supplements containing fish and marine oils identified provided a wide range from 270 to 5500 mg total fish/marine oil/day, in one or multiple doses (median 800 mg/day). These supplements delivered EPA in the range of 30 – 688 mg/day and DHA in the range of 27.5 to 442 mg/day. Out of the 39 products identified for adults on the UK and Irish market, 29 of these contained ≤ 1000 mg total fish/marine oil/day and 16 contained ≤ 500 mg total fish/marine oil/day. Some supplements intended for adults were designed with specific health claims, such as those claiming to be beneficial for ‘heart, brain and vision’, providing up to 5500 mg total fish/marine oil/day. Some supplements were specifically designed for women (range of total fish/marine oil from 400 – 2000 mg/day; median 550 mg/day), and one product was specifically designed for men (providing 400 mg total fish/marine oil/day).

3. Use of food supplements among European consumers

Results from consumer reviews

The results from consumer surveys (adults) on the use of food supplements and fortified foods conducted in several European countries are shown in Table 2 (data provided by GOED⁶).

Table 2. Results from adult surveys on use of omega-3 food supplements and omega-3 fortified foods.

Country	Year of survey	% use EPA/DHA omega-3 supplements	% use EPA/DHA omega-3 fortified foods
EU Member States			
France	2019	20.6	21.3
Germany	2021	23.2	19.3
Poland	2016	34.3	29.2
Italy	2014	21.4	22.2
Spain	2013	19.2	56.0
Non-EU countries			
UK	2019	25.6	15.1
Norway	2016	36.3	15.1

From these consumers surveys, it would appear that the range of users of food supplements containing EPA/DHA omega-3 oils ranges from 19.2 – 34.3%, and the range of users of foods fortified with EPA/DHA omega-3 oils ranges from 19.3 – 56.0% in the EU (however it is noted that the value for the percentage users of EPA/DHA omega-3 fortified foods reported in Spain is much higher than in other countries). The results are likely over-estimates because responses in health surveys tend to be aspirational, and consumers may be confused about what foods are fortified with omega-3 oils versus other ingredients.

Results from the Mintel GNPD review

Mintel's GNPD tracks many new product "events", which include original product releases, new product varieties, range extensions, product relaunchees and packaging updates, across the world. GOED applied this tool to the European market for the 36 months ending in April 2022. The tool discovered 507 new product events. The search parameters were designed to include any products with EPA or DHA, regardless of source species, including fish oils, fish liver oils, krill oils, algae oils and more. Of the 31 European countries analysed, 7 countries released 80% of those new products (Germany, UK, Netherlands, Spain, Norway, France and Sweden).

⁶ In terms of understanding the data, GOED provided the caveat that the results are likely over-estimates, because responses in health surveys tend to be aspirational. Also, consumers may be confused about what foods are fortified with omega-3 oils versus other ingredients. Exponent did not have access to the actual / raw survey data for this review.

Results from the literature review

A total of 14 studies conducted in the EU reported on the use of food supplements containing fish oil and other EPA/DHA omega-3 oils among their participants as part of their habitual dietary intakes. These studies included a multi-centre study in Europe (Augood *et al.*, 2008), along with studies conducted in Belgium (1 study), Denmark (2 studies), Finland (3 studies), France (1 study), Germany (1 study), Ireland (1 study), the Netherlands (1 study), Spain (1 study) and Sweden (2 studies) and are summarised in Table 3.

In the multi-centre European study, undertaken in 2007, it was found that 7.9% of participants were users of an omega-3 supplement, and 5% were users of a fish oil supplement (Augood *et al.*, 2008). Taking specific EU Member States into account, the reported use of fish/marine oil supplements ranges from 0% in Germany (Kleber *et al.*, 2016) to almost 14% of adults ≥ 40 years in Finland (Hameen-Antilla *et al.*, 2011). If males are considered separately, the reported use of fish/marine oil supplements ranges from 0% in Germany (Kleber *et al.*, 2016) to 15.8% of male adults aged 50-64 years in Denmark (Joensen *et al.*, 2010). For females, the reported use of fish/marine oil supplements ranges from 0% in Germany (Kleber *et al.*, 2016) to 39% in pregnant women in France (Jia *et al.*, 2015).

