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Short running head

Mediterranean Diet adherence and nutrient intakes

ABSTRACT

The Mediterranean-type diet combines several foods and nutrients already individually proposed as potential protective factors against adverse health outcomes, such as cardiovascular diseases.

The aim of the present study was to describe the association between adherence to a Mediterranean diet (MeDi) and intake of energy, macronutrients and micronutrients.

The study sample consisted of 1595 individuals from Bordeaux, France, included in 2001-2002 in the Three-City Study. Adherence to a MeDi (scored as 0 to 9) was computed from a food frequency questionnaire. Total energy intake (EI) and nutrient intake were evaluated on a 24 h recall. Statistical analyses were stratified by gender.

Both in men and women, greater MeDi adherence was associated with higher total vegetal protein, polyunsaturated fatty acids (PUFA), notably n-6 PUFA, and lower total saturated fat intakes, as expressed in % of EI. Higher total monounsaturated fat and oleic acid intakes (% EI) were observed with greater MeDi adherence in men. Women with the highest MeDi adherence exhibited a higher mean carbohydrate, polysaccharide and total n-3 PUFA intakes (% EI). The consumption of fibres, vitamins B6, C, E, folate, magnesium, potassium and iron increased with greater MeDi adherence, both in men and women. However, consumption of calcium significantly decreased with greater MeDi adherence in women, while the ratio of n-6/n-3 PUFA precursors increased.

This cross-sectional study provides the nutrient-related basis of the Mediterranean-type diet of French elderly community dwellers, which might participate to its well-documented beneficial effects on health.

KEY WORDS: Mediterranean diet, energy intake, nutrient intake

INTRODUCTION

In developed countries, the increasingly higher life expectancy is mostly attributed to a decline of mortality at older ages. Better living conditions and, notably healthy dietary practices, may explain this greater longevity in addition to considerable improvement in health care of older persons [37]. Among the general lifestyle recommendations, the traditional Mediterranean diet (MeDi) seems an optimal dietary strategy for health since greater MeDi adherence has been associated with longer survival, reduced risk of cardiovascular or cancer mortality, and reduced risk of neurodegenerative diseases [22, 29-30]. The traditional MeDi is characterized by high consumption of plant foods (vegetables, fruits, legumes and cereals), high intake of olive oil as the principal source of mono-unsaturated fat but low intake of saturated fat, moderate intake of fish, low-to-moderate intake of dairy products, low consumption of meat and poultry, and wine consumed in low-to-moderate amounts, normally with meals [36, 39]. Therefore, the MeDi combines several foods and nutrients already proposed as potential protective factors against several conditions that may contribute to the development and progression of age-related diseases [6, 12-13, 22-23, 26, 29-30, 34]. However, due to its computation method [36], a similar score on the MeDi does not mean a similar intake of nutrients across populations. Only few studies have yet conducted precise descriptions of its nutritional value [8]. Thus, a better knowledge of the dietary characteristics of individuals adhering more closely to a MeDi is necessary to support the biological plausibility of its protective effects before promoting this dietary pattern as a universal healthy diet.

The purpose of the current study was to describe the intake of macronutrients, micronutrients, minerals and trace elements according to MeDi adherence among French older community-dwellers, in order to explain the potential contribution of these nutrients to the health benefits of the MeDi.

METHODS

Participants

The data come from the Three-City (3C) study, a prospective cohort study of vascular risk factors of dementia whose methodology has been described elsewhere [33]. The 3C study protocol was approved by the Consultative Committee for the Protection of Persons participating in Biomedical Research at Kremlin-Bicêtre University Hospital (Paris). A sample of 9294 community dwellers aged 65 and over was selected in 1999-2000 from the electoral rolls of three French cities (Bordeaux, Dijon and Montpellier). All participants gave written informed consent. At baseline, data collection included socio-demographic information, lifestyle, symptoms and medical complaints, medical history, blood pressure, smoking status, drug use, anthropometric data, neuropsychological testing, and blood sampling. These data were completed by a comprehensive dietary survey only in the Bordeaux center in 2001-2002. The study sample comprises 1595 participants from Bordeaux, without missing nutritional data.

