

n-3 docosapentaenoic acid (DPA) intake and relationship to plasma long-chain n-3 fatty acid concentrations in the United States: NHANES 2003-2014

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Abbreviations: AHA, American Heart Association; CVD, cardiovascular disease; DHA, docosahexaenoic acid; DPA, docosapentaenoic acid; EPA, eicosapentaenoic acid; DGA, Dietary Guidelines for Americans; NHANES, National Health and Nutrition Examination Survey; WWEIA, What We Eat In America

1 **Abstract**

2 The long-chain n-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)
3 play a crucial role in health, but previous National Health and Nutrition Examination Survey
4 (NHANES) analyses have shown that EPA and DHA intake in the United States is far below
5 recommendations (~250-500 mg/d EPA+DHA). Less is known about docosapentaenoic acid
6 (DPA), the metabolic intermediate of EPA and DHA; however, evidence suggests DPA may be
7 an important contributor to long-chain n-3 fatty acid intake and impart unique benefits. We used
8 NHANES 2003-2014 data (n = 45,347) to assess DPA intake and plasma concentrations, as
9 well as the relationship between intake and plasma concentrations of EPA, DPA, and DHA.
10 Mean DPA intake was 22.3 ± 0.8 mg/d from 2013-2014, and increased significantly over time (p
11 < 0.001), with the lowest values from 2003-2004 (16.2 ± 1.2 mg/d). DPA intake was higher in
12 adults (20-55 y) and seniors (55+ y) compared to younger individuals. In regression analyses,
13 DPA intake was a significant predictor of plasma EPA ($\beta = 138.5$; $p < 0.001$) and DHA ($\beta =$
14 318.9 ; $p < 0.001$). Plasma DPA was predicted by EPA and DHA intake ($\beta = 13.15$; $p = 0.001$
15 and $\beta = 7.4$; $p = 0.002$), but not dietary DPA ($p = 0.3$). This indicates that DPA intake is not a
16 good marker of plasma DPA status (or vice versa), and further research is needed to
17 understand factors that affect the interconversion of EPA and DPA. These findings have
18 implications for future long-chain omega-3 fatty acids dietary recommendations.

19 Introduction

20 Long-chain n-3 fatty acids play a crucial biological role in health [1]. Regular intake of
21 fish/seafood (providing ~250-500 mg/d of eicosapentaenoic acid [EPA] and docosahexaenoic
22 acid [DHA]) is recommended by the American Heart Association (AHA) [2, 3], Academy of
23 Nutrition and Dietetics [4], and in the 2015-2020 Dietary Guidelines for Americans (DGA)[5] to
24 promote health and reduce the risk of cardiovascular disease (CVD) in the general population.
25 Much less is known about docosapentaenoic acid (DPA), the metabolic intermediate of EPA
26 and DHA. However, existing evidence suggests that DPA may also contribute to the health
27 benefits attributed to EPA and DHA [6-8]. Based on these potential health benefits, it is
28 important to assess the usual DPA intake of the US population compared to habitual EPA and
29 DHA intakes.

30 The majority of the population in the United States (US) consumes far less than the
31 recommended amount of EPA and DHA [9-12]. For instance, an analysis of National Health
32 and Nutrition Examination Survey (NHANES) data (2003-2008) found that in US adults the
33 mean intake of EPA and DHA from foods was 20 mg/d and 60 mg/d, and 40 mg/d and 70 mg/d
34 when accounting for foods plus supplements [9]. We previously reported that the mean total n-3
35 fatty acid intake (including EPA, DHA, and EPA-equivalents accounting for potential conversion
36 of alpha-linolenic acid and stearidonic acid) was 170 mg/d (NHANES 2003-2008) [10]. Even
37 when accounting for the potential endogenous, albeit limited, conversion of shorter chain plant-
38 based n-3 fatty acids, over 90% of the study population (n = 24,621) consumed less than the
39 recommended ~500 mg/d [10]. A recent analysis that included the most current NHANES cycles
40 (2003-2014) also found similarly inadequate EPA and DHA intake [13].

41 Much less is known about DPA consumption. A small number of studies in Australia [14-
42 16], France [17], the UK [18], Japan [19, 20], Norway [21], the Netherlands [22], and Belgium
43 [23] have reported estimated mean DPA intake, with values ranging from 10 – 106 mg/d. These

44 analyses indicate that DPA may contribute an appreciable proportion of total long-chain n-3 fatty
45 acid intake, depending on the population. For instance, in an analysis of the Australian 1995
46 National Nutrition Survey (n = 13,858) median DPA intake (40 mg/d and 60 mg/d for women
47 and men, respectively) accounted for 29% of the mean total long-chain n-3 fatty acid intake [14,
48 24]. With regard to the US, DPA intake has been reported as part of What We Eat in America
49 (WWEIA) since NHANES 1999-2000, with 10 mg/d reported for 1999-2000 (n = 8,604) and 20
50 mg/d for each of the subsequent cycles in men and women 2 years and older [25-32]. However,
51 these reports have been limited to mean intakes rather than deciles, and to our knowledge, no
52 comprehensive analysis of DPA intake over this period has been published, particularly for
53 specific age, sex, and race/ethnicity subgroups. Additionally, little is known about the
54 relationship between dietary DPA intake and plasma concentrations of EPA, DPA, and DHA.

55 The objective of the current analysis was to provide an updated and comprehensive
56 assessment of DPA intake in the US using data from NHANES 2003-2014, as well as to
57 compare this to EPA and DHA intake using the most recent data. Long-chain n-3 fatty acid
58 intake (EPA, DPA, DHA, EPA+DHA, and EPA+DPA+DHA) from foods was analyzed for the
59 total US population, and by age, sex, and race/ethnicity subgroups. We also evaluated the
60 relationship between self-reported dietary intake and plasma concentrations of each fatty acid.