Table 3. Percentage supplement users of EPA/DHA Omega-3 oil Food Supplements in the EU

Country	Reference	Study sample	Study details	Type of Supplement	% Supplement users		
					All	Men	Women
Europe, 7 centres	Augood <i>et al.</i> , 2008	EUREYE study - cross sectional study in 2276 adults > 65 yrs	Semi-quantitative FFQ from the EPIC study	n-3 PUFA	7.9	-	-
				Fish oil	5	-	-
Belgium	Sioen <i>et al.</i> , 2010	414 women 18-39 yrs, convenience sample, Flanders region	Market study on all n-3 PUFA supplements (Aug - Oct 2008). Semi-quantitative FFQ	n-3 PUFA	-	-	5
Denmark	Joensen <i>et al.</i> , 2010	53,803 adults (24786 men, 29017 women), aged 50 – 64 yrs.	Validated FFQ containing 192 food items	Fish oil	-	15.8	17.3
Denmark	Knudsen <i>et al.</i> , 2002	3707 women (18-65 yrs), 942 men (60-65 yrs)	Danish Investigation on Iodine Intake & Thyroid disease. Personal interview on supplement use	Fish oil	-	14.0	1.1 (18-22 yrs), 1.2 (25-30 yrs), 4.0 (40-45 yrs), 18.3 (60-65 yrs)
Finland	Hameen-Antilla <i>et al.</i> , 2011	Parents of children <12 years old	Questionnaire to parents on supplement use	Fish oil and fatty acids	6.1 (< 30 y); 13.7 (≥40 y)	-	-
Finland	Suominen-Taipale <i>et al.</i> , 2010	5,840 adults. Nationally representative survey	Health 2000 Survey: 2000-2001; Validated FFQ containing 128 items	Fish oil	-	1	3
		308 fishermen and wives	Fishermen Study: 2004-2005; Validated FFQ containing 128 items	Fish oil	-	5	8
Finland	Helldan <i>et al.</i> , 2013	1708 adults. Nationally representative survey	48-hour dietary recall; FINDIET Survey as part of The National FINRISK Study	n-3 PUFA	-	15	21
France	Jia <i>et al.</i> , 2015	481 pregnant females aged >16 years	Supplement intake questionnaires in the Alberta Pregnancy Outcomes and	n-3 PUFA	-	-	39
				DHA	-	-	30

Country	Reference	Study sample	Study details	Type of Supplement	% Supplement users		
					All	Men	Women
			Nutrition (APrON) cohort study				
Germany	Kleber <i>et al.</i> , 2016	3316 adults referred for coronary angiography	Self-report of supplement use in the LURIC study	Fish oil	0	0	0
Ireland	Li <i>et al.</i> , 2016	1051 Irish adults (aged 18–90 years). Nationally representative survey	4-day semi-weighed food record in cross-sectional national food survey of Irish adults: NANS	n-3 PUFA	12.5	-	-
Netherlands	Dijkstra <i>et al.</i> , 2009	Rotterdam Study – prospective cohort study in 5299 men and women aged 55 years and older	Interview administered validated, semiquantitative FFQ. Intakes of specific fatty acids based on food consumption database derived from TRANSFAIR study	Fish oil	0.45	-	-
Spain	Lavado-García <i>et al.</i> , 2018	1865 females aged 20–79 years	131-item FFQ	n-3 PUFA	-	-	0
Sweden	Levitan <i>et al.</i> , 2009	39,367 men aged 45-70 years	Self-administered FFQ containing 96 items	Fish oil	-	5	-
Sweden	Wallström <i>et al.</i> , 2007	10,564 male subjects born between 1923 and 1945	A combined interview-based dietary history method, a FFQ containing 168 items, and a 45- minute complementary interview	EPA or DHA	-	3	-

Abbreviations: FFQ: food frequency questionnaire; PUFA: polyunsaturated fatty acids; EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid

4. Intakes of EPA/DHA omega-3 oils from fortified foods and beverages

Some foods and beverages on the market in EU countries may also be fortified with EPA/DHA omega-3 fatty acids. EPA/DHA omega-3 oils used as ingredients to fortify foods are practically all refined oils (some cod and salmon, as well as smaller volumes of other oils, but these oils are also refined). Tuna oil is used as an ingredient in infant formula, and EPA/DHA omega-3 oils used in clinical nutrition products is split between concentrates and refined oil.