Dietary assessment

Participants were visited at home by a specifically trained dietician who administered a food frequency questionnaire (FFQ) and a 24 h dietary recall [11, 25]. During the 24 h recall the dietician registered all the meals and beverages consumed in a period of exactly 24 h before the subject awoke on the day of the interview. No week-end day was recorded. Quantities were assessed according to a book of photographs [32] edited for the SUVIMAX study [16]. A table gave the correspondence between the portion size and the weight of the food item. Photographs of dishes and glasses with the corresponding volume were also available. The same dietician then entered the data of the 24 h recall in the BILNUT® software to obtain an estimation of the daily nutrient intake of each participant. Food composition tables were

already included in the BILNUT® software and complemented as earlier described [11].

Among the whole nutrient database, key macronutrients (proteins, carbohydrates, fats and

alcohol) were used to compute total energy intake (EI). The different classes of lipids

(saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids) were

recorded, as the consumption of carotenes, fibres, retinol, vitamins B1, B2, B5, B6, B12, C,

D, E, folate, and of minerals and trace elements (calcium, phosphorus, magnesium,

potassium, iron, and zinc).

Computation of the MeDi score

Based on the FFQ, frequency of consumption of 40 categories of foods and beverages for

each of the three main meals and three between-meals snacks was recorded in eleven classes.

The number of usual weekly servings, but not portion size, of each of the 148 food items and

alcohol, ranging as a result from 0 to 42 was recorded (with a maximum of six meals a day).

The food items were aggregated into 20 food and beverage groups [25] and we identified

those considered to be part of the MeDi: vegetables, fruits, legumes, cereals (including bread,

pasta and rice, without distinction between whole and refined grains), fish, meat and dairy

products. The number of servings/week for each food group was determined and the MeDi

score was computed as follows: a value of 0 or 1 was assigned to each food group using sex-

specific medians of the population as cut-offs [35]. Briefly, subjects received one point if their

intake was higher than the sex-specific median for a presumed protective component

(vegetables, fruits, legumes, cereals, fish and MUFA-to-SFA ratio) and lower than the sex-

specific median for a presumed deleterious component (meat and dairy products). For alcohol,

one point was given to mild-to-moderate consumers. Cut-offs, chosen to be close to the

second quartile of distribution of total alcohol consumption, were defined in men and women

separately [13]. One point was attributed for men if consumption was within 6-to-14 glasses

per week (8.5-to-20g/d) and for women if consumption was within 1-to-4 glasses per week (1.4-to-5.7g/d). Data from the 24 h recall were used to compute the MUFA-to-SFA ratio (ratio of the nutrient intake in g/d). The MeDi score was generated by adding the scores for each food category for each participant. Thus, the MeDi score could range from 0 to 9, with higher scores indicating greater MeDi adherence [13].

Covariates

Socio-demographic information included age, gender, education, income and marital status. Vascular risk factors included measured Body Mass Index (BMI in kg/m^2), diabetes, hypercholesterolemia (total cholesterol $\geq$ 6.2 mmol/L) and hypertension (measured blood pressure $\geq$ 140/90 mmHg or treated).

Statistical analyses

All statistical analyses were performed with SAS Statistical package (Version 9.1 SAS Institute). Participants were classified according to categories of MeDi adherence (Low MeDi adherence, score 0-3; Middle MeDi adherence, score 4-5; or High MeDi adherence, score 6-9) defined to be nutritionally relevant, as previously described and used in the literature [13, 26, 35]. Demographic and clinical characteristics were compared between the three categories of the MeDi score. We then explored associations between the MeDi adherence at baseline and EI and macronutrient intakes, as expressed in proportion of total energy intake (% EI) with alcohol. We also compared micronutrient intakes, expressed in g/d, across categories of MeDi adherence. Separate analyses were performed for each gender since the MeDi score was computed according to the sex-specific medians of consumption of food groups.

RESULTS

The study sample consisted of 1595 individuals (607 men and 988 women), aged 76.1y on average (range 67.7-94.9) in 2001-2002.

The MeDi score ranged from 0 to 9 with 1.1% of the total population in the extreme values (0 or 9); 43.5% participants had a MeDi score of 4 or 5. The mean (SD) MeDi score was 4.36 (1.67) and was slightly but significantly higher in men (4.54 (1.72) *vs* 4.25 (1.63) in women, P=0.0006). High MeDi adherence (score 6-9) was significantly more frequent in men (30.1% *vs* 23.0% in women, P=0.003). As expected, greater MeDi adherence was characterized by higher intake of vegetables, fruits, legumes, cereals and fish and lower intake of meat and dairy products (**Table 1**). Greater MeDi adherence was associated with male sex and being married (**Table 2**). Individuals in the middle or high MeDi categories had a lower mean BMI than those in the lowest category of MeDi score. Greater MeDi adherence was not associated with hypertension, hypercholesterolemia or diabetes (**Table 2**).

