Energy, macronutrient and fatty acid intake of French elderly community dwellers and association with socio-demographic characteristics: data from the Bordeaux sample of the Three-City Study.

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TITLE PAGE

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Short running head

Energy and fatty acid intake in the elderly

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ABSTRACT

Few data are available regarding dietary habits of the elderly, in particular about fatty acid consumption whereas these are major risk or protective factors of several age-related diseases. The aim of this study was to characterize the dietary intake of a French elderly population in terms of energy, macronutrients and fatty acids based on their socio-demographic characteristics. The study population (range 67.7-94.9 years of age) consisted of 1786 subjects from Bordeaux (France), included in the Three-City cohort. Dietary assessment was performed by a 24 h recall, allowing the estimation of energy, protein, carbohydrate, total fat, saturated fatty acids, MUFA and PUFA intakes. Socio-demographic characteristics (age, sex, marital status, educational level and income), practice of sports and BMI were registered. Total energy intake (EI) was lower in women and in older participants ($\geq$ 85 years) but higher in single subjects. Higher EI was associated with higher income, but not with educational level. Mean contribution of macronutrients to EI (proteins 18%, carbohydrates 46% and total fat 31%) was higher in women than men, except for alcohol. The oldest persons consumed fewer proteins and more mono/disaccharides. Excess saturated fat intake (43% of total fat), associated with a relative deficit in MUFA consumption (36% of total fat) were observed. The mean $18:2n$-6/$18:3n$-3 ratio was 9.9 and decreased with higher educational level. Our results suggest that female gender, older age, being widowed and low income level could be considered as risk factors of inadequate dietary intake.

1   **INTRODUCTION**

2   The increasingly higher life expectancy observed in developed countries is in most part

3   attributed to a decline of mortality at older ages. Besides considerable improvement in health

4   care of older persons, better living conditions and, in particular, healthy dietary practices, may

5   explain this greater longevity [1]. In addition to the general recommendations for adults, the

6   older population has specific nutritional requirements in order to avoid protein-energy

7   malnutrition but also more subtle deficiencies due to imbalanced diets. In particular, there is a

8   growing interest in the putative protective effects of omega 3 poly-unsaturated fatty acids (n-3

9   PUFA) against cardiovascular disease [2], cancer [3] and neuro-psychiatric disorders [4], such

10   as dementia [5] or depression [6], whose incidence sharply increases with age. The respective

11   essential fatty acid precursors of the n-3 ($18{:}3n$-3, alpha-linolenic acid) and n-6 ($18{:}2n$-6,

12   linoleic acid) families cannot be endogenously synthesized and must therefore be provided by

13   diet. The dietary ratio of (n-6/n-3) essential fatty acids must also be considered. This has led

14   to the recommendation of about 2% of total energy for adults provided by $18{:}2n$-6, 1% by

15    $18{:}3n$-3 and 0.3% by EPA and DHA taken together (with at least 0.05% each) [7, 8].

16   Knowing that the biosynthesis of long-chain PUFA occurs only at a very low rate in young

17   adults as in elderly [9], and that experimental evidence indicates that the activity of the

18   desaturase enzyme, which converts essential precursors in longer chain PUFA, might be

19   decreased in aging [10, 11], the needs for EPA and DHA must be mostly covered by way of

20   diet. Therefore, the evaluation of the adequacy of fatty acids intake in the older population

21   requires an estimation of the dietary intake of both precursors and long-chain PUFA.

22   However, few data have been published regarding dietary fat intake of free living elderly

23   people and insufficient data are available on the actual intake of individual PUFA in human

24   populations. Moreover, a good knowledge of dietary patterns is necessary to improve dietary

25   counselling provided to high-risk individual groups whose characteristics have yet to be

26   identified.

27   In France, where life expectancy is among the highest in the world [12], very few

28   epidemiological studies have focused on nutrient intake of representative samples of elderly

29   community dwellers. Surveys of the food habits of the French population were conducted in

30   1998-99 and in 2002 in representative samples but they did not include individuals above

31   seventy-five years [13]. The SU.VI.MAX study reported very detailed data on dietary fat

32   intake of French adults but did not include subjects over sixty years [14]. Therefore, we lack

33   data on fatty acid intake of the elderly, whereas this might contribute to the particularly high

34   life expectancy [15] and low coronary heart disease mortality rate observed in France (the so-

35   called "French Paradox") [16].

36   The aim of this study was to describe patterns of energy and macronutrient intakes and their

37   link to socio-demographic characteristics in a population-based sample of elderly community

38   dwellers in southwestern France, with a special focus on dietary fat intake.

SUBJECTS AND METHODS

39 The data come from the Three-City (3C) study, a prospective cohort study of vascular risk

40 factors of dementia whose methodology is described in detail elsewhere [17, 18]. The

41 protocol of the 3C study was approved by the Consultative Committee for the Protection of

42 Persons participating in Biomedical Research of the Kremlin-Bicêtre University Hospital

43 (Paris). To be eligible for recruitment into the 3C study, persons had to be (i) living in

44 Bordeaux, Dijon or Montpellier (three French cities), (ii) aged sixty-five and over and (iii) not

45 institutionalized. A personal letter was sent to each potential subjects inviting them to

46 participate and including a brief description of the study protocol and an acceptance/refusal

47 form. Subjects from the Bordeaux sample were randomly chosen from the electoral rolls of

48 ten districts of the urban aera of Bordeaux in order to ensure a representative socio-

49 economical variability. Hence, a sample of 9294 community dwellers was selected in 1999-

50 2000 on the electoral rolls of Bordeaux (n 2104), Dijon (n 4931) and Montpellier (n 2259).

51 All participants signed a written consent. The baseline (wave 1) data collection included

52 socio-demographic information, lifestyle, symptoms and complaints, main chronic conditions,

53 neuropsychological testing, a physical examination and a blood sampling. The present study

54 is based on the second wave (wave 2) of data collection conducted in 2001-2002 in Bordeaux,

55 which placed a particular emphasis on nutritional data.

56

Dietary assessment

57 In Bordeaux, 1811 persons already visited at wave 1 participated in the nutritional survey

58 included in wave 2 of the 3C study. We did not intend to be representative of the whole 3C

59 cohort but of the Bordeaux sample. All these participants were visited at home by one of the

60 four specifically trained dieticians who administered a food frequency questionnaire (FFQ)

61 and a 24 h dietary recall during a face-to-face interview. These dieticians received a collective

62 training and monitoring to optimize the standardization of the nutritional interviews. The 24 h

63 recall was used to estimate nutrient intake. During the 24 h recall the dietician registered all

64 the meals and beverages consumed in a period of exactly 24 h before the subject awoke on the

65 day of the interview. No week-end day was recorded. Quantities were assessed according to a

66 book of photographs [19] edited for the SUVIMAX study [20]. The book showed three

67 portion sizes for each food and proposed two intermediate categories plus one below the

68 smallest one and one above the largest one; i.e., seven portion sizes were available for each of

69 the 236 foods or beverages. A table gave the correspondence between the portion size and the

70 weight of the food item. Photographs of dishes and glasses with the corresponding volume