From the EU exposure assessment described in the 2012 GOED report for the five main food categories fortified with EPA and DHA (bread, eggs, margarine/spreads, milk and yogurt), which was based on data from the EFSA Comprehensive database, mean EPA and DHA intakes ranged from 156.5 - 239.6 mg/day in infants, from 248.6 - 451.7 mg/day in toddlers, from 255.7 - 659.2 mg/day in other children, from 300.6 - 630.5 mg/day in adolescents, from 363.3 - 623.9 mg/day in adults, from 376.9 - 629.2 mg/day in the elderly and from 413.8 - 661.5 mg/day in the very elderly.

As the proportion of EPA+DHA in EPA/DHA omega-3 oils is reported in the range of 30% for typical oils (data provided by GOED), this results in estimated intakes of EPA/DHA omega-3 oils in each population group from fortified foods and beverages as follows: 521.7 - 798.7 mg/day in infants, 828.7 - 1505.7 mg/day in toddlers, 828.7 - 1505.7 mg/day in other children, 1002 - 2101.7 mg/day in adolescents, 1211.0 - 2079.7 mg/day in adults, 1256.3 - 2097.32 mg/day in the elderly and 1379.3 - 2205.0 mg/day in the very elderly. However, these results assumed that everyone in the population was a consumer of these fortified foods, as the assessment did not take into account market share (which was in the range of 3-8%), so do not reflect the average habitual population-level intakes of EPA/DHA omega-3 oils. If market share was taken into account in the exposure assessment, the intakes of EPA + DHA (and therefore the calculated levels of EPA/DHA omega-3 oils) from these staple food categories per population group would be much lower. While the detailed exposure assessment in the 2012 GOED report is a useful source of data to indicate potential intake of LCPUFA from fortified uses (GOED, 2012), the value of these results is limited in the present task as these did not account for much market share (which is only 3-8% for the main food groups fortified with EPA/DHA), and therefore do not present a realistic estimate of intake.

Based on information collected by GOED on the volume of EPA/DHA omega-3 oils used for various industries in the EU (see Table 1 above), it is reported that 82.5% is used in food supplements, and 5.7% used in food and beverages (excluding medical foods and infant formula). Using these values and the median intake ranges of EPA/DHA omega-3 oils observed from the survey for food supplement products on the market in Europe (i.e. Ireland and the UK, and 800 mg/day for adults), the estimated intake of EPA/DHA omega-3 oils in EU adults from fortified foods and beverages is calculated at approximately 55 mg/day. This is considerably lower than the values estimated from fortified uses as presented in the paragraph above, due to this being a population-level estimate of intake.

5. Intakes of EPA/DHA omega-3 oils from infant formula and follow-on formula

Based on the volume of EPA/DHA omega-3 oils used in the EU in infant formula (5.8%; Table 1), the intake of EPA/DHA omega-3 oils in infant formula could also be expected to be in the region of 55 mg/day for infants and young children in the EU. However, to review the intake of EPA/DHA omega-3 oils in infants and young children who exclusively consume an infant formula or a follow-on formula containing EPA/DHA omega-3 oils as a source of DHA, levels stipulated by Commission Delegated Regulation (EU) 2016/127⁷ regarding specific compositional and information requirements for infant formula and follow-on formula were used. DHA (typically sourced from fish or algal sources) must be present in infant and follow-on formula at a level of 20-50 mg per 100 kcal (4.8 – 12 kJ /100 ml). Infant and follow-on formula needs to provide 60-70 kcal per 100 ml (250 – 293 kJ/100 ml).

A high consumption of infant formula has been estimated to be 260 mL/kg bw per day for infants aged 0–16 weeks (EFSA Scientific Committee, 2017)⁸. For infants up to 12 months of age, with an average weight of 5 kg (EFSA, 2012), this would lead to an intake of 1,300 ml infant formula per day. Based on the required DHA content, this would provide an intake of 156 – 455 mg DHA per day. If a refined fish oil used in infant and follow-on formula contains 22% EPA+DHA (data provided by GOED⁹), this would indicate that the amount of fish/marine oil which was used as an ingredient in the infant formula as the sole source of DHA would be consumed by the infant in the region of 709 – 2,068 mg per day.

