AGING, FOOD, CULTURE AND HEALTH

ML Wahlqvist, A Kouris-Blazos and BH-H Hsu-Hage

Department of Medicine, Monash University Medical Centre, Monash University, 246 Clayton Road, Clayton, Vic 3168, Australia

Abstract. International comparison of food intake and health studies amongst the aged is providing new insight into the importance of food culture in social context for healthy aging. At same time the possible variance in eating behavior compatible with good health requires consideration. The IUNS (International Union of Nutritional Sciences) FHILL (Food Habits in Later Life) Project, comprises (1) a morbidity study on about 2,000 elderly in 13 communities (now available on CD Rom) and (2) a mortality follow-up study. In the morbidity study, a total health assessment score or Later Life Status Score (LLSS) has been considered in relation to non-nutritional and nutritional factors. The elderly Greek cohorts aged 70+ in Melbourne, Australia (M=94, F=95) and Spata, Greece (M=51, F=53) have been used as a model for multivariate analyses to determine separately the importance of non-nutritional (well-being, memory, general health, medication-use, activities of daily living, exercise, social activity and social networks scores) and nutritional variables (intake of food groups g/day, food group variety scores, nutrients) in accounting for LLSS. A mortality follow-up study on the elderly cohort in Spata, Greece has also been completed and published. The findings from these preliminary analyses on the Greek cohorts will be reviewed as an example of how food culture may be influencing both quality of life and survival in Greek elderly. The most important non-nutritional determinants of LLSS in Greeks included: mobility and independence (exercise and activities of daily living), well-being and memory (collectively explained 80% of the variation of LLSS). For nutritional variables, a high intake and variety of plant foods (in particular vegetables, legumes and fruit); a high intake and variety of seafood and a low intake of meat emerged with statistical and biological significance. Results from the mortality study also agree with findings from the morbidity study - particularly the importance of the overall traditional greek food culture, with its emphasis on plant derived food of various kinds, as opposed to individual food categories, in protecing against premature death. Strategies are advanced which may optimise nutritionally related health problems amongst the aged around the globe.

INTRODUCTION

In 1988, the International Union of Nutritional Sciences (IUNS) Committee on Nutrition and Aging (II-8) undertook to coordinate cross-cultural studies of food habits, health and survival in later life with the following objectives:

Objective 1: to *describe* and *compare* lifestyle, health status and the range of food habits (present and past), amongst the aged in developed and developing countries (descriptive morbidity study);

Objective 2: to determine to what extent food habits and lifestyle variables *account for quality of life and health status* in the aged (cross-sectional morbidity study).

Objective 3: to determine to what extent food habits *predict survival* in the elderly cohorts after 5 years (prospective mortality study).

From 13 elderly communities in Australia (Greek and Anglo-Celt), China, Greece, Japan, the Philippines, and Sweden, a total of 2,013 subjects aged 70 and over have been described, fulfilling the first objective of the study (Wahlqvist *et al,* 1995). Additionally, similar studies undertaken by the EURONUT-SENECA group (de Groot *et al,* 1991). Horwath and colleagues in Australia (1989) and New Zealand (1992), and the Institute of Nutrition and Food Hygiene in Beijing, China, are also included, comprising 27 centers in all. Cross-cultural multivariate analyses and mortality follow-up studies (objectives 2, 3) are investigating food habits as contributors to quality of life and survival in the elderly cohorts (Trichopoulou *et al,* 1995).

Fax : 61-3 9550 5524; Email : mark.wahlguist@med. monash. edu. au

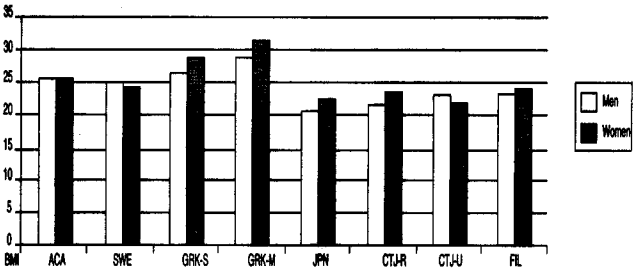
The Greek cohorts in Melbourne (M=94, F=95) and Spata (M=51, F=53) have been used as a model for multivariate analyses whereby quality of life scores have been generated and tested against food intake g/ day and scores (Kouris-Blazos and Hsu-Hage, 1995; Kouris-Blazos 1994; Kouris-Blazos *et al,* 1996). A mortality follow-up study on the elderly cohort in Spata and two neighbouring villages in Greece (M=91, F=91) has been published (Trichopoulou *et al,* 1995). Findings from these Greek cohorts are reviewed as an example of how food culture may influence both quality of life and survival in Greek elderly.