73 were also available. The same dietician then entered the data of the 24 h recall in the
74 BILNUT® software (SCDA, Cerelles, France) to obtain an estimation of the daily nutrient
75 intake of each participant. Food composition tables for France [21] are included in the
76 BILNUT® software. Detailed data for fatty acids from the Food Composition and Nutrition
77 tables edited by Souci, Fachman and Kraut [22] were added. As the 24 h recall was open-
78 ended, additional data were found by consulting a French table developed by the INSERM
79 and the University of Montreal [23], the USDA National Nutrient Database, on food
80 packaging, and by contact with food manufacturers. Some specific data for fatty acids were
81 directly provided by the Institut des Corps Gras – Centre technique Industriel (ITERG) in
82 Bordeaux.
83 The results are expressed in quantities and in proportion of total energy intake (EI) with or
84 without alcohol. For fatty acids, results are also expressed in percent of total fat.
85 As suggested by Willett *et al.*, the validity of dietary questionnaires was assessed by the
86 evaluation of the association between total fat intake estimated from the 24 h recall and
87 ln(triacylglycerol) assessed at wave 1 [24].
88
89 *Other variables*
90 Age was recorded at the time of the dietary survey. Three age groups were defined as follows:
91 less than seventy-five years, between seventy-five and eighty-four years and eighty-five years
92 and over. Socio-demographic information recorded at wave 1 included gender and education
93 (in four classes: no education or primary school only, secondary (middle) school, high school,
94 vocational school or university). Socio-demographic characteristics also included marital
95 status (married, divorced or separated, widowed, single), and income in five categories (less
96 than 750 euros, 750 to 1500 euros, 1500 to 2250 euros, more than 2250 euros per month and
97 refuse to answer). People who did not know their monthly income were added to the group of
98 subjects who refused to answer this question.
99 Practice of physical exercise was assessed between waves 1 and 2 on a self-administered
100 questionnaire by two questions « Do you practice sports? (yes/no) and "Do you perspire when
101 you practice sports? (never/sometimes/most of the time/always). A three-level variable was
102 computed to describe intensity of physical exercise: no physical exercise (answer no to the
103 first question), moderate intensity (answer yes to the first question and never or sometimes to
104 the second one), high intensity (answer yes to the first question and most of the time or
105 always to the second one). Subjects who did not answer the first question were represented in
106 another group ("no answer").

107   Height (in m) was measured at wave 1. Weight (wt, in kg) was measured by the dietician at

108   the time of the dietary survey. BMI was computed as the weight/height² ratio and then

109   grouped in five categories (less than twenty-one, twenty-one to twenty-three, twenty-three to

110   twenty-seven, twenty-seven to thirty and more than thirty) according to Guigoz *et al.* and

111   Heiat *et al.* as previously established by Deschamps *et al.* [25-27].

112   The calculation of the BMR (in MJ/d) was predicted using Henry's equations based on age,

113   sex and body weight [28]. For men aged 60-69.9, the equation used is [BMR= 0.0543 wt +

114   2.37]; for men 70 years-old and over [BMR= 0.0573 wt + 2.01]. For women aged 60-69.9, the

115   equation used is [BMR= 0.0429 wt + 2.39]; for women 70 years-old and over [BMR= 0.0417

116   wt + 2.41].

117   The macronutrient and fatty acid intakes were compared to the French recommended dietary

118   allowances [8] and, for 20:5*n*-3, to the recommended levels of EPA intake of Simopoulos *et*

119   *al.* [7].

120

121   *Statistical methods*

122   Intake of energy and macronutrients were described by their mean, standard deviation (SD),

123   median, and quartiles. The cross-sectional associations of total EI and nutrient intake with

124   socio-demographic characteristics of the participants were assessed by Student's t-test (when

125   comparing two categories) or by ANOVA (when comparing more than two categories)

126   followed by Dunnett's post-hoc tests to compare means of categories to one of them taken as

127   reference group. Dunnett's statistical significance was accepted at $P<0.05$. Stepwise backward

128   linear regression was used to identify the socio-demographic variables associated with total

129   EI. The normal distribution of EI was verified since the mean and the median were similar

130   and the mean ± 2 SD included about 95% of the total EI of the subjects.

131   The SAS Statistical package (Version 9.1 SAS Institute) was used for these analyses.

132   **Results**

133   After exclusion of twenty-two participants who gave incomplete information on the 24 h

134   recall and three with extremely low reported EI (less than 2000 kJ/d), the sample included

135   1786 participants aged sixty-seven and over (range: 67.7 to 94.9) (62.7% women, mean age

136   76.8 years and 37.3% men, mean age 76.1 years). Their total EI based on their socio-

137   demographic characteristics is given in Table 1. Men had a significantly higher EI mean than

138   women (8389 *vs.* 6335 kJ, $P<0.0001$). Mean EI was significantly lower after eighty-five years

139   as for widowed persons and for people with income below 750 euros. Mean EI was

140   significantly higher in participants with higher educational level (significant Dunnett's tests).

141   The total EI was described based on BMI and the practice of physical exercise in Table 2.

142   Weight and height were absent in 152 subjects. In the remaining 1634 participants, total EI

143   was not significantly different between the five predefined categories of BMI of the whole

144   population, as was the case in men, although the EI was lower in the group of subjects whose

145   BMI was the highest. However, the reported EI was significantly higher in women with BMI

146   higher than twenty-three (significant Dunnett's test). As expected, the mean EI significantly

147   increased with the intensity of the practice of physical exercise.

148   Since all these socio-demographic characteristics are closely linked, they were entered as

149   dummy explanatory variables in a multilinear regression model on total EI (Table 3). In the

150   whole population, female gender and age eighty-five and over were significantly related to a

151   lower EI whereas being single, having a monthly income greater than 2250 euros or unknown

152   were associated with a higher EI. There was no significant association of EI with educational

153   level. The model explained 20% of total variance of EI (adjusted R-square). Given that

154   dietary intakes of men are significantly higher than those of women, we performed the

155   analyses of the association between EI and socio-demographic characteristics stratified by

156   sex. As in the whole population, education was not associated with EI in men or in women.

157   However, a significant interaction between sex and education ($P=0.015$) was found. Although

158   no significant association was observed for each educational level, the coefficients were in the

159   opposite way in men and women. Mean EI tended to decrease drastically with age in men

160   whereas a lowest decrease was observed only in the oldest women. EI was significantly

161   related to marital status in women, with a noticeable decreased intake in widowed women.

162   The association between income and EI showed similar trends in men and women.

163   In comparison with the recommendation concerning EI (125 kJ/kg/d), 73.1% of the subjects

164   on average, and mainly women, had an insufficient daily EI (70.4% of men *vs.* 74.8% of

165   women, $P =0.046$). This proportion did not vary significantly between the three age groups

166   defined previously (ANOVA, $P = 0.57$). The total reported EI was lower than the estimated

167   BMR for 20.2% of men and 27.2% of women.

168   Intake of macronutrients based on gender is given in Table 4. The macronutrient intake

169   expressed in g/d was all significantly different between men and women. Men had a higher

170   intake of every macronutrient in terms of quantities but, when expressed in proportion of EI,

171   they had a lower intake of proteins ($P<0.0001$), carbohydrate ($P<0.0001$), with significant

172   differences between the mono/disaccharides and polysaccharides intakes, and total fat

173   ($P=0.017$), mainly saturated fat ($P=0.006$). Concerning alcohol, men had a higher alcohol

174   intake ($P<0.0001$) than women as expressed in g/d or in proportion of EI. Alcohol was an

175   important component of total EI since the mean daily intake of alcohol was 21.6 g in men

176   (range: 0.0 to 115.2) and 6.9 g in women (range: 0.0 to 76.8). In men, 70.5% of proteins were

177   of animal origin *vs.* 72.1% for women ($P = 0.007$).

178   Table 5 reports the intake of macronutrients based on age in three groups. Mean consumption

179   of alcohol was not different between the three age groups ($P=0.19$). The intake of

180   macronutrients expressed in proportion of EI based on age in three groups showed that the

181   protein intake decreased with age (ANOVA, $P=0.007$) notably after eighty-five years

182   (significant Dunnett's test). This is particularly true for proteins of animal origins (ANOVA,

183    $P=0.013$) but less marked for the proteins of vegetable origins (ANOVA, $P=0.044$).