6. Estimates of intake of EPA/DHA omega-3 oils calculated from EPA/DHA consumption

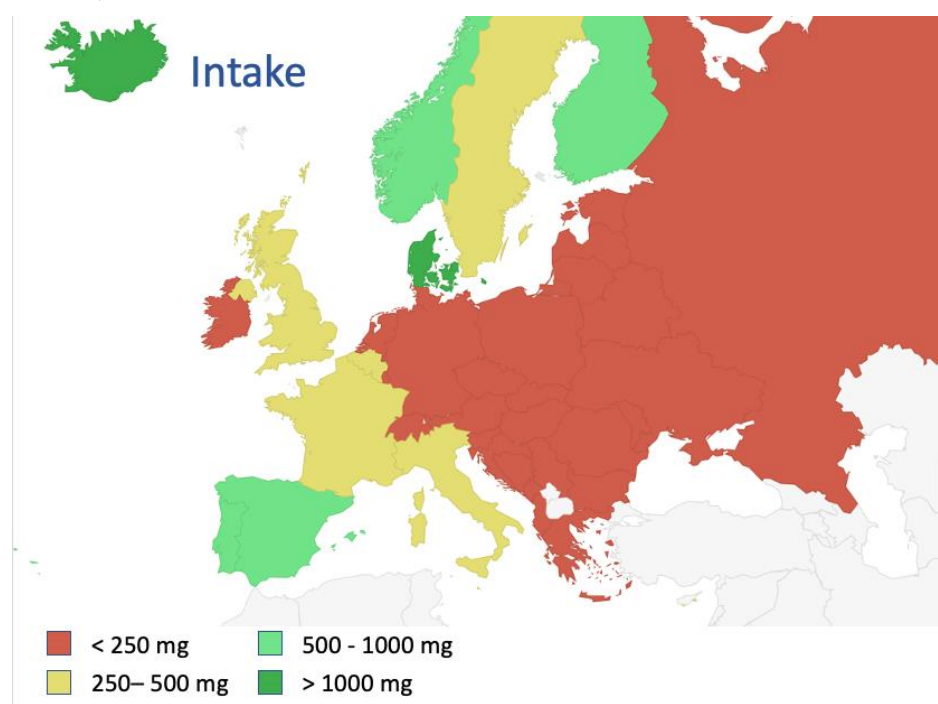
Estimates of the ranges of EPA/DHA omega-3 intake (expressed in mg per person per day) by country as compiled by GOED are shown in Figure 1. Please note that these data include EPA/DHA omega-3 intake derived from both fish consumption and from food supplements and fortified foods. Therefore, Spain and Portugal, which are countries that use few supplements but who have a high proportion of oily fish consumers for products such as sardines, have relatively high EPA/DHA omega-3 intakes.

⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02016R0127-20220401>

⁸ High infant formula consumption per body weight is derived from 95th percentile consumption and the first weeks of life is the time of the highest relative consumption on a body weight basis. Therefore, when performing an exposure assessment, EFSA proposes to use the highest consumption figures reported for the period of 14–27 days of life (i.e. 260 mL/kg bw per day).

⁹ In Europe, this is mostly (88%) tuna oil, the rest is algae. For a more straightforward approach we can assume this is all tuna, and tuna contains approximately 22% DHA, so this value can be used.

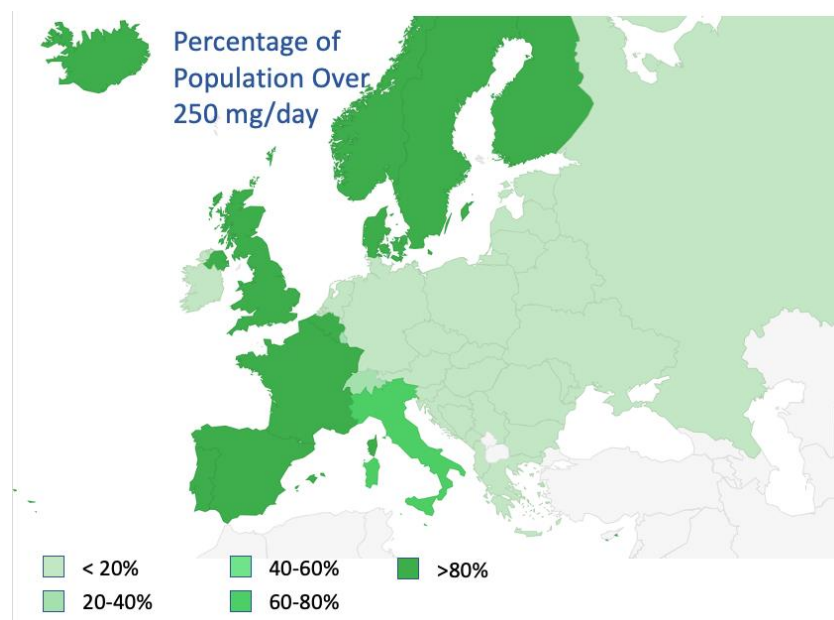
Figure 1. Ranges of EPA+DHA omega-3 intakes in Europe (data compiled and provided by GOED)