PRINCIPAL NUTRITION-HEALTH PROBLEMS IN THE AGED

Frailty is the most usual descriptor of emergent quality of life and morbidity in the aged. Insofar as it reflects strength, ability to carry out the required activities of daily living, proneness to falls, apathy and cognitive impairment, there is a general acceptance that it might have something to do with nutritional status (Rosenberg and Miller, 1992). The problem is that its definition and investigation is still embryonic, certainly in relation to food intake, with more descriptive, longitudinal and intervention studies still required. There is growing awareness that the major health problems in the aged do have nutritional contributors. These problems are (Wahlqvist *et al,* 1995a): i) protein energy dysnutrition: ii) immune dysfunction: iii) macrovascular diseases: iv) insulin resistance syndromes; v) osteopenia and fractures; vi) cognitive impairment; vii) neoplastic disease; viii) visual impairment; and ix) mood disturbance, notably depression (Glueck *et al,* 1993). These health problems will themselves contribute to "frailty".

In the elderly Greek study, Melbourne women had the highest prevalence of obesity (BMI ≥ 30 kgm^{-2}) (women 45%; men 30%; Spata <30%), and the risk of protein energy malnutrition was low overall (<10%). An index of impaired immunity was high and more prevalent in Melbourne Greeks (20% had total lymphocyte counts <1,500mm^{-3}) than Spata Greeks (7%). The most common nutrition-health complaint was hypertension (45%), followed by coronary disease in Melbourne Greek women (40%), which was significantly greater than the prevalence amongst men and Spata women (20%). The third most common complaint was diabetes (M 10%, F 20%). The least common health complaint was cancer (<5%) (Kouris-Blazos *et al,* 1996).

Some comment is required about what constitutes a preferred level of body fatness in later life. In the IUNS FHILL studies, there was a wide range of BMIs (Fig 1) with European communities (Anglo-Celtic, Australian, Swedes, Greeks) generally having higher values than Asian communities (Japanese, Tianjin Chinese, Filipinos). For these people, survivors over the age of 70, mean BMIs ranged between 20 and 30. BMI is an index of total body fatness (or the upper end) or of chronic energy undernutrition and reduced lean mass (or the lower end). Remarkably, across a wide range of BMIs in elderly Indonesians studied with the IUNS protocol (Iswarawanti *et al,* 1996) physical activity levels in those with BMIs<17 were very similar to those with BMIs ≥22. What allows these equivalent functions? What compensatory measures are at work? Is a nutritional debt incurred by those with the lower BMIs or is there reserve capacity in those with higher BMIs? We do know, in nonagenarian Bostonians (Fiatarone *et al,* 1990) that the combination of strength training and food supplementation can improve lean mass and body composition - the corollary is presumably, that, not to do so, creates protein energy dysnutrition. Additionally, elderly in Finland (≥85 years) with BMIs <22 (Mattila *et al,* 1986), Sweden (70-79 years) with BMIs <24 (Steen *et al,* 1994) and the USA with similarly low BMIs (Andres *et al,* 1993) lived shorter lives than those with higher BMIs, with ones about 27 kg m^2 being optimal. There are trade offs here between obesity which is central, with higher BMIs compatible with optimal survival, and the morbidity of insulin resistance, associated with greater body fatness.



(ACA = Anglo-Celts M 42, F 40; SWE = Swedes M 52, F 80; GRK-S = Spata Greeks M 32, F 31; GRK-M = Melbourne Greeks M 66, F 59; JPN = Okazaki Japanese M 28, F 33; CTJ-R = Tianjin Chinese rural M 73, F 79; CTJ-U = Tianjin Chinese urban M 107 F 102 FIL = Filipinos M 33 F 109, upper decile of Filipino community sampled - 55 yrs and over)

Fig 1 - FHILL descriptive morbidity study mean body mass indices (kg / m^2) of elderly aged 70-79 years by centre and gender (Wahlqvist *et al,* 1995).

QUALITY OF LIFE AND MORBIDITY STUDY

The World health Organisation's definition of 'health and quality of life' is not simply the absence of disease but includes something positive as well, that moves beyond the body to include personal and social well-being (WHO, 1984). There is general agreement in the literature on the five areas that should be included in a *total health assessment* of the elderly. This has been defined as *multidimensional assessment of health status*, which has become synonymous with quality of life (Fillenbaum, 1984). These include not only physical health, but also function health (*eg* ability to carry out activities of daily living, disability), mental health (*eg* well-being, depression), social health (*eg* social activity, social networks and living arrangements) and economic functioning (Fillenbaum, 1984). Surprisingly, however, the literature is devoid of a single index or score that measures all these aspects of 'health status'. Information on physical health alone is inadequate when considering well-being and quality of life in elderly folk. For example, many of the disabling problems of older persons cannot be 'solved' or cured. However, when interviewed, older patients state frequently that their health is good in spite of the presence of these chronic conditions (Fillenbaum, 1984; Granney and Zimmerman, 1981).