184   Furthermore, there was no difference in total carbohydrate intake between the three age

185   groups (ANOVA, $P=0.12$). Nevertheless, the consumption of mono/disaccharides

186   significantly increased with age (ANOVA, $P=0.001$), notably after seventy-five years

187   (significant Dunnett's test). The consumption of carbohydrates (46% of EI on average) was

188   below recommended levels (about 50 to 55% of daily total EI provided by carbohydrates) for

189   almost 63% of the subjects. Concerning fat intake, there were no significant differences

190   between the three age groups in terms of total fat, saturated fat, MUFA nor PUFA intake. As

191   expected, the total fat intake reported at wave 2 was inversely linked to ln(triacylglycerol)

192   levels (r=-0.05, $P= 0.038$).

193   The proportion of participants with a daily intake of proteins below the recommended value

194   of 1 g/kg of body weight per day was 44.1% with a slight and insignificant difference between

195   men (41.4%) and women (45.7%, $P = 0.07$). There was no significant effect of age on this

196   proportion (43.4% of subjects under seventy-five years; 43.9% of subjects aged between

197   seventy-five and eighty-four years and 50.5% of those aged eighty-five and over, $P = 0.37$).

198   Fatty acid intake is described in Table 6. The main contributor to fat intake in proportion of EI

199   was 18:1n-9 (oleic acid), followed by 16:0 (palmitic acid). The mean consumption of 18:2n-6

200 (3.35% of EI) was just below recommended levels (4% of EI) whereas the mean 18:3n-3

201 intake (0.40% of EI) was half the recommendation (0.8% of EI). The 18:2n-6/18:3n-3 ratio

202 (9.90 in mean) was twice higher to the recommended threshold of five, which corresponded to

203 approximately the first quartile. Concerning the long-chain n-3 PUFA, the intake of EPA

204 (0.07% of EI) was below recommended levels by Simopoulos *et al.* (0.1% of EI) [7].

205 Moreover, 61.6% of the subjects consumed less than 50% of the recommended DHA intake

206 (about 0.05% of EI); however, the mean consumption of DHA in proportion of EI (0.15%)

207 was about three fold above recommended levels. This intake of DHA points out the great

208 inter-individual variability observed, which is also shown for EPA but less obvious for 20:4n-

209 6 (arachidonic acid).

210 The consumption of 18:2n-6 and 18:3n-3 PUFA and the ratio 18:2n-6/18:3n-3 based on socio-

211 demographic characteristics are described in Table 7. There was no significant difference in

212 the proportion of each n-6 and n-3 PUFA precursor in proportion of EI according to sex, age

213 groups and education or income levels. Compared to married people, being widowed was

214 significantly linked to a lower 18:2 n-6 intake, but not to 18:3n-3 intake, as expressed in

215 percent of EI (significant Dunnett's test). The 18:2n-6/18:3n-3 ratio was significantly

216 associated with educational level (ANOVA, P=0.011) with a significant difference between

217 the least educated participants who had the highest ratio and the subjects with secondary or

218 high school, but not university, levels (significant Dunnett's test). The 18:2n-6/18:3n-3 ratio

219 did not change according to sex, age, marital status, and income. Concerning long-chain n-6

220 PUFA, the intake of 20:4n-6 in g/d was lower in women than in men (P<0.0001) and

221 significantly decreased as age increased (ANOVA, P=0.011). The intake of 20:5n-3 in g/d

222 significantly increased with higher income levels (ANOVA, P=0.044). When the long-chain

223 n-6 or n-3 PUFA intakes were expressed in proportion of EI, there was no significant

224 association with the socio-demographic characteristics studied (data not shown).

Discussion

225

226 In this cross-sectional study, we observed a significant association between total EI and

227 several socio-demographic characteristics such as age, sex, marital status, levels of income,

228 but not educational level, in a multivariate analysis. Despite an adequate intake of total fat,

229 our findings indicate an excessive intake of saturated fat concomitant to a relative deficit of

230 MUFA intake according to the current French recommendations. Being widowed was

231 significantly associated with lower 18:2n-6 PUFA intakes as expressed in percent of EI. The

232 18:2n-6/18:3n-3 ratio was linked to education.

233 The accuracy of food-intake assessment is crucial in dietary studies [29, 30]. In the present

234 study, a single 24 h recall was used to assess the dietary EI as a surrogate measure of the total

235 quantity of food intake even if this method presents limitations. Indeed, it cannot capture

236 long-term dietary intake patterns for each subject because of high intra-individual variation.

237 Thus, a reported single day of intake is unlikely to be representative of usual individual

238 intake. However, if sample sizes are sufficiently large, it may be used to determine average

239 intake in defined subgroups of a population [31]. Moreover, it is usually recognized that the

240 mean total EI was generally underestimated with such methodology [32]. Indeed, we

241 observed a relatively high proportion of subjects who declared to consume less than 125 kJ/

242 kg of body weight per day. However, in only 4% of men and 6% of women, the reported EI

243 was under 80% of the estimated BMR. In others studies, the intakes recorded in reports were

244 more than 20% below the estimated BMR [33]. Nevertheless, the validity of the BMR

245 estimation seems to be questionable in the sample studied of the very elderly [34, 35].

246 Even so, mean total EI observed in this sample of French elderly community dwellers is very

247 close to the figures reported in elderly participants (mean age seventy-seven years) in the New

248 Mexico Aging Process Study (2079 kcal (8698 kJ) for men and 1494 (6251 kJ) for women),

249 although the methodology of the dietary survey differed [36]. Furthermore, in the EPIC-

250 Elderly study, Bamia *et al.* reported that among almost 100 000 individuals aged sixty and

251 over living in nine European countries, the mean EI estimated by FFQ ranged from 8135 to

252 10820 kJ for men and from 5945 to 9439 kJ for women [37]. The mean EI estimated in the

253 present study was also close to that observed by Drewnowski *et al.* in French community

254 dwellers aged sixty-five years and over [38]. In addition, the food photographs, as used here,

255 generally have a positive influence on the relative validity for absolute food group intake [39].

256 In the present study, the mean EI was positively associated with the intensity of the practice of

257 physical exercise. Altogether, these observations allowed us to validate the methodology

258   employed in the present study to estimate the mean EI and macronutrients intake for this

259   group of elderly subjects.

260   The decreased mean EI in the oldest group might be due in part to dental and digestive

261   disturbances which increased with age [40, 41]. A decrease of perceived attractiveness of food

262   with increased age in terms of taste, appetite and palatability of food was also commonly

263   admitted [42, 43]. As already observed in the literature [30, 44], there was a trend to lowest EI

264   for the subjects who had the highest BMI. The low energy reporters with high BMI may be

265   people who have difficulties estimating their actual food intake. They are also more likely to

266   be dieters or they tend to have higher levels of energy restraint [44, 45]. Since this study is

267   cross-sectional, we cannot assert that the socio-demographic characteristics identified as

268   markers of unbalanced dietary patterns are responsible for this poor dietary pattern. Moreover,

269   the differences in mean EI with marital status described in this sample of subjects already

270   enrolled in the 3C cohort were expected. Indeed, according to the FFQ administered to all

271   participants of the 3C study at wave 1, subjects living alone had poorer dietary habits [18].

272   However, the association between mean EI and educational level already demonstrated in the

273   3C cohort at wave 1 disappeared in the present study when adjusted on the other socio-

274   demographic characteristics. This result could be in part due to the association of income with

275   EI because of the co-linearity between income and educational level. The association between

276   income and dietary habits was not assessed at wave 1 in 3C study [18]. An association

277   between energy density and diet cost was also demonstrated in a population of 837 French

278   adults [46]. Altogether, these results obtained at wave 1 in the 3C cohort and wave 2 in this

279   Bordeaux sample suggest that these particular socio-demographic characteristics are

280   associated with a specific dietary pattern. According to these studies and others, these lifestyle

281   characteristics, which are known to be associated with age-related disorders such as cognitive

282   decline or dementia [47], should be considered as potential confounding factors in the

283   relationship between nutritional and pathological status in older persons. However, since this

284   study is cross-sectional and because of the methodology employed, some associations

285   between EI and socio-demographic characteristics could be due to chance finding. This could

286   partly explain why some of these associations disappeared in men or in women when they

287   were analysed separately by sex. Moreover, another explanation is that stratifying on sex may

288   also have generated insufficient statistical power to detect associations.