61 **Methods**

62 Six cycles of the National Health and Nutritional Examination Survey (NHANES; 2003-
63 2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012, and 2013-2014) were used for the
64 analysis. NHANES is a cross-sectional survey conducted by the National Center for Health
65 Statistics (NCHS), under the Centers for Disease Control and Prevention, using a complex
66 multistage probability sample that is designed to be representative of the national civilian US
67 population [33]. Sampling weights were adjusted to account for multiple cycles. Males and
68 females aged 1 year or older were included. Adult men with kilocalorie intakes per day <800 or

69 >8000 were excluded. Similarly, adult women with kilocalorie intakes per day <600 or >6000
70 were excluded. Daily intake of eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA), and
71 docosahexaenoic acid (DHA) were calculated for the total US population and the following age
72 groups: infants (1 – 5 years [y]), children (6 – 11 y), adolescents (12 – 19 y), adults (20- 55 y)
73 and seniors (55+ y). Intake of n-3 fatty acids was reported as mg/d per 1000 kcal in order to
74 account for differences in caloric intake according to age. Each of the age groups were also
75 analyzed by sex. Intakes were also analyzed based on the following race/ethnicity groups:
76 Mexican Americans, Hispanics, Non-Hispanic whites, Non-Hispanic blacks, and Other (including
77 multi-racial). The combined sample included 45,347 individuals.

78 As part of the “What We Eat in America” (WWEIA) component of the NHANES
79 examination, trained dietary interviewers collected detailed information on all foods and
80 beverages consumed by respondents in the previous 24-hour time period (midnight to
81 midnight). A second dietary recall was administered by telephone 3 to 10 days after the first
82 dietary interview, but not on the same day of the week as the first interview. Average EPA, DPA,
83 and DHA was calculated based on these two dietary interviews. If an individual did not complete
84 the second dietary interview, data from only the first dietary interview was used. Using these
85 averages, EPA + DHA and EPA + DPA + DHA were then calculated. The sum of EPA + DHA
86 was considered missing only if both EPA and DHA were missing. Similarly, the sum EPA + DHA
87 + DPA was considered missing only if values for all three fatty acids were missing.

88 Participants were also asked if they had taken a dietary supplement in the past 30 days,
89 how long they had been taking it, how many days it was taken in the past 30 days, the amount
90 that was taken on those days, and the reason(s) that they were taking it. Label information such
91 as supplement name, manufacturer and/or distributor, serving size, form of serving size, and
92 ingredients were recorded for each supplement reported by participants. For each supplement,
93 the amount of EPA and DHA provided was obtained from the supplement label. When the EPA
94 and DHA content was not specified on the supplement label, the EPA and DHA content was

95 imputed based on the proportion of EPA and DHA in the n-3 fatty acid-containing ingredient
96 (i.e., 18% EPA and 12% DHA per 1 g of fish oil; 8% EPA and 10% DHA per 1 g of cod liver oil;
97 and 8% EPA and 12% DHA per 1 g of salmon oil). Supplements containing fish oil, cod liver oil,
98 salmon oil, krill oil, and DHA-only preparations were included in this analysis.

99 Fatty acid concentrations were measured in a subset of NHANES 2003-2004 plasma
100 samples (n = 1,845). Plasma samples were collected from adults ≥ 20 years of age following an
101 8 hour overnight fast. Fatty acid concentrations were quantified using a modified version of the
102 method described by Lagerstedt et al. [34]. In brief, a 100 μ L plasma sample was spiked with a
103 100 μ L mixture of 11 internal standards (fatty acids labeled with stable isotopes) to account for
104 recovery. Esterified fatty acids were hydrolyzed from lipids (e.g., triglycerides, phospholipids,
105 and cholesteryl esters) using sequential treatment with acid then base. Following base
106 hydrolysis, samples were re-acidified and total fatty acids were hexane-extracted from the
107 matrix along with internal standards. Extracts were derivatized with pentafluorobenzyl bromide
108 in the presence of triethylamine to form pentafluorobenzyl (PFB) esters and were reconstituted
109 in hexane. PFB-fatty acid derivatives were injected onto a capillary gas chromatographic column
110 to resolve individual *cis*-fatty acids of interest from other matrix constituents. Analytes were
111 detected using electron capture negative-ion mass spectrometry. For each fatty acid, recovery
112 was estimated and results were adjusted using the most appropriate isotopically-labeled internal
113 standard.

114 *Statistical Analysis*

115 All statistical analyses were performed using SAS (version 9.4; SAS Institute, Cary, NC).
116 Descriptive statistics and regression analyses were computed using SURVEYFREQ,
117 SURVEYMEANS, and SURVEYREG, which account for complex survey design and sampling
118 weight. The Rao-Scott chi-square test was used to assess the association between categorical
119 variables. Continuous variables were compared using a regression model (SURVEYREG). For
120 all tests, α was set at 0.05.

121 **Results**

122 The demographic characteristics of the NHANES participants included in the present analysis
123 are provided in **Table 1**.

124 *DPA intake in the US population*

125 The mean intake of EPA, DPA, DHA, EPA + DHA, and EPA + DPA + DHA is shown in **Figure**
126 **1**. The values for EPA and DHA intake are reproduced from Thompson et al. [13] in order to
127 compare those values to mean DPA intake. Mean DPA intake (19.0 ± 0.3 mg/d) was lower than
128 that of EPA (32.6 ± 1.0 mg/d) and DHA (64.4 ± 1.5 mg/d). Even when accounting for DPA
129 intake, total long-chain n-3 fatty acid intake (EPA+DPA+DHA; 106 ± 2.7 mg/d) was less than
130 half the estimated amount provided by consuming 8 oz/wk of fish/seafood (~250-500 mg/d).
131 Deciles of DPA intake for the total participant population and the subgroups of sex, age, and
132 race/ethnicity are presented in **Table 2**.

133 *Changes in n-3 fatty acid intake over time*

134 Intake of EPA, DPA, DHA, EPA+DHA, and EPA+DPA+DHA changed significantly over the 11
135 year period of data collection (main effect of time, $p < 0.01$; **Figure 2**). DPA intake increased
136 significantly in later NHANES cycles, with the lowest mean intake observed during the 2003-
137 2004 cycle (16.2 ± 1.2 mg/d). During the 2013-2014 cycle, mean intake increased significantly
138 to 22.3 ± 0.8 mg/d ($p < 0.0001$). Conversely, EPA intake decreased significantly from 2003-2008
139 to 2011-2014 ($p \leq 0.04$), and mean DHA intake decreased from 2005-2006 to 2011-2014 ($p <$
140 0.01). In the most recent NHANES cycle (2013-2014), mean DPA intake was 22.3 ± 0.8 mg/d,
141 whereas mean EPA and DHA intakes were 25.9 ± 1.6 mg/d and 56.2 ± 3.6 mg/d, respectively.