If quality of life is of major importance in the aged, to what extent is it influenced by nutrition or vice versa? Rosenberg and Miller (1992) point to the growing evidence supporting the view that good nutritional status is an important determinant of quality of life due to its effect on the nervous system. A healthy nervous system facilitates independence by maintaining physical mobility, cognitive and visual function which allows an elderly person to be socially and physically active.

A standardised later life status score (LLSS) was developed (Kouris-Blazos and Hsu-Hage, 1995) which incorporated eight dimensions or 'life factors' in an elderly person's life (Table 1), including well-being, memory, general health, medication-use, activites of daily living, exercise, social activity and social networks. Standardised scores were generated for all these dimensions and summed to form the standardised LLSS (score = 0-80; higher score = better quality of life). Sub-scores for each contributing dimension are shown in Table 1. The eight dimensions of life, whilst being inter-related statistically, are considered independent resources that determine quality of life in old age (Butler 1992; Schlettwein-Gsell 1992). Contributors to variance have been used as the criteria of biological sigificance, rather than reference to weightings in the scores, which have been arbitrarily set.

Ten food groups were constructed from the 238 food items in the food frequency questionnaire (the main ingredient in a mixed dish was used for grouping) and described:

a) intake (g / day) (Table 2)

b) as 9 standardised food group intake variety scores (alcohol and fats were collapsed into one group) to describe variety of foods consumed within a food group; a medium serving of a food or mixed dish within a food group had to be consumed at least once a month or more to score (Table 3).

Table 1

The Standardised Later Life Status Score (1-80) and its components (standardised to a value of 10*).

1. Well-being score (0-7): questions on feelings of worry, depression, tiredness, loss of interest in life, contentedness with life, tendency to laugh, enjoyment of music, feeling lonely, sleeplessness and feelings of acknowledgement and respect by friends and relatives.

2. Memory score (0.5): ability to recall year, month and day of the week, including their address and whether they feel they forget names of people more often.

3. General health score (33-74): self rated health, frequency of physician visits, self reported health conditions, questions on eyesight and hearing.

4. Medication-use score (21-42): prescribed and non-prescribed medications (self-reported and checked by interviewer).

5. Activites of daily living (ADL) score (15-62): Questions regarding degree of difficulty in coping with basic bodily functions (*eg* using the toilet, eating) and with performing basic tasks *eg* cooking, housework, walking between rooms.

6. Exercise score (1-7): questions on often subjects go out of their house and how many minutes/ hours spent per day / week doing various activities.

7. Social activity score (22-176): questions on ways in which subjects spent their time either with others (social) or alone (leisure) *eg* meetings, church, hobbies, gardening.

8. Social networks score (12-46): questions regarding contact with friends and relatives, feelings of loneliness and degree of support.

* The scores shown in parentheses are those which reflect the basic questionnaire, but for each component these have been standardised to 10, providing a total available score of 80.

Table 2

Food groupings (G/day).

1) **Meat group** - included beef, lamb, chicken, turkey, game, bird, rabbit, pork, offal, processed meat.

2) **Seafood group** - fish, shellfish, fish roe dip.

3) **Dairy group** - milk, cheese, cheese pie, yoghurt, custard, milk puddings, custard pastry.

4) **Vegetable group** - all vegetables, garlic, olives, including mixed dishes where vegetables are main ingredient (*eg* mousaka, spinach rice casserole, eggplant and garlic / potato dip) and nuts.

5) **Legume group** - all legume soups, salads and casseroles, chickpea felafel, green peas and split peas.

6) **Cereal group** - bread, rice, noodles, pasta (including mixed pasta dishes like pastichio, lasagna), break fast cereals, polenta, trahana (flour and sour milk pasta), cakes, sweet and dry biscuits.

7) **Fruit group** - all fresh and dried fruit.

8) **Alcohol group** (beer, wine, spirits, liqueurs)

9) **Fats group** (butter, margarine, oils, peanut butter, tahini paste)

10) **Sweets group** - all foods where sugar is major ingredient *eg* softdrinks, juices, sugar, jam, honey, confectionery, jelly, halva (tahini paste and sugar), chocolate, Turkish delight.

Table 3

Food group variety scores.
(score = number of different foods within a food group consumed over a *mounth*)

1) **Meat variety score (0-24)** - consists of 24 foods from the meat group.

2) **Seafood variety score (0-19)** - consists of 19 foods from the fish group.

3) **Dairy variety score (0-30)** - consists of 30 foods from the dairy group.

4) **Cereal variety score (0-34)** - consists of 34 foods from the cereal group.

5) **Vegetable variety score (0-48)** - consists of 48 foods from the vegetable group

6) **Legume variety score (0-13)** - consists of 13 foods from the legume group.

7) **Fruit variety score (0-33)** - consists of 33 foods from the fruit group.

8) **Sweets variety score (0-17)** - consistsof 17 foods from the sweets group.