289   In comparison with the French recommended dietary allowances [8], the food patterns in this

290   sample of the French elderly seem to be low in carbohydrates, rich in proteins and acceptable

291   for total fatty acids, yet showing an excess in saturated fat and deficiency in MUFA intakes.

292   The decreased consumption of polysaccharides with age might be due in part to changes in

293   behaviour with advanced age, suggesting that the elderly have a greater taste for sweet foods.

294   A previous study on dietary patterns prevailing among the elderly across Europe reported that

295   the "sweet- and fat- dominated" diet reflected the choice of older women with low

296   educational achievement [37]. Indeed, a notably lower carbohydrates intake (38 to 40% of EI)

297   was observed in a population of younger French persons [48]. The proportion of proteins was

298   on average superior to the recommendation (about 10 to 15% of total EI). In younger French

299   adults, Czernichow *et al.* reported a similar protein intake (16 to 17% of EI) [48]. However,

300   the protein intake decreased with age and almost half of the population enrolled in this study

301   ate less than 1 g of proteins/ kg of body weight per day. Taking into account that lower

302   weights were observed in the oldest group, these observations suggest that some protein-

303   energy malnutrition occurs in the oldest persons, putting them at risk of sarcopenia [49]. It is

304   worth noting that foods from animal protein sources are generally high in fats, particularly in

305   saturated fat and cholesterol. In the average French adult diet, 30 to 35% of energy were

306   estimated to come from total fat [8], which is the case in the population sample enrolled in

307   this study but notably lower than the values found in younger French adults where 36 to 40%

308   of EI come from total fat in men and women aged no more than sixty-five years [14, 48, 50].

309   In the present study, as previously described by Willett *et al.* [24], an inverse association

310   between the ln(triacylgycerol) and total fat intake was observed whereas the food

311   questionnaire completion and blood collection were within two years of each other and not

312   one year as Willett *et al.* This result could be interpreted as a relative stability of dietary

313   intake of the elderly during these two years. Concerning saturated fat, the consumption was

314   almost twice superior to recommendations (8% of EI) as already observed in the elderly [37]

315   and also reported in the literature for French adult consumers [50]. According to these

316   authors, the higher intake in saturated fat is largely the consequence of high intakes of butter,

317   cheese, meat products, and baked products. Indeed, 93% of the population enrolled in the 3C

318   study were regular consumers of dairy products [18]. Hence, the common opinion of the

319   elderly French that "*there is no good meal without cheese*" seems to be held in the population

320   studied. Recent analysis on dietary habits among Americans reported that they consumed too

321   much saturated fat, as was observed in our study in French elderly people [51]. Moreover, we

322   observed that the excess of saturated fat was associated with a relative deficit in MUFA

323   consumption, compared to the dietary allowances (about 20% of EI). Concerning PUFA, the

324   intake of 18:3n-3, despite it being an essential fatty acid, was below the recommendations

325   (about 0.8% of EI) and quantitatively comparable to that observed by others in a younger

326 French population [14]. As a consequence, the 18:2n-6/18:3n-3 ratio is fairly high (9.90 on

327 average) and close to the ratio observed in younger populations [14]. The very large range of

328 intake and the asymmetric quartiles of distribution for EPA and DHA have already been

329 observed in various studies and countries [14]. Knowing that the main source of EPA and

330 DHA is fish, a food not consumed daily in the 3C cohort [52], this result might also be due in

331 part to the single 24 h recall used which allows a good estimation of the mean but not of the

332 variance of the consumption. The analysis of the FFQ assessed at wave 2 allowed us to ensure

333 that in this sample the fish consumption frequency was linked to the estimated EPA and DHA

334 intake (Spearman coefficient, r=0.16, P<0.0001). As well, the analysis of the FFQ allowed us

335 to identify about 17.3% of subjects who consumed only rarely (i.e. less than once a week)

336 poultry or eggs which are rich in 20:4n-6. This pattern of food consumption could explain the

337 large distribution of arachidonic acid intake observed in this sample of elderly and not

338 mentioned by others in younger French populations [14]. Indeed, there was a significant

339 correlation between the poultry or eggs consumption estimated by FFQ and the 20:4 intake

340 (Spearman coefficient, r=0.12, P<0.0001). Since essential n-6 and n-3 fatty acid intake were

341 below the recommendations and that the biosynthesis of long-chain PUFA occurs only at a

342 very low rate and seems to decrease with age [10, 11], the intake of long-chain PUFA seems

343 to be insufficient for a non negligible part of the sample compared to the recommendations.

344 Moreover, our findings indicate a statistical association between the educational level and the

345 18:2n-6/18:3n-3 ratio in the elderly. A difference from 9.35 to 10.64 of this ratio between the

346 lowest educated subjects and subjects with higher educational level seems apparently too

347 small to have any nutritional consequences. However, the effects of n-3 PUFA intake or

348 educational level on age-related disorders such as dementia have already been demonstrated

349 [2-6, 53]. Likewise, marital status was associated with the intake of the precursor of n-6

350 PUFA. Knowing that the intake of long-chain n-3 fatty acids was correlated to indicators for

351 healthy dietary habits [54], the socio-demographic characteristics, such as marital status and

352 education, associated with inadequate intake of fatty acids could be considered as markers of

353 vulnerability in the elderly.

354 Thanks to this cross-sectional study, it was possible to identify socio-demographic

355 characteristics associated with quantitatively and qualitatively poor dietary patterns in a

356 French elderly group. Older persons at risk of malnutrition, mainly women, the very elderly,

357 the widowed or single subjects, or people with low educational or income level, all of whom

358 seem particularly vulnerable to age-related diseases, should be targeted for nutritional

359 counselling. Our findings suggest that the elderly of southwestern France have an unbalanced

360   fatty acid intake, characterized by, on average, an excessive intake of saturated fats related to

361   a deficit of MUFA and PUFA, notably in *n*-3, intake.

