Nutrient intake in an elderly population in Southern France (POLANUT): deficiency in some vitamins, minerals and ω3 PUFA.

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Running title: Nutrient deficiency in a French aged population.

Keywords: nutrition surveys; aged; fatty acids; vitamins.

Abstract

Objective: Evaluation of the nutritional status of an elderly cohort from a French Mediterranean area.

Design: Cross-sectional nutritional assessment in the framework of the population-based POLA cohort.

Subjects and methods: 832 subjects aged 70 years or more answered a 165 items semi-quantitative food frequency questionnaire. Mean Nutritional Need (MNN) was defined as 77 % of the French Recommended Daily Allowance (RDA). The risk for clinical deficiency (CD) was defined as intakes lower than the Limit Threshold Intake (70 % of the MNN).

Results: Consumption was characterised by an excess of saturated fatty acids (SFA) (95.4 % of subjects above the RDA) and a deficit of ω 3 polyunsaturated fatty acids (PUFA) (60.1 % and 46.9 % of subjects at risk for CD for alpha-linolenic (ALA) and long chain ω 3 PUFA, respectively). Median intakes of fibre, vitamins B6, B9, D, calcium and magnesium were below the RDA. Dairy products were the first providers of SFA, nuts of ALA and fish of long chain ω 3 PUFA and vitamin D.

Conclusion: The study identified an unbalanced food intake, with an excess of mammal animal products, mainly of dairy products, and a deficit of fish and vegetal foods. This resulted in a deficiency in some vitamins, minerals and ω 3 PUFA.

Introduction

The demographic trend towards longer life expectancy makes the prevention of degenerative diseases a public health priority in developed countries. Nutrition is a major tool to achieve such a goal. But a decline with age was observed in most nutrient intakes and a substantial number of older Americans (10%) were found to consume only one fifth or one third of the recommended dietary allowance (RDA) [1]. In the last few years, surveys of aged populations have been conducted in Australia [2], France [3], Germany [4] and in Italy [5]. In an Italian elderly rural population Correa Leite et al [5] found a high proportion (about half) of "small eaters" at risk of undernutrition and showed that the elderly Italians combine the typical elements of the Mediterranean diet (high intake of olive oil, fruit and vegetables) with those of the "wealthy" diet (high in fats and free sugars, low in complex carbohydrates). Since we have observed a disappearance of Mediterranean food habits, recognised as beneficial for health [6], in previous studies in subjects of Southern France aged 20 to 75 years [7, 8], evaluation of the nutritional status of an over 70 years cohort in this region appeared as a public health objective.

We took advantage of the POLA study implemented to investigate age-related eye diseases and their risk factors [9]. Nutritional information was then elicited from this population sample.

Thus, the aim of this paper is to assess the level of deficiency and malnutrition in a Southern French aged population and to identify foods contributing to the nutrient intakes in order to recommend a more balanced diet.

Subjects and methods

Study population

Recruitment of the population sample has already been published elsewhere [10, 11]. Briefly, inclusion criteria were: 1) being a resident of Sète, located on the French Mediterranean coast, 2) being aged 60 years or over on the day of the baseline examination.. In 2002-2003, six years after the baseline examination, surviving participants aged 70 years or more were invited to participate in a dietary survey (POLANUT Study). Of these 1393 subjects, 832 (59.7 %) participated in the POLANUT study. Fifty-six (4.0 %) subjects had moved out of the area, 57 (4.1 %) were in physical incapacity to participate, 423 refused (30.4 %) and 25 (1.8 %) could not be located. The design of this study has been approved by the Ethical Committee of Montpellier's University Hospital.