9) **Alcohol and fats score (0-20)** - consists of 20 foods from the alcohol and fats group, including tea, coffee and water.

c) as nutrients (unrefined and refined carbohydrate, protein, saturated fat, polyunsaturated fat, monounsaturated fat, cholesterol, alcohol, fibre, sodium, potassium, calcium, phosphorus, magnesium, iron, zinc, vitamin A, thiamin, riboflavin, niacin, vitaminC).

Statistics

1. Non-nutritional variables: Stepwise regression analysis was firstly performed on eight non-nutritional variables variables (well-being, memory, general health, medication-use, activities of daily living, exercise, social activity and social networks scores) to determine the relative importance of each standardised life factor in explaining the variance of the standardised LLSS, after controlling for age group (70-79 and 80 + years).

2. Nutritional variables: Stepwise regression analysis was subsequently performed on the nutritional variables (controlling for age) to show the percentage variation of the standardised LLSS explained separately by:

a) 10 food groups - intake g /day

b) 9 food group variety scores

c) 21 nutrients

Non-nutritional factors affecting quality of life in Greek elderly

The most important non-nutritional factors identified as determining the variance in later life status or quality of life in Greek elderly included mobility and independence (exercise in the village of Spata and activities of daily living in the city of Melbourne), well-being and memory (collectively explained 80% of the variance of LLSS). Social activity and networks were the next most important contributors to variance - mainly in Melbourne. Health and medication were of least importance in determining later life status variance (Table 4). The factors, which, in effect, discriminate between the members of an elderly community, appear to reflect what kind of place (*eg* urbanised) that is.

In other studies (Heikkinen, 1987; Butler, 1992; Schlettwein-Gsell, 1992; Dwyer *et al,* 1991; Saltman

et al, 1989), being free of illness did not necessarily ensure quality of life; mobility, independence, cognitive function, psychological state, social relations or networks assumed greater importance. The important finding from these studies is that older people do not associate absence or control of illness with ' health'. In fact, good health is defined consistently in non-medical terms. This suggests that quality of life in the elderly is associated with mobility (ADL, exercise), cognitive status (memory) and psychological status (well-being) rather than presence or absence of disease or medication use. For example a possible scenario may be 'I feel great, I am mobile, I can remember most people and places even though I have high blood pressure'.

The aggregate LLSS does have comparative interest. The men in both Spata and Melbourne had sigificantly greater LLSS (63) than the women (57), which was mainly attributed to their significantly greater exercise levels and ability to cope with most activities of daily living (Table 4). The score also decreased with age. Centre differences were significant for the women only aged 70-79. Melbourne women had a greater LLSS (and well-being and self-rated health scores) than the Spata women, even though they reported more health problems. This is probably related to their greater social networking and social activity scores. Furthermore, social activity / networks explained a greater proportion of the variance (5%) of the LLSS in Melbourne women compared with Spata women <2% (Table 4, Fig 2). In Spata, exercise explained about 60% of the variation of the LLSS, where as in Melbourne, activities of daily living explained up to 43% of the score. These differences are probably related to the lifestyle changes that have occurred on migration. Melbourne Greeks no longer have the opportunity to exercise as muchsince farming is no longer part of their of lifestyle. Therefore, other forms of 'mobility' such as activities of daily living, may assume greater immportance (Table 4). It is not surprising that exercise and mobility were the strongest determinants of the LLSS variance in Greek elderly. Impairments exert negative influences not only on morbidity and mortality, but also on social and psychological function. They limit an individual's quality of life and ability to live independently, to maintain or begin relational, and to pursue recreational activities and other goals (Dwyer *et al,* 1991).

Table 4

Percentage variation of later life status score explained by Non-nutritional factors for Spata and Melbourne (controlling for age group), by gender.

	Parameter estimate	R^2 x 100@	p-value
Spata			
Men (N = 51)			
Age group	-6.6	14	**
Exercise	0.1	64	****
Well-being	0.1	15	****
Activities of daily living	0.1	3	****
Memory	0.1	1	****
Social activities	0.1	1.5	***
Social networks	0.1	0.4	***
General health	0.1	0.4	***
Medication	0.1	0.7	****
Women (N = 53)			
Age group	-3.6	6	NS
Exercise	0.1	62	****
Well-being	0.1	18	****
Activities of daily living	0.1	5	****
Memory	0.1	6	****
Social activities	0.1	1.5	***
Social networks	0.1	0.7	***
General health	0.1	0.7	***
Medication	0.1	0.1	****
Melbourne			
Men (N = 94)			
Age group	-6.6	18	****
Exercise	0.1	7	****
Well-being	0.1	6	****
Activities of daily living	0.1	43	****
Memory	0.1	21	****
Social activites	0.1	3	***
Social networks	0.1	1.3	***
General health	0.1	0.5	***
Medication	0.1	0.2	****
Women (N = 95)			
Age group	-7.3	21	NS
Exercise	0.1	1.3	****
Well-being	0.1	44	****
Activities of daily living	0.1	16	****
Memory	0.1	11	****
Social activites	0.1	5	***
Social networks	0.1	1	****
General health	0.1	0.7	***
Medication	0.1	0.0	****

NS = not significant; * p<0.05; ** p<0.001; *** p<0.0001 **** p<0.0001;@,R^2 x 100 = % variation explained by the variable.

