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Food and nutrient intakes of Greek (Cretan) adults. Recent data for food-based dietary guidelines in Greece

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The present study aimed to estimate current nutrient intake levels and food group consumption patterns in Greece using cut-off levels derived from the results of dietary recall interviews with 470 Cretan adults. It was found that the present-day Greek diet contains, in the main, adequate levels of fibre. In comparison with the traditional diet, however, the levels of saturated fat in the diet have greatly increased, particularly in younger adults. An association was found between low fruit and vegetable and low fibre intake and a fat intake that was mainly in the form of saturated fat, this being particularly evident in female subjects. Given the wide availability of olive oil, fish, fresh fruit and vegetables in Greece, the development of national dietary guidelines would be of great potential benefit, particularly to the younger generations.

National nutrition policy: Mediterranean diet

There is no existing national nutrition policy in Greece. This is also the case in all other European Mediterranean countries apart from Malta (Serra-Majem *et al*. 1997). One general explanation for the lack of structured national nutrition guidelines, which is thought particularly applicable to Greece, is that nutrition receives very little attention from the public health sector. Greece has in recent years, however, participated in several large-scale studies, which have linked dietary patterns to chronic diseases. One such study is the Seven Countries Study, which began in 1960 and followed the changes in dietary habits of a cohort of 686 Greek men initially aged between 40 and 60 years. Between 1960 and 1988, there was a 24·5 % increase in the saturated fatty acid (SFA) content of adipose tissue in Cretan male adults aged 40 to 60 years, accompanied by a 4 % reduction in the monounsaturated fatty acid (MUFA) content and a 30 % decrease in the polyunsaturated (PUFA) content. The study also indicated that consumption of meat, fish and cheese in Greece has increased greatly, whilst the consumption of bread, potatoes, fruit, eggs, milk and olive oil has decreased over the 28-year period (Kafatos, 1995; Kafatos *et al*. 1997). The Seven Countries Study, together with other similar studies, provide evidence of an increase in the concentration of serum lipids, accompanied by rising obesity levels, decreasing physical activity levels, and the adoption of a more 'westernized' diet, higher in SFAs (Kafatos, 1995). Of utmost importance are the changes in the adipose tissue composition in children over the past 15 years; in a study on 7- to 8-year-olds, SFAs increased from 19 % to 29 %, whilst MUFAs decreased from 71 % to 59 % from 1980 to 1994 (A. Kafatos, unpublished data).

It is thought that Greek dietary guidelines should be based on the food intake in the early 1960s, given that the Greek diet at that time was health-promoting and aided the prevention of chronic diseases. Basic dietary guidelines have been developed at the University of Crete for use by the general public. These include recommendations of a daily SFA intake of less than 30 g, a dietary fibre intake of greater than 25 g and a protein intake between 50 g and 60 g.

Methods

There is no national food composition database available for use in Greece. The database used to analyse the nutrient content in the present study was developed in the Department of Social Medicine of the University of Crete. It contains about 500 foods, both single and composite. The macro- and micronutrient composition of about twenty foods has been chemically determined at Wageningen Agricultural University. The fatty acid content of 105 fat-containing foods was determined at the TNO Nutrition and Food Research Institute, The Netherlands, during 1997 (Aro *et al*. 1998; van Erp-Baart *et al*. 1998; van Poppel, 1998). For the remainder of the fat-containing foods, the fatty acid analyses were drawn from the analyses available within the European (TTDB) database developed at the TNO Nutrition

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and Food Research Institute between 1995 and 1997. For the foods whose composition was not determined at Wageningen Agricultural University, the US Department of Agriculture analyses, database Ver 11.1, have been entered into our operational database as appropriate. The energy value of each food has been adjusted according to the fat content. Recipe calculations have been used to estimate the make-up of composite Greek foods (with the ingredients being weighed prior to and also following cooking in each case) and suitable adjustments made.