In men, mean EI did not significantly differ across categories of MeDi adherence (**Table 3**). However, men in the middle MeDi category (MeDi score 4-5) had a significant higher mean EI computed without alcohol than the others. Regarding total protein intake, there was no significant difference among the three MeDi categories, although the mean protein intake from vegetal origin was higher with greater MeDi adherence. The mean carbohydrate and total fat intakes did not vary with MeDi adherence. MeDi adherence was inversely associated with total SFA intake and consumption of myristic, palmitic and stearic acids in men. Total MUFA intake was higher in men in the middle and highest MeDi categories, and oleic acid intake was only higher in the middle MeDi category compared with the others. Total PUFA, notably total n-6 PUFA and linoleic acid intakes, were higher in the middle MeDi category.

Moreover, there was no association between n-3 PUFA intake and MeDi adherence in men. The consumption of alcohol was lower in men with the highest MeDi adherence (**Table 3**). Regarding the consumption of macronutrients in g/d, similar trends were observed since the MeDi adherence was positively associated with vegetal proteins, total MUFA, oleic acid, total PUFA, n-6 PUFA, and linoleic acid intakes in men. Moreover, an inverse association between total SFA and myristic acid intakes (g/d) and MeDi adherence was observed (data not shown). In men, the mean linoleic/α−linolenic acid ratio was positively associated with MeDi adherence, ranging from 8.78 (SD 5.51) among low MeDi adherents to 9.46 (SD 6.09) and 10.42 (SD 6.00) among middle and high MeDi adherents respectively (P=0.034).

In women, the total mean EI computed with or without alcohol was positively associated with MeDi adherence (**Table 3**). As expressed in percent of EI computed with alcohol (**Table 3**), MeDi adherence in women was positively associated with intake of vegetal protein, total carbohydrate, polysaccharides, total PUFA, total n-6 PUFA, linoleic acid, total n-3 PUFA, and alpha-linolenic acid, and inversely associated with total SFA and myristic, palmitic and stearic acid intake (**Table 3**). Regarding the macronutrient intake as expressed in g/d, similar trends between MeDi adherence and higher mean consumptions of total protein, total MUFA and oleic acid were observed (data not shown). In addition, the mean (SD) linoleic/α−linolenic acid ratios were statistically different among women with low, middle and high MeDi adherence (i.e. 8.46 (5.51), 10.71 (7.93) and 10.61 (7.69) respectively, P<0.0001).

Regarding micronutrient, minerals and trace elements intake (**Table 4**), there was a positive significant association between MeDi adherence and the mean consumption of fibres, vitamins B6, C, E, folates, magnesium, potassium and iron, both in men and women. In men,

there was also a significant association between carotene intake and MeDi adherence, which was not observed in women. Conversely, vitamin B1 intake was positively and significantly associated with MeDi adherence in women only. Finally, there was an inverse association between MeDi adherence and calcium intake which was the lowest in the middle and highest MeDi categories in women, while this inverse association was of borderline significance in men (**Table 4**).

DISCUSSION

This large population-based cross-sectional study in older persons living in South-western France shows a high coherence between dietary data collected by FFQ and used to assess a diet modelled on the traditional MeDi, and the nutrient intake estimated by 24 h recall. As expected, greater MeDi adherence was associated with total mean higher vegetal protein intake (% EI), lower total mean SFA intake (% EI), higher total mean PUFA intake (% EI), but also notably with total n-6 PUFA and linoleic acid intakes, both in men and women. In men, higher total mean MUFA and oleic acid intakes but less alcohol consumption (% EI) were observed with greater MeDi adherence. Total carbohydrate and polysaccharide intakes (% EI) and total mean n-3 PUFA and alpha-linolenic acid intakes (% EI) were positively associated with MeDi adherence in women but not in men. The consumption of several micronutrients, minerals and trace elements (i.e. fibres, vitamins B6, C, E, folates, magnesium, potassium and iron) increased with higher MeDi adherence, in both men and women. Only the consumption of calcium decreased with greater MeDi adherence in women and with borderline significance in men.

