

# Diet and survival of elderly Greeks: a link to the past<sup>1-4</sup>

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**ABSTRACT** In 1988 and 1989, we investigated in three Greek villages the dietary patterns of 182 men and women aged > 70 y by using a validated semiquantitative food-frequency questionnaire and compared these dietary patterns with the traditional Greek diet as ascertained in the late 1950s by Keys and his colleagues. As in the traditional diet, olive oil dominated fat intake, total fat exceeded 35% of total energy intake, average daily consumption of fruits and vegetables exceeded 500 g, and average ethanol intake for men corresponded to two to three glasses of wine per day. In contrast, consumption of meat and meat products has substantially increased and intake of bread and other cereals has apparently declined. We observed no differences between the two periods with respect to consumption of legumes, eggs and egg products, and sugar and confectionery. We have also attempted to assess whether a gradient of adherence to the traditional Greek diet can be identified in the diets of the study subjects, and whether it can subsequently predict total mortality. During a follow-up period of  $\approx$ 5 y, 53 deaths were observed. The risk of death was apparently higher among the minority of study subjects whose diet deviated substantially from the traditional Greek pattern, compared with the majority whose diet adhered closely to the traditional pattern. *Am J Clin Nutr* 1995;61(suppl):1346S-50S.

**KEY WORDS** Greek diet, Mediterranean diet, olive oil, elderly people, survival, mortality, food groups, nutrients

## INTRODUCTION

The traditional diet of Greece is usually described as a diet low in saturated fat, with added fat mostly in the form of olive oil, high in complex carbohydrates from grains and legumes, and high in fiber derived mainly from vegetables and fruits. The total fat may be  $\approx$ 40% of total energy intake, but the monounsaturated-to-saturated fat ratio is elevated and is almost always  $\geq$  2. The high proportion of fresh plants and cereals in the diet, along with the abundant amount of olive oil, guarantees a high intake of  $\beta$ -carotene, vitamin C, tocopherols, various important minerals, and several nonnutrient substances such as polyphenols and anthocyanines that may also be beneficial. Moderate wine drinking by men during meals, an activity pattern associated with substantial energy expenditure, and a regular afternoon rest are also integral and related parts of the traditional Greek lifestyle (1).

During the past 30 y, the traditional diet of the Greeks has been modified under the influence of altered work habits, commercial trends, and changing cultural norms. In 1989, Katsouyanni et al (2) evaluated present-day dietary habits and

those of 20 y ago in a sample of 404 adult men and women by using both a food-frequency questionnaire and a 24-h recall. **Table 1** shows the ratio of the frequency of consumption of selected food items in 1989 compared with 1969 in a rural village and in an urban population in Athens. These data suggest a marked increase in the frequency of consumption of meat in both urban and rural areas, and a decrease in the frequency of consumption of various kinds of legumes.

## SUBJECTS AND METHODS

To obtain further information about the traditional Greek diet, we investigated the dietary habits of 182 elderly men and women (aged > 70 y; median age, 75 y) in three Greek villages by using a validated, semiquantitative, food-frequency questionnaire (3), the details of which are described in the *Manual of Operations for the Study on Nutrition and the Elderly* (4). It is widely assumed that elderly inhabitants of Greek villages have persisted in their traditional nutritional habits. As we have described previously, study subjects constituted a representative sample of the elderly inhabitants of three villages, with deliberate over-sampling of men (5, 6). We found no evidence of selection bias, and only eight elderly individuals who were asked to participate refused.

Our study subjects are members of a survival cohort, but this is unlikely to have introduced a substantial distortion in the ascertainment of the traditional Greek diet because this diet has been credited as being responsible for the longevity that characterizes the Greek population (7) and, in particular, the rural Greek population (8). The dietary questionnaires were interviewer-administered and probed for information concerning > 100 food items and beverages. On the basis of the reported frequency of consumption and the indicated portion sizes for the principal food items and dishes, we made quantitative estimates of the average daily consumption of 16 categories of

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<sup>2</sup> Supported in part by grant E103 from the Greek Ministry of Health.

<sup>3</sup> The studies reported in this paper were undertaken in the context of the SENECA project of the European Union and the cross-cultural study on food habits in later life of the International Union of Nutritional Sciences.