The review of data from the Global Burden of Disease project shows the percentage of the population in each EU country that has an intake of over 250 mg EPA + DHA per day, which is the value at the lower end of the range generally provided in national dietary intake recommendations for omega-3 fatty acids (generally in the range of 250 – 500 mg/day¹⁰) (Figure 2). Please note that the data illustrated in Figure 2 also contains data from the intake of fish and other types of seafood.

¹⁰ Adult recommendations coming from countries/societies/medical associations generally recommend an intake in range of between 250 to 500 mg/day. In this Figure, the value of 250 mg/day was used as a cut-off. The Global Burden of Disease project measures whether people are taking “enough” EPA+DHA. Their cut-off (the level below which they determined the risk of ischemic heart disease increases) is 250 mg/day.

Figure 2. Percentage of the population in European countries with an EPA+DHA intake of greater than 250 mg/day



From the estimated intake of EPA+DHA omega-3s from fish and food supplements as shown in Figures 1 and 2, it can be considered that many countries in the EU have an intake of less than 250 mg EPA+DHA per day, with very few countries having an intake of greater than 1000 mg EPA+DHA per day (i.e. Denmark)¹¹.

It is possible to estimate the intake of EPA/DHA omega-3 oils from the EPA+DHA intake given that the average content of EPA+DHA is about 30% in food supplements. For the range of 250 mg to 1000 mg EPA+DHA per day, this would broadly equate to the range of 833 mg/day to 3333 mg/day EPA/DHA omega-3 oils. Please note that the data used in ranges of EPA+DHA also take into account the intake from fish, however these ranges overlap with the ranges of intake estimated from the review of food supplements in the UK and Ireland.

Summary of Findings

As discussed in this report, EPA/DHA omega-3 oils are used as an ingredient in food supplements and also in certain foods as an added source of EPA and DHA. Estimating intakes of EPA/DHA omega-3 oils by EU consumers therefore needs to consider potential intakes from both food supplements and from fortified foods. In infants, the intake of EPA/DHA omega-3 oils from infant and follow-on formula also needs to be considered, as this is the major source of omega-3 oils (specifically DHA) in this population group.

Based on the knowledge that food supplements are the major source of EPA/DHA omega-3 oils for European consumers, we have reviewed the range of total EPA/DHA omega-3 oils in

¹¹ In the countries which have intakes >1000 mg/day, this may be largely due to omega-3 intake from fish rather than from food supplements. Oily fish intake in Denmark for example is quite high compared to other countries in Europe (Patel *et al.*, 2012).

these products that are available for consumers in the EU. Furthermore, based on the data provided by GOED on the other sectors of the food industry where EPA/DHA omega-3 oils are used, some assumptions can be made on the likely intake of EPA/DHA omega-3 oils from foods and beverages. And finally, based on the regulatory controls on infant and follow-on formula sold in the EU, the potential intake of EPA/DHA omega-3 oils in infants who consume these formulae was calculated.

The summary results for the estimated intake of EPA/DHA omega-3 oils in EU population groups as described in this report are summarised and provided in Table 4. These intake estimates are based on users of food supplements and fortified foods and are not an average for the entire EU population. Based on the compilation of estimated total intake of EPA/DHA omega-3 oils, the most likely or typical intakes are in the region of 0.86 g per day for most population groups (825 – 855 mg/day), and 1.79 g per day for infants (who are fed with a DHA-fortified infant / follow-on formula). There is also the potential of intakes in the range of up to 5.5 g of EPA/DHA omega-3 oils/day in adults. This represents a very unlikely scenario, as the intake of food supplements containing 5.5 g fish oil are only recommended for special groups with heart / blood pressure issues. Therefore, we recommend referring to the ‘typical’ intake results when consulting this summary table.