142 *DPA intake by age, sex, and race/ethnicity*

143 DPA intake was significantly higher in men compared to women when intake was reported as
144 mg/d (mean = 22.1 ± 0.4 mg/d vs. 16.1 ± 0.4 mg/d; $p < 0.001$), but this relationship was no
145 longer present when DPA intake was adjusted for kcal intake. When interpreted as mg/d of fatty
146 acid consumed per 1000 kcal, there was no significant difference between men and women for
147 either DPA intake ($p = 0.9$) or total intake of EPA+DPA+DHA ($p = 0.1$). However, DPA intake
148 was significantly different according to race/ethnicity and age (**Table 3**). With regard to
149 ethnicities, mean DPA intake was highest in the “Other” category (including Asian and multi-
150 racial; 24.5 ± 1.4 mg/d), followed by African Americans (24.2 ± 0.7 mg/d). Regardless of sex,
151 higher DPA intake was observed in adults (20-55 y) and seniors (55+ y) when compared to
152 younger age groups, even when total caloric intake was accounted for.

153 *Dietary intake and plasma fatty acid concentrations*

154 Mean plasma concentration of EPA, DPA, and DHA was 50.7 ± 1.7 $\mu\text{mol/L}$, 44.2 ± 0.7 $\mu\text{mol/L}$,
155 and 138.5 ± 4.0 $\mu\text{mol/L}$, respectively. Regression analyses demonstrated that plasma
156 concentrations of EPA and DHA were predicted by the dietary intake of those fatty acids (**Table**
157 **4**; $p < 0.001$). In contrast, DPA intake was a significant predictor of plasma EPA ($\beta = 139$; $p <$
158 0.001) and DHA ($\beta = 318.93$; $p < 0.001$), but not plasma DPA ($p = 0.3$). Plasma DPA was
159 predicted only by EPA and DHA intake ($\beta = 13.15$; $p = 0.001$ and $\beta = 7.4$; $p = 0.002$). There was
160 no significant relationship between the dietary intake of EPA, DPA, or DHA and the plasma
161 concentration of arachidonic acid ($p \geq 0.2$). The plasma concentrations of all three n-3 fatty
162 acids (EPA, DPA, and DHA) were significantly correlated with one another ($p < 0.0001$; data not
163 shown).

164 Discussion

165 This analysis of NHANES 2003-2014 data demonstrates that the average DPA intake in
166 the US is very low, as is that of EPA and DHA. Even when accounting for DPA intake, the total
167 daily long-chain n-3 fatty acid intake (defined as EPA + DPA + DHA) of the majority of the US
168 population is well below the ~250-500 mg/d amount estimated to be provided by the amount of
169 fish/seafood consumption recommended by the AHA [2] and the 2015-2020 DGA [5]. Similar to
170 previous findings for EPA and DHA in this population [13], DPA intake was lower in women and
171 younger age groups (< 19 y), even when adjusting for differences in caloric needs between age
172 groups. This pattern of DPA intake was also found in Norway [21] and similar trends have been
173 reported for EPA and DHA [9, 10, 13]. These differences may have implications for dietary
174 recommendations and should be further explored. Notably, DPA intake significantly increased
175 over time while EPA and DHA intake significantly declined. Consistent with existing evidence,
176 strong correlations were observed between dietary intake of EPA and DHA, and corresponding
177 plasma concentrations of these fatty acids. However, DPA plasma concentrations were
178 correlated only with EPA and DHA intake, not DPA intake.

179 Our findings about habitual DPA intake in the US may have important implications given
180 emerging evidence regarding the bioactive role and potential health effects of DPA [6, 8]. In
181 previous observational studies, plasma DPA has been inversely associated with total mortality
182 [35], nonfatal myocardial infarction [36], and incident CVD in some ethnic groups [37]. Lower
183 serum concentrations of DPA and DPA + DHA have also been associated with greater risk of
184 myocardial infarction [38] and acute coronary events [39], respectively. Furthermore, inverse
185 associations have been found for DPA and intermediate CVD risk factors, such as the
186 inflammatory marker C-reactive protein [7, 40, 41]. Pre-clinical evidence suggests that DPA
187 supplementation may have beneficial effects on triglycerides similar to those of EPA and DHA
188 [6, 42]. Additionally, an inverse association between red blood cell (RBC) DPA and triglyceride

189 concentrations has been documented [7, 43]. Seal oil—a relatively rich source of DPA—has
190 also been shown to reduce triglycerides in some populations [44]. Clinical DPA supplementation
191 studies are needed to clarify these potential biological effects, but existing evidence suggests
192 that the very low DPA intake (19 ± 0.3 mg/d) found in our analysis may have important
193 implications for health.

194 Relationships between dietary intake and plasma concentrations of EPA, DPA, and DHA
195 may provide insights into the metabolism of DPA and its potential health effects. In this analysis,
196 plasma EPA and DHA concentrations were both significantly predicted by the dietary intake of
197 these fatty acids, which is consistent with the strong correlation between dietary intake and
198 plasma concentrations found for EPA and DHA in prior studies [45, 46]. Conversely, plasma
199 DPA was significantly related to the dietary intake of EPA and DHA, but not DPA. Similar results
200 were found in the Nurses' Health Study [47] and a study of men in Japan [19]. However, in two
201 additional studies, dietary and plasma DPA levels were found to have a significant correlation in
202 female participants [19, 48], which may suggest a potential sex-related difference in these
203 associations. Because previous evidence has shown that DPA is metabolically active [6, 8], the
204 lack of association between dietary and plasma DPA may indicate that DPA is metabolized to
205 other compounds following consumption. For instance, DPA can be metabolized into a distinct
206 family of specialized pro-resolving mediators [49-52], which could deplete plasma DPA
207 concentrations. DPA may also serve as a biologic pool for EPA, as DPA supplementation has
208 been shown to increase EPA concentrations in both cell-based [53] and clinical studies [54]. In
209 the one clinical DPA supplementation study that has been conducted, DPA supplementation (8
210 g/d for 7 days) significantly increased the proportion of both DPA and EPA in plasma
211 phospholipids and triglyceride fractions [54]; however, it should be noted that this is a much
212 larger amount of DPA than is consumed by the general population and may result in different
213 blood concentrations than typical dietary intake levels. Additionally, supplementation with EPA
214 (and EPA+DHA) increases RBC and plasma DPA concentrations [44, 55-59], indicating

215 potential inter-convertibility between EPA and DPA. It has been suggested that plasma EPA is a
216 more readily available source of n-3 fatty acids than 22-carbon fatty acids, which that may be
217 preferentially stored in specific tissue compartments [36, 56, 60]. If plasma EPA that is
218 expended on cellular functions can be replenished with DPA, the health implications of this
219 warrant further study. Additional DPA supplementation studies are needed to assess the
220 potential relationship between dietary intake and blood concentrations, as well as aid in the
221 interpretation and clinical significance of any such correlations.