Dietary Assessment

Nutritional data were collected using a validated food frequency questionnaire (FFQ) that recorded the usual food intakes for the last year [12-14]. The interview was conducted by trained dieticians and lasted 45 to 60 minutes. The FFQ consists of 165 items and portions were estimated using a validated set of photographs [12-14]. It was arranged by food type and meal pattern. In the analysis the intakes were expressed in daily consumption in grams. The relevant period of consumption of seasonal items (e.g. cantaloupe melons, grapes, figs, strawberries), has been taken into consideration by dividing the item weight by the fraction of the year corresponding to the length of the season in months, as defined by national data [15]. Food composition table was REGAL [16] (Ciqual) expanded with carotenoid [17] and fatty acid contents from the SU.VI.MAX table [18].

Of the 832 subjects with dietary questionnaire, we excluded 20 subjects (2.4 %) with total energy intake lower than 3300 kJ/day or above 12500 kJ/day, leaving 812 subjects for statistical analysis.

Interview data

A standardized interview was performed to assess, in particular, socio-demographical variables, medical history, medications currently used and smoking. The interviewer measured height, weight (measured in light clothing), waist and hip circumferences, systolic and diastolic blood pressures.

Overweight was defined by a BMI between 25 and 30 kg/m^2, and obesity as a BMI greater or equal to 30 kg/m^2. At-risk waist circumference was defined by waist circumference greater than 102 cm for men and 88 cm for women.

Statistical analysis

Differences in nutrient intakes between men and women were tested using an analysis of variance for nutrients expressed as % of total energy intake (TEI) and an analysis of covariance adjusted on TEI for nutrients expressed in absolute units.

To analyse the percentage of population at risk of deficiency according to the nutrient intakes, the analysis was conducted in 3 steps: for all nutrients, we estimated the theoretical risk by the ratio of the median intake of the nutrient in the population to the RDA expressed as %. We used the RDA for the French population, using values for the elderly, when different from those of middle aged subjects [19]. A ratio< 70 % indicates a high risk of deficiency in the considered population, a ratio between 70 % and 90 % indicates that a risk might exist and a ratio >120 % an excess of intake. Then for the nutrients >120 %, we calculated the % of subjects above the RDA. For the others, we calculated the proportion of subjects below the mean nutritional need (MNN= 0.77 RDA), which best represents the individual need, and the lowest threshold intake (LTI) [20], defined as 0.7 MNN, which identifies possible clinical deficiency.

In order to adapt nutritional recommendations to the specific situation of our population, food items contributing to excessive (median intake ≥ 120% of RDA) and deficient (median intake ≤ 90% of RDA) intakes were identified. The analysis of contributions used the food groups shown in Annex 1.

Results

By comparison with the whole eligible population, our sample under-represents older persons (29.6% vs. 39.8% over 80 year old in participants and non participants respectively) and slightly over-represents the middle and upper social classes. No differences were observed for nutrition and health-related variables such as body mass index, waist circumference, hospitalisation, chronic diseases or smoking. Table 1 displays the characteristics of the participants by gender. At the time of nutritional evaluation men and women reported in the same proportion hospitalisation during the preceding year (27.5% and 24.5%, respectively) and hypertension (46.2 and 47.8 %, respectively). With respect to BMI, men were more overweight than women (50.3 vs. 37.1%); the proportion of obese subjects was similar in both genders, whereas that of at risk–waist circumference was higher in women (40.2 vs. 48.1 %). Concerning subjects at risk of undernutrition one man and nine women had a BMI below 18.5 and three men and 12 women had a BMI between 18.5 and 20.

Energy and macronutrient consumption is reported in table 2 for men and women. The median intake of energy appeared somewhat low in both gender, mainly because of globally low carbohydrate intake, median intake of carbohydrate representing 81 % of RDA (RDA for French elderly: 55% of TEI). This was mainly due to low intake of complex carbohydrates, whereas intake of simple sugars was much higher than recommended, 203 % of RDA

(RDA equal to 10% of TEI). While total protein and lipid intakes were close to the recommendations (RDA: 12% and 33% of TEI, respectively), the balance of lipid intake was not respected. The median intake of saturated fatty acids (SFA) and ω6 polyunsaturated fatty acids (PUFA) were over the recommended amount (RDA: 8% and 4% of TEI, respectively), whereas those of mono-unsaturated fatty acids (MUFA) and ω 3 PUFA were below the recommended amount (RDA: 20% and 0.8% of TEI, respectively). The percentage of trans-FA (TFA) was within an acceptable range. As expected, energy intake was higher in men, mainly because of a higher intake of simple and complex carbohydrates. They also had higher intakes of long chain (LC) ω 3 PUFA, and cholesterol. Women consumed more simple sugars as a percentage of TEI. Alcohol intake was more than twice higher in men than in women, and mainly resulted from wine consumption in both genders.