REFERENCES

[1]   Trichopoulou A, Vasilopoulou E. Mediterranean diet and longevity. Brit J Nutr. 2000;84:S205-S9.
[2]   Wendland E, Farmer A, Glasziou P, Neil A. Effect of alpha linolenic acid on cardiovascular risk markers: a systematic review. Heart. 2006 Feb;92(2):166-9.
[3]   Larsson SC, Kumlin M, Ingelman-Sundberg M, Wolk A. Dietary long-chain n-3 fatty acids for the prevention of cancer: a review of potential mechanisms. The American journal of clinical nutrition. 2004 June 1, 2004;79(6):935-45.
[4]   Bourre JM. Dietary omega-3 Fatty acids and psychiatry: mood, behaviour, stress, depression, dementia and aging. J Nutr Health Aging. 2005;9(1):31-8.
[5]   Barberger-Gateau P, Letenneur L, Deschamps V, Peres K, Dartigues JF, Renaud S. Fish, meat, and risk of dementia: cohort study. BMJ (Clinical research ed. 2002 Oct 26;325(7370):932-3.
[6]   Bruinsma KA, Taren DL. Dieting, essential fatty acid intake, and depression. Nutr Rev. 2000 Apr;58(4):98-108.
[7]   Simopoulos AP, Leaf A, Salem N, Jr. Workshop statement on the essentiality of and recommended dietary intakes for Omega-6 and Omega-3 fatty acids. Prostaglandins Leukot Essent Fatty Acids. 2000 Sep;63(3):119-21.
[8]   Martin A. The "apports nutritionnels conseilles (ANC)" for the French population. Reprod Nutr Dev. 2001 Mar-Apr;41(2):119-28.
[9]   Burdge GC, Calder PC. Conversion of alpha-linolenic acid to longer-chain polyunsaturated fatty acids in human adults. Reprod Nutr Dev. 2005 Sep-Oct;45(5):581-97.
[10]   Imre S, Firbas JH, Noble RC. Reduced lipid peroxidation capacity and desaturation as biochemical markers of aging. Archives of Gerontology and Geriatrics. 2000;31:5-12.
[11]   Bourre JM. Roles of unsaturated fatty acids (especially omega-3 fatty acids) in the brain at various ages and during ageing. J Nutr Health Aging. 2004;8(3):163-74.
[12]   Institut national de la statistique et des études économiques Version current 1 September 2006.   [cited 15 September 2006]; Available from:
[13]   Lioret S, Dubuisson C, Gautier A, Perrin-Escalon H, Guilbert P, Volatier J, et al. Comparaison de deux enquêtes nationales de consommation alimentaire auprès des adolescents et des adultes - Baromètre santé nutrition (2002) et INCA (1998-99) : éléments de méthode et résultats. Paris: Agence Française de Sécurité Sanitaire des Aliments, Institut National de Prévention et d'Education pour la Santé,; 2004 juin 2004.
[14]   Astorg P, Arnault N, Czernichow S, Noisette N, Galan P, Hercberg S. Dietary intakes and food sources of n-6 and n-3 PUFA in French adult men and women. Lipids. 2004 Jun;39(6):527-35.
[15]   Hooper L, Thompson RL, Harrison RA, Summerbell CD, Ness AR, Moore HJ, et al. Risks and benefits of omega 3 fats for mortality, cardiovascular disease, and cancer: systematic review. BMJ (Clinical research ed. 2006 Apr 1;332(7544):752-60.
[16]   Ferrieres J. The French paradox: lessons for other countries. Heart. 2004 Jan;90(1):107-11.
[17]   The 3C Study Group. Vascular factors and risk of dementia: design of the Three-City Study and baseline characteristics of the study population. Neuroepidemiology. 2003;22:316-25.
[18]   Larrieu S, Letenneur L, Berr C, Dartigues JF, Ritchie K, Alperovitch A, et al. Sociodemographic differences in dietary habits in a population-based sample of elderly subjects: the 3C study. J Nutr Health Aging. 2004;8(6):497-502.

[19]   SU.VI.MAX. Portions alimentaires. Manuel photos pour l'estimation des quantités. Paris: Diffusion Economica 2000.

[20]   Hercberg S, Preziosi P, Briancon S, Galan P, Triol I, Malvy D, et al. A primary prevention trial using nutritional doses of antioxidant vitamins and minerals in cardiovascular diseases and cancers in a general population: the SU.VI.MAX study--design, methods, and participant characteristics. SUpplementation en VItamines et Mineraux AntioXydants. Control Clin Trials. 1998 Aug;19(4):336-51.

[21]   Favier J, Ireland-Ripert J, Toque C, Feinberg M. Répertoire général des aliments. Table de composition. 2nde édition ed. Paris: Editions Tec et Doc Lavoisier et INRA éditions 1995.

[22]   Souci S, Fachman W, Kraut H. Food composition and nutrition tables. Stuttgart: medpharm Scientific publishers 2000.

[23]   Renaud S, Godsey F, Ortchanian E, Baudier F. Table de composition des aliments. Courbevoie: ASTRA-CALVE 1979.

[24]   Willett W, Stampfer M, Chu NF, Spiegelman D, Holmes M, Rimm E. Assessment of questionnaire validity for measuring total fat intake using plasma lipid levels as criteria. Am J Epidemiol. 2001 Dec 15;154(12):1107-12.

[25]   Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: the Mini Nutritional Assessment as part of the geriatric evaluation. Nutrition Reviews. 1996;54:S59-S65.

[26]   Heiat A, Vaccarino V, Krumholz HM. An evidence-based assessment of federal guidelines for overweight and obesity as they apply to elderly persons. Archives of internal medicine. 2001;161(9):1194-203.

[27]   Deschamps V, Astier X, Ferry M, Rainfray M, Emeriau JP, Barberger-Gateau P. Nutritional status of healthy elderly persons living in Dordogne, France, and relation with mortality and cognitive or functional decline. Eur J Clin Nutr. 2002 Apr;56(4):305-12.

[28]   Henry CJ. Basal metabolic rate studies in humans: measurement and development of new equations. Background document prepared for the joint FAO/WHO/UNU Expert consultation on energy in human nutrition. Rome: FAO; 2001.

[29]   Fraser GE. A search for truth in dietary epidemiology. The American journal of clinical nutrition. 2003 Sep;78(3 Suppl):521S-5S.

[30]   Johansson G, Wikman A, Ahren AM, Hallmans G, Johansson I. Underreporting of energy intake in repeated 24-hour recalls related to gender, age, weight status, day of interview, educational level, reported food intake, smoking habits and area of living. Public health nutrition. 2001 Aug;4(4):919-27.

[31]   Willett W. Nutritional epidemiology. Second edition ed. New York, Oxford: Oxford University Press 1998.

[32]   Bingham SA. Limitations of the various methods for collecting dietary intake data. Annals of nutrition & metabolism. 1991;35(3):117-27.

[33]   Livingstone MB, Black AE. Markers of the validity of reported energy intake. J Nutr. 2003 Mar;133 Suppl 3:895S-920S.

[34]   Ramirez-Zea M. Validation of three predictive equations for basal metabolic rate in adults. Public health nutrition. 2005 Oct;8(7A):1213-28.

[35]   Henry CJ. Basal metabolic rate studies in humans: measurement and development of new equations. Public health nutrition. 2005 Oct;8(7A):1133-52.

[36]   Koehler KM, Hunt WC, Garry PJ. Meat, poultry, and fish consumption and nutrient intake in the healthy elderly. J Am Diet Assoc. 1992 Mar;92(3):325-30.

[37]   Bamia C, Orfanos P, Ferrari P, Overvad K, Hundborg HH, Tjonneland A, et al. Dietary patterns among older Europeans: the EPIC-Elderly study. British Journal of Nutrition. 2005 Jul;94(1):100-13.

[38]   Drewnowski A, Henderson SA, Shore AB, Fischler C, Preziosi P, Hercberg S. The fat-sucrose seesaw in relation to age and dietary variety of French adults. Obes Res. 1997 Nov;5(6):511-8.

[39]   Ocke M, Bueno-de-Mesquita H, Goddijn H, Jansen A, Pols M, van Staveren W, et al. The Dutch EPIC food frequency questionnaire. I. Description of the questionnaire, and relative validity and reproducibility for food groups. Int J Epidemiol. 1997 February 1, 1997;26(90001):37S-48.

[40]   Walls AW, Steele JG. The relationship between oral health and nutrition in older people. Mech Ageing Dev. 2004 Dec;125(12):853-7.

[41]   Greenwald DA. Aging, the gastrointestinal tract, and risk of acid-related disease. Am J Med. 2004 Sep 6;117 Suppl 5A:8S-13S.

[42]   Roberts SB, Rosenberg I. Nutrition and aging: changes in the regulation of energy metabolism with aging. Physiol Rev. 2006 Apr;86(2):651-67.

[43]   Kennedy ET. Evidence for nutritional benefits in prolonging wellness. The American journal of clinical nutrition. 2006 Feb;83(2):410S-4S.

[44]   Trabulsi J, Schoeller DA. Evaluation of dietary assessment instruments against doubly labeled water, a biomarker of habitual energy intake. Am J Physiol Endocrinol Metab. 2001 Nov;281(5):E891-9.