222 Compared to previous WWEIA reports of DPA intake, our results provide a more
223 comprehensive assessment of DPA intake over a 12-year period, and analysis of changes in
224 intake patterns over time. In NHANES 1999-2000, mean DPA intake was 10 ± 0.1 mg/d [25],
225 whereas we found that the average daily intake from 2003-2014 was 19 ± 0.3 mg/d . Within the
226 2003-2014 time period, DPA intake was significantly higher during 2009-2014 compared to
227 2003-2008 ($p \leq 0.02$). This is particularly notable given that EPA and DHA intakes significantly
228 decreased over the aforementioned time periods. This may be due in part to the different food
229 sources of EPA/DHA versus DPA. For instance, although fish/fish oil is the primary source of
230 EPA and DHA, it provides relatively little DPA (~2-5% by weight [61]). DPA is found in greater
231 concentrations amounts in red meat (e.g., beef and lamb) [24]. In Australia, Howe et al. found
232 that while the primary food sources of EPA and DHA were fish/seafood products, the primary
233 contributor to DPA intake was meat, poultry, and game (at 73%) [14]. We did not assess
234 changes in the intake of these food categories, but it is possible that the changes in EPA, DPA,
235 and DHA intake found in our analysis may reflect changes in food consumption patterns.

236 Analyses of DPA intake in other countries demonstrate distinct variations in intake and
237 provide valuable comparisons for our findings regarding US intake. Similarly low DPA intakes
238 were found in the Netherlands (10 mg/d) [22], Belgium (25.3 mg/d) [23], the UK (37.1 mg/d)
239 [18], Canada (40 mg/d for men and 30 mg/d for women) [48] and one study in Japan (10 mg/d)
240 [20]. However, it should be noted that much higher n-3 fatty acid intakes are typically found in

241 Japanese populations, which is consistent with the highest DPA intake (106 mg/d for men and
242 85 mg/d for women) reported by Kuriki et al. [19]. Higher intakes were also reported in France
243 (75 mg/d for men and 56 mg/d for women) [17], Norway (70 mg/d) [21], and Australia (71 mg/d)
244 [14]. In Japan, France, and Norway, this may be due to a higher intake of oily fish (and thus
245 higher EPA and DHA, as well). Higher DPA intake in Australia has been attributed to the
246 consumption of meat, poultry, and game—which accounted for 73% of DPA intake and 43% of
247 total long-chain n-3 fatty acid intake [14]. Although meat consumption is higher in the US than
248 Australia, the higher DPA intake in Australia is likely due in part to the predominance of grass-
249 fed beef, which contains a greater proportion of DPA [14, 62] compared to grain-fed beef in the
250 US. However, red meat may provide an alternative means of increasing DPA intake in the US
251 given the consistently low intake of oily fish by the majority of the US population [9]. Numerous
252 barriers may prevent individuals from following recommendations to regularly consume oily fish,
253 including: personal preferences (e.g., ethical or environmental concerns, aversion to eating
254 fish), unfamiliarity with seafood preparation and cooking methods, cost and/or availability in the
255 local food environment, food allergies, a vegetarian or vegan dietary pattern, concerns about
256 depleting fish stocks, and a perceived risk of pollutants. Red meat (e.g., beef and lamb) is the
257 richest terrestrial source of DPA and is consumed more frequently than oily fish in the US. This
258 may offer a potential means of increasing DPA intake in the US, but it should be noted that
259 DPA-rich grass-fed beef [62, 63] may not be widely available and/or is more costly in the US.
260 The potential benefits of increasing DPA intake via the consumption of red meat should be
261 weighed with the negative impacts of consuming higher-than-recommended quantities. Current
262 recommendations outlined by the US Department of Agriculture (USDA) Dietary Guidelines for
263 Americans advise that red meat consumption should not exceed 26 oz-equivalents/wk and that
264 saturated fat intake remain below 10% of total daily caloric intake [5].

265 Taken together, our results provide a key assessment of US DPA intake relative to that
266 of EPA and DHA, along with potential insights regarding the relationship between dietary intake

267 and plasma concentrations of EPA, DPA, and DHA. Similar to EPA and DHA intake, the general
268 US population consumes very little DPA. However, DPA intake significantly increased during the
269 2009-2014 period, whereas EPA and DHA intake significantly decreased. DPA intake differed
270 significantly according to age and race/ethnicity in this study population. Additional analyses are
271 needed to establish whether specific population subgroups may be more likely to have low
272 intakes. Clinical supplementation studies are needed, but there is increasing evidence to
273 suggest that DPA is a bioactive n-3 fatty acid with both independent and shared effects with
274 EPA and DHA on health outcomes. In conjunction with previous findings, the relationships
275 between dietary intake and plasma concentrations of EPA, DPA, and DHA in our analysis
276 provide insight into the metabolism of DPA and potential inter-conversion of these fatty acids.
277 Additional research is needed to further characterize DPA intake in the US and clarify potential
278 implications for health outcomes.