In the present study, a validated 24 h dietary recall was administered by dieticians to all subjects, with food quantities being assessed by the use of household measures and colour food-model photographs. The validation of the 24 h dietary recall method in relation to fat intake has been measured by adipose tissue aspiration and fatty acid composition analysis (Kafatos *et al*. 1991). The 470 subjects in the present study were residents of Crete, drawn from two population groups and invited to participate in a complete medical examination, including dietary assessment. The participants were

Table 1. Mean, median, 10th (P10) and 90th (P90) percentiles of nutrient intakes of Greek adults by age group

		Age group				
		< 30 (n = 67)	30–39 (n = 168)	40–49 (n = 166)	50+ (n = 69)	All (n = 470)
Energy (MJ)	Mean	7·4	7·4	8·1	7·1	7·6
	Median	7·2	6·9	7·5	6·7	7·1
	P10	4·2	4·2	4·8	4·1	4·3
	P90	10·8	11·0	12·5	10·6	11·3
Protein (%energy)	Mean	14·6	14·4	13·3	15·5	14·2
	Median	14·1	13·4	13·1	14·2	13·4
	P10	10·4	8·2	8·5	8·3	8·5
	P90	20·4	21·3	18·5	24·9	20·8
Carbohydrate (%energy)	Mean	41·6	44·0	45·1	43·9	44·0
	Median	40·0	44·9	44·3	44·3	43·9
	P10	30·8	29·5	32·7	27·0	31·4
	P90	53·9	57·7	58·7	57·9	57·4
Alcohol (%energy)	Mean	0·9	1·1	1·4	1·1	1·2
	Median	0·0	0·0	0·0	0·0	0·0
	P10	0·0	0·0	0·0	0·0	0·0
	P90	4·0	3·5	5·1	4·1	4·3
Total fat (%energy)	Mean	42·7	40·4	39·8	39·3	40·3
	Median	43·8	40·5	40·3	39·8	40·9
	P10	28·5	28·1	26·1	24·1	27·0
	P90	53·9	52·9	52·7	55·1	53·4
SFA* (%energy)	Mean	13·2	12·1	11·4	10·6	11·8
	Median	13·4	12·1	11·1	9·4	11·4
	P10	6·7	6·7	6·7	5·0	6·5
	P90	17·3	17·6	17·4	18·1	17·4
MUFA (%energy)	Mean	19·7	19·6	19·9	20·2	19·8
	Median	20·0	18·8	19·7	20·8	19·6
	P10	9·9	10·4	10·7	11·8	10·6
	P90	29·9	29·5	30·8	30·5	30·2
PUFA (%energy)	Mean	6·0	5·0	4·9	4·6	5·1
	Median	5·1	4·2	4·5	4·4	4·4
	P10	3·0	2·4	2·4	2·6	2·5
	P90	9·2	7·8	8·4	8·0	8·3
Cholesterol (mg/MJ)	Mean	34·8	29·0	24·9	28·0	28·2
	Median	27·2	23·5	18·7	23·0	22·1
	P10	10·3	6·5	3·0	3·7	5·3
	P90	67·0	58·0	51·2	56·3	56·9
Fibre (g)	Mean	15·2	17·5	20·2	18·5	18·2
	Median	13·2	15·9	18·3	17·3	16·4
	P10	5·1	6·0	8·6	6·5	6·9
	P90	27·4	29·7	34·8	28·6	32·0
Fibre (g/MJ)	Mean	2·1	2·4	2·6	2·6	2·5
	Median	1·6	2·2	2·4	2·7	2·3
	P10	0·9	1·1	1·2	1·1	1·1
	P90	4·0	3·8	4·0	4·0	4·0

* $P < 0{\cdot}0001$, Kruskal-Wallis test.
SFA = saturated fatty acid; MUFA = monounsaturated fatty acid; PUFA = polyunsaturated fatty acid.

Table 2. Mean daily intakes of fibre and energy and the distribution of energy intake in Greeks aged 18–64, classified according to the lowest and highest quartile of intake of total fat, saturated fatty acids, dietary fibre and fruit and vegetable intake

	Total fat (%energy)		SFA (%energy)		Fibre (g/MJ)		Fruit & vegetables (g)	
Quartile	Low	High	Low	High	Low	High	Low	High
Cut-off value	< 33·4	> 47·3	< 8·6	> 14·6	< 1·5	> 3·2	< 200	> 616
Energy (MJ)	6·7	8·0	6·8	7·9	7·7	7·1	6·8	8·6*
Protein (%energy)	15·6	12·8	15·4	14·6	15·0	13·8	15·2	12·9
Carbohydrate (%energy)	55·7	33·5*	51·9	38*	38·3	49·2	42·0	48·2*
Alcohol (%energy)	1·3	0·5	1·2	0·7	1·4	0·6	1·1	0·6
Total fat (%energy)	26·9	53·1	31·1	46·6*	44·8	36·2*	41·2	38·0
SFA (%energy)	8·0	14·8*	6·4	17·7	15·0	8·7*	14·1	9·6*
MUFA (%energy)	11·9	27·8*	16·6	20·2	20·9	19·7	18·4	20·1
PUFA (%energy)	3·5	6·4*	4·9	4·6	4·9	4·5	4·9	4·9
Cholesterol (mg/MJ)	24·0	32·8	18·1	36·8*	42·8	17·2*	35·6	17·7*
Fibre (g)	21·4	16·0	23·3	12·3*	8·6	29·2	9·7	29·3*
Fibre (g/MJ)	3·2	2·0*	3·5	1·6*	1·1	4·2	1·5	3·6*