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**TABLE 1**

Ratio of frequency of consumption of selected food items in 1989 to 1969 in a rural village and in an urban middle class population in Greece<sup>1</sup>

|              | Frequency ratio 1989:1969 |       |
|--------------|---------------------------|-------|
|              | Rural                     | Urban |
| Pork         | 5.7                       | 8.4   |
| Beef or veal | 7.0                       | 5.7   |
| Sheep        | 4.2                       | 2.4   |
| Beans        | 0.3                       | 0.2   |
| Chickpeas    | 0.4                       | 0.4   |
| Lentils      | 0.4                       | 0.3   |

<sup>1</sup> Modified from Katsouyanni et al (2).

foods and beverages. In addition, using data from a food- and dish-specific nutrition data bank that has recently been developed in Greece (9), we calculated our study subjects' average daily intake of several macro- and micronutrients.

## RESULTS

Several conclusions can be drawn from **Table 2**. Compared with populations in northern European countries (10, 11), elderly people in rural Greece generally consume higher quantities of fruits, vegetables, and legumes and similar quantities of meat and fish. They also consume similar amounts of cereals, although more in the form of bread. They consume lower quantities of sugar, confectionery, eggs, and egg products. Quantities of added fats are generally similar, although most of the added fat in Greece is olive oil. The majority of elderly men in rural Greece consume alcoholic beverages, mostly wine and mostly during meals. In contrast, only a minority of women use alcoholic beverages. The consumption of nonalcoholic beverages among elderly Greeks is generally low.

With respect to nutrients (**Table 3**), comparison of our results with those from northern European countries (12, 13) and the United States (14, 15) indicates that, after adjustment for energy intake (16), elderly Greeks consume generally similar or somewhat lower amounts of protein, total carbohydrate, and alcohol, and generally higher amounts of total fat. It is worth emphasizing, however, that the composition of energy-generating nutrients is different in elderly people in Greece than in northern Europe and North America. In Greece, most of the fat is monounsaturated; a substantial portion of protein is of plant origin; large quantities of carbohydrates are derived from bread, vegetables, and fruits rather than from "breakfast cereals;" and most of the alcohol is derived from wine rather than from beer or spirits. Comparison of micronutrient intake is complicated by the fact that enrichment and supplementation are more common in northern Europe and North America than in Greece. However, there are lingering doubts as to whether the well-known antioxidant vitamins and the frequently measured trace elements are indeed the active ingredients responsible for the beneficial effects attributed to vegetables, fruits, and other fiber-containing foods (17).

We have also attempted to assess whether a gradient of adherence to the traditional Greek diet can be identified in the diets of the elderly study subjects, and whether this gradient can subsequently predict disease occurrence and mortality. On the basis of evidence from several studies (1, 2, 5, 6, 8, 12), we

have concluded that the traditional Greek diet is characterized by eight components: 1) a high ratio of monounsaturated to saturated fat, with the median value as the cutoff point; 2) moderate alcohol consumption, with 10 g ethanol for men and 0 g ethanol for women as the cutoff points, but excluding individuals who are heavy drinkers; 3) high consumption of legumes; 4) high consumption of cereals (including bread); 5) high consumption of fruits; 6) high consumption of vegetables; 7) low consumption of meat and meat products; and 8) low consumption of milk and dairy products. The cutoff points for characteristics 3–8 are the corresponding sex-specific median values.

We consider a diet with most of these components closer to the traditional Greek diet (1). We have further assumed that in our study population, which comes as close as any living population to meeting the standards of a traditional Greek diet, only a minority of the subjects can be considered as deviating from the traditional Greek dietary pattern. Indeed, in our study sample, only 33 subjects, or 18% of the total, were found to consume two or less of the eight desirable dietary components, and only 72 subjects, or 40% of the total, consumed three or less.

We are currently studying mortality from all causes in this small cohort of 182 elderly persons over a 5-y period. In a preliminary analysis, we found evidence that individuals whose diets deviate substantially from the traditional Mediterranean pattern have higher mortality from all causes. Thus, among 33 persons consuming no more than two of the desirable components of the traditional Greek diet, 15 deaths (45%) were noted, whereas among the remaining 149 persons, only 38 deaths (26%) occurred. A multivariate proportional hazards analysis is currently in progress.