279 *Strengths and Limitations*

280 This assessment was conducted using a large, representative sample of the US
281 population and provides the first comprehensive assessment of DPA intake in the US.
282 Furthermore, we analyzed changes in n-3 consumption patterns over time using 12 years of
283 NHANES data. Age, sex, and race/ethnicity subgroups were also analyzed, but patterns of
284 intake in these subgroups may vary in different populations/countries. The 24-hour dietary recall
285 method is considered sufficient for accurately measuring mean dietary intake on the population
286 level as it produces less systematic error and is less likely to alter eating behavior (compared to
287 a Food Frequency Questionnaire), is less burdensome, relies only on short-term memory, and
288 can overcome random error associated with day-to-day fluctuations in intake if days of the week
289 are evenly represented in the data [64]. However, 24-hour recalls are not a reliable indicator of
290 an individual's habitual dietary intake (may miss days of fish consumption) and may be prone to
291 self-reporting bias (e.g., underreporting intake). Additionally, Howe et al. found substantial

292 underreporting of the DPA content of foods in Australia prior to using an updated fatty acid
293 composition database [14, 16]. Thus, the minimal DPA content in current USDA food
294 composition tables may reflect similarly imprecise fatty acid data or true differences in the n-3
295 fatty acid content of foods, such as grass-fed versus grain-fed beef [14]. However, if DPA intake
296 is being underreported due to imprecise fatty acid databases, it is unlikely that the magnitude of
297 this difference would substantially alter our primary finding that DPA intake (and total long-chain
298 n-3 fatty acid intake) in the US remains far below recommended values. NHANES does not
299 differentiate between the n-3 and n-6 forms of DPA; however, n-6 DPA content is much lower in
300 most tissues [6] and likely would not alter our findings if the DPA values reported in WWEIA
301 include both the n-3 and n-6 forms. Plasma fatty acid concentrations were only available from
302 one NHANES cycle (2003-2004) and additional analyses are needed to confirm the
303 relationships between dietary intake and plasma fatty acid concentrations observed in this
304 sample.

305 **Conflict of Interest**

306 The contents are solely the responsibility of the authors. All authors take responsibility for the
307 manuscript's final content. All of the authors have no conflicts of interest to declare.

References

1. Calder PC (2015) Marine omega-3 fatty acids and inflammatory processes: Effects, mechanisms and clinical relevance. *Biochim Biophys Acta* 1851: 469-484
2. Kris-Etherton PM, Harris WS, and Appel LJ (2002) Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation* 106: 2747-2757
3. Kris-Etherton PM, Harris WS, Appel LJ, and Committee AN (2003) Omega-3 fatty acids and cardiovascular disease new recommendations from the American Heart Association. *Arteriosclerosis, thrombosis, and vascular biology* 23: 151-152
4. Vannice G, and Rasmussen H (2014) Position of the academy of nutrition and dietetics: dietary fatty acids for healthy adults. *J Acad Nutr Diet* 114: 136-153
5. U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015-2020 Dietary Guidelines for Americans, 2015.
6. Kaur G, Cameron-Smith D, Garg M, and Sinclair AJ (2011) Docosapentaenoic acid (22:5n-3): a review of its biological effects. *Prog Lipid Res* 50: 28-34
7. Skulas-Ray A, Flock M, Richter C, Harris W, West S, and Kris-Etherton P (2015) Red Blood Cell Docosapentaenoic Acid (DPA n-3) is Inversely Associated with Triglycerides and C-reactive Protein (CRP) in Healthy Adults and Dose-Dependently Increases Following n-3 Fatty Acid Supplementation. *Nutrients* 7: 6390-6404
8. Kaur G, Guo XF, and Sinclair AJ (2016) Short update on docosapentaenoic acid: a bioactive long-chain n-3 fatty acid. *Curr Opin Clin Nutr Metab Care* 19: 88-91
9. Papanikolaou Y, Brooks J, Reider C, and Fulgoni VL, 3rd (2014) U.S. adults are not meeting recommended levels for fish and omega-3 fatty acid intake: results of an analysis using observational data from NHANES 2003-2008. *Nutr J* 13: 31
10. Richter CK, Bowen KJ, Mozaffarian D, Kris-Etherton PM, and Skulas-Ray AC (2017) Total Long-Chain n-3 Fatty Acid Intake and Food Sources in the United States Compared to Recommended Intakes: NHANES 2003–2008. *Lipids*
11. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food and Beverages: Mean Amounts Consumed per Individual, by Gender and Age, in What We Eat in America, NHANES 2011-2012/2014.
12. Zhang Z, Fulgoni VL, Kris-Etherton PM, and Mitmesser SH (2018) Dietary Intakes of EPA and DHA Omega-3 Fatty Acids among US Childbearing-Age and Pregnant Women: An Analysis of NHANES 2001-2014. *Nutrients* 10
13. Thompson M, Hein N, Hanson C, Smith LM, Anderson-Berry A, Richter CK, Stessy Bisselou K, Kusi Appiah A, Kris-Etherton P, Skulas-Ray AC, and Nordgren TM (2019) Omega-3 Fatty Acid Intake by Age, Gender, and Pregnancy Status in the United States: National Health and Nutrition Examination Survey 2003(-)2014. *Nutrients* 11
14. Howe P, Meyer B, Record S, and Baghurst K (2006) Dietary intake of long-chain omega-3 polyunsaturated fatty acids: contribution of meat sources. *Nutrition* 22: 47-53
15. Meyer BJ (2016) Australians are not Meeting the Recommended Intakes for Omega-3 Long Chain Polyunsaturated Fatty Acids: Results of an Analysis from the 2011-2012 National Nutrition and Physical Activity Survey. *Nutrients* 8: 111
16. Meyer BJ, Mann NJ, Lewis JL, Milligan GC, Sinclair AJ, and Howe PR (2003) Dietary intakes and food sources of omega-6 and omega-3 polyunsaturated fatty acids. *Lipids* 38: 391-398
17. Astorg P, Arnault N, Czernichow S, Noiset N, Galan P, and Hercberg S (2004) Dietary intakes and food sources of n-6 and n-3 PUFA in French adult men and women. *Lipids* 39: 527-535

