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Proceeding Paper

Polyunsaturated Fatty Acid Intake in Young Individuals Attending an English University †

Antonio Peña-Fernández [1,2,*], Edna Segura [3], María de los Ángeles Peña [4], Mark D. Evans [2] and Manuel Higueras [3]

1 Department of Surgery, Medical and Social Sciences, Faculty of Medicine and Health Sciences, University of Alcalá, Ctra. Madrid-Barcelona, Km. 33.600, 28871 Alcalá de Henares, Madrid, Spain
2 Leicester School of Allied Health Sciences, De Montfort University, Leicester LE1 9BH, UK; email1@email.com (M.D.E.)
3 Scientific Computation & Technological Innovation Center (SCoTIC), Universidad de La Rioja, Logroño, Spain; email2@email.com (E.S.); email3@email.com (M.H.)
4 Departamento de Ciencias Biomédicas, Universidad de Alcalá, Crta. Madrid-Barcelona Km, 33.6, 28871 Alcalá de Henares, Madrid, Spain; email4@email.com (M.d.l.Á.P.)
* Correspondence: antonio.penafer@uah.es
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Abstract: Omega-3 long-chain polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are poorly synthesised in the human body, and are substantially lower in Western diets compared with their shorter chain omega-3 essential fatty acid precursors α-linolenic acid (18:3n-3; ALA). We assessed their intake in 111 (20.45 yrs-old; 78 female) De Montfort University (DMU, England) students. The dietary intakes of total fat (100.55 vs. 81.72; p-value = 0.032), PUFA (14.61 vs. 12.91; NS), linoleic acid (LA; 3.893 vs. 2.787; p-value = 0.0019), ALA (0.925 vs. 0.613; p-value = 0.00008), arachidonic acid (AA; 0.109 vs. 0.082; p-value = 0.0303), EPA (0.088 vs. 0.075; NS), DHA (0.153 vs. 0.121; NS) and docosapentaenoic acid (DPA; 0.043 vs. 0.032 all in g/day; NS) were significantly higher or higher in male participants, respectively. The dietary intakes of DHA + EPA in the whole group monitored (0.130 + 0.079 = 0.209 g/day) was lower than the RDI of 0.5 g/day that considers the intake of one to two portions of fish per week. Our results highlight that some DMU students did not meet the nutritional goals for ALA, EPA and DHA. DMU students should specifically enhance the intake of oily fish (12.422, 13.406 and 10.054 g/day for the overall, female and male population, respectively), as these intakes only provide around 0.228, 0.246 and 0.184 g of DHA + EPA/day. Education would be required to aid increased awareness of the importance of consuming more fish in these young adults. Another option would be to encourage the intake of dietary fish oil supplements or the enrichment of food items largely consumed by young British adults with these long-chain PUFAs.

Keywords: essential fatty acids; EPA and DHA intakes; university students; ethnicity; Leicester

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1. Introduction

Omega-3 long-chain polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3), are poorly synthesised in the human body, and are considered as essential components of a healthy and balanced diet [1]. Thus, EPA and DHA have been associated with human homeostasis, healthy aging, and are important for appropriate foetal development and neural, retinal and immune system function. DHA is the principal omega-3 fatty acid in humans' cortical grey matter, so its intake is crucial in patients with dementia and other neurodegenerative disorders involving the progressive degeneration of the central and peripheral nervous systems [2].

However, the intake of EPA and DHA are substantially lower in Western diets compared with their shorter chain omega-3 essential fatty acid precursors α-linolenic acid (18:3n-3; ALA, $C_{18:3}$), although ALA does not provide the health benefits observed with the intake of EPA and DHA. ALA, and the omega-6 fatty acid linoleic acid (LA, $C_{18:2}$), are essential fatty acids that cannot be synthesised by humans, but can go through different elongation and desaturation steps to produce long chain PUFAs in the human body, including EPA and DHA, and docosapentaenoic acid (DPA, 22:5n3) and arachidonic acid (ARA, 20:4n−6), which also have important functions in the human body [3,4]. Thus, AA is as essential for brain development as DHA (Conway et al., 2021).