* $P < 0{\cdot}0001$, Wilcoxon rank sum test.
SFA = saturated fatty acid; MUFA = monounsaturated fatty acid; PUFA = polyunsaturated fatty acid.

222 employees of the Agricultural Bank of Greece and 248 practising lawyers. The participation rate was 90 % in the bank employees (247 Heraklion employees invited) and 45 % for the lawyers (a total of 549 lawyers invited); the main reason for non-participation was inability to attend the examination on the specified day. The age range of the subjects was from 18 to 64 years, with 228 females (49 %) and 242 males (51 %). The mean body mass index (BMI), calculated as weight divided by height in metres squared, was 26·3 kg/m^2 (SD 4·2); 25·0 kg/m^2 (SD 4·6) for females and 27·6 kg/m^2 (SD 3·4) for males.

In order to examine food intake patterns for high and low consumers of fat, saturated fat, fibre, and the fruit and vegetables food group, the data were divided into the corresponding quartiles and comparisons of nutrient and food group intake were made between the upper and lower quartile. The macronutrient intake is presented in terms of percentage of energy intake (%energy) and the total dietary fibre intake in both g and g/MJ is presented. The food group consumption values are all in g/d per person. Average intakes are presented both for the consumers of each food group only and for the entire sample. Non-parametric statistical tests were used (the Wilcoxon rank sum test for the low vs. high intake comparisons and the Kruskal-Wallis test for age group comparisons) and differences were considered significant if they reached the 0·01 % level (i.e. $P < 0{\cdot}0001$, to take account of the multiple comparisons). Comparisons were also made between the sexes using the non-parametric Wilcoxon rank-sum tests (on all subjects).

Table 3. Percent consumers of selected foods in 18- to 64-year-old subjects with mean and median intakes for consumers only, and mean intakes for all subjects, classified according to lower and upper quartiles of total fat intake (< 33·4 and > 47·3 %energy respectively)

	Fat intake (%energy)							
	Low (intake < 33·4 %energy)				High (intake > 47·29 %energy)			
	Consumers only			All (n = 117)	Consumers only			All (n = 117)
Grams/day	%	Mean	Median	Mean	%	Mean	Median	Mean
Bread*	91	126	103	114	85	81	70	68
Pasta & rice	31	255	245	78	9	259	250	24
Potatoes	30	191	150	57	32	147	122	47
Milk	58	158	110	92	62	135	90	84
Yoghurts	14	207	220	30	11	141	150	16
Cheese	38	53	40	21	52	73	56	38
Meat	32	103	85	33	39	122	90	48
Poultry	19	82	85	15	6	125	60	7
Fish	27	163	120	45	21	120	100	26
Eggs	5	87	100	4	6	73	50	4
Nuts	5	71	75	4	18	68	50	12
Take-away food	6	104	115	6	15	131	120	20
Vegetables	78	260	220	202	89	292	255	259
Fruit*	83	380	344	315	61	220	180	135
Fats & oils*	55	19	15	10	69	37	30	26
Biscuits, cakes	88	42	16	37	85	51	32	44
Alcoholic drinks	24	207	135	50	14	181	140	25

* $P < 0{\cdot}0001$, Wilcoxon rank sum test.

Table 4. Percent consumers of selected foods in 18- to 64-year-old subjects with mean and median intakes for consumers only and mean intakes for all subjects, classified according to lower and upper quartiles of saturated fatty acid intake (< 8·6 and > 14·6 %energy respectively)