Micronutrient intake is reported in Table 3 for men and women. After adjustment for TEI, iron was the only micronutrient with a higher consumption in men than in women, whereas women consumed more vitamins B6, B9, C, E, calcium and potassium than men.

The estimation of theoretical risk identifies the nutrients for which important proportions of the population may have inadequate intakes, either because of too high or too low consumption. Thus for those nutrients which showed a ratio median/RDA above 120%, we computed the proportion of subjects above the RDA. 95.4 % of the subjects consumed more than the RDA of SFA (8% TEI) and in 93.2 % the ratio ω 6/ ω 3 PUFA was > 5 (RDA). It has been debated whether TEI from proteins above 12% (animal proteins representing 1/3 of the total protein intake for an appropriate balance), TEI from ω 6 PUFA above 4%, and TEI from simple sugars above 10% are deleterious. In the present study, 99% of the subjects were above the 4% RDA for animal proteins, 79% above the 4% RDA for ω 6 PUFA intake and 98% above the 10% for simple sugars. Although vitamin B12 has no recommended upper limit of intake, the fact that 94.3 % of the population intake was above the RDA also indicates a large animal source of food intake in this population (Median intake: 270.5 % of RDA).

Table 4 describes the distribution of the population below MNN and LTI. An important deficit was observed for alphalinolenic acid (ALA) and LCω3 PUFA, with about 50% of the subjects at risk of clinical deficiency. About 66% of the population sample showed a fibre intake below the MNN. Vitamins A and B12, carotenoids and potassium do not appear in the table because their median intake expressed as % of RDA was above 120%. For vitamins B6 and B9, 1/5 and 1/4 of the population were at risk for clinical deficiency. Risk of clinical deficiency was around 10% for vitamins E and C. With respect to iron, calcium and magnesium, 2%, 17% and 22% were at risk of clinical deficiency respectively. The highest risk was related to vitamin D, with only 1% of the sample out of risk for clinical deficiency.

Dairy products appeared as major contributors of both SFA and proteins and consequently of animal proteins (Figures 1A and 1B). They were also the 3rd contributor of simple sugars (14%) behind confectionery (15%) and fruits (24%) and the first contributor of calcium (57%). Cheeses, which contribute for 19 % to SFA intake, were also the 3rd contributor of ALA, after nuts and dried fruits, and olive oil (Figure 1C). 83% of the LCω 3 FA were provided by fish and seafood. ω 6 FA were provided by sunflower oils for 47%, followed by other oils and margarine (14%), whereas nuts and olive oil were modest contributors (7.3 and 6.6%, respectively). For the other micronutrients which were deficient, their main providers were fruits and vegetables: between 37% (vitamin B6) and 55 % (vitamin B9) and, when including cereals, up to 73% (fibre). Regarding magnesium, contributors were more numerous (Figure 1D) with a mixture of animal and vegetal products. For vitamin D, the main providers were fish (54%), followed by eggs (13%) and omega 6 oils (7%), all others foods contributing to less than 5%.

Discussion

This study allowed an estimation of the actual risk faced by an elderly Southern French population with regard to clinical deficiency of essential fatty acids, vitamins and minerals but also with regard to nutritional factors associated with chronic degenerative disease development, the major cause of mortality after 65 years. Moreover, qualitative nutritional factors might be a cause of handicap in ageing [21]. Foods contributing to the excess or to the lack of nutrients were identified in order to provide basis for nutritional recommendations.