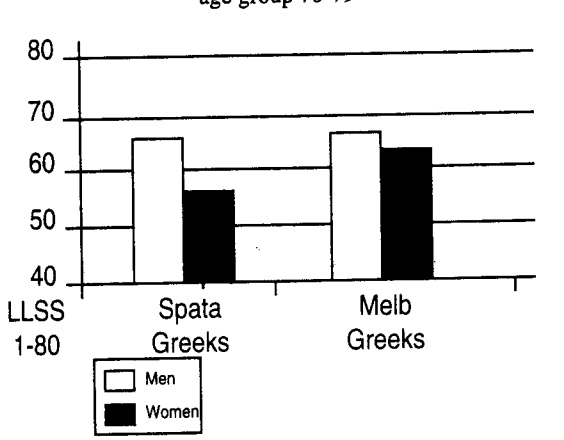


Fig 2 - Mean later life status scores (1-80) for elderly Greeks in Spata, Greece and Melbourne, Aus tralia, by gender.

Buskirk's (1985) review of data on health maintenance and exercise supports the assumption that regular exercise blunts many of the physiological declines associated with aging, improves sense of well-being and quality of life. An exercise intervention study in mid-life has been shown to compress morbidity towards the end of life (Fries, 1996). This is a principal health goal for successful aging. In a study by La Croix *et al,* (1996), regular walking (>4 hours/ week) significantly deceased the risk of cardiovascular disease hospitalisation and death in older adults. At increased ages there is a gradual reduction in the basal metabolic rate, but no proportional reduction of the demand for essential nutrients. Physical activity has been associated with greater energy intakes and subsequently nutrient intakes and quality of life in the aged (Astrand, 1992; Smiciklas-Wright, 1990). Taken together with prospective studies which show that increased energy intakes of the order of 300-500 kcal per day over the usual in sedentary populations confer either decreased cardiovascular (Kushi *et al,* 1985; Lapidus and Bengtsson, 1986; Morris *et al,* 1977) or total mortality (Kromhout *et al,* 1984) and those which show similar increases in daily physical activity energy requirements similarly improve life expectancy (Paffenbarger *et al,* 1993) the case for a higher plane of energy nutrition than that prevailing in industrialised societies is strong. This runs counter to the disturbing advocacy principally on the basis of animal studies for energy restriction to prolong life where frailty has much to do with less lean mass. The evidence is, however, that any extra energy intake must be from nutrient (and phytochemical) dense foods, without excessive body fatness.

Nutritional factors affecting quality of life in Greek elderly

Daily intake of food categories: A high intake (grams/ day) of vegetables, fruit and legumes appeared to be the most important 'food' determinants of later life status in Greek elderly, followed by a low intake of meat (except Melbourne elderly). Fish intake was positively associated with the LLSS in Spata men only. Fat and alcohol consumption in the men were also positively associated (barely significant) with a high LLSS whereas in women the association was negative (fat only, not significant) (Tables 5, 6). The relationship between quality of life and food intake has not been reported in other studies. In a study by Walker and Beauchene (1991) on 61 elderly aged 60-94 years, physical health (measured using the Guttman Health Scale) was related to nutrients (vitamin A, ascorbic acid and fibre) predominantly found in plant foods. Nevertheless, epidemiological data indicate that a high intake of vegetables, fruit and fish are associated with reduced rates of heart disease and colonic cancer (Kushi *et al,* 1985; James *et al,* 1989; US National Research Council, 1989; Wahlqvist and Kouris-Blazos, 1991). Legumes have also been shown to be cholesterol lowering (Kestin et al, 1989; Shutler *et al,* 1987) and potentially protective against cancer (Ireland and Giles, 1993).

Table 5

Mean values (±SD) for seclected non-nutritional and nutritional variables, for Spata and Melbourne Greek elderly, by gender and age group. (for all scores, a higher score is a favorable score)