The concept of Mediterranean diet has been first introduced in the Seven-Country study by Keys et al. who reported low all-cause and coronary heart disease death rates in cohorts of the Mediterranean basin with olive oil as the main fat [18]. Not a specific pattern but a collection of eating habits traditionally followed by the populations of the Mediterranean basin first defined the so-called "traditional" Mediterranean diet. However, there is no single Mediterranean diet but several definitions, because dietary habits vary considerably across the Mediterranean countries bordering the sea [2, 28]. Compared with usual single-food or nutrient methods, the dietary pattern approach is appealing because analyses based on single nutrients ignore important interactions (additive, synergistic or antagonist effects) between components of diet and because people did not eat isolated

nutrients [17]. The computation of the MeDi score [35], as used in the present study, combines several foods providing nutrients which have been identified as potential protective factors against cardiovascular diseases such as fruit and vegetables, fish, as the main provider of long-chain n-3 PUFA, olive oil as main source of MUFA, and a moderate consumption of alcohol. On the other hand, higher total fat and SFA intake have been considered as harmful factors for cardiovascular diseases and related mortality [7, 20, 24].

Our findings support the presumed beneficial effects of the MeDi. Regarding macronutrients, higher adherence to a MeDi was characterized by a high intake of vegetal protein but not animal protein, complex carbohydrates hence a lower glycemic index, a low consumption of SFA whose detrimental effects are well documented – although debated [1], and a high consumption of MUFA, especially oleic acid, and PUFA. Despite a higher intake of n-3 PUFA with greater MeDi adherence, notably in women, the ratio of n-6/n-3 PUFA precursors increased with MeDi score. This may be in part due to the high proportion of consumers of oils from various vegetal origins, which are providers of linoleic acid, the precursor of n-6 PUFA. Indeed, 60% of the whole sample was regular consumers (i.e. preferred dietary fats used for dressing or cooking) of olive oil, and 44% of sunflower oil, although 32% was simultaneously regular consumers of both oils (data not shown). Hence, the ratio of n-6/n-3 PUFA precursors, high in our sample and far above the recommended value of 5 [19], might be a restriction to beneficial effects of the MeDi. Higher adherence to the MeDi was also associated with higher intake of various antioxidants (vitamins C and E, carotenes in men, and also probably polyphenols from plants although we could not ascertain their amount) which contribute to protect long-chain n-3 PUFA from lipid peroxidation. The MeDi also provided B vitamins, especially folate. Nevertheless, higher MeDi adherence is characterized by lower intake of dairy products. Therefore, the lower dietary intake of calcium associated with higher MeDi adherence in women, may be a threat to their bone health. This

finding suggests that the MeDi as presently defined may not be a universally protective diet. Refinement in the computation of the score is needed to disentangle the presumed detrimental effects of some SFA from the beneficial effects of calcium found in dairy products.

Overall, the results of the present analysis showed a high coherence between the two methodologies used in the 3C study to describe the anatomy of the Mediterranean-type diet of older participants of the 3C cohort. However, some expected associations between MeDi adherence and various nutrient intakes (for instance, total mean n-3 PUFA in men, carotene in women, vitamins D and B12) have not been highlighted. This may be due to the use of a single 24 h recall which cannot handle high intra-individual variation [11]. Thus, a reported single day of intake is unlikely to be representative of usual individual intake. However, a sufficiently large sample may allow to determine average intake of a defined subgroups [38]. Moreover, a single 24 h recall prevented us to capture the intake of nutrients which are not consumed on a daily basis, but less often. The FFQ used in the present study assessed number of servings but not portion size. The lack of consideration of amount of each food consumed may lead to consider people with same frequency of each food group of the MeDi score, and same MeDi score, as comparable, although they may have different quantitative food consumptions. We cannot exclude that the quantity of presumed protective or deleterious nutrients consumed by men and women with a similar MeDi score may differ, which reduced our chance to evidence associations between food and nutrient intakes. Finally, alcohol was an important component of total EI, notably in men [11], leading us to consider this nutrient provider of energy in the computation of the total EI in the present analysis. However, a low-to-moderate alcohol consumption is also one of the 9 components of the MeDi score, which may have added bias in the present study.