This study shows that the POLANUT sample suffers more of an unbalanced food intake -too much simple sugars, saturated fatty acids, not enough ω3 PUFA, vitamin D, fibre and vitamin B9, and to a lesser extent in decreasing order, vitamins B6, magnesium, and calcium - than of under nourishment: the risk of clinical deficiency was very limited, less than 25%, and MNN was covered in about half of the population, except for vitamin D, which may be somewhat compensated by sunshine exposure in this Southern region. In addition it is a community dwelling cohort living in an affluent environment in a country where life expectancy is especially high. This might explain why our results differ from the observations of hospital geriatricians.

Our study has several limitations. Firstly, in our sample, middle and upper classes were overrepresented, which may have biased our estimates. However, although in lower quantity, the relative proportions of nutrient intakes and anthropometric measures were quite comparable to that of a representative sample of the same region (aged 20 to 75) surveyed at the end of the 90s [8], confirming the loss of Mediterranean food habits in this area of Southern France to the benefit of Western food profile.

The validity of our data might also be questioned since nutritional assessment faces usual types of errors, in particular being based on self-declaration. However the FFQ has been validated [12-14] and used in several previous studies [8, 22, 23]. Our questionnaire was mainly focused on consumption of vegetal food with 27 questions on vegetables and legumes and 28 questions on fresh, canned, juice and dried fruits, ensuring a large coverage of the intake. Furthermore in this study, trained dieticians conducted the interview.

In order to correct for the unbalanced food habits observed in this and other studies [8] from this area of France a diet higher in vegetable content needs to be promoted in order to prevent the risk for vitamin B6, B9, fibre, and magnesium deficiency. With regard to fatty acids, a higher consumption of olive oil should be recommended. Rapeseed oil may also be advised to replace sunflower oil. The need for LCω 3 PUFA, provided mainly by fish, is reinforced by the recent studies showing the relationship of these FA with chronic degenerative diseases [24, 25] and especially age-related neurodegenerative diseases [26-28]. Increasing fish intake would also help preventing deficiency in vitamin D, which is extremely prevalent in this population.

Finally, whereas there is a tendency to recommend high intake of animal protein and dairy products in elderly, our study indicates that this must be done with caution and that the characteristics of the animal products to be consumed preferentially needs to be taken into account: fish intake should be increased (for LCω 3 PUFA as well as for vitamin D intake) and the choice of dairy products modified in favour of low-fat dairy products, yoghourts and cottage cheese types, in order to decrease SFA intake. Although this may lead to a slight decrease in calcium intake, balanced intake of other minerals (potassium, magnesium), fruit and vegetables as large and diversified sources of micronutrients, a moderate sun exposure and physical exercise are recognised as important components of osteoporosis prevention [29]. Considering the findings of the POLANUT sample, it might be worthwhile to reconsider the usual guidelines in that direction, given the importance of these nutrients in successful ageing.

Several difficulties related to this type of intake have to be taken into consideration: difficulty of absorption, of digestion and of purchasing. The first ones may be overcome by recommending easily acceptable recipes; the last one necessitates an adaptation of ready to use and out of the shelf foods appropriate for the elderly.

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Title and legend to figure 1

Title:

Percentages of foodstuff contributions to nutrient intakes.

Legend:

A: protein. B: saturated fatty acids (SFA). C: α-linolenic acid (ALA). D: Magnesium

