Age-fitness. How achievable with food?

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Abstract

To be fit as we age could be described as “Age fitness”. Increasing evidence points to opportunities for greater wellness, health maintenance and reduction of the burden of disease in later life for a growing proportion of the community than previously envisaged. The scope of “age fitness” is social, mental, physiological and physical.

We know a great deal about food cultures associated with successful aging – Greek, Okinawan, and Scandinavian, for example. Within these cultures, we are beginning to account for variances in health and survival by integrative scores of food intake and their validation.

Introduction

In the last few decades increases in life expectancy have been associated with less morbidity in most developed countries (1). WHO have developed a healthy life expectancy indicator, Disability Adjusted Life Expectancy (DALE), which estimates the number of years to be lived in 'full health'. (2) The 10 nations that have the highest DALE are summarised in Table 1. Factors that influence disease, disability and longevity include the rate of decline in physiological function which, in turn, appears to be associated with social, mental and physical activities and with food habits.

The IUNS FHILL (Food Habits in Later Life) study, a study of older adults (70 years and over) in communities that have demonstrable longevity has explained the effects of social and mental activity, physiological function, physical activity and food habits on survival (36).

Predictors of survival

The overall predictors of survival include genetic background, environmental factors (such as, work, pollution, pesticides, housing, social upheaval and war) and personal behaviour. Personal behaviour is the area that is most modifiable and includes lifestyle factors that cover eating habits, physical activity and substance abuse.

Age-related changes in physiological function

Some age-related changes in physiological function that can be slowed with certain lifestyle measures include those that have to do with the cardiovascular and respiratory system (3, 4, 5), the integumentary system (6, 7), and the musculoskeletal system (8)

Age-fitness defined

Maintaining independence with age depends on age-fitness. *Age-fitness* includes all areas of fitness; social, mental, physiological and physical. *Social fitness* is the ability to make and maintain satisfying social contacts and networks. Mental fitness fit refers to the way we think, feel, our capacity for learning and the absence of illness like dementia, depression and anxiety. The ability to have sufficient strength, endurance, range of movement and balance to avoid frailty is known as physical fitness. Key physiological states essential for successful ageing include the reserve capacity of the cardio-respiratory, gut, renal and immune system, the special senses such as sight and hearing and, the metabolic system, for example, insulin sensitivity.

The scope of age-fitness to predict health and well-being - the evidence

Social/mental fitness and health

Social activity may protect against dementia (9), the most serious mental health problem among ageing adults. Socially engaged (fit) adults also appear to be a less risk of experiencing the more common decline in cognitive function with age and are more likely to be in better health. (10, 11) Among highly educated adults, mental fitness in relation to cognitive function appears to be better preserved in those who continue to seek mental challenges.(12) Many studies that examine mental fitness and health usually look at the other parameters of age-fitness on mental health. Social isolation for instance is likely to have an adverse effect on mental fitness and physical activity seems to reduce the risk of depression, a major mental health problem. (13, 14, 15)

Physical fitness and health

Physical fitness appears to have the potential to compress morbidity in older populations.(16) Regular brisk walking has been shown to improve cognition in previously sedentary older adults and, (17) being aerobically fit appears to favourably influence glucose tolerance and insulin action.(18, 19) Maintaining and/or improving strength and muscle mass to reduce the risk of frailty can be achieved though strength fitness.(20, 21)

Physiological fitness and health

As muscle mass declines with age there is also a reduction in muscle strength, therefore; having an adequate reserve of muscle may help to preserve functional ability with age.(22,23). Cross-sectional food intake data from the FHILL study on 453 people aged 70 and over (which included Greeks in Spata Greece, Greek migrants in Melbourne, Anglo-Celts in Melbourne, Swedes in Sweden) found that 32% of the variance for skin wrinkling in a sun-exposed site was predicted by food intake.(6) Older people with less skin wrinkling were generally found to have better health (higher general health score), less functional disabilities (higher activities of daily living score) and a higher dehydroepiandrosterone (DHEA) level.(24)

The scope of age-fitness to predict survival - the evidence

Social/mental fitness and survival

Several prospective studies in older adults have found that those who are the least socially active are more likely to die prematurely compared with those who are the most socially active. (25, 26). Interestingly, one community-based study of moderately to severely disabled older women who were followed for three years showed that women who were emotionally vital (in other words women who were positive in their outlook) had the highest probability of survival.(27)

