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The challenges of nutrition and aging

Abstract

From the time of birth and throughout the lifecycle, the human organism depends on food and nutrients to sustain its growth, development and functionality. With increasing knowledge of biological processes within the human body, the term 'you are what you eat', takes on more and more meaning. One of the new levels of understanding relates to the interaction of food components with genes to set off cascades of events that affect health and disease (1). This new understanding provides a detailed view of the dynamic relationship between genes and the environment, represented through food. Our health, our lifespan, can be seen as a product of this continuous interaction, following a process of stimulation, utilization and response. Over time, these events take their toll and this could be viewed as 'aging'. The challenge for nutrition is how to actively engage with this process, anticipate the downturns and use the available knowledge to slow the process, maintain functionality and assure quality of life for the years that remain. This review considers the significance of nutrition in two main areas that may be associated with aging: preventable or lifestyle related diseases such as obesity, diabetes, and cardiovascular disease, and the maintenance of functionality such as eyesight, cognition and physical activity.

Keywords

challenges, aging, nutrition

Disciplines

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The Challenges of Nutrition and Aging

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Introduction

From the time of birth and throughout the lifecycle, the human organism depends on food and nutrients to sustain its growth, development and functionality. With increasing knowledge of biological processes within the human body, the term ‘you are what you eat’, takes on more and more meaning. One of the new levels of understanding relates to the interaction of food components with genes to set off cascades of events that affect health and disease (1). This new understanding provides a detailed view of the dynamic relationship between genes and the environment, represented through food. Our health, our lifespan, can be seen as a product of this continuous interaction, following a process of stimulation, utilization and response. Over time, these events take their toll and this could be viewed as ‘aging’. The challenge for nutrition is how to actively engage with this process, anticipate the downturns and use the available knowledge to slow the process, maintain functionality and assure quality of life for the years that remain. This review considers the significance of nutrition in two main areas that may be associated with aging: preventable or lifestyle related diseases such as obesity, diabetes, and cardiovascular disease, and the maintenance of functionality such as eyesight, cognition and physical activity.

Lifestyle related disease

The global burden of disease is currently dominated by lifestyle related conditions such as cardiovascular disease, diabetes and obesity (2). The three are interrelated under the rubric of the metabolic syndrome, whereby increasing body fatness is associated with insulin resistance which leads to diabetes, a disease with associated problems in fat metabolism, including fat transport. The resulting high circulating lipids, such as cholesterol levels, are in turn associated with cardiovascular disease and premature death (3). Whether the disease itself affects quality of life or causes death, it represents a facet of aging that offers a clear challenge to nutrition.

Large scale intervention studies have repeatedly shown that changes to diet and exercise can prevent diabetes in at risk individuals (4,5,6). In these studies attention was placed on increasing exercise and losing weight. Specific changes in the diet included reducing dietary fat, saturated fat, and refined carbohydrates and avoiding sugar, but increasing dietary fibre or including fibre rich foods. It is the combination of these effects that help to produce the outcomes. Losing weight reduces the burden of body fat, and exercising ensures that body fuels are appropriately utilized. From a nutrition perspective, reducing the amount of dietary fat, and in particular saturated fat would also influence circulating cholesterol levels and risk factors for heart disease (7). More recently, functional foods containing plant sterols have been introduced to the food supply to provide an additional, pharma-food, approach to enhance the efficacy of the low fat diet, by reducing the re-absorption of cholesterol by the gut. Increasing the amount of dietary fibre is likely to

help reduce the demand on insulin and promote better balance in the metabolic profile of the body (8).

While the evidence is there for the beneficial effects of these nutrition and lifestyle changes, the ability to translate it to practice draws the attention back to food. There is a need to be able to identify foods that are low in fat and saturated fat, and to develop appropriate food products and cuisine styles. The type of fat is also important (8,9). Foods that deliver essential (polyunsaturated) fatty acids will still be required, and in particular those that deliver omega 3 fatty acids, such as oily fish. At the same time, foods that are high in fibre content need to be identified. There is increasing evidence, for example, that fiber rich wholegrain cereals in the diet reduce the risk of developing type 2 diabetes (10). Thus, while fat, fibre and carbohydrate containing foods gained a great deal of initial attention in diabetes prevention trials, identifying the foods that deliver the best balance of supportive food components remains one of the biggest challenges for nutrition today.