	Saturated fatty acid intake (%energy)							
	Low (intake < 8·6 %energy)				High (intake > 14·6 %energy)			
	Consumers only			All (n = 117)	Consumers only			All (n = 117)
Grams/day	%	Mean	Median	Mean	%	Mean	Median	Mean
Bread*	93	126	105	118	82	81	70	67
Pasta & rice	17	246	245	42	32	248	250	79
Potatoes	38	176	140	68	28	121	120	34
Milk	48	136	100	65	67	160	120	107
Yoghurts	11	180	200	20	11	144	110	16
Cheese*	18	40	35	7	68	87	70	59
Meat*	14	116	118	16	51	109	85	56
Poultry	16	95	85	15	8	136	95	10
Fish*	40	188	170	75	8	169	120	14
Eggs	3	83	100	2	3	58	50	2
Nuts	6	54	50	3	15	49	45	8
Take-away food	1	120	—	1	27	144	120	39
Vegetables*	85	305	250	261	74	169	140	126
Fruit*	87	392	305	341	57	241	210	138
Fats & oils	73	30	30	21	52	24	20	12
Biscuits, cakes	86	35	15	30	89	62	50	55
Alcoholic drinks	23	194	120	45	17	212	230	36

* P < 0·0001, Wilcoxon rank sum test.

Results

In Table 1 are presented the contribution to the energy intake of the various nutrients for all subjects and also for the four age groups < 30 years, 30–39 years, 40–49 years and 50–64 years. The overall contribution of fat to energy intake is 40·3 % and there is only a very slight (non-significant) decrease in the older age groups. The contribution of saturated fat, however, is significantly higher in the younger age groups (13·2 % for those < 30 compared with 10·6 % for those aged 50+). The only other clear monotonic trend (though not significant at the stated 0·01 % level) is the

Table 5. Percent consumers of selected foods in 18- to 64-year-old subjects with mean and median intakes for consumers only and mean intakes for all subjects, classified according to lower and upper quartiles of dietary fibre intake (< 1·5 and > 3·3 g/MJ respectively)

	Dietary fibre intake (g/MJ)							
	Low (intake < 1·51 g/MJ)				High (intake > 3·18 g/MJ)			
	Consumers only			All (n = 117)	Consumers only			All (n = 117)
Grams/day	%	Mean	Median	Mean	%	Mean	Median	Mean
Bread	85	83	70	71	91	110	93	100
Pasta & rice	23	213	200	49	14	269	250	37
Potatoes	28	116	100	33	28	178	180	50
Milk	67	150	120	100	50	119	55	59
Yoghurts	16	157	220	25	15	173	210	27
Cheese	51	67	50	34	38	59	60	23
Meat*	51	129	100	66	23	97	85	22
Poultry	12	109	100	13	8	64	60	5
Fish	19	171	150	32	26	165	120	44
Eggs	4	76	100	3	3	88	100	3
Nuts	8	49	40	4	15	67	55	10
Take-away food	20	157	130	31	5	103	110	5
Vegetables*	72	155	120	111	95	368	345	350
Fruit*	48	169	140	81	84	433	385	362
Fats & oils	56	25	20	14	73	27	25	20
Biscuits, cakes	95	59	38	56	83	40	25	33
Alcoholic drinks	25	268	240	66	14	196	120	29

* P < 0·0001, Wilcoxon rank sum test.

Table 6. Percent consumers of selected foods in 18- to 64-year-old subjects with mean and median intakes for consumers only and mean intakes for all subjects, classified according to lower and upper quartiles of fruit and vegetable intake (< 200 g and > 616 g respectively)

	Fruit & vegetable intake (g)							
	Low (intake < 200 g)				High (intake > 616 g)			
	Consumers only			All (n = 117)	Consumers only			All (n = 117)
Grams/day	%	Mean	Median	Mean	%	Mean	Median	Mean
Bread	85	90	80	76	93	117	100	109
Pasta & rice	36	261	250	93	14	253	220	35
Potatoes	31	143	120	45	34	182	180	62
Milk	66	136	120	90	51	156	120	80
Yoghurts	15	158	200	24	9	185	220	17
Cheese	45	53	40	24	44	76	70	34
Meat*	52	87	78	45	21	134	85	29
Poultry	16	124	95	20	7	78	68	5
Fish	14	153	150	22	30	163	120	49
Eggs	5	71	75	4	2	75	75	1
Nuts	12	61	50	7	12	64	45	8
Take-away food	21	153	125	33	8	132	120	10
Vegetables*	63	84	80	54	94	427	405	401
Fruit*	29	98	100	28	97	503	490	486
Fats & oils*	49	19	15	9	79	31	30	25
Biscuits, cakes	93	51	33	47	82	50	30	41
Alcoholic drinks	20	231	160	47	20	157	120	32

* $P < 0.0001$, Wilcoxon rank sum test.

dietary fibre intake, which is higher in the older age groups (median 1·6 g/MJ in the under-30s compared with a median value of 2·7 g/MJ in those aged 50–64 years).

