



## Conference on ‘Nutrition at key life stages: new findings, new approaches’ Symposium 3: Nutritional issues for older adults

### Nutritional issues for older adults: addressing degenerative ageing with long-term studies

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The ageing process is influenced by a variety of factors, including extrinsic, malleable lifestyle variables. The present paper deals with the epidemiological evidence for the role of dietary patterns and key nutritional concerns in relation to survival and ageing-related disorders that present themselves in later life. Healthful dietary patterns appear to be most relevant in old age. Specific nutritional concerns are related to vitamin D, vitamin B<sub>12</sub> and protein malnutrition. An important challenge to further expand the knowledge base is currently addressed by the NuAge project, acknowledging the complexity of the ageing process and integrating different dimensions of research into human healthy ageing. In the meantime, reversing poor adherence to existing guidelines for a healthy diet remains a first challenge in public health nutritional practices.

#### Nutrition: Aged: Health: Survival

#### Ageing and nutrition

Many industrialised countries now have ageing populations. In EU-27, the proportion of Europeans over the age of 65 is projected to increase from 17.4 % (2011) to approximately 30 % by 2060<sup>(1)</sup>. Even though most people reach old age in reasonable health, they are facing potential consequences of the ageing process. Ageing occurs through the lifelong accumulation of subtle faults in cells and tissues resulting in progressive loss of function, frailty and disease<sup>(2)</sup>. Common features such as a mild chronic pro-inflammatory status, or inflammageing<sup>(3)</sup>, are implicated in several ageing-related pathologies such as osteoporosis, dementia and sarcopenia and may become major disabling conditions<sup>(4)</sup>. As yet, there is substantial mechanistic evidence that it is possible to impact on the interplay between intrinsic factors and nutrition<sup>(5)</sup>. Moreover, in the past decades many epidemiological studies have uncovered a significant role of diet quality in the prevention of chronic disease and mortality later in life, whereby nutrition intervention studies have demonstrated benefits for dietary patterns and specific nutrients. The present paper aims to address the epidemiological evidence for the role of dietary patterns and key nutritional

concerns in relation to survival and ageing-related disorders that present themselves later in life. In the meantime Nu-Age, an European Commission-funded project, is holistically interrogating the link between diet and ageing in order to define new dietary strategies addressing the specific needs of older adults<sup>(6)</sup>.

#### Dietary patterns and survival

The dietary intake of foods and nutrients are related, and, as people do not eat single nutrients or foods, evaluating dietary patterns has attracted considerable interest in nutritional epidemiology. Assessing dietary quality by dietary patterns has the advantage of capturing the high inter-correlation of nutrients within a diet, as well as integrating complex interactive effects of many dietary exposures<sup>(7)</sup>. This follows from several systematic reviews of prospective studies relating adherence to a healthful diet to survival or increased longevity.

A recent review<sup>(8)</sup> included eleven cohorts from Europe and the USA and comprised a total sample of 396 391 elderly participants with 84 978 deaths. Overall, a healthier diet according to WHO guidelines was



associated with lower risk of death (average relative risk 0.90, for a 10 points increase on a scale of 0–70). Depending on the cohort, up to 18 % of deaths could be attributed to an unhealthy diet, and an increase in 10 healthy diet points was associated with a 2-year increase in life expectancy for a person aged 60 years. Such analyses confirm that the WHO dietary guidelines are valuable to promote overall good health.

Correspondingly adherence to a Mediterranean diet type appears to be relevant in old age. Combined analysis of eighteen prospective studies involving an overall study population of more than 4 000 000 subjects, uncovered that a 2-point increase in adherence score to the Mediterranean diet (scale 0–9/10) reduces the risk of overall mortality (8 %), and the incidence and/or mortality from cardiovascular (10 %) and neoplastic causes (4 %)<sup>(9)</sup>.

Additional evidence from a recent review suggest that better adherence to a Mediterranean diet is also associated with less cognitive decline, dementia, or Alzheimer's disease as shown by four of six cross-sectional studies, six of twelve longitudinal studies, one trial and three meta-analyses<sup>(10)</sup>.

In the European Prospective Investigation into Cancer and Nutrition, the EPIC-Elderly study, it has been questioned to what extent dietary patterns relate to health expectancy using quality-adjusted life years as outcome parameter. It turned out that two of the five studied dietary patterns, the modified Mediterranean Diet Score and the Healthy Diet Indicator, were statistically significantly associated with approximately 2 months longer healthy life, which is noteworthy from a public health perspective<sup>(11)</sup>.