18. Givens D, and Gibbs R (2006) Very long chain n-3 polyunsaturated fatty acids in the food chain in the UK and the potential of animal-derived foods to increase intake. *Nutrition Bulletin* 31: 104-110
19. Kuriki K, Nagaya T, Tokudome Y, Imaeda N, Fujiwara N, Sato J, Goto C, Ikeda M, Maki S, Tajima K, and Tokudome S (2003) Plasma concentrations of (n-3) highly unsaturated fatty acids are good biomarkers of relative dietary fatty acid intakes: a cross-sectional study. *The Journal of nutrition* 133: 3643-3650
20. Kobayashi M, Sasaki S, Kawabata T, Hasegawa K, and Tsugane S (2003) Validity of a self-administered food frequency questionnaire used in the 5-year follow-up survey of the JPHC Study Cohort I to assess fatty acid intake: comparison with dietary records and serum phospholipid level. *J Epidemiol* 13: S64-81
21. Johansson LR, Solvoll K, Bjorneboe GE, and Drevon CA (1998) Intake of very-long-chain n-3 fatty acids related to social status and lifestyle. *European journal of clinical nutrition* 52: 716-721
22. Otto SJ, van Houwelingen AC, Badart-Smook A, and Hornstra G (2001) Changes in the maternal essential fatty acid profile during early pregnancy and the relation of the profile to diet. *The American Journal of Clinical Nutrition* 73: 302-307
23. Sioen IA, Pynaert I, Matthys C, De Backer G, Van Camp J, and De Henauw S (2006) Dietary intakes and food sources of fatty acids for Belgian women, focused on n-6 and n-3 polyunsaturated fatty acids. *Lipids* 41: 415-422
24. Howe P, Buckley J, and Meyer B (2007) Long-chain omega-3 fatty acids in red meat. *Nutrition & Dietetics* 64: S135-S139
25. Ervin RB, Wright JD, Wang CY, and Kennedy-Stephenson J (2004) Dietary intake of fats and fatty acids for the United States population: 1999-2000. *Adv Data*: 1-6
26. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, One Day, 2001-2002, 2002.
27. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, One day, 2003-2004, 2004.
28. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, in the United States, 2005-2006, in *What We Eat in America, NHANES 2005-2006* 2006.
29. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, in the United States, 2007-2008, in *What We Eat in America, NHANES 2007-2008* 2008.
30. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, in the United States, 2009-2010, in *What We Eat in America, NHANES 2009-2010* 2010.
31. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, in the United States, 2011-2012, in *What We Eat in America, NHANES 2011-2012* 2012.
32. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, in the United States, 2013-2014, in *What We Eat in America, NHANES 2013-2014* 2014.
33. Zipf G, Chiappa M, Porter KS, Ostchega Y, Lewis BG, and Dostal J (2013) National health and nutrition examination survey: plan and operations, 1999-2010. *Vital Health Stat* 1: 1-37
34. Lagerstedt SA, Hinrichs DR, Batt SM, Magera MJ, Rinaldo P, and McConnell JP (2001) Quantitative determination of plasma c8-c26 total fatty acids for the biochemical diagnosis of nutritional and metabolic disorders. *Mol Genet Metab* 73: 38-45

35. Mozaffarian D, Lemaitre RN, King IB, Song X, Huang H, Sacks FM, Rimm EB, Wang M, and Siscovick DS (2013) Plasma phospholipid long-chain omega-3 fatty acids and total and cause-specific mortality in older adults: a cohort study. *Annals of internal medicine* 158: 515-525
36. Sun Q, Ma J, Campos H, Rexrode KM, Albert CM, Mozaffarian D, and Hu FB (2008) Blood concentrations of individual long-chain n-3 fatty acids and risk of nonfatal myocardial infarction. *The American Journal of Clinical Nutrition* 88: 216-223
37. de Oliveira Otto MC, Wu JH, Baylin A, Vaidya D, Rich SS, Tsai MY, Jacobs DR, Jr., and Mozaffarian D (2013) Circulating and dietary omega-3 and omega-6 polyunsaturated fatty acids and incidence of CVD in the Multi-Ethnic Study of Atherosclerosis. *J Am Heart Assoc* 2: e000506
38. Oda E, Hatada K, Katoh K, Kodama M, Nakamura Y, and Aizawa Y (2005) A case-control pilot study on n-3 polyunsaturated fatty acid as a negative risk factor for myocardial infarction. *Int Heart J* 46: 583-591
39. Rissanen T, Voutilainen S, Nyyssonen K, Lakka TA, and Salonen JT (2000) Fish oil-derived fatty acids, docosahexaenoic acid and docosapentaenoic acid, and the risk of acute coronary events: the Kuopio ischaemic heart disease risk factor study. *Circulation* 102: 2677-2679
40. Reinders I, Virtanen JK, Brouwer IA, and Tuomainen TP (2012) Association of serum n-3 polyunsaturated fatty acids with C-reactive protein in men. *Eur J Clin Nutr* 66: 736-741
41. Micallef MA, Munro IA, and Garg ML (2009) An inverse relationship between plasma n-3 fatty acids and C-reactive protein in healthy individuals. *Eur J Clin Nutr* 63: 1154-1156
42. Kaur G, Begg DP, Barr D, Garg M, Cameron-Smith D, and Sinclair AJ (2010) Short-term docosapentaenoic acid (22:5 n-3) supplementation increases tissue docosapentaenoic acid, DHA and EPA concentrations in rats. *Br J Nutr* 103: 32-37
43. Dai XW, Chen YM, Zeng FF, Sun LL, Chen CG, and Su YX (2016) Association between n-3 polyunsaturated fatty acids in erythrocytes and metabolic syndrome in Chinese men and women. *Eur J Nutr* 55: 981-989
44. Meyer BJ, Lane AE, and Mann NJ (2009) Comparison of seal oil to tuna oil on plasma lipid levels and blood pressure in hypertriglyceridaemic subjects. *Lipids* 44: 827-835
45. Baylin A, and Campos H (2006) The use of fatty acid biomarkers to reflect dietary intake. *Current opinion in lipidology* 17: 22-27
46. Harris WS (2008) The omega-3 index as a risk factor for coronary heart disease. *The American Journal of Clinical Nutrition* 87: 1997S-2002S
47. Sun Q, Ma J, Campos H, Hankinson SE, and Hu FB (2007) Comparison between plasma and erythrocyte fatty acid content as biomarkers of fatty acid intake in US women. *The American Journal of Clinical Nutrition* 86: 74-81
48. Garneau V, Rudkowska I, Paradis AM, Godin G, Julien P, Perusse L, and Vohl MC (2012) Omega-3 fatty acids status in human subjects estimated using a food frequency questionnaire and plasma phospholipids levels. *Nutr J* 11: 46
49. Dalli J, Colas RA, and Serhan CN (2013) Novel n-3 immunoresolvents: structures and actions. *Scientific reports* 3: 1-13
50. Weylandt KH (2016) Docosapentaenoic acid derived metabolites and mediators - The new world of lipid mediator medicine in a nutshell. *Eur J Pharmacol* 785: 108-115
51. Vik A, Dalli J, and Hansen TV (2017) Recent advances in the chemistry and biology of anti-inflammatory and specialized pro-resolving mediators biosynthesized from n-3 docosapentaenoic acid. *Bioorg Med Chem Lett* 27: 2259-2266
52. Markworth JF, Kaur G, Miller EG, Larsen AE, Sinclair AJ, Maddipati KR, and Cameron-Smith D (2016) Divergent shifts in lipid mediator profile following supplementation with n-3 docosapentaenoic acid and eicosapentaenoic acid. *Faseb J* 30: 3714-3725