[45]   Kant AK. Interaction of body mass index and attempt to lose weight in a national sample of US adults: association with reported food and nutrient intake, and biomarkers. Eur J Clin Nutr. 2003 Feb;57(2):249-59.

[46]   Darmon N, Briend A, Drewnowski A. Energy-dense diets are associated with lower diet costs: a community study of French adults. Public health nutrition. 2004 Feb;7(1):21-7.

[47]   Launer LJ. The epidemiologic study of dementia: a life-long quest? Neurobiol Aging. 2005 Mar;26(3):335-40.

[48]   Czernichow S, Bruckert E, Oppert JM, Bertrais S, Paillard F, Astorg P, et al. Intake of added oils and fats among middle-aged French adults: relationships with educational level and region of residence. J Am Diet Assoc. 2005 Dec;105(12):1889-94.

[49]   Fujita S, Volpi E. Amino acids and muscle loss with aging. J Nutr. 2006 Jan;136(1 Suppl):277S-80S.

[50]   Volatier JL, Verger P. Recent national French food and nutrient intake data. Br J Nutr. 1999 Apr;81 Suppl 2:S57-9.

[51]   German JB, Dillard CJ. Saturated fats: what dietary intake? The American journal of clinical nutrition. 2004 Sep;80(3):550-9.

[52]   Barberger-Gateau P, Jutand MA, Letenneur L, Larrieu S, Tavernier B, Berr C. Correlates of regular fish consumption in French elderly community dwellers: data from the Three-City study. Eur J Clin Nutr. 2005 Jul;59(7):817-25.

[53]   Ott A, vanRossum CTM, vanHarskamp F, vandeMheen H, Hofman A, Breteler MMB. Education and the incidence of dementia in a large population-based study: The Rotterdam Study. Neurology. 1999;52(3):663-6.

[54]   Johansson LR, Solvoll K, Bjorneboe GE, Drevon CA. Intake of very-long-chain n-3 fatty acids related to social status and lifestyle. Eur J Clin Nutr. 1998 Oct;52(10):716-21.

Table 1. Total energy intake based on socio-demographic characteristics of elderly community dwellers from Bordeaux (France), 2001-2002.

| Socio-demographic characteristics | n | Energy intake (kJ) | | | | | | $P^{\dagger}$ |
		Mean	SD	1st quartile	Median	3rd quartile	Range	
Total	1786	7100	2272	5427	6933	8556	[2176 ; 16900]	
Sex	1786							< 0.0001
Men	666	8389	2243	6983	8242	9774	[3046 ; 16900]	
Women	1120	6335	1912	5004	6130	7422	[2176 ; 14519]	
Age (years)	1786							0.006
< 75	769	7259	2368	5494	7037	8719	[2200 ; 16900]	
[75-84]	904	7025	2180	5418	6912	8460	[2176 ; 15322]	
≥ 85	113	6594	2230	5050	6381	7858	[2498 ; 13146]	*
Marital status	1782							< 0.0001
Married	946	7506	2218	5895	7268	8941	[2351 ; 15322]	
Divorced/Separated	141	7054	2335	5197	7029	8510	[2335 ; 13644]	
Widowed	577	6448	2155	4954	6121	7719	[2176 ; 14343]	*
Single	118	7125	2410	5335	6979	8519	[2402 ; 16900]	

Education	*1777*							< 0.0001
No or primary	*619*	6791	2159	5243	6699	8021	[2200 ; 14975]	
Secondary	*479*	7058	2163	5468	6933	8481	[2276 ; 15192]	
High school	*366*	7234	2397	5456	7000	8749	[2176 ; 16900]	*
University	*313*	7594	2389	5824	7385	9100	[2347 ; 14494]	*
Monthly income (euros)	*1786*							< 0.0001
< 750	*139*	6167	2008	4720	5996	7372	[2200 ; 13506]	
[750 - 1500]	*545*	6736	2180	5188	6468	8000	[2402 ; 14518]	*
[1500 - 2250]	*434*	7226	2234	5427	7058	8569	[2176 ; 16900]	*
≥ 2250	*519*	7623	2322	5837	7456	9100	[2598 ; 15192]	*
Refused to answer	*149*	7113	2297	5619	7004	8514	[2276 ; 15322]	*

† *P*-value for the ANOVA comparing mean energy intake

* Significant Dunnett's test (*P*<0.05) comparing energy intake with the reference group. The reference groups were respectively subjects aged less than seventy-five years or married or the lowest educated or subjects with the lowest income.

Table 2. Total energy intake based on BMI and physical exercise of elderly community dwellers from Bordeaux (France), 2001-2002

Variables	n	Energy intake (kJ)						$P^{\dagger}$
		Mean	SD	1st quartile	Median	3rd quartile	Range	
BMI	1634							0.10
< 21	181	7259	2293	5519	7063	8648	[2874 ; 15322]	
[21 - 23]	249	7155	2167	5594	6945	8468	[2176 ; 13510]	
[23 - 27]	669	7293	2222	5627	7138	8757	[2347 ; 15192]	
[27 - 30]	322	7088	2406	5259	6837	8807	[2276 ; 14974]	
≥ 30	213	6824	2289	5259	6586	8180	[2335 ; 16900]	
Men	635							0.16
< 21	33	8502	2464	6895	8594	9464	[3824 ; 15322]	
[21 - 23]	63	9067	2130	7372	8899	10636	[4912 ; 13510]	
[23 - 27]	294	8318	2113	7071	8167	9531	[3046 ; 15192]	
[27 - 30]	164	8326	2310	6586	8230	9924	[3339 ; 14974]	
≥ 30	81	8284	2351	6786	8138	9447	[3230 ; 16900]	
Women	999							< 0.0001
< 21	148	6983	2167	5364	6908	8217	[2874 ; 13297]	
[21 - 23]	186	6506	1766	5322	6280	7460	[2176 ; 11594]	
[23 - 27]	375	6489	1958	5146	6381	7519	[2347 ; 14518]	*

[27 - 30]	158	5803	1475	4481	5489	6971	[2276 ; 11184]	*
≥ 30	132	5925	1724	4699	5636	6966	[2335 ; 11104]	*
Physical exercise	1786							< 0.0001
No	923	7004	2226	5343	6858	8297	[2402 ; 16900]	
Moderate	288	7468	2435	5640	7205	8874	[2176 ; 15322]	*
Intensive	122	7971	2469	6075	7598	9916	[3230 ; 14343]	*
No answer	453	6824	2121	5268	6707	8196	[2200 ; 14974]	

[†] P-value for the ANOVA comparing mean energy intakes

* Significant Dunnett's test ($P<0.05$) comparing energy intake with the reference group. The reference groups were respectively subjects with BMI lower than twenty-one or subjects who declared no physical exercise.