Moreover, high intake of the essential fatty acids ALA and LA has been associated with the pathogenesis of many inflammatory diseases [5].

Owing to the relevance of long chain PUFAs, the aim of our work was to assess the intake of total PUFAs, EPA, DHA, DPA, ARA and essential fatty acids in a young cohort of students attending De Montfort University (DMU), a British university located in the East Midlands, United Kingdom.

2. Material and Methods

Comprehensive nutrient intake was collected from 111 (20.45 ± 1.16 yrs-old; 78 female) DMU students between 2015–2016 from three different ethnic backgrounds (41 Asia, 41 Africa, 27 Europe), using a validated variant of the Nutrition Norfolk Food Frequency Questionnaire (FFQ; version 6, CAMB/PQ/6/1205) [6] with more than 130 food items. More information about the development of this FFQ has been briefly described in Peña-Fernández et al. [7,8].

Questionnaires were processed with Nutritics® software (v.5.7 Research Edition, Nutritics Ltd., Dublin, Ireland) as briefly described in Peña-Fernández et al. [8]. This nutritional software has been successfully used in similar studies previously [4,9]. Body mass index (BMI) was calculated as weight in kilograms divided by squared height in meters, using a digital scale (Tanita SC 330-S, London, UK), to identify underweight or obese individuals, depending on their ethnic background [10].

Statistical analyses were performed using the free software R-project, version 4.1.0 [11]. Significance scores were based on Kruskal-Wallis for nonparametric multiple comparisons; one-way analysis of variance with for normal multiple comparisons. For normality, Shapiro-Wilk test was used. Differences were considered statistically significant at *p*-values lower than 0.05.

3. Results and Discussion

The dietary intakes of total fat (100.55 vs. 81.72; *p*-value = 0.032), total polyunsaturated fatty acids (PUFA; 14.61 vs. 12.91; NS), linoleic acid (LA; 3.893 vs. 2.787; *p*-value = 0.0019), α-linolenic acid (ALA; 0.925 vs. 0.613; *p*-value = 0.00008), arachidonic acid (AA; 0.109 vs. 0.082; *p*-value = 0.0303), eicosapentaenoic acid (EPA; 0.088 vs. 0.075; NS), docosahexaenoic acid (DHA; 0.153 vs. 0.121; NS) and docosapentaenoic acid (DPA; 0.043 vs. 0.032 all in g/day; NS) were significantly higher or higher in male participants, respectively.

Our results could be explained by higher intakes of food items rich in long chain PUFAs [12,13]. Thus, male DMU students shown to eat higher/significantly higher intakes of food products rich in long chain PUFAs from **aquatic** [fish (72.656 vs. 53.907 g/day; *p*-value = 0.826) and seafood dishes (8.995 vs. 0.575 g/day; *p*-value = 0.149)], **animal** [meat (271.553 vs. 193.063 g/day; *p*-value = 0.016), eggs (17.625 vs. 16.998 g/day; *p*-value = 0.860), and cow milk (228.09 vs. 163.55; *p*-value = 0.037)] and **plant sources** [vegetable oils (1.094 vs. 0.955 g/day; *p*-value = 0.426)]. However, the consumption of oily fish (13.406 vs. 10.056 g/day; *p*-value = 0.857) and shellfish (12.842 vs. 10.826 g/day; *p*-value = 0.717) were higher in female counterparts, although without showing statistical differences, which in turn might explain that we have not observed differences in the intake of EPA and DHA in the monitored population.