	Spata		Melbourne	
	70-79	80+	70-79	80+
Men (N)	32	19	66	28
Non-nutritional				
Later life status score (1-80)	66±8^{ae}	59.5±8^{be}	66.5±6^{cf}	60±8^{df}
Exercise score (1-7)	4.4±2^{aei}	2.7±2^{ej}	4±1^{ci}	3.5±1^{dj}
Well-being score (0-7)	5.5±2^{a}	4.7±2	6±1^{df}	5±1^{f}
Memory score (0-5)	5±1^{aei}	4.6±1^{bej}	4.5±1^{fi}	3.7±1^{fi}
ADL score (15-62)	59±5^{ae}	55±9^{e}	60±4^{cf}	56±9^{df}
Nutritional				
Vegetables				
g / day	378±163^{aei}	274±143^{ej}	486±186^{cfi}	387±152^{fi}
variety score (1-48)	13.5±5^{i}	11.6±4^{j}	19±5^{i}	17±6^{j}
Legumes				
g / day	60±42^{ai}	44±26^{j}	93±59^{i}	78±48^{dj}
variety score (1-13)	2.7±2^{ai}	2.3±2^{j}	3.7±2^{ic}	3.7±2^{jd}
Fruit				
g / day	192±138	189±92	240±142	232±106
variety score (1-33)	7.2±4^{i}	8.5±3	9±4^{i}	10±4
Seafood				
g / day	60±40	49±30	63±41	48±35
variety score(1-19)	3±2^{a}	3±2^{bj}	2.5±1	2.3±1^{j}
Meat				
g / day	98±51^{ai}	114±86^{bj}	158±62^{ci}	149±65^{di}
variety score (1-24)	3.7±1^{i}	3.7±2^{j}	5±2^{j}	5±2^{j}
Women (N)	31	22	59	36
Non-nutritional				
Later life status score (1-80)	58±7^{ak}	54.5±8^{b}	62±7^{cgk}	55±7^{dg}
Exercise score (1-7)	2.8±1^{ak}	2.8±1	3±1^{chk}	2.6±1^{dh}
Well-being score (0-7)	4±2^{ak}	4±2	5±2^{dk}	4.6±2
Memory score (0-5)	4.5±1^{ag}	3.3±1^{bg}	4.4±1^{h}	3±2h
ADL score (15-62)	54±9^{a}	52±11	57±8^{ch}	49±10^{dh}
Nutritional				
Vegetables				
g / day	291±144^{ak}	239±122^{l}	400±155^{chk}	326±136^{hi}
variety score (1-48)	11±5^{k}	10±5^{l}	18.5±5^{k}	16±5^{l}
Legumes				
g / day	38±33^{ak}	48±29^{l}	77±59^{hk}	55±48^{dhl}
variety score (1-13)	1.7±2^{ak}	2.3±2	3.1±2^{kc}	2.5±2^{d}
Fruit				
g / day	176±95	163±129	200±122	205±118
variety score (1-33)	7.5±3	6.7±4^{l}	8.5±3	9±4^{l}
Seafood				
g / day	48±42	40±37	49±37	41±34
variety score (1-19)	2±1^{a}	2±2^{b}	2±1	2±1
Meat				
g / day	71±40^{ak}	86±34^{b}	109±52^{ck}	99±53^{d}
variety score (1-24)	3.3±2^{k}	3.6±1^{l}	4.7±2^{k}	4±1^{l}

Pairs of letters indicate significant differences, Wilcoxon $p<0.05$

a,b,c or d, identical superscript indicate statistical significance within centers - between genders for a given age group; e,f,g or h, identical superscript indicate statiscance within centres - between age groups for a given sex; i,j,k or l, identical superscript indicate statistical significance between centres - for a given age group and gender.

Table 6

Percentage variation of standardised later life status score explained by food groups (grams/day) (controlled for age group) stepwise regression.

	Parameter estimate	R^2 x 100@	p-value
Spata			
Men (N = 51)			
Age group	-6.6	14.0	**
Seafood	0.02	9.0	*
Fat	0.2	4.7	NS
Vegetables	0.02	4.7	NS
Meat	-0.03	6.0	*
Alcohol	0.08	3.4	NS
Women (N = 53)			
Age group	-3.6	5.8	NS
Fruit	0.03	12.3	**
Legumes	0.09	13.7	**
Cereal	0.01	4.0	NS
Meat	-0.03	4.0	NS
Dairy	-0.01	3.0	NS
Fat	-0.01	2.7	NS
Melbourne			
Men (N = 94)			
Age group	-6.6	17.6	***
Fruit	0.08	2.7	NS
Alcohol	0.07	2.8	NS
Women (N = 95)			
Age group	-7.3	21.1	****
Vegetable	0.016	9.5	***

Significance : NS = not significant; * p<0.05; ** p<0.01; *** p<0.001; **** p<0.0001; A high later life status score indicates 'better guality of life';@ R^2 x 100 = % variation explained by the variable

Food variety scores: The effect of limited food choice on the health and nutritional status of the elderly can be serious, because consumption of a varied diet is considered the most effective way to assure adequate nutrient intake. Additionally, a variety of foods are recommended in order to provide other nutrients and non-nutrients for which human requirments have been less well defined (Wahlqvist and Kouris-Blazos, 1997; Hodgson *et al,* 1994). The relationship between quality of life and food variety has not been reported in other studies. Wahlqvist *et al,* (1989) showed that food variety is associated with less non-invasive evidence of macrovasclar disease. Horwath (1987) has shown that, as dietary variety increases, so the self assessment of health also increases from poor to very good in elderly Australians. Horwath also showed that social/ leisure activity alone accounted for 15% of the variance of the total food variety score, and 11% of the variance of the vegetable variety score. Participation in a greater variety of social activities was associated with use of a greater variety of foods, which in turn was linked with higher micronutrient intakes. Similarly to the study by Horwath, in the current study, a greater total food variety was significatly correlated with better self rated health (R^2=0.5, p<0.01 Spata only), a higher total health score (R^2=0.35, p<0.05), greater well-being (Spata women only R^2=0.5, p<0.01) and social activity and network scores in Greek elderly (R^2=0.5, p<0.01) (Kouris-Blazos, 1994).