Table 3. Influence of socio-demographic characteristics on total energy intake in a multilinear regression model in the whole study population of elderly community dwellers from Bordeaux (France) and stratified by sex (*n* 1773)

Socio-demographic characteristics	Whole population			Men			Women		
	Coef. β	95% CI	*P*	Coef. β	95% CI	*P*	Coef. β	95% CI	*P*
Sex			< 0.0001						
(Reference Group: Men)									
Women	-1970	[-2184 ; -1754]	< 0.0001						
Age (year)			0.08			0.11			0.10
(Reference Group: ≤ 75)									
[75-84]	-50	[-250 ; 150]	0.62	-309	[-663 ; 45]	0.09	142	[-99 ; 383]	0.25
≥ 85	-470	[-882 ; -58]	0.025	-617	[-1389 ; 154]	0.12	-330	[-809 ; 148]	0.18
Marital status			0.002			0.64			0.001
(Reference Group: Married)									
Divorced / Separated	391	[3 ; 779]	0.048	453	[-419 ; 1325]	0.31	262	[-172 ; 696]	0.24
Widowed	-123	[-376 ; 131]	0.34	147	[-357 ; 652]	0.57	-289	[-585 ; 6]	0.055
Single	572	[154 ; 991]	0.007	441	[-634 ; 1517]	0.42	448	[-3 ; 899]	0.051
Education			0.86			0.10			0.37
(Reference Group: No or Primary)									
Secondary	-2	[-256 ; 251]	0.98	-166	[-658 ; 324]	0.50	96	[-193 ; 384]	0.52
High school	107	[-176 ; 391]	0.46	363	[-173 ; 899]	0.18	-59	[-388 ; 270]	0.72

University	7	[-316 ; 329]	0.97	-232	[-788 ; 324]	0.41	291	[-122 ; 704]	0.17
Monthly income (euros)			0.064			0.66			0.21
(Reference Group: < 750)									
[750 - 1500]	195	[-195 ; 584]	0.33	31	[-1463 ; 1526]	0.97	196	[-189 ; 583]	0.32
[1500 - 2250]	290	[-142 ; 723]	0.19	229	[-1282 ; 1739]	0.77	184	[-273 ; 640]	0.43
≥ 2250	521	[58 ; 984]	0.027	390	[-1133 ; 1913]	0.61	481	[-24 ; 987]	0.06
Refused to answer	587	[91 ; 1082]	0.020	560	[-1072 ; 2192]	0.50	483	[-29 ; 995]	0.06

Table 4. Macronutrient intake based on sex of elderly community dwellers from Bordeaux (France), 2001-2002 (*n* 1786)

Nutrients	Intake (g/d)					% of total EI [†]			% of EI [†] without alcohol		
	Mean	SD	1st quartile	Median	3rd quartile	Mean	SD	*P* [*]	Mean	SD	*P* [*]
Alcohol	12.4	16.2	0.0	7.2	19.2	4.7	5.8	<0.0001			
Men	21.6	20.1	5.8	17.6	32.0	7.5	6.6		-		
Women	6.9	10.0	0.0	1.9	11.3	3.1	4.4		-		
Proteins	74.9	26.9	55.4	71.4	90.6	18.0	4.7	<0.0001	18.9	4.9	0.067
Men	85.0	27.2	66.3	82.8	101.2	17.2	4.3		18.7	4.7	
Women	68.9	24.8	51.7	65.5	83.0	18.5	4.9		19.1	5.1	
Animal proteins	53.5	24.0	36.4	49.8	66.4	12.9	5.0	<0.0001	13.6	5.3	0.009
Men	59.9	25.0	43.2	55.9	74.6	12.2	4.5		13.2	5.0	
Women	49.7	22.6	34.1	46.5	62.0	13.4	5.3		13.8	5.5	
Vegetable proteins	21.4	9.1	15.1	20.3	26.3	5.1	1.6	0.63	5.3	1.6	0.006
Men	25.1	9.2	19.2	23.9	30.1	5.0	1.4		5.5	1.5	
Women	19.2	8.2	13.6	17.7	23.4	5.1	1.7		5.2	1.7	
Carbohydrates	194.0	70.0	144.8	187.3	233.9	46.1	9.8	<0.0001	48.4	9.5	0.96
Men	223.3	73.1	172.7	216.8	263.9	44.8	9.7		48.4	9.4	
Women	176.5	61.8	133.5	171.3	213.2	46.9	9.7		48.4	9.6	
Mono/disaccharides	89.1	39.9	61.2	83.7	111.5	21.7	8.7	<0.0001	22.7	8.8	<0.0001

Men	96.1	44.3	64.0	89.9	121.0	19.5	8.2		21.0	8.5	
Women	85.0	36.4	59.0	80.3	106.3	23.0	8.7		23.7	8.9	
Polysaccharides	104.8	49.6	70.2	98.9	134.4	24.5	8.2	0.0003	25.7	8.4	<0.0001
Men	127.2	51.1	92.9	122.3	155.0	25.4	7.6		27.4	7.7	
Women	91.5	43.5	60.9	87.3	114.8	24.0	8.4		24.7	8.6	
Total fat	59.4	27.5	40.5	54.1	74.4	31.1	8.7	0.017	32.7	9.0	0.30
Men	69.0	29.7	47.7	64.3	85.4	30.5	8.5		33.0	9.0	
Women	53.7	24.3	36.8	49.6	67.4	31.5	8.9		32.5	9.1	
Saturated fat	25.5	12.9	16.1	23.2	32.6	13.3	4.6	0.006	14.0	4.8	0.88
Men	29.5	13.8	19.7	27.4	37.6	13.0	4.2		14.0	4.5	
Women	23.2	11.8	14.9	21.1	29.6	13.6	4.8		14.0	4.9	
MUFA	21.2	10.9	13.4	19.0	27.6	11.1	3.9	0.30	11.6	4.2	0.10
Men	24.8	12.1	16.1	22.1	30.7	10.9	4.0		11.8	4.3	
Women	19.0	9.5	12.4	17.2	24.1	11.1	3.9		11.5	4.1	
PUFA	8.4	6.0	4.8	6.9	10.1	4.4	2.6	0.37	4.7	2.7	0.45
Men	9.8	6.6	5.8	8.3	11.9	4.4	2.4		4.7	2.6	
Women	7.6	5.5	4.4	6.3	9.0	4.5	2.7		4.6	2.8	

[†] EI, energy intake

[*] P-value for the Student's t-test comparing alcohol and macronutrient intakes in proportion of energy intake with or without alcohol consumption between men and women

Table 5. Macronutrient intake based on age of elderly community dwellers from Bordeaux (France), 2001-2002 (*n* 1786)

Variables	Intake (g/day)					% of total EI[‡]			% of EI[‡] without alcohol		
	Mean	SD	1st quartile	Median	3rd quartile	Mean	SD	P[†]	Mean	SD	P[†]
Alcohol								0.19			
< 75 years	13.3	17.7	0.0	7.7	19.2	4.9	6.0		-		
75-84 years	12.0	15.3	0.0	7.4	19.2	4.7	5.6		-		
≥ 85 years	9.5	12.2	0.0	4.8	16.0	3.9	4.9		-		
Proteins								0.007			0.002
< 75 years	77.8	27.7	57.9	74.9	93.4	18.3	4.8		19.3	5.0	
75-84years	73.6	25.9	55.4	70.0	88.8	17.9	4.7		18.8	4.9	*
≥ 85 years	66.1	26.1	48.2	60.8	79.4	17.0	4.3	*	17.7	4.5	*
Animal sources								0.013			0.006
< 75 years	55.7	25.0	38.4	51.9	69.5	13.2	5.2		13.9	5.4	
75-84 years	52.7	23.1	35.6	49.6	65.1	12.9	5.0		13.5	5.2	
≥ 85 years	45.7	22.6	28.4	41.4	58.6	11.7	4.2	*	12.2	4.5	*
Vegetable sources								0.044			0.043
< 75 years	22.1	9.4	15.5	20.8	27.3	5.1	1.6		5.4	1.7	
75-84 years	20.9	8.8	14.8	20.0	25.5	5.0	1.5		5.2	1.6	*
≥ 85 years	20.5	8.4	14.2	19.6	26.2	5.3	1.6		5.5	1.7	

