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6.22 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. Whithin 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. 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.

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

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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6.23 Antioxidants Status and Physical Fitness in Seniors Aerobically Trained and Supplemented with a Multivitamin Drink

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Introduction

Ageing is associated with a risk of micronutrient deficiency due to a lower food energy intake. Different reports found for this population group borderline antioxidant and trace element status [1, 2] which is suggested to be correlated with mental and cognitive behaviour and immune responses [3, 4]. Poor nutritional status has also been implicated in the development and progression of chronic diseases including diabetes mellitus, osteoporosis, cancer and cardiovascular disease [5, 6]. Beside nutritional status a main cause of morbidity is an increased sedentary lifestyle and the resulting lower energy expenditure. Both factors, inactivity and a low micronutrient status are connected not only with a reduction in lean body mass, total body water, bone density, increase in body fat [7] but also to the risk of coronary heart diseases [8]. These alterations affect also quality of life. This study was planned to investigate the influence of aerobic endurance exercise and/or nutrition intervention on the antioxidant status, lipid oxidation and some fitness parameters of elderly people.

Subjects and Methods

The study included data of 53 elderly people living in three senior homes in Vienna.

General intervention design

During a period of eight weeks subjects underwent medical screenings for inclusion. Before the interventions baseline measurements of nutritional antioxidants and lipid parameters were performed. The maximal aerobic capacity test was ascertained with a spiroergometric test procedure. All included participants were randomised into one of the four groups: (1) *supplement + endurance training*, (2) *endurance training*, (3) *supplement*, (4) *control without supplement or endurance training*. Total study period was 17 weeks. The controls were requested to maintain their normal nutrition habits and normal activity level for this period.
After the intervention again the status of nutritional antioxidants and plasma lipid parameters were analysed and a spiroergometric test performed.

Spiroergometric test procedure

The maximal aerobic capacity tests were performed on a cycle ergometer (Sensormedics, Ergometrics 900). Oxygen and CO_2 fractions in expired air were measured continuously by the system Sensormedics 2900 Metabolic measurement cart. The values attained were compared with reference values of the Austrian Cardiologic Society.

Endurance Training and Nutrition Intervention Program

Endurance training ("aqua running") was performed twice a week in the hostels own swimming pools with training sessions of 20 minutes. The heart frequency (HF) during the trainings session (HFTr) was defined individually on a 60% level of the first ergometric test according to the formula:

HFTr = HFresting + (HFmaximal - HFresting) * 0,6 +/- 5 beats/min

Endurance training in the pool was chosen because physiological changes by physical strain are intensified due to the physical properties of the water. Therefore exercise in the water is not only more effective but also more convenient. Nutritional intervention was performed by the additional intake of 250ml/d of a commercially available multivitamin beverage to the normal daily food consumption. The additional daily vitamin consumption via beverage intake was between 13 and 100% of the personnel daily reference intake: Vitamin A (additional intake/d): 300µg, B_1: 525µg, B_6: 750µg, B_{12}: 0.38µg, C: 22.5 mg, E: 3.8 mg, Biotin: 56.3 µg, Folic acid: 75 µg, Niacin: 6.8 mg, Panthotenic acid: 2.3 mg, Pro-vitamin A: not declared. Additional total energy intake of the beverage was 0.45 MJ/d.

Biochemical parameters

Plasma concentrations of retinol, α-, γ-tocopherol, α-, β-carotene, crypthoxanthin and lycopene were determined by reversed phase HPLC according to the method of Jakob and Elmadfa [9], ascorbic acid was detected photometrically [10]. MDA was determined by HPLC using the method of Wong et al. [11].

Statistical analysis

Unpaired t-tests were used to compare characteristics between groups for statistics with normal distribution. Mann-Whitney U test was used for comparing groups that were not normally distributed. Pearson correlation coefficients and multiple regression analysis were conducted using SPSS 9.0 for Windows. Values were expressed as mean ± SE, differences were considered to be significant at a value of $p < 0.05$.

Results and Discussion

Most of the published studies deal with seniors aged between 60 and 75. Less information is available on the group of very old people of 80 years or older and no information if exercise and nutritional intervention is able to influence their quality of life. The mean age of the seniors included in this study was 83±6 years. While uniform criteria to select such old people are still lacking we defined them on basis of inclusion criteria of the spiroergometric test procedure. To contain uniformity of their physical activity and nutritional habits but also to simplify their personal strain within the study period people were selected who are living in senior homes. The groups had a nearly identical mean age, the BMI was comparable and so no gender specific comparison was foreseen.
Except ß-carotene which was borderline (17.3±10.6 µg/dl) the mean serum levels of the other plasma antioxidants analysed were within the reference values. Especially levels of plasma α-tocopherol equivalents (1.4±0.3 mg/dl) and vitamin C (1.1±0.3 mg/dl) were very satisfying for this population group. Adjusted to total lipids the mean plasma α-tocopherol content was 1.9±0.6 mg/g. Similar results of 1.8±0.4 mg/g of institutionalised elderly females (mean age 79 years) were presented by Morinobu et al. [12] who also found some lower levels of 1.65±0.4 mg/g for men. MDA serum levels were slightly higher when compared with the reference values for adults [11], however, so far no reference values were defined for this age class.
After intervention plasma ß-carotene levels of all groups, except the control group, increased significantly compared to their baseline values. The highest increase was observed in the two groups which received daily 250 ml of the multivitamin beverage. The increase of ß-carotene plasma levels in the exercise group and also the non significant increase in the control group, which both received no multivitamin beverage could be explained by seasonal varia-

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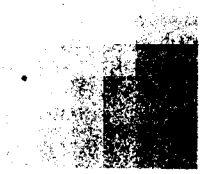

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