In the current study, vegetble variety was the most significant contributor to the variation of the LLSS, particularly for the women in both Spata and Melbourne where it explained up to 10% of the variation (p<0.01) of the LLSS. In other words, the high vegetable intake should probably include a variety of vegetable in order to be of benefit in later life. For the men, fruit variety (Melbourne) and fish variety (Spata) assumed importance, explaining 4% and 19.6% of the variation of the LLSS respectively (Tables 7, 4). Interstingly, eating a variety of 'tradit-ional' foods alone was not associated with better later life status. However, eating traditional food was associated with a greater total health score in Melbourne men (R^2=0.25, p<0.05) and better well-being (R^2=0.53, p<0.0001) in Spata women).

Nutrients: Rosenberg and Miller (1992) point to the growing evidence supporting the view that good nutritional status is an important determinant of quality of life because of its effect on the nervous system. For example, a health nervous system will maintain physical mobility, cognitive, psychological and visual function. Visual function has been shown to be advantageously affected by antioxdants such as vitamins C and E (Jacques *et al,* 1988), physical mobility and cognitive function by vitamins B6, B12,

folate, vitamin C, riboflavin, thiamin and iron (Goodwin *et al,* 1983). Similarly in the current study, a greater intake of vitamin C was associated with a higher LLSS (6% variation, $p<0.05$) and well-being score in Spata men ($R^2=0.36$, $p<0.05$). The total health score was also positively correlated with thiamin intake in Spata women ($R^2=0.5$, $p<0.01$) (Table 7). The nutrients at greatest risk of deficiency included thiamin, magnesium and vitamin A, with more than 50% of Spata Greeks failing to achieve two-thirds of the RDI compared with less than 20% of Melbourne subjects. The risk of deficency was lower for calacium, followed by zinc and lastly riboflavin, in both study sites. Vitamin C, niacin, iron, potassium and phosphorus were least likely to be inadequately consumed, especially in Melbourne (Kouris-Blazos *et al,* 1996; Wahlqvist *et al,* 1994). Published studies of elderly people have also reported similarly low intakes of these nutrients (Horwarth, 1989).

Table 7

Percentage variation of standardised later life status score explained by food groups variety scores (controlled for age group) stepwise regression.

	Parameter estimeate	R^2 x 100@	p-vlue
Spata			
Men (N = 51)			
Age group	-6.6	14.0	**
Seafood variety	-6.6	14.4	***
Women (N = 53)			
Age group	-3.6	5.8	NS
Vegetable variety	2.1	9.0	*
Melbourne			
Men (N = 94)			
Age group	-6.6	17.6	****
Fruit variety	1.2	3.6	*
Legume variety	1.0	2.0	NS
Vegetable variety	1.2	2.4	NS
Women (N = 95)			
Age group	-7.3	21.1	****
Vegetable variety	1.8	7.0	**

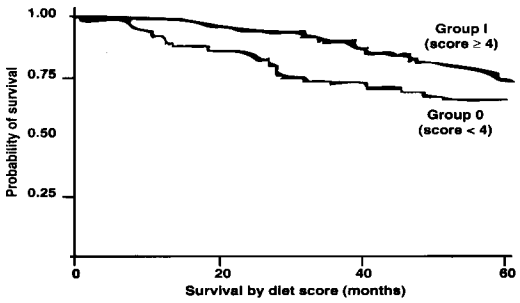
Significance: NS = not significant; * p<0.05; ** p<0.01; *** p<0.001; **** p<0.0001;@,R^2 x 100 = % variation explained by the variable.

Table 8

Percentage variation of later life status score explained by nutrient intake (controlled for age group and energy intake) stepwise regression.