There is growing evidence from intervention studies for a protective role of healthful dietary patterns. In a dietary intervention study conducted in Spanish middle-aged over a follow-up period of 4.8 years, subjects following the Mediterranean diet were reported to have a 30 % lower risk of CVD in a primary prevention setting<sup>(12)</sup>, whereas the efficacy of a hybrid of Mediterranean-Dietary Approach to Systolic Hypertension diet intervention for neurodegenerative delay (MIND-diet) is yet to be demonstrated<sup>(13)</sup>.

Much more established is the evidence for the effect of adherence to a healthful, Mediterranean type of diet along with other healthful lifestyle practices, including non-smoking, moderate alcohol consumption and physical activity. Taken together, the combinations of lifestyle practices appeared to be associated with a mortality rate of about one-third that of those with none or only one of these healthful lifestyle behaviours<sup>(14)</sup> and with an estimated increase in life-expectancy of 2 (SD 0.3) years.

### Specific nutritional concerns in old age

In general, the nutritional requirements of older adults are the same as for the rest of the adult population<sup>(15)</sup> although for some nutrients, including for example vitamins D and B<sub>12</sub>, an adequate supply is hard to achieve, even with an apparently adequate food intake.

In most European countries, the percentage of the population with vitamin D insufficiency is high among

the aged, though prevalences vastly depend on the set serum 25-hydroxyvitamin D level<sup>(16)</sup>. The European Survey on Nutrition and the Elderly (SENECA) on community dwelling older persons showed that 40 % had serum 25-hydroxyvitamin D levels below 30 nm/l<sup>(17)</sup>. The latter standard is much below the currently proposed level of at least 50 nm/l in e.g. the Netherlands and the USA<sup>(18)</sup>. Approximately one-third of the vitamin D requirements can be obtained from the diet. The rest is synthesised in the skin under the influence of sunlight. As a result of limited sunlight exposure and a fourfold reduced capacity of the skin to produce vitamin D, deficiencies may occur even in apparently healthy older people<sup>(16)</sup>. In most countries, dietary intakes of mostly vitamin D are far lower than recommended levels<sup>(19)</sup>. As a consequence, options for optimising vitamin D status, depending largely on medical, social, cultural, legal and financial aspects, e.g. vitamin D supplements or vitamin D-enriched food products, have been implemented or are still considered across Europe<sup>(20)</sup>.

As for vitamin D, vitamin B<sub>12</sub> deficiency is highly prevalent in the elderly. Among elderly participants of the SENECA study Europe some 25 % had plasma cobalamin levels <260 pm/l and plasma methylmalonic acid levels >0.32 μm/l<sup>(17)</sup>. Both vitamins D and B<sub>12</sub> are predominantly derived from animal sources. However, deficiencies can occur when vitamin B<sub>12</sub> malabsorption is present. Atrophic gastritis reduces the absorption of several nutrients, which leads, especially for vitamin B<sub>12</sub> to a deficiency state, which only partly could be explained by dietary intake or atrophic gastritis<sup>(17)</sup>. As yet there is no evidence that vitamin B<sub>12</sub> is handled differently in old age once the vitamin is absorbed. Therefore, other factors responsible for the cobalamin deficiency need to be sought<sup>(21)</sup>.

There is a large body of evidence to indicate that malnutrition is a common problem in older adults. Estimates of the prevalence are undeniably high: up to 60 % of hospitalised elderly and 70 % of those in residential care are malnourished. Among community-dwelling elderly, 44 % are considered at risk and 11–35 % are malnourished<sup>(22)</sup>. Most malnutrition risk exists in the community, where numbers will grow as recent policies aim at ageing at home in the community, not in institutions. Inadequate nutritional intake is the predominant cause of under nutrition in old age. When intakes decline to levels below requirements, foods which are nutrient-dense become particularly important<sup>(23)</sup>.

### Consequences of nutritional inadequacies

Much remains to be learned about how nutrition interacts with intrinsic and extrinsic factors in order to extend healthy life expectancy, independence and wellbeing in old age. In the meantime, observational studies continue to provide clues to healthy ageing, whilst supporting evidence from well-designed controlled trials needs to be expanded.

Vitamin D is with calcium known for its critical importance for bone health. Both seem crucial targets for



preventive and treatment measures of osteoporosis. On whether or not to combine the two nutrients, not only randomised trials examining the effect of vitamin D supplementation, with or without calcium, on the incidence of fractures/falls have produced conflicting results, but also recent meta-analyses do so, even within 1 year: 'A higher received dose of supplemental vitamin D (482–770 UI/d) should reduce fractures by at least 18 %; the addition of calcium to adequate intakes of vitamin D does not seem to enhance the effect of vitamin D'<sup>(24)</sup>; 'Vitamin D alone appears unlikely to be effective in preventing hip fracture. Vitamin D with calcium reduces hip fractures (relative risk 0.84, 95 % CI 0.73, 0.96)'<sup>(25)</sup>.