In Table 2 it can be seen that those with a low fat intake have a higher fibre intake than those in the upper quartile of fat intake (with mean fibre intake 3·2 g/MJ in the lower quartile and 2·0 g/MJ in the upper fat intake quartile). Low-fibre eaters have higher intakes of fat, in particular SFA, and a higher cholesterol intake. When considering the subjects according to their daily fruit and vegetable consumption, it is interesting to note that those with the lowest fruit and vegetable intake have a significantly higher saturated fat contribution (mean 14·1 %energy vs. 9·6 %energy) although there are no significant differences between the total fat, MUFA or PUFA contributions. Those with low fruit and vegetable intakes also have significantly higher cholesterol intakes (mean 35·6 mg/MJ vs. 17·7 mg/MJ).

Table 3 compares the quantity of selected foods consumed by those with a low-fat intake compared to those with a high-fat intake. Those with a low-fat intake have significantly higher intakes of bread and fruit than those with high-fat intakes. These observations are also true when the divisions are restricted to SFA intake quartile comparisons (Table 4). In addition, those who report a low saturated fat diet have higher intakes of fish and vegetables. In Table 5, food group intakes according to dietary fibre intake are displayed. As would be expected, those with a high fibre intake have significantly higher fruit and vegetable intakes. They also have significantly lower meat intakes. Those within the upper quartile of fruit and vegetable consumption had significantly lower overall meat consumption and higher oil consumption than those in the lowest quartile (Table 6).

In comparing nutrient intake between the sexes it was found that the contribution of saturated fat to energy intake was higher in females (median saturated fat 12·9 %energy in females and 10·1 %energy in males). Absolute fibre intake was significantly higher in males (median 19·1 g in males and 14·1 g in females). Of the food group intakes, bread, fruit and vegetable intake was significantly higher in males (with median intakes of 96 g bread, 210 g fruit and 213 g vegetables for males and 60 g bread, 130 g fruit and 160 g vegetables for females) whilst the average milk intake was significantly higher in females (median 40 g in females and 10 g males). There were no other differences between the sexes significant at the 0·01 % level.

Discussion

For the three Mediterranean countries participating in the Seven Countries Study in 1960, total fat provided 25–37 % of total energy with saturated fat contributing 7 %, 8 % and 11 % for Greece, Italy and Yugoslavia respectively (Keys, 1980). In comparison with the present study, these values are most similar to those for the subjects aged over 50 years, even though the values for the latter are somewhat higher. The fat contributions to energy in the present study increase across the decreasing age groups, indicating that the younger generations are being influenced by the less healthy foods and food patterns. This hypothesis is corroborated by the results of the 3 d weighed food record measurements obtained on 139 six-year-old children in an intervention study on primary school children in Crete (Manios *et al*. 1998). The mean saturated fat intakes were 34·4 g and 32·9 g at baseline in the interventions and controls respectively. The present findings also indicate that Greek (working) women tend to have relatively high-SFA diets. In comparison with the other European countries, it has been found that both Greek males and Greek females have relatively low-fat and low-SFA

intakes (TRANSFAIR group, 1998). In comparison with the WHO nutrition objectives for Europe (James *et al*. 1988, as cited in Serra-Majem *et al*. 1997), the findings of the present study indicate that Greek BMI levels are above the ideal and total fat contribution to energy should be decreased by about 10 %, although daily fibre intakes are ample. In the present study it was found that the subjects in the lowest quartile for fruit and vegetable intake not only have low fruit and vegetable intakes but have a diet in which the fat intake is mainly in the form of saturated fat. These subjects would potentially benefit immensely from national dietary policies.

The Mediterranean diet should not be considered only as a relatively low-fat and low-SFA diet, which is beneficial in lowering cholesterol. It is important to realize the contribution of olive oil, fish, fruit and vegetables, which are an integral part of the Mediterranean diet, to maintaining good health. It is now thought that the plant foods present in the Mediterranean diet contain substances that may be influential in the regulation of metabolic processes, and whose derangement may be partly responsible for chronic disorders in affluent societies (Serra-Majem *et al*. 1997). The fibre intake results of the present study indicate, on this basis as previously, that older-generation Greeks have a diet more conducive to good health than the younger Greek adults. It is thought that the development of comprehensive, structured nutrition policy is vital for the survival of the traditional Mediterranean-Cretan dietary patterns, which have become renowned for their benefits on health.

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