Physiological fitness and survival

Immune function declines with age and may play a role in predicting survival. (28) A reduction in lean body mass also occurs with age and it too is associated with survival. (29) Poor physiological (metabolic) fitness, such as Type II diabetes, is also related to a higher risk of mortality. (30)

Physical fitness and survival

Moderate to high levels of habitual physical activity has been associated with increased survival (31) and a substantially lower risk of coronary events. (32) Moreover, cardio-respiratory fitness, an important indicator of longevity, appears to be more important than obesity in terms of survival. (33)

Modelling

Many disciplines use modelling to predict certain outcomes. Clinical science has preferred clinical trials to modelling as a method to predict outcomes, although this is changing. This has meant that complex biological systems and processes like ageing, which are not amenable to randomisation, variable by variable, have not received the attention they deserve in health care.

Food cultures and survival (the FHILL type studies)

Food variety, a measure of dietary adequacy,(34) appears to be associated with survival.(35) Studies on food and health among ageing populations (*Phase I* of the FHILL study) have shown that comparable health in old age can be achieved in different cultural settings with widely differing food habits. (36)

Phase II (mortality follow-up) of the FHILL study commenced in 1993 and examined prospectively the effect of food patterns, social and lifestyle variables on survival in five elderly cohorts (Greeks in Greece, Greeks in Australia, Anglo-Celts in Australia, Swedes in Sweden and Japanese in Japan). Findings from *phase II* indicate food patterns remain predictive of survival and are also associated with function and morbidity even after controlling for age, gender and smoking status (37). In particular, the adherence to a varied, but traditional "Mediterranean" type food pattern (e.g high in plant food, low in animal food) appeared to be important for longevity in both Mediterranean and non-Mediterranean cohorts (38, 39), regardless of food preparation/cuisine.

Age-fitness in the prediction of survival - the evidence from the FHILL study

Ethnicity and locality

When Greeks in Greece were used as the reference point to investigate the effect of ethnicity and locality in predicting survival in the FHILL cohorts to be Greek in Australia conferred the lowest risk of death (risk ratio 0.23, *P=0.0001*). The risk of death was also lower among

Swedes in Sweden and Japanese in Japan (risk ratio 0.37, *P=0.0001*) and (risk ratio 0.37, *P=0.0008*), respectively. Similar findings were observed for Anglo-Celts in Australia, although the risk ratio did not reach significance (*P=0.056*).

Social Fitness

Social fitness (including social activity and social networks) was assessed by questionnaire modified from the Multi-level Assessment Instrument (40) and WHO Western Pacific Study.(41). The Social Activity and Social Network scores were separately introduced into the Cox's Proportional Hazards model. After adjusting for age, gender, smoking status and ethnicity/locality, both a higher Social Activity score and a higher Social Network Score were associated with a lower risk of death.

Physical Fitness (Exercise and ADL)

Physical Fitness was assessed using questions from the WHO 11-country study, (42) earlier adapted from the validated instrument of Katz and Akpom (43). Physical fitness (which included an Exercise and Activities of Daily Living (ADL) score) was associated with a significantly lower risk of death after adjusting for age, gender, smoking status, and ethnicity/locality. A 5% reduction in risk of death was associated with each unit increase in the ADL score (*P=0.0001*) and a higher exercise score was associated with an 18% lower risk of death (*P=0.0037*).

Nutrition Fitness

Food intake promises to be, not surprisingly, one of the best measures of nutrition fitness. Together with body composition and various performance measures such as strength and endurance, it represents the inputs, outputs and the sum total of energy and food component through put and status or balance in human biology. Bio-markers of food intake offer ways in which its validity can be increased and its perturbations recognised. The FHILL studies have concentrated on food intake and food intake patterns as differentiators and common denominators in health susceptibility and for survival within and between cultures (people of different ethnicity living in different localities). (44, 45, 46)