The latest analysis of individual patients' data from eleven large fracture trials however indicates that only a high intake of vitamin D leads to a significant reduction in the risk of hip fracture (30 %) and any non-vertebral fracture (14 %), whereby a smaller amount of calcium supplementation (<1000 mg/d), as compared with a larger amount ( $\geq$ 1000 mg/d), may be more beneficial in reducing the risk of fracture<sup>(26)</sup>.

It is currently assumed that vitamin D generates more biological responses than previously thought. As illustrated by the tissue distribution of the vitamin D receptor the biological effects of vitamin D are widening, from mediating only calcium homeostasis to functioning in other physiologic areas including the brain, muscle, the immune system, insulin secretion by the pancreatic  $\beta$ -cell, heart functioning and blood pressure regulation<sup>(27)</sup>. Thus, deficiency may affect the broader spectrum of functional outcomes, involving brain, muscle, vascular and heart health.

Vitamin B<sub>12</sub> deficiency has widely been known as pernicious anaemia, arising from an uncommon lack of intrinsic factor due to severe gastric atrophy. In old age, the main cause of deficiency is food-cobalamin absorption, characterised by the inability to release vitamin B<sub>12</sub> from food or its binding proteins<sup>(4)</sup>. Cobalamin deficiency manifests itself in a variety of ways, haematological, gastrointestinal and neurological. The efficacy studies which have been done so far, provide however no consistent evidence either way, that vitamin B<sub>12</sub> and/or folic acid have a beneficial effect on cognitive function of unselected healthy or cognitively impaired older people<sup>(28)</sup>. So far, only one relatively small study demonstrated that high doses of B vitamins can be used to reduce the rate of atrophy of the brain in elderly people with mild cognitive impairment<sup>(29)</sup>.

In the past decade, it has been shown that vitamin B is also involved in bone health. Its deficiency may lead to decreased bone mass by increased osteoclast formation due to increased methylmalonic acid and Hcy levels<sup>(30)</sup>. Meta-analyses and some cross-sectional and cohort studies suggest a small but significant role of vitamin B<sub>12</sub> status on risk of fracture but not on bone mineral density<sup>(31)</sup>, but these findings do not find support in a large and long-lasting homocysteine lowering trial in elderly people with mildly increased homocysteine levels<sup>(32)</sup>.

Undernutrition is one of the features of malnutrition, reflecting poor energy and protein intake, generally accompanied by inadequate micronutrient intakes<sup>(33)</sup>. A review on

protein and energy supplementation in malnourished elderly reported evidence for weight gain, but found no evidence for positive effects on functional performance<sup>(34)</sup>. However, there is growing evidence that older adults can improve their muscle mass, muscle strength and functional performance by consuming an adequate amount of protein in combination with physical activity<sup>(35,36)</sup>.

### Recommendations and guidelines

With basically similar nutritional requirements as the adult population at large, in old age both the quality and the quantity of the diet are important to ensure that requirements for both macronutrient and micronutrient intakes are met. However, as older people age, they may need fewer calories because they are not as physically active as when they were younger and their metabolic rate slows down. As a result nutrients and food components need to be obtained with less energy intake and nutrient and food density of the diet needs to increase<sup>(4)</sup>. Generic guidance on a healthy diet for older adults is provided by national and international bodies (WHO: Keep fit for life; UK: Food Standard Agency; USDA: Dietary Guidelines for Americans). Unfortunately sustained adherence to such generic guidelines tends to be low. Effective strategies to enhance or sustain adherence to such guidance are therefore warranted, further to the development of age-specific and up-to-date guidelines or recommendations specifically for older adults<sup>(37)</sup>.

Still a major challenge for the future of nutrition and ageing research is to further expand the knowledge base, acknowledging the complexity of the ageing process (including its inflammatory features) and integrating different dimensions of research into human healthy ageing. NuAge is addressing this challenge by studying the efficacy of counteracting inflammaging through a whole-diet approach. By an integrating and holistic view of the effect of such whole-diet approach on the prevention of age-related decline, it aims at contributing to dietary standards, recommendations and guidelines and showing how diet can help European seniors to live a healthier, longer life<sup>(5)</sup>.

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### Conflicts of Interest

None.

## Authorship

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