Analyses of single nutrients using 24 h dietary recalls could help understanding specific mechanisms involved in physio-pathological processes leading to diseases, by

establishing biological plausibility. Therefore, the biological basis for the well documented health benefits of the MeDi involves a decrease in oxidative stress and inflammation which also participates in the dysregulation of cellular function, the exacerbation of degenerative diseases, such as cardiovascular diseases or atherosclerosis [5, 7, 20, 31]. Individuals with higher MeDi adherence have been shown to have higher reduced–to-oxidized glutathione ratio, and lower insulin resistance, oxidized low-density lipoprotein, C-reactive protein and interleukin-18 levels [3, 9, 15]. It has been hypothesized that the n-3 PUFA and a balanced n-6/n-3 PUFA ratio associated with a high intake of antioxidant in the MeDi could be important determinants in influencing cardiovascular and cerebral diseases [14, 21, 27]. In the current study, participants with lower MeDi adherence exhibited also greater BMI. Surprisingly, there was no apparent vascular benefits of a greater MeDi adherence in the current sample where the prevalence of hypertension, hypercholesterolemia and diabetes did not differed across MeDi categories. This has already been observed in similar samples of elderly people involved in the 3C study, who exhibited a global healthy lifestyle [13, 33]. Finally, the computation of the MeDi score able to assess associations between a diet modelled on the traditional MeDi, but which is specific to the sample studied. Indeed, the use of sex-specific cut-off points does not measure adherence to a universal traditional MeDi pattern but rather to a specific pattern, which precludes generalising results of the present study to other populations who have on the whole different food intake and MeDi adherence [4]. Moreover, including only 9 food groups, the MeDi score does not consider the overall correlation between all foods [17], among which some food groups could reflect specific health concerns and behaviours, such as the consumption of dietary supplements. Despite these limitations, the strengths of the present study are its sample size, the population-based design, and the accuracy of food-intake assessment which validates the methodology employed.

In conclusion, this study conducted in French elderly community dwellers allowed to describe the basis of their Mediterranean-type diet and the actual consumption of nutrients associated with MeDi adherence. As residual confounding by other aspects of lifestyle cannot be ruled out, these nutrients probably do not fully explain the better health of persons who adhere to this MeDi but they likely contribute directly. At least regarding clinical parameters, old consumers conform with MeDi have only a lower BMI and no adverse effects of an elevated n-6/n-3 PUFA ratio. This dietary pattern may indirectly constitute an indicator of a complex set of favorable social and lifestyle factors that contribute to global better health. Indeed, food choices and dietary habits which reflect individual food preferences are highly sensitive to culture, education, socio-economic status, socio-demographic characteristics, environmental and lifestyle determinants, as well as to age- or nutrition- related diseases [10].

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Table 1. Mean number of servings per week for individual food categories, proportion of mild-to-moderate alcohol consumers and mean ratio of daily intake of MUFA-to-SFA by categories of Mediterranean Diet score among older persons living in Bordeaux, The Three-City study (2001-2002). (N=1595)

	Low Category (MeDi Score 0-3) n=492	Middle Category (MeDi Score 4-5) n=693	High Category (MeDi Score 6-9) n=410
Food Categories [†]			
Mean serving/week (SD)			
Dairy products	20.65 (8.02)	18.08 (7.69) *	16.14 (6.71) *[‡]
Meat	5.36 (2.59)	4.80 (2.41) *	4.18 (2.22) *[‡]
Vegetables	15.56 (6.41)	19.37 (7.11) *	23.44 (6.61) *[‡]
Fruits	10.66 (6.79)	13.84 (6.55) *	16.45 (6.50) *[‡]
Legumes	0.42 (0.68)	0.62 (0.62) *	0.82 (0.65) *[‡]
Cereals	19.78 (6.52)	22.16 (5.76) *	24.54 (5.48) *[‡]
Fish	2.02 (1.49)	2.91 (1.69) *	3.76 (1.73) *[‡]
Mild-to-moderate alcohol (%)	14.63	25.40 *	46.10*[‡]
MUFA-to-SFA ratio, Mean (SD)	0.77 (0.26)	0.88 (0.32) *	1.00 (0.31) *[‡]

Abbreviations: MeDi Mediterranean diet; MUFA-to-SFA Monounsaturated fatty acid-to-saturated fatty acid ratio (intake g/d)

[†]All P values <.0001 for the analysis of variance (ANOVA) or for the Chi-Square test (proportion of mild-to-moderate alcohol consumers) among categories of Mediterranean diet score.

* 2X2 significant comparisons (P<0.05) for mean number of servings per week for individual food categories, proportion of mild-to-moderate alcohol consumers and mean ratio of daily intake of MUFA-to-SFA between categories of Mediterranean diet score taking the lowest category as reference group or [‡]between individuals in middle and high categories of Mediterranean diet score.