Table 4. Estimates of intake of EPA/DHA omega-3 oils from food supplements, fortified foods and infant formula in the EU

Population group	Estimated intake of EPA/DHA omega-3 oils in the EU (mg/day)					
	Food supplements		Fortified Foods & beverages		Total intake	
	Range ¹	Median	Range ²	Typical ³	Range	Typical
Infants	400	400	709 – 2068	1390	1109 - 2468	1790
Children	400 - 2500	800	nc	55	400 - 2500	855
Adolescents	540 - 1906	770	nc	55	540 - 1906	825
Adults	333 - 5500	800	nc	55	333 - 5500	855

nc: not calculated.

¹ Range of concentration of fish/marine oil in omega-3 food supplements available on the UK and Irish market (source of data: <https://www.hollandandbarrett.ie/>)

² A range of EPA/DHA omega-3 oil intakes derived from the addition to foods and beverages was estimated using data from the 2012 GOED report (GOED, 2012). The results are very conservative as they do not account for market share data or brand loyalty and are therefore not presented in this table. For infants, the value is the range likely present in infant and follow-on formula.

³ For fortified foods & beverages, the ‘typical’ value for each population group is calculated based on estimated use of EPA/DHA omega-3 oils for human consumption in Europe (data provided by GOED – Table 1); use of EPA/DHA omega-3 oils for food supplements = 82.5%; use in fortified foods & beverages = 5.7%; For infants, this typical value is the average intake of EPA/DHA omega-3 oils calculated from their likely intake from infant and follow-on formula.

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Appendix I

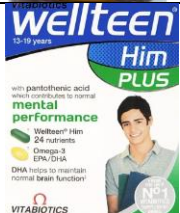
Survey of Fish/marine oil and omega-3 oil-containing food supplements from Holland and Barrett sold in the UK and Ireland

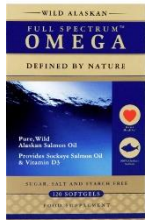
Appendix I

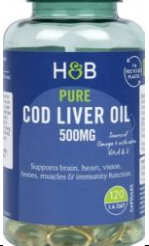
Survey of Fish/marine oil and omega-3 oil-containing food supplements from Holland and Barrett sold in the UK and Ireland

Survey conducted December 2022

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Infants								
Nature's Aid DHA Drops Lemon 50 ml		1 ml	500	100	350	NS	Infants and children 3 m - 5 y	
Children								
Holland and Barrett Kids Omega 3 60 Chewy Capsules		2 capsules	400	36	168	240	Children >3 y	
Equazen Eye Q Family 60 Capsules		2 capsules (or 6 capsules for first 12 weeks when starting or after a long break)	800 (2 capsules) – 2400 (6 capsules)	186 - 558	58 - 174	NS	5+ y	Brain Health

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Adolescents								
Paradox Omega 3 6 & 9 60 Capsules 1000mg		1-2 capsules	1000 (1 capsule) – 2000 (2 capsules)	250 - 500 EPA + DHA		300 - 600	12+ y	
Holland & Barrett Teen Brain Health With Omega 60 Softgel Capsule		2 capsules	1906	170	800	1142	Adolescents 13+ y	
Vitabiotics Wellteen Him Plus 56 Tablets		1 capsule	540	180	120	540	Adolescents: Male	
Vitabiotics Wellteen Her Plus 56 Tablet		1 capsule	540	180	120	540	Adolescents: Female	

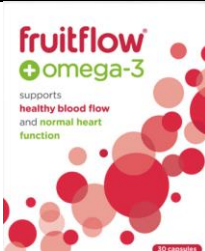
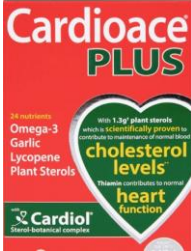
Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Adults								
Holland & Barrett Omega 3 Fish Oil + D3 1200 mg 120 Capsules		1 capsule	1200	378	286	664	Adults	
Holland & Barrett Pure Cod Liver Oil 1000 mg 240 Capsules		1 capsule	1000	80	90	170	Adults	
Holland & Barrett Pure Cod Liver Oil & Multivitamins 500 mg 180 Capsules		1 capsule	500	40	50	100	Adults	
Solgar Wild Alaskan Full Spectrum Omega 120 Softgels		2 capsules	2400	202	180	500	Adults	