## DISCUSSION

Several recent developments have strengthened the biological credibility of the hypothesis that the traditional Greek diet has beneficial health effects. It has been shown that energy expenditure is inversely associated with risk for coronary heart disease (CHD) and, perhaps, for several forms of cancer (18). Energy expenditure must have been high in people living in the mostly mountainous rural Greece. It has also been shown that high concentrations of serum high-density-lipoprotein (HDL) cholesterol are as important for the prevention of CHD as are low concentrations of serum low-density-lipoprotein (LDL) cholesterol (19), and there is strong evidence that monounsaturated fat increases HDL cholesterol more than does polyunsaturated fat and substantially more than do carbohydrates (20, 21). It has been conclusively demonstrated that moderate drinking of alcoholic beverages reduces the risk of CHD (22), while having a rather small detrimental effect on the risk for breast cancer (23). Drinking wine in moderation during meals is a tradition for Greek men, but not for Greek women (24). Lastly, it has been found in several analytic epidemiological studies, several of which were undertaken in Greece (25–27), that intake of fiber and consumption of fruits and vegetables are inversely associated with risk of atherosclerosis and several forms of cancer. High intake of vegetables and fruits is characteristic of the Greek diet, and olive oil is used frequently with vegetables and legumes in both salads and cooked meals.

The diet of elderly people in rural Greece shows important similarities but also some differences from that of men in Crete and Corfu as reported by Keys and his colleagues in the Seven

TABLE 2

Representative values of daily food consumption in grams by 91 elderly men and 91 elderly women in rural Greece as estimated from a semiquantitative food-frequency questionnaire

|                               | Food consumption               | Percentiles |       |       |
|-------------------------------|--------------------------------|-------------|-------|-------|
|                               |                                | 25%         | 50%   | 75%   |
|                               |                                | <i>g</i>    |       |       |
| Potatoes and other tubers     |                                |             |       |       |
| Males                         | 67.3 ± 5.5 (52.6) <sup>1</sup> | 28.5        | 57.0  | 85.7  |
| Females                       | 60.7 ± 5.0 (47.7)              | 28.0        | 42.8  | 85.7  |
| Vegetables                    |                                |             |       |       |
| Males                         | 297.4 ± 17.7 (169.4)           | 177.3       | 270.0 | 396.3 |
| Females                       | 236.3 ± 13.0 (124.4)           | 148.4       | 220.6 | 306.0 |
| Legumes                       |                                |             |       |       |
| Males                         | 60.5 ± 4.3 (41.5)              | 29.8        | 53.0  | 96.0  |
| Females                       | 51.1 ± 3.4 (33.4)              | 23.0        | 47.5  | 68.0  |
| Fruits, nuts, and seeds       |                                |             |       |       |
| Males                         | 254.1 ± 19.6 (187.0)           | 118.0       | 218.9 | 353.2 |
| Females                       | 222.4 ± 16.9 (161.9)           | 89.1        | 201.1 | 316.0 |
| Dairy products                |                                |             |       |       |
| Males                         | 224.0 ± 20.5 (196.3)           | 75.3        | 170.0 | 306.3 |
| Females                       | 219.6 ± 18.0 (172.3)           | 91.7        | 166.4 | 301.0 |
| Cereals                       |                                |             |       |       |
| Males                         | 286.0 ± 14.7 (141.1)           | 184.3       | 263.4 | 375.3 |
| Females                       | 233.1 ± 13.0 (124.7)           | 146.7       | 206.0 | 281.6 |
| Meat and meat products        |                                |             |       |       |
| Males                         | 108.9 ± 7.1 (68.3)             | 58.1        | 95.5  | 140.1 |
| Females                       | 90.8 ± 4.8 (45.8)              | 59.0        | 80.1  | 120.2 |
| Fish and shellfish            |                                |             |       |       |
| Males                         | 41.4 ± 4.2 (40.3)              | 14.0        | 28.4  | 60.6  |
| Females                       | 35.4 ± 3.5 (34.0)              | 13.6        | 26.0  | 51.7  |
| Eggs and egg products         |                                |             |       |       |
| Males                         | 12.9 ± 1.7 (16.6)              | 0.0         | 7.0   | 15.7  |
| Females                       | 10.5 ± 1.8 (17.7)              | 0.0         | 3.9   | 14.0  |
| Added fat and oil             |                                |             |       |       |
| Males                         | 51.8 ± 4.5 (43.7)              | 25.0        | 35.0  | 60.0  |
| Females                       | 39.7 ± 4.1 (39.8)              | 16.0        | 25.0  | 50.0  |
| Sugar and confectionery       |                                |             |       |       |
| Males                         | 20.9 ± 2.1 (20.0)              | 10.0        | 15.0  | 29.2  |
| Females                       | 16.6 ± 1.2 (12.2)              | 10.0        | 15.0  | 22.0  |
| Cakes, biscuits, and pastries |                                |             |       |       |
| Males                         | 15.0 ± 2.8 (26.9)              | 0.0         | 5.0   | 21.0  |
| Females                       | 15.8 ± 2.1 (20.9)              | 0.0         | 8.0   | 22.0  |
| Nonalcoholic beverages        |                                |             |       |       |
| Males                         | 247.4 ± 17.3 (165.3)           | 160.0       | 200.0 | 309.4 |
| Females                       | 200.5 ± 19.0 (181.7)           | 94.2        | 157.0 | 240.0 |
| Alcoholic beverages           |                                |             |       |       |
| Males                         | 184.1 ± 20.5 (196.1)           | 0.0         | 130.0 | 250.0 |
| Females                       | 28.1 ± 8.2 (79.0)              | 0.0         | 0.0   | 0.0   |
| Condiments and sauces         |                                |             |       |       |
| Males                         | 2.6 ± 0.6 (6.3)                | 0.0         | 0.0   | 2.0   |
| Females                       | 2.3 ± 0.5 (5.6)                | 0.0         | 0.0   | 2.1   |
| Soups and boullion            |                                |             |       |       |
| Males                         | 38.2 ± 4.3 (41.9)              | 11.7        | 29.9  | 53.0  |
| Females                       | 28.6 ± 3.5 (34.0)              | 8.2         | 20.0  | 36.0  |