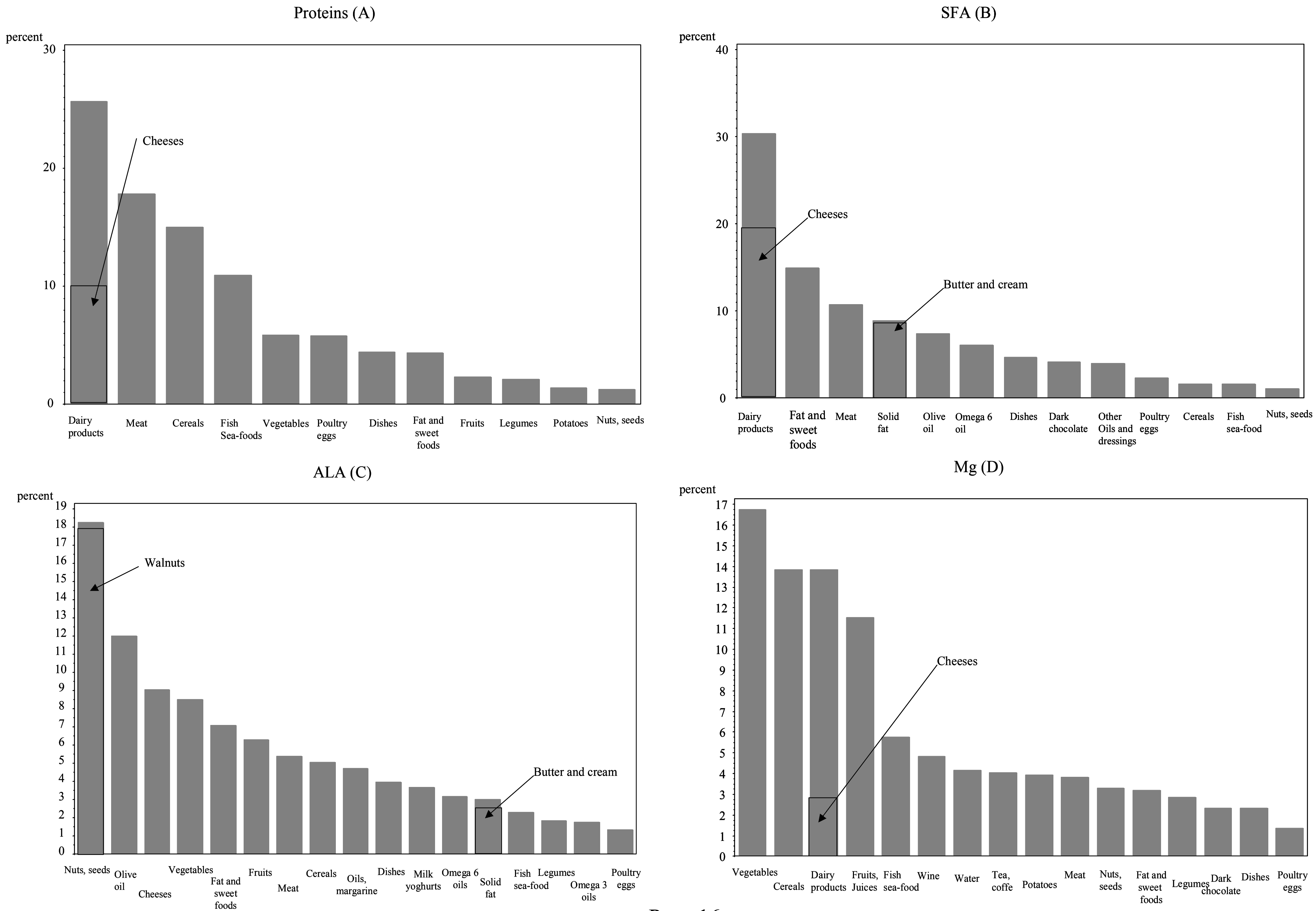
Proteins (A)
percent
30
20
10
0
Cheeses
Dairy products
Meat
Cereals
Fish Sea-foods
Vegetables
Poultry eggs
Dishes
Fat and sweet foods
Fruits
Legumes
Potatoes
Nuts, seeds
SFA (B)
percent
40
30
20
10
0
Cheeses
Butter and cream
Dairy products
Fat and sweet foods
Meat
Solid fat
Olive oil
Omega 6 oil
Dishes
Dark chocolate
Other Oils and dressings
Poultry eggs
Cereals
Fish sea-food
Nuts, seeds
ALA (C)
percent
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Walnuts
Butter and cream
Nuts, seeds
Olive oil
Cheeses
Vegetables
Fat and sweet foods
Fruits
Meat
Cereals
Oils, margarine
Dishes
Milk yoghurts
Omega 6 oils
Solid fat
Fish sea-food
Legumes
Omega 3 oils
Poultry eggs
Mg (D)
percent
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Cheeses
Vegetables
Cereals
Dairy products
Fruits, Juices
Fish sea-food
Wine
Water
Tea, coffe
Potatoes
Meat
Nuts, seeds
Fat and sweet foods
Legumes
Dark chocolate
Dishes
Poultry eggs