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Solgar Omega 3-6-9 Fish, Flax, Borage 60 Softgels		3 capsules	2600	688	442	2300	Adults	
Solgar Fish Gel Omega-3 740 mg 50 Softgel Capsules		1 capsule	1350	405	270	742.5	Adults	
Holland & Barrett Omega 3 & Garlic 120 Softgel Capsules		3 capsules	3000	540	360	1050	Adults	
Holland & Barrett Pure Cod Liver Oil 500 mg 120 Capsules		1 capsule	500	NS	NS	NS	Adults	

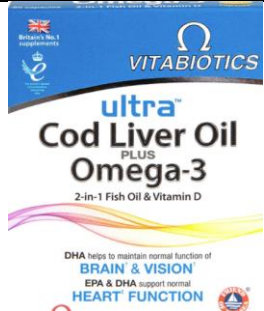
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			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Holland & Barrett Enteric Coated Omega 3 Fish Oil 60 Capsules 500mg		3 capsules	1500	495	330	825	Adults	
Bioglan Super Fish Oil 100 Capsules		1-2 capsules	556 (1 capsule) – 1112 (2 capsules)	NS	NS	NS	Adults	
Holland & Barrett Pure Cod Liver Oil & Turmeric 500 mg 60 Capsules		2 capsules	1000	80	100	180	Adults	

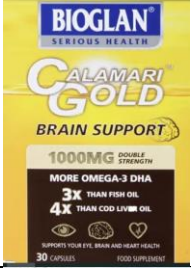
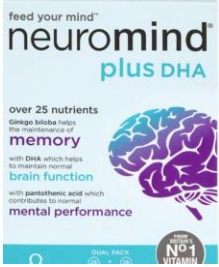
Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Neubria Krill Oil Omega - 3 60 Capsules		1-2 capsules	500 (1 capsule) – 1000 (2 capsules) (Krill Oil)	62.5 / 125	333 / 66	121 - 241	Adults	
Holland & Barrett Pure Cod Liver Oil & Multivitamins 500 mg 60 Capsules		1 capsule	500	40	50	100	Adults	
Holland & Barrett Pure Cod Liver Oil & Glucosamine 500 mg 60 Capsules		1 capsule	500	41	41	110	Adults	
Holland & Barrett Pure Cod Liver Oil with Evening Primrose Oil 500 mg 120 Capsules		1 capsule	500	NS	NS	120	Adults	

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Holland & Barrett Pescatarian Cod Liver Oil 1000 mg 120 Capsules		1 capsule	1000	80	80	215	Adults Pescatarians	
Holland & Barrett Omega 3 Fish Oil 1000 mg 240 Capsules		1 capsule	1000	180	120	350	Adults	Heart Health
Holland & Barrett Omega 3 Fish Oil 1200 mg 120 Capsules		3 capsules	3600	648	432	1080	Adults	Heart Health
Holland & Barrett Omega 3 Fish Oil 1500 mg 240 Capsules		1 capsule	1500	225	150	435	Adults	Heart Health

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
H&B Expert Triple Action Heart Support 60 Capsules & Tablets		1 capsule	1000	NS	NS	NS	Adults	Heart Health – Heart support
Provexis Fruitflow + Omega 3 30 Capsules		1 capsule	500	150	100	NS	Adults	Heart Health – healthy blood flow and normal heart function
Vitabiotics Cardioace Plus 60 Capsules		2-3 capsules	333 (2 capsules) – 500 (3 capsules)	NS	NS	333 - 500	Adults	Heart Health – normal cholesterol levels and heart function
Bioglan Red Krill Oil Advanced Omega-3 30 Capsules		4 capsules	800 (fish oil) 1340 (krill oil)	368	208	NS	Adults	Heart, Brain, Vision