<sup>1</sup>  $\bar{x} \pm \text{SE}$ ; SD in parentheses.

Countries Study (1, 28, 29). Similar to previous studies, olive oil dominated fat intake and total fat exceeded 35% of total energy intake; in addition, daily intake of fruits and vegetables exceeded 500 g on the average, and the average daily alcohol intake was two to three glasses, mostly in the form of wine. Fish and dairy products continued to be consumed in moderate quantities. In contrast, intake of meat and meat products has

substantially increased and intake of bread and other cereals has declined. Consumption of legumes is not markedly different between the two periods; additionally, intake of eggs and egg products and sugar and confectionery has been and continues to be relatively low.

During the 1960s and 1970s, adult Greek men and, to a lesser extent, women, exhibited lower mortality rates than did North

TABLE 3

Representative values of daily nutrient consumption by 91 elderly men and 91 elderly women in rural Greece as estimated from a semiquantitative food-frequency questionnaire


|                             | Nutrient consumption                 | Percentiles |        |          |
|-----------------------------|--------------------------------------|-------------|--------|----------|
|                             |                                      | 25%         | 50%    | 75%      |
| Energy (kJ)                 |                                      |             |        |          |
| Males                       | 9487.3 ± 298.5 (2849.1) <sup>1</sup> | 7877.2      | 9218.6 | 11 026.8 |
| Females                     | 7729.7 ± 259.6 (2477.9)              | 5752.5      | 7356.0 | 9082.3   |
| Protein (g)                 |                                      |             |        |          |
| Males                       | 84.7 ± 3.0 (28.6)                    | 64.8        | 83.5   | 104.6    |
| Females                     | 70.9 ± 2.5 (23.9)                    | 54.1        | 66.8   | 87.4     |
| Saturated fat (g)           |                                      |             |        |          |
| Males                       | 30.9 ± 1.3 (12.5)                    | 22.2        | 29.3   | 36.5     |
| Females                     | 28.0 ± 1.1 (10.7)                    | 21.0        | 25.8   | 33.1     |
| Monounsaturated fat (g)     |                                      |             |        |          |
| Males                       | 52.1 ± 1.7 (16.2)                    | 40.9        | 53.5   | 62.9     |
| Females                     | 44.9 ± 1.3 (12.7)                    | 34.8        | 44.1   | 54.0     |
| Polyunsaturated fat (g)     |                                      |             |        |          |
| Males                       | 11.5 ± 0.3 (3.5)                     | 9.0         | 11.6   | 13.3     |
| Females                     | 9.9 ± 0.3 (3.3)                      | 7.6         | 9.5    | 12.4     |
| Cholesterol (mg)            |                                      |             |        |          |
| Males                       | 258.1 ± 11.5 (110.6)                 | 179.0       | 245.5  | 317.7    |
| Females                     | 220.4 ± 10.7 (102.1)                 | 147.3       | 197.0  | 288.0    |
| Mono- and disaccharides (g) |                                      |             |        |          |
| Males                       | 76.8 ± 4.3 (41.1)                    | 50.9        | 68.2   | 93.3     |
| Females                     | 66.9 ± 3.6 (34.4)                    | 41.2        | 62.3   | 79.7     |
| Polysaccharides (g)         |                                      |             |        |          |
| Males                       | 147.3 ± 6.7 (64.5)                   | 99.4        | 137.2  | 189.9    |
| Females                     | 118.5 ± 6.1 (58.6)                   | 81.4        | 106.1  | 141.2    |
| Dietary fiber (g)           |                                      |             |        |          |
| Males                       | 23.1 ± 0.9 (9.2)                     | 16.7        | 21.7   | 28.5     |
| Females                     | 18.3 ± 0.7 (7.5)                     | 12.4        | 17.6   | 23.2     |