For FHILL cohorts overall higher intakes of legumes, fish, shellfish, and olive oil (and the corresponding monounsaturated:saturated fat ratio) were significant predictors of survival in later life. Interestingly, quite different food patterns exist in all of the five relatively long-lived food cultures studied for survival. But in the three longest living (Greeks in Australia, Japanese in Japan and Swedes in Sweden) fish consumption is the highest in two of these three. The Anglo-Celtic Australians may compensate for their relatively low fish intakes by relatively higher intakes of vegetables, fruits and nuts and meat. Where olive oil is consumed less, in Swedes in Sweden and Anglo-Celtic Australians, dairy products are consumed relatively more. Japanese in Japan not only have the most fish, the most cereals, and alcohol but are equal highest consumers of legumes with Greeks in Australia. The differences as well as the commonalties

are instructive as to the extent to which food categories, on the one hand, and food patterns on the other, may confer longevity. The overall survival data indicate that legumes and fish are the most cohesive food predictors of survival, both conferring favourable prediction.

The relative importance of difference forms of fitness

Social sciences are in increasingly arguing that health and survival are principally dependent on social and societal factors provided there is enough food to eat. The FHILL study through its cross-cultural indices of predictors of survival is allowing this question to be addressed.

Conclusions

- Genetic, environmental and behavioural factors not only act as primary predictors of survival but also influence intermediate outcomes which are themselves predictors of survival.
- Behavioural and biologically related survival predictors include all areas of fitness; social, mental, physiological, physical and nutritional.
- There is interaction between each of these areas and, each is important in its own right.
- Intermediate outcomes can determine the ultimate outcomes of well-ness, the burden of disease and survival.

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Table 1
Disability Adjusted Life Expectancy (DALE) of the top 10 nations

NATION	**DALE**
Japan	74.5
Australia	73.2
France	73.1
Sweden	73.0
Spain	72.8
Italy	72.7
Greece	72.5
Switzerland	72.5
Monaco	72.4
Andorra	72.3

Table 2

Food and nutrients associated with skin wrinkling is a sun-exposed site (8).

Less skin wrinkling was associated with **higher intakes** of*:*

Foods

olive oil and olives
fish (especially fatty fish like sardines)
reduced fat milk/yoghurt, cheese
eggs
nuts and legumes (especially lima, broad beans)
vegetables *(especially leafy greens, spinach, eggplant, asparagus, celery, onions/leeks, garlic)*
whole grain cereals
fruit and fruit products (especially prunes, cherries, apples, jam)
tea and water

Nutrients

Total fat
Monounsaturated fat
Zinc

More skin wrinkling was associated with **higher intakes** of:

Foods

Meat (especially fatty processed meat)
full fat dairy (especially unfermented products, ice cream)
soft drinks/cordials
cakes, pastries, desserts
potatoes
butter
margarine

Nutrients

Saturated fat
Vitamin C

Table 3
The average Social and Physical fitness scores among the elderly cohorts in the FHILL study.

Variables	**Japanese in Japan** *n = 81*	**Swedes in Sweden** *n = 217*	**Anglo-Celts in Australia** *n = 135*	**Greeks in Australia** *n = 189*	**Greeks in Greece** *n = 104*
	Mean	Mean	Mean	Mean	Mean
Social Activity Score (22-176)	50	54	65	54	48
Social Network Score (12-46)	28	33	35	38	36
Activities of Daily Living (ADL) Score (15-62)	56	58	57	56	56
Exercise Score (1-7)	4	5	5	3	3

Table 4
The average daily consumption* of major food groups in the elderly cohorts from the FHILL study.

Variables	**Japanese in Japan** *n* = 89	**Swedes in Sweden** *n* = 184	**Anglo-Celts in Australia** *n* = 141	**Greeks in Australia** *n* = 189	**Greeks in Greece** *n* = 182
	Mean	Mean	Mean	Mean	Mean
Vegetables	283	165	346	353	295
Legumes	85	21	14	86	63
Fruits and nuts	140	298	330	252	261
Dairy products	165	404	346	245	243
Cereals	366	102	204	261	280
Meat and meat products	43	73	151	190	110
Fish and shellfish	102	73	21	73	42
Ethanol	15	5	8	7	10
Monounsaturated:saturated ratio	1.3	0.7	0.8	1.7	1.8
Energy (kcal)	1599	2501	2096	2118	2060

** grams, adjusted for energy intake: 2500 kcal (10460 kJ) for men and 2000 kcal (8368 kJ) for women*