Carbohydrates								0.12			0.23
< 75 years	197.3	73.4	145.2	190.0	238.5	45.8	9.8		48.1	9.5	
75-84 years	192.0	67.5	145.0	184.3	231.4	46.2	9.9		48.4	9.8	
≥ 85 years	186.3	63.7	144.0	183.4	225.5	47.8	8.2		49.8	7.9	
Mono/disaccharides								0.001			0.003
< 75 years	88.3	40.4	59.1	84.6	112.6	20.9	8.4		21.9	8.6	
75-84 years	90.0	39.7	62.3	83.0	111.6	22.1	8.9	*	23.1	9.0	*
≥ 85 years	88.3	37.5	63.7	82.0	103.4	23.4	8.8	*	24.2	8.7	*
Polysaccharides								0.08			0.06
< 75 years	109.0	51.7	72.7	101.8	138.8	25.0	8.1		26.2	8.3	
75-84 years	102.1	47.8	69.2	98.0	129.8	24.1	8.2		25.3	8.5	*
≥ 85 years	98.0	46.3	64.1	95.1	131.0	24.5	7.8		25.5	8.1	
Total fat								0.70			0.83
< 75 years	60.2	25.6	40.1	54.4	75.5	30.9	8.6		32.6	9.0	
75-84 years	59.3	27.5	40.8	54.2	74.4	31.3	8.9		32.8	9.3	
≥ 85 years	55.6	27.1	37.5	52.5	64.9	31.3	7.8		32.5	7.9	
Saturated fat								0.13			0.25
< 75 years	25.7	12.8	16.1	23.3	33.4	13.1	4.5		13.8	4.6	
75-84 years	25.5	13.0	16.2	23.3	32.5	13.4	4.7		14.1	4.9	
≥ 85 years	25.0	13.8	15.2	21.8	30.3	13.9	4.4		14.5	4.4	
MUFA								0.50			0.33

< 75 years	21.8	11.1	13.8	19.6	27.6	11.2	4.0		11.8	4.2
75-84 years	20.9	11.8	13.3	18.7	26.2	11.0	3.9		11.6	4.1
≥ 85 years	19.1	9.9	12.8	17.1	24.0	10.8	3.8		11.3	3.9
PUFA								0.42		0.45
< 75 years	8.4	5.8	5.1	7.0	10.0	4.4	2.4		4.6	2.5
75-84 years	8.6	6.3	4.6	6.9	10.2	4.5	2.8		4.7	2.9
≥ 85 years	7.5	4.8	4.4	6.6	9.3	4.3	2.1		4.4	2.3

‡ EI, energy intake

[†] P-value for the ANOVA comparing alcohol and macronutrient intakes in proportion of energy intake with or without alcohol consumption among the three age groups

* Significant Dunnett's test (P<0.05) comparing alcohol and macronutrient intakes in proportion of energy intake with or without alcohol consumption between the reference group (subjects aged less than 75 years) and the others.

Table 6. Fatty acid intake of elderly community dwellers from Bordeaux (France), 2001-2002 (n 1786)

Fatty acid	Intake (g/d)		% of total fat intake		% of total energy intake				
	Mean	SD	Mean	SD	Mean	SD	1st quartile	Median	3rd quartile
14:0	2.85	1.82	4.80	2.12	1.49	0.77	0.92	1.41	1.93
16:0	12.71	6.69	21.22	4.33	6.63	2.41	4.96	6.35	7.93
18:0	5.43	3.21	9.11	3.07	2.85	1.29	1.97	2.65	3.48
16:1n-7	1.53	1.60	2.49	1.79	0.78	0.67	0.48	0.65	0.89
18:1n-9	18.22	9.85	30.32	6.78	9.55	3.77	6.86	8.96	11.75
Total n-6 PUFA	6.55	5.27	11.15	6.51	3.44	2.36	2.00	2.79	4.07
18:2n-6	6.38	5.23	10.86	6.48	3.35	2.35	1.91	2.70	3.97
20:4n-6	0.16	0.17	0.29	0.34	0.09	0.09	0.02	0.06	0.13
Total n-3 PUFA	1.23	1.40	2.17	2.34	0.65	0.69	0.30	0.43	0.63
18:3n-3	0.78	0.80	1.30	0.84	0.40	0.32	0.25	0.33	0.44
EPA	0.14	0.34	0.26	0.66	0.07	0.18	0.00	0.00	0.05
DHA	0.28	0.69	0.54	1.35	0.15	0.38	0.00	0.02	0.10
18:2n-6/18:3n-3 ratio	9.90	7.05	-	-	-	-	-	-	-

Table 7. *n*-6 and *n*-3 PUFA intakes and 18:2*n*-6/18:3*n*-3 ratio based on socio-demographic characteristics (sex, age, marital status, education, income) of elderly community dwellers from Bordeaux (France), 2001-2002 (*n* 1786)

Socio-demographic characteristics	18:2*n*-6						18:3*n*-3						18:2*n*-6/18:3*n*-3 ratio		
	Intake (g/d)			% of total EI[‡]			Intake (g/d)			% of total EI[‡]					
	Mean	SD	$P^{\dagger}$	Mean	SD	$P^{\dagger}$	Mean	SD	$P^{\dagger}$	Mean	SD	$P^{\dagger}$	Mean	SD	$P^{\dagger}$
Sex			<0.0001			0.75			<0.0001			0.92			0.54
Men	7.50	5.70		3.33	2.17		0.92	0.92		0.40	0.33		9.78	6.03	
Women	5.72	4.82		3.36	2.45		0.69	0.70		0.40	0.32		9.97	7.59	
Age (years)			0.30			0.43			0.15			0.29			0.70
< 75	6.36	4.98		3.29	2.19		0.78	0.76		0.39	0.30		9.75	6.50	
75-84	6.49	5.54		3.42	2.52		0.79	0.86		0.41	0.35		10.00	7.44	
≥ 85	5.69	4.33		3.21	1.96		0.64	0.42		0.36	0.18		10.19	7.42	
Marital status			<0.0001			0.034			0.002			0.42			0.57
Married	7.02	5.71		3.50	2.51		0.84	0.89		0.41	0.36		10.07	6.67	
Divorced/ Separated	5.91	4.04		3.20	2.02		0.75	0.58		0.40	0.28		9.41	6.48	
Widowed	5.52	4.70	*	3.16	2.22	*	0.70	0.73	*	0.39	0.29		9.66	7.79	
Single	6.17	4.37		3.22	1.95		0.68	0.39		0.36	0.18		10.08	6.60	
Education			0.90			0.07			0.15			0.95			0.011
No or primary	6.42	4.91		3.55	2.49		0.73	0.67		0.39	0.29		10.64	7.87	

Secondary	6.26	5.05		3.27	2.12		0.78	0.74		0.40	0.29		9.45	6.58	*
High school	6.38	5.69		3.26	2.43		0.81	0.90		0.41	0.35		9.35	6.15	*
University	6.54	5.66		3.21	2.33		0.84	0.96		0.40	0.38		9.83	6.95	
Monthly income (euros)			0.006			0.77			0.021			0.74			0.44
< 750	5.30	3.63		3.24	2.09		0.63	0.44		0.38	0.22		10.16	7.84	
[750 - 1500]	5.99	4.60		3.35	2.34		0.72	0.68		0.40	0.29		9.94	7.53	
[1500 - 2250]	6.71	5.39	*	3.45	2.36		0.80	0.83		0.40	0.31		10.13	7.19	
≥ 2250	6.82	5.68	*	3.34	2.41		0.83	0.86	*	0.40	0.36		9.89	6.44	
Refused to answer	6.37	6.32		3.18	2.44		0.86	1.03	*	0.43	0.40		8.89	5.92	

‡ EI, energy intake

[†] P-value for the Student's t-test or ANOVA comparing mean 18:2n-6/18:3n-3 ratio or 18:2n-6 and 18:3n-3 intakes in g/d or in proportion of total energy intake

* Significant Dunnett's test ($P<0.05$) comparing 18:2n-6 and 18:3n-3 intakes in g/d or in proportion of total energy intake with the reference group. The reference groups were respectively subjects aged less than seventy-five years or married or the lowest educated or subjects with the lowest income.

Contributions of each author:

Catherine Féart contributed to the analysis of data and the writing of the manuscript.

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