The high intakes of LA and ALA versus EPA and DHA observed would be consistent with that reported in Western countries [13]. However, none of them presented statistical differences according to ethnic background or BMI, except for the intake of total fat (*p*-value = 0.0069) and PUFA (*p*-value = 0.0013), which were significantly higher in students from Asia and Europe. However, although without significance, the higher intakes of EPA and DHA were seen in Asian [values reported as mean and range (in g/day); 0.086 (0.005–0.498) and 0.144 (0.002–0.818)] and African [0.078 (0.0096–0.512) and 0.125 (0.011–0.723)] students versus European [0.068 (0.007–0.251) and 0.118 (0.013–0.402)], possibly due to differences in the diet between these individuals based on their different traditions.

3.1. Estimated Daily Intakes of EPA + DHA according to Sex and Ethnic Background

The dietary intakes of DHA plus EPA in the whole group monitored (0.130 + 0.079 = 0.209 g/day) met the recommended daily intake (RDI) of 0.2 g/day recommended by the UK's Department of Health, but was lower than the RDI of 0.5 g/day that considers the intake of one to two portions of fish per week [14]. The combined intake also did not meet the RDI of EPA + DHA of 0.45 g/day recommended by the Scientific Advisory Committee on Nutrition/Committee on Toxicity [14], and were below than the 0.25–2 g/day established by the Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) in 2008 [13].

However, the higher intakes of EPA + DHA in the monitored group than that reported in 19–24 years-old UK population (97 and 98 mg/day, in males and females, respectively) could be explained by the higher intake of fish observed (59.4) when compared with that reported in general UK adult population (31 g/day) [15]. Moreover, the intake of total fish was higher in Asian and European students than those reported in African participants (65.895, 63.899 vs. 49.972 g/day), although these differences were not statistically different. Further analysis will evaluate the potential contribution of poultry, milk and eggs to the intake of EPA and DHA in the monitored group for each ethnical background.

Finally, male and female participants (0.925 vs. 0.613 g/day, respectively) would not cover the adequate intake of ALA (1.6 and 1.1; g/day) established by the US National Institutes of Health [16].

3.2. Nutritional Recommendations

In order to meet the RDI of 0.5 g EPA + DHA per day, DMU students should specifically enhance the intake of oily fish, specially male counterparts (12.422, 13.406 and 10.054 g/day for the overall, female and male population, respectively), as they would provide around 0.228, 0.246 and 0.184 g/day of these two long-chain PUFAs, respectively. These intakes are calculated if we consider the estimation reported by Givens and Gibbs [14], which suggest that 50 g of oily fish per week can provide around 131 mg/day of EPA + DHA. Considering the characteristics of the population monitored, education would be needed to increase awareness of the importance of consuming more fish. This intervention would be more significant if introduced at younger ages in the British educational system, as reported previously [14].

The intake of oily fish ($r = 0.526$; p-value < 0.001), shellfish ($r = 0.574$; p-value < 0.001), meat ($r = 0.459$; p-value < 0.001), fruit ($r = 0.414$; p-value < 0.001) and grains ($r = 0.555$; p-value < 0.001), showed a significant and positive correlation with the intake of EPA in the monitored group, meanwhile the intake of oily fish (r = 0.473; p-value < 0.001), fish products (r = 0.387; p-value < 0.001), low fat fish (r = 0.414; p-value < 0.001), shellfish (r = 0.450; p-value < 0.001) and meat (r = 0.389; p-value < 0.001), were positively correlated with the intake of DHA. As a result, an enhancement in the intake of these food products will also contribute to meet the requirements indicated.

Another option would be to encourage the intake of dietary fish oil supplements in the studied group, although this may be challenging for students that are from low income backgrounds. Similarly, the enrichment of food items largely consumed by young British adults with long-chain PUFAs could be another option to ensure that these RDIs are met [14].

4. Conclusions

Our results would highlight that some DMU students monitored did not meet the nutritional goals for ALA, EPA and DHA. Therefore, it would be advisable to increase the consumption of fish (especially oily fish) and/or foods enriched with these long chain PUFAs in these university students. Implementation of nutritional supplementation policies for all these components could tackle the low intake observed and aid with the recommended allowances in individuals at risk.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to further processing for a future submission as a manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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