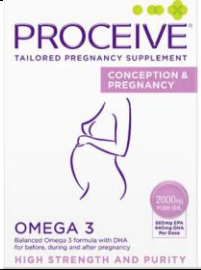
Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Bioglan Red Krill Oil 1000mg Max Strength 30 Capsules		1 capsule	1000 (Krill Oil)	132	70	NS	Adults	Heart, Brain, Vision
Bioglan Red Krill Oil 500mg Extra Strength 30 Capsules		1 capsule	5500 (Krill Oil)	60	27.5	NS	Adults	Heart, Brain, Vision
Holland & Barrett Omega 3 Triple Strength Fish Oil 60 Capsules 1360 mg		1 capsule	1360	680	270	950	Adults	Heart, Brain, Vision
Vitabiotics Ultra Omega-3 60 Capsules		2 capsules	1082	330	232	NS	Adults	Heart, Brain, Vision

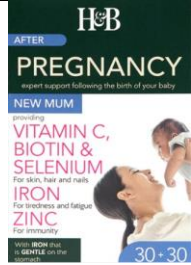
Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Vitabiotics Ultra Omega 369 Formula 60 Capsules		1-2 capsules	400 (1 capsule) – 800 (2 capsules)	NS	NS	185-370	Adults	Heart, Brain, Vision
Vitabiotics Ultra Cod Liver Oil 60 Capsules		1-2 capsules	270 (1 capsule) – 540 (2 capsules)	58 / 116	53 / 106	540	Adults	Heart, Brain, Vision
Bioglan Calamari Gold 500mg 30 Capsules		1 capsule	500 (Squid Oil)	NS	200	NS	Adults	Brain Health

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Bioglan Calamari Gold 1000mg 30 Capsules		1 capsule	1000 (Squid Oil)	NS	400	NS	Adults	Brain Health
Vitabiotics Neuromind Plus 56 Tablets		1 capsule	541	165	116	541	Adults	Brain Health – memory, normal brain function and mental performance
Bioglan Blood Pressure Formula 60 Capsules		2 capsules	473	166	118	473	Adults	Blood pressure
Vitabiotics Jointace Max Tablets Triple Pack Super Strength 84 Tablets		1 capsule	541	165	116	541	Adults	Joint Health

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Vitabiotics Jointace 30 Capsules		2 capsules	400	NS	NS	400	Adults	Joint Health
H&B Expert Multi Action Joint Support 30 Capsules		1 capsule	1000	180	120	300	Adults	Joint Health
Vitabiotics Diabetone Plus Omega 3 56 Tablets		1 capsule	541	179	119	541	Adults	Blood glucose – normal blood glucose levels
Vitabiotics Perfectil Max 84 Capsules		1 capsule	300	150	30	300	Adults	Skin, Hair, Nails

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Vitabiotics Perfectil Plus Skin Extra Support Tablets 56 Tablets		1 capsule	300	30	150	300	Adults	Skin, Hair, Nails
Adults – Women only								
Health & Her Omega 90 Softgels		3 capsules	Algae Oil - 500	250 EPA + DHA		NS	Adults: Women	
Vitabiotics Wellwoman Max 84 Tablets		1 capsule	400	NS	NS	185	Adults: Women	
Vitabiotics Pregnacare Max 84 Capsules		1 capsule	600	60	300	600	Pregnancy	

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
PROCEIVE® Omega 3 60 Capsules		2 capsules	2000	660	440	1100	Conception, Pregnancy	
Holland & Barrett Pregnancy Complete 30 Tablets + 30 Capsules		1 capsule	1000	330	220	550	Pregnancy	
Vitabiotics Pregnacare Breastfeeding 84 Tablets		1 capsule	600	300	60	600	Post-partum, lactation	
Holland & Barrett Breastfeeding Support 30 Tablets & 30 Capsules		1 capsule	500	165	110	275	Post-partum, lactation	

Product	Image	Recommended Daily Intake	mg/daily dose				Target Population	Health claims
			Fish / Marine Oil	EPA	DHA	Total Omega-3 Fatty Acids		
Holland & Barrett New Mum 30 Tablets + 30 Capsules 1 Month Supply		1 capsule	500	165	110	275	Women Post-Partum	
Adults – Men only								
Vitabiotics Wellman Plus Omega 3 Tablets		1 capsule	400	NS	NS	185	Adults: Men	