Table 2. Demographic and clinical characteristics by categories of Mediterranean diet score among older persons living in Bordeaux, The Three-City study, 2001-2002 (N=1595)

	Low Category (MeDi Score 0-3) (n=492)	Middle Category (MeDi Score 4-5) (n=693)	High Category (MeDi Score 6-9) (n=410)	P
Demographic characteristics				
Age, (n) mean (SD),y	(492) 76.4 (5.1)	(693) 76.2 (5.1)	(410) 75.8 (4.7)	.13
Women, (n) %	(325) 66.1	(436) 62.9	(227) 55.4	.003
Education, (n) %				.11
no or primary school	(182) 37.1	(221) 32.1	(125) 30.7	
secondary	(136) 27.8	(192) 27.9	(106) 26.0	
high school	(102) 20.8	(143) 20.8	(90) 22.1	
university	(70) 14.3	(133) 19.3	(86) 21.1	
Monthly income (€), (n) %				.06
refused to answer	(40) 8.1	(55) 7.9	(26) 6.3	
< 750	(36) 7.3	(53) 7.7	(22) 5.4	
750-1500	(168) 34.1	(202) 29.1	(109) 26.6	
1500-2250	(122) 24.8	(166) 24.0	(111) 27.1	
> 2250	(126) 25.6	(217) 31.3	(142) 24.6	
Marital Status, (n) %				.0006
married	(237) 48.2	(371) 53.5	(257) 62.7	
divorced/separated	(43) 8.7	(49) 7.1	(29) 7.1	
widowed	(183) 37.2	(227) 32.8	(97) 23.7	
single	(29) 5.9	(46) 6.6	(27) 6.6	
Clinical characteristics				
BMI, (n) mean (SD)	(480) 26.9 (4.8)	(676) 25.2 (4.1)*	(408) 26.1 (3.7)*	.01
Hypertension, (n) %	(371) 75.9	(529) 76.6	(322) 78.5	.62
Hypercholesterolemia, (n) %	(257) 56.0	(372) 57.8	(237) 59.9	.52
Diabetes, (n) %	(55) 11.2	(64) 9.2	(35) 8.6	.36

Abbreviations: MeDi Mediterranean diet, BMI, Body Mass Index

P value for the Chi-Square test or analysis of variance (ANOVA) among categories of Mediterranean diet score

* 2X2 significant comparisons (*P*<0.05) for means of age and BMI between categories of Mediterranean diet score taking the lowest category as reference group

Table 3: Energy, macronutrient and alcohol intakes as expressed in proportion of energy intake by categories of Mediterranean diet score among older persons living in Bordeaux, The Three-City study, 2001-2002 (N=1595)