53. Benistant C, Achard F, Ben Slama S, and Lagarde M (1996) Docosapentaenoic acid (22:5,n-3): metabolism and effect on prostacyclin production in endothelial cells. *Prostaglandins Leukot Essent Fatty Acids* 55: 287-292
54. Miller E, Kaur G, Larsen A, Loh SP, Linderborg K, Weisinger HS, Turchini GM, Cameron-Smith D, and Sinclair AJ (2013) A short-term n-3 DPA supplementation study in humans. *Eur J Nutr* 52: 895-904
55. Cao J, Schwichtenberg KA, Hanson NQ, and Tsai MY (2006) Incorporation and clearance of omega-3 fatty acids in erythrocyte membranes and plasma phospholipids. *Clin Chem* 52: 2265-2272
56. Katan MB, Deslypere JP, van Birgelen AP, Penders M, and Zegwaard M (1997) Kinetics of the incorporation of dietary fatty acids into serum cholesteryl esters, erythrocyte membranes, and adipose tissue: an 18-month controlled study. *J Lipid Res* 38: 2012-2022
57. Mori TA, Burke V, Puddey IB, Watts GF, O'Neal DN, Best JD, and Beilin LJ (2000) Purified eicosapentaenoic and docosahexaenoic acids have differential effects on serum lipids and lipoproteins, LDL particle size, glucose, and insulin in mildly hyperlipidemic men. *The American Journal of Clinical Nutrition* 71: 1085-1094
58. von Schacky C, and Weber PC (1985) Metabolism and effects on platelet function of the purified eicosapentaenoic and docosahexaenoic acids in humans. *J Clin Invest* 76: 2446-2450
59. Krul ES, Lemke SL, Mukherjea R, Taylor ML, Goldstein DA, Su H, Liu P, Lawless A, Harris WS, and Maki KC (2012) Effects of duration of treatment and dosage of eicosapentaenoic acid and stearidonic acid on red blood cell eicosapentaenoic acid content. *Prostaglandins Leukot Essent Fatty Acids* 86: 51-59
60. Brown AJ, Pang E, and Roberts DC (1991) Persistent changes in the fatty acid composition of erythrocyte membranes after moderate intake of n-3 polyunsaturated fatty acids: study design implications. *The American Journal of Clinical Nutrition* 54: 668-673
61. Byelashov OA, Sinclair AJ, and Kaur G (2015) Dietary sources, current intakes, and nutritional role of omega-3 docosapentaenoic acid. *Lipid Technol* 27: 79-82
62. Mann N, Ponnampalam E, Yep Y, and Sinclair A (2003) Feeding regimes affect fatty acid composition in Australian beef cattle. *Asia Pacific journal of clinical nutrition* 12
63. Droulez V, Williams P, Levy G, Stobaus T, and Sinclair A (2006) Composition of Australian red meat 2002. 2. Fatty acid profile.
64. Ahluwalia N, Dwyer J, Terry A, Moshfegh A, and Johnson C (2016) Update on NHANES Dietary Data: Focus on Collection, Release, Analytical Considerations, and Uses to Inform Public Policy. *Adv Nutr* 7: 121-134

Figure 1. Mean daily intake eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA), docosahexaenoic acid (DHA), EPA + DHA, and EPA + DPA + DHA in the total NHANES population (n = 45,347). Values are means with standards errors represented by vertical bars.

Figure 2. Change in n-3 fatty acid intake by NHANES data collection cycle, from 2003 to 2014. Values are means with standards errors represented by vertical bars.

Table 1. Characteristics of analyzed NHANES participants (n = 45,347)¹

	n	Mean (SE)
Age (y)	45347	37.2 (0.3) ³⁰⁸
Income (\$1K per month)	42415	2.9 (0.04) ³¹⁰
<i>Gender</i>		
Male (%)	22056	48.5 ³¹¹
Female (%)	23291	51.5
<i>Race</i>		
Mexican American (%)	9421	9.9 ³¹³
Hispanic (%)	3627	5.0
White (%)	18118	66.5 ³¹⁴
Black (%)	10600	12.1
Other (%)	3581	6.4 ³¹⁵
<i>Education</i>		
< High School (%)	19047	32.2 ³¹⁶
High School/GED (%)	6748	19.5 ³¹⁷
> High School (%)	14025	48.3
<i>Pregnant</i>		
Yes (%)	762	4.8
No (%)	8381	92.1 ³¹⁹
Do not know (%)	287	3.1 ³²⁰
<i>Age group</i>		
Infant (1-5) (%)	5495	6.9 ³²¹
Child (6-11) (%)	5550	8.3 ³²²
Adolescent (12-19) (%)	8186	11.5
Adult (20-55) (%)	15937	50.2 ³²³
Senior (56+) (%)	10179	23.1
		324

Table 2. Deciles of DPA intake in the total US population and by sex, age, and race/ethnicity subgroups.