Table 1: Sample characteristics of the participants according to gender

Characteristics	Men n=346	Women n=466	Chi2 test p
Age (years)			
median	76.7	77.7	0.02[a]
5°-95° percentiles	71.6-86.8	71.7-88.2	
Body mass index (kg/m^2)			
< 25	34.4	48.1	
25-30	50.3	37.1	0.002
≥ 30	15.3	14.8	
Waist circumference (cm)			
> 102 for men, > 88 for women	40.2	48.1	0.03
Housing			
Alone	18.8	51.5	
With family members	78.9	45.5	< 0.0001
Institutionalised	2.3	3.0	
Hospitalised during the last year	27.5	24.5	0.33
Self-reported hypertension	46.2	47.9	0.65
Self-reported coronary heart disease	15.4	9.9	0.02
Self-reported thyroid disease	2.0	13.9	< 0.001
Smoking status			
Former smoker	66.2	9.6	
Current smoker	6.9	2.8	
Never smoker	26.9	87.6	< 0.0001

[a]Wilcoxon's test

Table 2: Daily macronutrient intakes according to gender in the POLANUT Study (2002-2003)

	Men			Women			p	RDA
	median	5%	95%	median	5%	95%		
Total energy with alcohol (kJ)	7516	5175	11002	5944	3974	9154	$p < 0.0001$	
Total energy without alcohol (kJ)	7027	4640	10341	5793	3859	8903	$p < 0.0001$	
Total proteins (g)	63.37	41.56	93.84	52.61	32.66	83.80	p=0.09	
Total proteins (%TEI[a])	14.81	11.32	19.60	15.19	11.11	19.91	NS	12%
Carbohydrates (g)	185.90	115.40	304.00	154.20	90.56	252.50	NS	
Carbohydrates (%TEI[a])	45.03	32.54	56.98	44.57	32.79	55.32	NS	55%
Lipids (g)	72.62	41.07	118.10	60.39	33.88	102.40	NS	
Lipids (%TEI[a])	38.85	26.85	51.49	38.14	27.38	50.97	NS	33%
Animal protein (g)	37.80	22.30	63.61	33.74	17.81	57.63	NS	
Animal protein (%TEI[a])	9.02	5.67	14.69	9.57	5.50	14.72	p=0.06	4%
Saturated fatty acids (g)	22.63	11.03	42.81	18.84	10.24	33.61	NS	
Saturated fatty acids (%TEI[a])	12.37	8.15	18.07	12.34	8.05	17.37	NS	8%
Trans fatty acids (g)	1.74	0.73	3.54	1.42	0.66	2.84	NS	
Trans fatty acids (%TEI[a])	0.91	0.48	1.60	0.91	0.50	1.56	NS	2%
Monounsaturated fatty acids (g)	27.90	15.45	50.39	22.78	11.89	42.90	NS	
Monounsaturated fatty acids (%TEI[a])	14.81	9.52	23.21	14.51	9.65	22.91	NS	20%
Omega-6 PUFA[b] (g)	11.34	4.79	28.15	9.59	3.81	27.14	NS	
Omega-6 PUFA[b] (%TEI[a])	5.85	2.94	15.26	6.22	2.86	16.34	NS	4%
Omega-3 PUFA[b] (g)	1.10	0.57	2.24	0.85	0.44	1.93	NS	
Omega-3 PUFA[b] (%TEI[a])	0.58	0.37	1.10	0.56	0.34	1.01	p=0.06	
Omega-6/omega-3 ratio	9.33	4.71	30.70	10.20	4.74	37.45	p=0.08	5
Alpha-linolenic acid (g)	0.78	0.43	1.74	0.61	0.32	1.48	NS	
Alpha-linolenic acid (%TEI[a])	0.40	0.27	0.82	0.40	0.25	0.77	NS	0.8%
EPA + DHA (g)	0.22	0.08	0.66	0.17	0.05	0.53	p=0.03	
EPA + DHA (%TEI[a])	0.12	0.04	0.35	0.11	0.03	0.34	p=0.04	0.2%
Cholesterol (mg)	218.40	115.90	405.10	176.10	86.24	318.60	p=0.03	300
Simple carbohydrates (g)	79.35	39.07	160.10	74.09	37.30	135.80	p<0.0001	
Simple carbohydrates (%TEI[a])	19.25	11.24	30.81	21.05	12.60	32.95	p<0.0001	10%
Complex carbohydrates (g)	99.89	48.05	171.00	76.58	36.49	130.80	p<0.0001	
Complex carbohydrates (%TEI[a])	23.67	13.76	35.73	21.94	12.07	34.07	p<0.0001	
Fibre (g)	17.88	10.33	30.21	15.52	8.67	28.17	p=0.01	25
Alcohol# (g)	17.60	1.61	45.90	8.80	1.07	21.88	$p < 0.0001$	
Alcohol# (%TEI[a])	6.83	0.76	17.32	4.26	0.59	11.58	$p < 0.0001$	
Alcohol from wine[d](g)	17.60	2.51	40.69	8.80	1.37	19.20	$p < 0.0001$	
Alcohol from wine[d] (%TEI[a])	6.04	0.85	15.97	4.42	0.64	10.94	$p < 0.0001$	
Water (g)	1000	250	1500	1000	250	1500	NS[c]	