	Men				Women			
	Low MeDi category (score 0-3) n=167	Middle MeDi category (score 4-5) n=257	High MeDi category (score 6-9) n=183	*P*	Low MeDi category (score 0-3) n=325	Middle MeDi category (score 4-5) n=436	High MeDi category (score 6-9) n=227	*P*
Total energy intake, kcal, mean (SD)	1967 (555)	2058 (533)	2004 (498)	0.19	1453 (457)	1540 (449)*	1585 (467)*	0.002
Energy intake without alcohol, kcal, mean (SD)	1786 (516)	1909 (510)*	1873 (494)	0.049	1400 (441)	1492 (435)*	1538 (451)*	0.0007
Nutrient intake, mean (SD) [a]								
Proteins	17.1 (4.6)	17.3 (4.2)	17.3 (4.2)	0.85	18.6 (5.1)	18.5 (5.0)	18.3 (4.7)	0.77
Animal proteins	12.3 (4.8)	12.2 (4.4)	12.1 (4.6)	0.89	13.9 (5.4)	13.3 (5.4)	12.8 (5.0)	0.07
Vegetal proteins	4.8 (1.5)	5.1 (1.3)	5.3 (1.5)*	0.005	4.7 (1.6)	5.1 (1.6)*	5.5 (1.7)*	<0.0001
Carbohydrates	44.5 (10.0)	44.3 (10.0)	46.1 (9.3)	0.14	46.1 (10.0)	46.9 (9.9)	48.2 (9.6)*	0.044
Mono/disaccharides	20.0 (10.3)	18.7 (8.0)	20.0 (6.7)	0.18	23.3 (9.8)	22.6 (8.1)	23.1 (8.0)	0.50
Polysaccharides	24.5 (8.4)	25.6 (7.3)	26.1 (7.4)	0.16	22.8 (8.7)	24.3 (8.4)*	25.2 (8.0)*	0.003
Total Fat	29.7 (8.3)	31.2 (8.7)	30.0 (8.6)	0.13	31.9 (9.2)	31.6 (8.8)	30.6 (8.9)	0.26
Total SFA	13.6 (4.3)	13.4 (4.3)	11.9 (4.1)*‡	<0.0001	14.8 (5.1)	13.4 (4.6)*	11.9 (4.1)*‡	<0.0001
Myristic acid	1.58 (0.75)	1.49 (0.70)	1.22 (0.64)*‡	<0.0001	1.78 (0.89)	1.48 (0.76)*	1.20 (0.62)*‡	<0.0001
Palmitic acid	6.64 (2.18)	6.59 (2.22)	6.12 (2.26)*‡	0.042	7.21 (2.60)	6.66 (2.52)*	6.15 (2.36)*‡	<0.0001
Stearic acid	2.97 (1.22)	2.87 (1.27)	2.58 (1.17)*‡	0.0007	3.06 (1.29)	2.86 (1.37)	2.56 (1.19)*‡	<0.0001
Total MUFA	10.2 (3.7)	11.3 (4.1)*	11.2 (4.1)*	0.01	10.9 (3.9)	11.2 (4.1)	11.5 (4.1)	0.23
Palmitoleic acid	0.72 (0.45)	0.78 (0.63)	0.78 (0.71)	0.51	0.80 (0.60)	0.83 (0.83)	0.74 (0.67)	0.32
Oleic acid	8.70 (3.44)	9.73 (3.95)*	9.60 (3.82)	0.017	9.37 (3.67)	9.63 (3.85)	10.04 (3.95)	0.13
Total PUFA	3.8 (2.1)	4.3 (2.6)	4.7 (2.3)*	0.004	3.9 (2.1)	4.6 (2.6)*	5.0 (3.2)*	<0.0001
Total n-6 PUFA	2.9 (1.9)	3.4 (2.3)	3.7 (2.1)*	0.005	2.9 (2.0)	3.6 (2.4)*	3.8 (2.8)*	<0.0001
Linoleic acid	2.85 (1.87)	3.28 (2.31)	3.58 (2.12)*	0.006	2.84 (2.01)	3.49 (2.40)*	3.76 (2.80)*	<0.0001

Arachidonic acid	0.07 (0.07)	0.08 (0.08)	0.09 (0.09)	0.13	0.09 (0.10)	0.09 (0.09)	0.09 (0.09)	0.81
Total n-3 PUFA	0.6 (0.5)	0.6 (0.6)	0.7 (0.6)	0.36	0.6 (0.7)	0.7 (0.8)	0.8 (0.8)*	0.041
a-Linolenic acid	0.37 (0.25)	0.42 (0.39)	0.40 (0.28)	0.32	0.37 (0.19)	0.39 (0.32)	0.44 (0.44)*	0.03
EPA	0.07 (0.17)	0.06 (0.15)	0.08 (0.18)	0.39	0.06 (0.19)	0.08 (0.21)	0.09 (0.18)	0.26
DHA	0.12 (0.29)	0.12 (0.31)	0.17 (0.40)	0.24	0.14 (0.41)	0.16 (0.40)	0.20 (0.42)	0.23
Alcohol	9.0 (7.7)	7.2 (6.1)	6.6 (5.9)*	0.007	3.5 (4.8)	3.0 (4.3)	2.9 (4.2)	0.23

Abbreviations: MeDi Mediterranean diet; SFA saturated fatty acids; MUFA monounsaturated fatty acid; PUFA polyunsaturated fatty acid; EPA eicosapentaenoic acid; DHA docosahexaenoic acid

[a] Expressed as % of energy intake (computed with alcohol)

P-value for the ANOVA comparing energy intake, macronutrient and alcohol intakes in g/d among the three Mediterranean Diet Score categories

* 2X2 significant comparisons (*P*<0.05) for means of nutrient intake between categories of Mediterranean diet score taking the lowest category as reference group or [‡]between individuals in middle and high categories of Mediterranean diet score.