Getting the whole diet right is the main task in addressing lifestyle related disease. First, it means not over consuming energy (calories or kilojoules), from any source, in relation to energy expenditure (physical activity). Next it means including the foods that provide the right kind of fat (limited saturated fat, enough polyunsaturated fat) and fibre (from plant foods, such as wholegrains, fruits and vegetables) and other essential nutrients (vitamins, minerals). Despite the focus on fat and fibre, they are not the only issues to consider in preventing lifestyle related disease. Indeed there is good argument that a

reductionist approach to nutrition focused on food components may in the end be detrimental because the synergies provided in foods and whole diets themselves may be under-valued and overlooked (11). Plants and animals consumed as food represent biological systems themselves, such that their nutrient composition is purposeful and connected, and there may be implications for meeting the nutritional requirements for humans. Developing new food products with modified fat, carbohydrate and fibre components might take their cues from an understanding of the synergies that exist between food components in their original form, whether plant or animal. There appears to be good reason, for example, in manufacturing food with the wholegrain as an ingredient. Finally, preventing lifestyle related disease from a nutritional point of view is about balance, so the approach to food should also consider the fundamental principle of balance.

Aging and functionality

Cut-off points in biological measures (for example, blood glucose levels) can be seen to create a point of differentiation between health and disease in healthcare practice. In reality, however, maintaining functionality and quality of life is as much a major nutritional challenge for aging as preventing or managing lifestyle related disease.

Energy balance remains the primary baseline for considering nutritional needs, and with aging this level may reduce. However, energy balance is dependent on physical activity and where the ability to undertake activity is lost, a downward turn may begin.

Supporting the ability to remain active represents an important challenge for nutrition.

This means

- Foods that support balanced energy intake (that is, are satiating) and produce supportive metabolic responses (for example, are not overly demanding on insulin). Such foods would be high in fibre, have properties that support appropriate appetite signaling and produce a low glycemic response.
- Foods that provide nutrients that help to sustain bone and muscle mass. Protein rich foods are important for retaining muscle (combined with exercise), and foods rich in calcium and vitamin D support bone health. There is ample research now underpinning the important role of calcium and vitamin D in bone health (12) to highlight the significance of these nutrients in the food supply.
- Foods that deliver compounds that may help to ameliorate the symptoms of osteoarthritis. This is a very new area in nutrition, and therefore will take time and substantial investment in science to provide the evidence for practice, but there is an emerging literature (13).

Moving from supporting functionality related to physical activity (and the musculo-skeletal system), other areas associated with aging that present challenges for nutrition include the maintenance of sight (eye health), cell integrity (cancer protection), regularity and balance (gut health), and cognition and mood (brain health). Most of these are emerging areas for applications of nutritional science but they provide promise.

- Intakes of fruits and vegetables rich in lutein and zeaxanthin have been associated with a reduction in the risk of age related macular degeneration (14), a cause of

blindness with aging There may also be some benefits from omega 3 fatty acids but the studies are only just beginning (15)

- Nutrients and other components in food, particularly those with anti-oxidant activity, may interfere in pathways to cancer development in cells within the body (16,17). However, caution is required given the observations that simply providing these nutrients ‘out of the food context’ may be deleterious (18).
- At the level of the gut, cell integrity is especially important. Regularity of bowel movement is seen as potentially protective and the effects of foods on this function have been known for some time. The evolution of prebiotics and probiotics is another relatively new application for which further investment in research is providing evidence for effects (19).
- As with gut health, mood and cognition is an emerging area with particular interests in the effects of fatty acids (given the lipid composition of the brain), however scientific methodologies are still developing to prove the effects (20).

Conclusions

Providing the human body with optimal levels of raw material to maximize function is the challenge for nutrition throughout the lifecycle. Following maturation, the aging process presents with a number of challenges, and these are likely to emerge with significant influence from a person’s genotype. The dye is not entirely set by this code, however, it is the interactions between the environmental stimuli such as that provided by food and physical activity that are likely to present the final outcomes. While pieces of this relationship appear daily in the scientific literature, the situation is complex and there

are no quick fixes or magic bullets. No single food or nutrient will address the effects of aging on its own. The challenge for nutrition is to continue to build the knowledge base on the functionality of food and its components. Scientists in nutrition and food technology must work together with this knowledge to produce better food and dietary patterns that protect health. Most importantly, the scientific community must also continue to develop methodologies that provide the evidence of these effects.

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