	Mean	Median	Percentiles								
			10 th	20 th	30 th	40 th	50 th	60 th	70 th	80 th	90 th
Total population	19.0 ± 0.3	11.6 ± 0.2	0 ± 0.1	2.6 ± 0.2	5.6 ± 0.2	8.6 ± 0.2	11.6 ± 0.2	15.2 ± 0.2	19.6 ± 0.3	26.4 ± 0.4	40.1 ± 0.6
Sex											
Women	9.5 ± 0.2	9.9 ± 0.2	0 ± 0.1	2.3 ± 0.2	4.9 ± 0.2	7.4 ± 0.2	9.9 ± 0.2	12.9 ± 0.2	16.5 ± 0.2	21.8 ± 0.4	33.5 ± 0.7
Men	9.6 ± 0.2	14.1 ± 0.3	0 ± 0.1	3.1 ± 0.3	6.8 ± 0.3	10.3 ± 0.3	14.1 ± 0.3	18.2 ± 0.3	23.2 ± 0.3	31.3 ± 0.5	46.9 ± 1.1
Race/ethnicity											
Mexican-American	9.4 ± 0.3	12.2 ± 0.4	0 ± 0.2	3.6 ± 0.5	6.3 ± 0.4	9.2 ± 0.4	12.2 ± 0.4	15.2 ± 0.5	19.9 ± 0.6	26.7 ± 0.8	39.2 ± 1.1
Hispanic	11.4 ± 0.6	13.4 ± 0.5	1.0 ± 0.5	4.7 ± 0.5	7.5 ± 0.5	10.5 ± 0.5	13.4 ± 0.5	17.2 ± 0.5	21.7 ± 0.8	29.1 ± 1.2	45.5 ± 2.5
Caucasian	8.6 ± 0.2 ^a	10.6 ± 0.3	0 ± 0.1	1.9 ± 0.3	4.8 ± 0.3	7.7 ± 0.3	10.6 ± 0.3	14.1 ± 0.3	18.1 ± 0.3	24.2 ± 0.5	37.1 ± 0.9
African-American	11.6 ± 0.4	15.3 ± 0.4	0.8 ± 0.3	5.1 ± 0.3	8.4 ± 0.4	11.7 ± 0.3	15.3 ± 0.4	19.7 ± 0.4	24.9 ± 0.4	33.3 ± 0.6	49.4 ± 1.4
Other	12.9 ± 0.6	13.9 ± 0.6	0.3 ± 0.1	3.7 ± 0.5	6.9 ± 0.5	10.4 ± 0.6	13.9 ± 0.6	18.4 ± 0.7	24.2 ± 1.1	33.3 ± 1.4	51.2 ± 2.5
Age groups											
Infant (1-5 y)	5.3 ± 0.1	4.8 ± 0.2	0 ± 0.1	0.4 ± 0.1	1.8 ± 0.2	3.2 ± 0.2	4.8 ± 0.2	6.7 ± 0.3	8.6 ± 0.2	11.7 ± 0.4	16.9 ± 0.4
Child (6-11 y)	6.4 ± 0.1	8.3 ± 0.3	0 ± 0.1	1.1 ± 0.3	3.6 ± 0.3	5.8 ± 0.3	8.3 ± 0.3	10.7 ± 0.3	13.6 ± 0.4	17.6 ± 0.4	25.7 ± 0.8
Adolescent (12-19 y)	7.7 ± 0.2	10.5 ± 0.3	0 ± 0.1	2.0 ± 0.3	4.9 ± 0.3	7.7 ± 0.3	10.5 ± 0.3	13.6 ± 0.4	17.2 ± 0.4	22.5 ± 0.5	33.3 ± 0.8
Adult (20-55 y)	10.4 ± 0.2	14.1 ± 0.3	0 ± 0.1	3.9 ± 0.3	7.3 ± 0.2	10.5 ± 0.3	14.1 ± 0.3	18.0 ± 0.3	22.9 ± 0.3	30.9 ± 0.6	46.6 ± 1.1
Senior (55+ y)	11.0 ± 0.3	11.8 ± 0.3	0 ± 0.1	2.9 ± 0.3	6.0 ± 0.3	8.9 ± 0.3	11.8 ± 0.3	15.4 ± 0.4	19.4 ± 0.4	26.4 ± 0.6	41.7 ± 1.5

Table 3. Average intake of DPA and EPA+DPA+DHA by sex, race/ethnicity, and age group.^{1,2}

	DPA	EPA+DPA+DHA
Sex		
Female	9.5 ± 0.2	60.3 ± 1.8
Male	9.6 ± 0.2	57.4 ± 1.5
Race/ethnicity³		
Mexican-American	9.4 ± 0.3 ^a	53.1 ± 2.2 ^a
Hispanic	11.4 ± 0.6 ^a	67.9 ± 5.3 ^a
Caucasian	8.6 ± 0.2 ^a	53.5 ± 1.4 ^a
African-American	11.6 ± 0.4 ^b	70.5 ± 3.0 ^b
Other	12.9 ± 0.6 ^b	95.1 ± 6.5 ^b
Age group³		
Infant (1-5 y)	5.3 ± 0.1 ^a	28.4 ± 1.1 ^a
Child (6-11 y)	6.4 ± 0.1 ^{a,b}	32.3 ± 1.5 ^{a,b}
Adolescent (12-19 y)	7.7 ± 0.2 ^b	37.4 ± 1.5 ^b
Adult (20-55 y)	10.4 ± 0.2 ^c	63.7 ± 1.7 ^c
Senior (55+ y)	11.0 ± 0.3 ^c	77.6 ± 2.8 ^c

¹Different letters within the column indicate a significant difference between groups.

²Reported as mg of fatty acid intake per 1000 kcal per day to adjust for differences in caloric needs among age groups.

³p<0.001 for main effect of categorical variable on intake of DPA and EPA+DHA+DPA.

Table 4. Relationship between plasma fatty acid concentrations and self-reported dietary intake

	β Coefficient (SE)	R-Square	P-value
Plasma EPA (μmol/L)			
<i>Dietary EPA (mg/d)</i>	114 ± 26	8.9%	<0.001
<i>Dietary DPA (mg/d)</i>	139 ± 63	2.3%	<0.001
<i>Dietary DHA (mg/d)</i>	60 ± 19	6.8%	<0.001
Plasma DPA (μmol/L)			
<i>Dietary EPA (mg/d)</i>	13 ± 5	0.7%	0.001
<i>Dietary DPA (mg/d)</i>	9 ± 8	0.1%	0.3
<i>Dietary DHA (mg/d)</i>	7 ± 4	0.6%	0.002
Plasma DHA (μmol/L)			
<i>Dietary EPA (mg/d)</i>	212 ± 31	8.6%	<0.001
<i>Dietary DPA (mg/d)</i>	319 ± 104	3.4%	<0.001
<i>Dietary DHA (mg/d)</i>	122 ± 27	7.6%	<0.001
Plasma arachidonic acid (μmol/L)			
<i>Dietary EPA (mg/d)</i>	76 ± 54	0.1%	0.2
<i>Dietary DPA (mg/d)</i>	66 ± 101	0.1%	0.6
<i>Dietary DHA (mg/d)</i>	36 ± 24	0.1%	0.3