Table 4: Micronutrient intakes, as expressed in mg/d, by categories of Mediterranean diet score among older persons living in Bordeaux, The Three-City study, 2001-2002 (N=1595)

	Men				Women			
	Low MeDi category (score 0-3) n=167	Middle MeDi category (score 4-5) n=257	High MeDi category (score 6-9) n=183	*P*	Low MeDi category (score 0-3) n=325	Middle MeDi category (score 4-5) n=436	High MeDi category (score 6-9) n=227	*P*
Nutrient intake, mean (SD) [a]								
Miconutrients								
Carotenes	2.97 (4.59)	3.06 (4.07)	4.58 (6.67)*‡	0.003	3.60 (5.65)	3.38 (5.11)	3.73 (4.72)	0.69
Fibres	16.82 (7.20)	20.28 (8.24)*	21.47 (8.01)*	<0.0001	13.88 (6.88)	16.41 (6.89)*	18.20 (8.07)*‡	<0.0001
Retinol	708.1 (1851.6)	644.1 (1545.2)	736.7 (2021.0)	0.85	840.7 (4652.4)	628.5 (2621.7)	607.4 (1828.3)	0.62
Vitamin B1	1.08 (0.41)	1.15 (0.52)	1.17 (0.44)	0.20	0.88 (0.39)	0.95 (0.40)	1.01 (0.41)*	0.0008
Vitamin B2	1.69 (0.66)	1.72 (0.63)	1.68 (0.66)	0.85	1.50 (0.81)	1.46 (0.75)	1.50 (0.66)	0.76
Vitamin B5	4.31 (1.76)	4.56 (1.59)	4.60 (1.71)	0.20	3.76 (1.94)	3.85 (1.68)	4.05 (1.72)	0.17
Vitamin B6	1.52 (0.54)	1.69 (0.62)*	1.68 (0.58)*	0.008	1.22 (0.51)	1.34 (0.53)*	1.42 (0.58)*	0.0001
Folates	271.3 (119.9)	305.2 (128.7)*	325.9 (144.5)*	0.0005	230.8 (125.9)	257.9 (119.8)*	294.0 (143.6)*‡	<0.0001
Vitamin B12	6.17 (10.39)	5.91 (8.19)	6.00 (10.23)	0.96	5.45 (12.78)	5.44 (12.20)	5.23 (0.64)	0.97
Vitamin C	74.7 (63.6)	84.74 (60.52)	95.25 (67.72)*	0.011	74.05 (57.53)	82.16 (57.01)	92.10 (66.30)*	0.002
Vitamin D	1.68 (1.91)	2.13 (3.11)	1.78 (2.15)	0.16	1.55 (2.70)	1.64 (2.96)	1.71 (2.93)	0.79
Vitamin E	5.72 (4.99)	7.02 (4.17)*	8.59 (5.58)*‡	<0.0001	5.10 (3.47)	6.39 (4.63)*	6.86 (4.30)*	<0.0001
Minerals and trace elements								
Calcium	947.7 (481.9)	953.7 (433.6)	862.1 (415.7)	0.07	892.9 (471.9)	810.2 (402.1)*	773.5 (381.4)*	0.002
Phosphorus	1.24 (0.42)	1.27 (0.39)	1.22 (0.35)	0.38	1.02 (0.39)	1.03 (0.36)	1.04 (0.36)	0.87
Magnesium	276.0 (78.5)	294.7 (83.3)	301.2 (80.0)*	0.01	221.0 (71.5)	235.1 (74.8)*	252.6 (83.7)*‡	<0.0001
Potassium	2.90 (0.88)	3.04 (0.86)	3.13 (0.83)*	0.04	2.37 (0.76)	2.52 (0.83)	2.72 (0.88)*‡	<0.0001
Iron	12.53 (5.56)	13.01 (4.71)	14.44 (8.14)*	0.01	8.79 (4.53)	9.73 (4.76)*	10.88 (5.62)*‡	<0.0001
Zinc	6.41 (4.98)	7.24 (5.27)	7.21 (5.76)	0.24	7.30 (7.51)	7.53 (7.19)	8.40 (7.42)	0.20

Abbreviations: MeDi Mediterranean diet

[a] Expressed as mean intake in mg/d except for fibres, sodium, phosphorus and potassium, both expressed in g/d, and for retinol, vitamin D and folates, both expressed in µg/d

P-value for the ANOVA comparing energy, macronutrient, alcohol and micronutrients intakes among the three Mediterranean Diet Score categories

* 2X2 significant comparisons (*P*<0.05) for means of energy and nutrient intake between categories of Mediterranean diet score taking the lowest category as reference group or [‡]between individuals in middle and high categories of Mediterranean diet score.