[a]TEI : total energy intake, [b] PUFA: polyunsaturated fatty acids
[c] Man-Whitney test, [d] Alcohol intake in alcohol drinkers only
EPA: eicosapentaenoic acid
DHA: docosahexaenoic acid

Table 3: Daily micronutrient intakes (expressed as nutrient density) according to gender in the POLANUT Study (2002-2003)

	Men			Women			p
	median	5%	95%	median	5%	95%	
Vitamin B6 (mg/4180kj)	0.87	0.64	1.21	0.89	0.64	1.38	p=0.01
Vitamines B9 (µg/4180kj)	172	123	266	187	115	303	p<0.0001
Vitamin B12 (µg/4180kj)	3.58	1.42	8.83	3.33	1.44	8.26	p=0.08
Vitamin A (mg/4180kj)	0.66	0.31	1.45	0.72	0.30	1.50	NS
Vitamin E (mg/4180kj)	7.02	3.69	17.12	7.85	3.85	18.50	p=0.009
Vitamin C (mg/4180kj)	57.5	29.0	124.4	69.5	29.5	159.3	p< 0.0001
Vitamin D (µg/4180kj)	1.07	0.38	2.50	1.02	0.32	2.38	NS
Total carotenoids (mg/4180kj)	6.44	2.38	11.72	7.18	3.06	13.42	p< 0.0001
Calcium (mg/4180kj)	485	292	835	542	299	892	p< 0.0001
Iron (mg/4180kj)	6.17	4.59	8.16	5.96	4.48	7.91	p= 0.008
Magnesium (mg/4180kj)	153	119	207	156	120	208	NS
Potassium (mg/4180kj)	1618	1158	2286	1741	1164	2376	p= 0.0002

Table 4: Estimation of median intake as % of RDA and % of subjects below MNN and LTI for nutrients with risk of deficiency at the population level, in the POLANUT Study (2002-2003)