	Parameter estimate	R^2 x 100@	p-vlue
Spata			
Men (N = 51)			
Age group	-5.8	20.2	***
Kcal	0.004		
Carbohydrate	-0.07	6.8	*
Zinc	-1.02	14.3	**
Vitamin C	0.08	6.1	*
Vitamin A	0.003	2.5	NS
Women (N = 53)			
Age group	-3.6	12.0	NS
Kcal	0.004		
Fibre	1.5	21.3	***
Zinc	-0.7	4.8	NS
Polyunsaturated fat	-0.85	3.4	NS
Melbourne			
Men (N = 94)			
Age group	-6.7	17.9	****
Kcal	-0.0007		
Sodium	-0.003	3.3	NS
Magnesium	0.04	2.0	NS
Niacin	-0.4	4.0	*
Carbohydrate	-0.03	2.5	NS
Women (N = 95)			
Age group	-7.1	23.5	****
Kcal	0.003		
Cholesterol	-0.02	3.7	*
Carbohydrate	-0.06	3.4	*

Significance: NS = not significant; * p<0.05; ** p<0.01; *** p<0.001; **** p<0.0001;@,R^2 x 100 = % variation explained by the variable.



Kaplan-Meier survival curves for individual subjects with diet score up to 3 and 4 or more.

Fig 3 - Mortality follow-up: Survival curves of elderly Greeks by diet score (Trichopoulou *et al,* 1995).

MORTALITY STUDY

The elderly Greeks in rural Greece (n=182, aged 70+) were followed up after 5 years to assess the influence of the traditional Greek diet on survival. The Greek version of the traditional Mediterranean diet was scored in terms of eight component characteristics, giving a final score ranging between 0-8 (Trichopoulou *et al,* 1995): 1) high monounsaturated: saturated fat ratio; 2) moderate ethanol consumption; 3) high consumption of legumes; 4) high consumption of cereals (including bread and potatoes); 5) high consumption of fruits (fresh and dried) and nuts; 6) high consumption of vegetables; 7) low consumption of meat, fish and meat and fish products; 8) low consumption of milk and milk products. The cut off point for all characteristics was taken as the corresponding median values specific for each sex.

It was *a priori* hypothesised that a more *varied* diet with at least four of these components would have beneficial health effects whereas a diet with fewer of these components (<4) would be less healthy. These considerations are based on the collective epidemiological and biological evidence (Wahlqvist and Kouris-Blazos, 1991a). A statistical model was developed (Cox's proportional hazards regression) that controlled for age at enrolment, sex, and current smoking status and evaluted the total diet score as a predictor of the hazard of death. Older age was, as expected, a highly significant predictor of the hazard of death, whereas current smoking and male sex were not significantly associated with this hazard. A higher diet score was significantly associated with a sharply reduced risk of death, by 17% per one unit increase and by more than 50% per four unit increase (Fig 1). The individual components of the diet score, however, had weak and generally non-significant associations with survival. The key messages from this study are: 1) a Mediterranean diet is beneficial to health; 2) the longevity of Mediterraneans can be in part explained by their *varied* diet; 3) the overall dietary patterm is more important for health and longevity than individual nutritional components. The Lyon Diet Heart Study also showed that adherence to the Mediterranean diet significantly reduced the number of cardiovascular deaths and recurrent myocardial infarction in survivors of a first myocardial infarction over a 5 year period (de Lorgeril *et al,* 1994). A mortality study by Kant *et al,* (1993) showed the importance of food variety in protecting against premature death.

CONCLUSION AND STRATEGIES

In summary, results from the FHILL morbidity study suggest that the most important non-nutritional factors to optimise an integral index of later life status or quality of life in village and metropolitan Greek elderly are: mobility and independence (exercise and activities of daily living), a sense of well-being and intact memory (these collectively explained 80% of the variance of LLSS). Social activity and networks were the next most important factors - mainly in the city of Melbourne. Health and medication were of least importance in determining later life status. The most important nutritional factors accounting for later life status were a higher plant food intake (in particular vegetables, legumes and fruit) and seafood intake and a lower meat intake. The extent to which these findings can be extrapolated to other communities remains to be determined, especially where the food supply has been precarious. The beneficial high plant food intake comprised a variety of vegetables and fruits. The mortality study supported the findings from the morbidity study, and showed the importance of overall traditional Greek food culture, more than individual food categories, in protecing against earlier death. The FHILL cohorts protecting an opportunity to consider the cross-cultural robustness of these findings.

Straegies for communities with elderly people

Some of the important strategies which emerge from the study of communities of elderly people that have a bearing on the whole community are:

1. To engage older people with the young in food and health information transfer and care bidirectionally. Practically, this means developing relationships between grandchildren and their grand parents. Amongst other benefits, this encourages retention of the best of traditional practices, beliefs and values.

2. For nutritional well-being to be seen in food socio-cultural terms, one of the functions of eating is to create social well-being. And social activity stimulates preferred eating patterns, notably use of a variety of foods.

3. For nutritionally related health to be the product of physical activity and composite eating patterns and to be measured and evaluated in integral ways.

4. To retain a "village" or neighbourhood approach to food and health, even in the face of major urbanization and metropolis development - new information technologies and more innovative town planning and architecture should facilitate this approach.

5. To use an ecosystem appoach to food and health; choose food and eat in a way which is environmentally respectful (this will in turn have its own health benefits).

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