| Ethanol (g)                 |                                      |             |        |          |
| Males                       | 16.2 ± 1.7 (16.8)                    | 0.3         | 11.1   | 22.7     |
| Females                     | 2.3 ± 0.7 (6.9)                      | 0.0         | 0.0    | 0.3      |
| Calcium (mg)                |                                      |             |        |          |
| Males                       | 929.4 ± 53.9 (515.1)                 | 595.0       | 754.3  | 1185.5   |
| Females                     | 811.2 ± 44.1 (421.1)                 | 490.2       | 725.4  | 996.0    |
| Phosphorus (mg)             |                                      |             |        |          |
| Males                       | 1252.2 ± 47.6 (454.4)                | 979.5       | 1186.6 | 1389.6   |
| Females                     | 1068.4 ± 40.6 (387.7)                | 839.7       | 1007.0 | 1271.0   |
| Iron (mg)                   |                                      |             |        |          |
| Males                       | 18.1 ± 0.9 (8.9)                     | 12.5        | 15.9   | 21.0     |
| Females                     | 15.1 ± 1.0 (10.3)                    | 8.8         | 12.3   | 16.6     |
| Zinc (mg)                   |                                      |             |        |          |
| Males                       | 12.7 ± 0.5 (5.3)                     | 9.0         | 12.7   | 15.7     |
| Females                     | 10.9 ± 0.4 (4.5)                     | 7.6         | 10.6   | 13.0     |
| Retinol A (mg)              |                                      |             |        |          |
| Males                       | 0.6 ± 0.1 (1.5)                      | 0.1         | 0.3    | 0.6      |
| Females                     | 0.4 ± 0.0 (0.6)                      | 0.1         | 0.2    | 0.4      |
| β-Carotene (mg)             |                                      |             |        |          |
| Males                       | 2.2 ± 0.1 (1.2)                      | 1.4         | 1.9    | 3.0      |
| Females                     | 2.1 ± 0.1 (1.5)                      | 1.2         | 1.8    | 2.6      |
| Ascorbic acid (mg)          |                                      |             |        |          |
| Males                       | 118.9 ± 9.4 (89.7)                   | 64.2        | 91.5   | 143.4    |
| Females                     | 102.5 ± 8.2 (78.8)                   | 50.3        | 83.1   | 121.3    |

<sup>1</sup>  $\bar{x} \pm SE$ ; SD in parentheses.

Americans or other Europeans. Although this advantage has diminished with the passage of time, Greek middle-aged men, particularly those in rural areas, continue to have a longer life expectancy than do North Americans or other Europeans (1). The traditional Greek diet, which remains entrenched in sub-

stantial segments of the population, particularly in rural areas, appears to be the most important factor responsible for the relatively low mortality of adult Greeks. We found that the diet of our sample of elderly Greek rural residents shares many of the distinguishing characteristics of the diet of men in the

islands of Crete and Corfu as reported by Keys and his colleagues in the 1950s and 1960s (30). The most important of these characteristics appears to be the high consumption of olive oil, which, in addition to its beneficial effects on blood lipids, is used to facilitate consumption of raw vegetables as salads and of legumes and vegetables in cooked meals.

In a preliminary analysis of the 5-y survival of the elderly men and women in our sample, we found evidence that individuals whose diets deviate substantially from the traditional Mediterranean pattern demonstrate an increased probability of dying (all causes combined) during the follow-up period compared with individuals with more traditional eating habits. It appears that adherence to the traditional Greek diet may convey survival advantages even for men and women of fairly advanced age. 

We gratefully acknowledge the technical assistance of K Georga.

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