	RDA	Median (% of RDA)	MNN	% subjects below MNN	LTI	% subjects below LTI†
ALA (%TEI)	0.8	50.2	0.616	88.4	0.431	60.1
EPA+DHA (%TEI)	0.2	57.0	0.154	64.7	0.108	46.9
Fibre (g)	25	66.5	19.25	65.9	13.475	28.7
Vitamin B6 (mg/day)	2	67.0	1.54	68.2	1.08	22.2
Vitamin B9 (µg/day)	400	69.3	308	62.6	215.6	25.4
Vitamin E (mg/day)	12	95.6	9.24	33.5	6.47	13.4
Vitamin C (mg/day)	100	99.8	77	31.9	53.9	12.3
Vitamin D (µg/day)	10	15.7	7.7	99.7	5.4	99.4
Calcium (mg/day)	1000	79.2	770	48.3	539	17.1
Iron (mg/day)	9	102.2	6.93	19.7	4.851	2.1
Magnesium (mg/day)	350	67.4	269.5	69.3	188.65	22.4

† Possible clinical deficiency.

Abbreviations: RDA (Recommended Dietary Allowance), MNN (Mean Nutritional Need), LTI (Lowest Threshold Intake).

Annex 1: Food groups

Vegetables	carrot, leek, radish, lettuce, curly endive (chicory), Swiss chard, celery stalk, red cabbage, cauliflower, chicory (Belgian endive), cucumber, tomato, parsley, canned green beans, pumpkin, zucchini, eggplant, boiled beet root, raw celery, boiled onion, ratatouille, pepper, vegetable soup, canned peeled tomatoes,
Legumes	chick peas, lentils, beans
Fruits	apple, pear, green olives, apricot, cherries, peach, grape, strawberry, fig, orange, kiwi fruit, banana, melon, grapefruit,
Preserved fruits	orange marmalade, canned pineapple, stewed apples, canned apricots, canned fruit in light syrup
Fruit juices	Apple, pear, grape, orange commercial juices, fresh orange and lemon juices, ,
Dried fruits	Prunes, dates, figs, apricots
Nuts, seed	Walnuts, almonds, pistachios
Solid fat	Butter, Margarine, low-fat spread, cocoa fat, goose fat
Fat and sweet foods	milk chocolate, chocolate bars (Mars type), cookies, croissants, muffins, cream pastries, fruit pies, custards, ice creams
Olive oil	olive oil
Other oils and dressings	peanut oil, , dietetic blended vegetable oil
Omega 3 oils	rapeseed oil, soya oil, walnut oil
Omega 6 oils	sunflower oil , sunflower margarine, grapeseeds oil, mayonnaise
Margarine	Margarine, low-fat margarine
Dishes	sauerkraut with meat, quiche Lorraine, lasagna, ravioli, paëlla, beef stew, cassoulet , couscous, vegetable quiche,
Fast food	Pizza, sandwiches, hamburgers
Fish and sea-food	White and blue (fatty) fishes, oysters, shrimps prawns, canned sardines in oil, breaded fish or

	fish cakes, fish soup
Cereals	Rice, bread, breakfast cereals, rusks, crisp bread, pasta, semolina
Potatoes	potato chips, boiled potatoes,
Confectionery	Honey, white sugar, jam
Meat	Red and processed meat, offals, meat products, delicatessen
Poultry, eggs	Chicken, duck, eggs
Cheeses	Roquefort, goat cheese, emmenthal, Camembert, edam
Milk, yoghurts	Whole and skimmed milk, 40% and 0% “fromages frais,” plain and yoghurts
Alcohol	alcoholic beverages
Wine	Fortified, red and white wines
Tea and coffee	black coffee, tea infusion
Other beverages	soft-drinks
Dark chocolate	Dark chocolate, (tablet and powder)

For magnesium, the groups "fruits", "preserved fruits" and "fruit juices" were combined.

For proteins, SFA and magnesium, the groups "cheeses" and "milk, yoghurts" were combined in "dairy products"

For ALA, the groups "margarine" and "other oils" were combined.