

Nutrition and Healthy Cognitive Aging: Lifestyle Interventions and Opportunities for Educators

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Learning Objectives

1. Workshop participants will increase their understanding of the physiological changes that occur as the brain ages, and how these changes can be mitigated by lifestyle choices.
2. **Workshop participants will increase their knowledge about dietary components, individual foods, and dietary patterns that promote or are associated with healthy cognitive aging.**
3. **Workshop participants will incorporate information from this session in their teaching, research, and/or community outreach programs.**



Introduction

Demographic shifts will increase the prevalence of mild cognitive decline and advanced forms of cognitive disorders, such as Alzheimer's disease or other dementias.

Over the past 10 years, cognitive aging has become a public health issue for a myriad of reasons including:

- Heightened awareness of the risk of cognitive impairment and dementia
- Increasing societal burden of disease (families, healthcare system)
- Strong marketing campaigns promising to slow the aging process and increase cognitive powers

Introduction

The human brain changes with age in both its physical structures and its ability to carry out various functions. As a person ages, these functions may change—a process called cognitive aging.

This process not well understood by the public. Most are not aware that all individuals will experience cognitive aging throughout the lifespan and across a wide range of functional areas - not just memory.



Figure: Spectrum of cognitive function

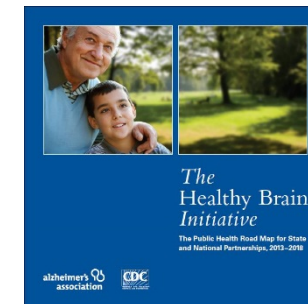
Alish C. The connection between malnutrition and cognitive decline in older adults. Available at: <http://anhi.org/articles/connection-between-malnutrition-cognitive-decline>. Accessed on July 17, 2017.

Public health & cognitive aging milestones

2005: Centers for Disease Control and Prevention (CDC) began the Healthy Brain Initiative

2007: CDC partnered with the Alzheimer's Association to create the first in a series of road maps to integrate cognitive health and functioning into the routine practice of public health

2012: The Department of Health and Human Services spearheads the National Plan to Address Alzheimer's Disease



2013: CDC develops the *Healthy Brain Initiative: the Public Health Road Map for State and National Partnerships, 2013 - 2018*

The Healthy Brain Initiative: the public health road map for state and national partnerships, 2013 – 2018. Interim progress report. Accessed on: July 17, 2017. Available at: <https://www.cdc.gov/aging/pdf/2013-healthy-brain-initiative.pdf>.



Public perceptions of successful aging

- 2017 West Health Institute surveyed a representative sample of adults 30 and older to understand perceptions on aging. Memory loss persists across the decades as a key area of concern.

| | Top Worry | Second | Third | Fourth | Fifth |
|-------------|-------------------------|--------------------------|--------------------------|--------------------------|-------------------------------|
| 30s | Financial security (79) | Poor health (77) | Losing memory (75) | Losing independence (65) | Being burden on family (57) |
| 40s | Financial security (78) | Losing memory (73) | Poor health (70) | Losing independence (60) | Being a burden on family (59) |
| 50s | Financial security (74) | Poor health (71) | Losing memory (70) | Losing independence (64) | Nursing home (56) |
| 60s | Losing memory (73) | Poor health (72) | Losing independence (67) | Financial security (65) | Nursing home (59) |
| 70 or older | Losing memory (67) | Losing independence (62) | Poor health (59) | Nursing home (54) | Financial security (50) |

Question: How worried are you about each of the following happening to you personally as you age?

West Health Institute, 2016. Perceptions of aging during each decade of life after 30. Accessed on: July 16, 2017. Available at: http://www.norc.org/PDFs/WHI-NORC-Aging-Survey/Brief_WestHealth_A_2017-03_DTPv2.pdf.



Role of diet in cognitive aging

Given the brain's high energy and nutrient needs – it is logical to surmise that optimizing dietary intake can impact the brain positively.

The brain is an organ with a high metabolic rate, and is sensitive to oxidative stress and neurodegeneration.

Exogenous antioxidants and trace minerals may protect against oxidative stress.

Dietary modifications are safer and more easily integrated into lifestyle changes than pharmacotherapeutics.

Coley N, Vauris C, & Andrieu S (2015). Nutrition and cognition in aging adults. Clin. Geriatr Med. 31: 453-464.

Phillips, C. Lifestyle modulators of neuroplasticity: how physical activity, mental engagement and diet promote cognitive health during aging. Neural Plast. 2017;2017:3589271. doi: 10.1155/2017/3589271. .

Zamroziewicz MK, Barbey AK. Nutritional cognitive neuroscience: innovations for healthy brain aging. Front Neurosci. 2016 Jun 6;10:240. doi: 10.3389/fnins.2016.00240.



Understanding our diet

Nutrition assessment – characterizes nutrient intake of individuals, to assess their exposure to nutrients and non-nutrients available in the diet, and identify populations for intervention purposes, at risk of poor nutrition.

Approaches:

- Anthropometric
- Clinical examination
- Questionnaires/Diet recall
- **Biomarkers**

Traditional research in nutritional epidemiology has examined food intake based on self-reported dietary assessment. While the resulting findings have been impactful, these methods are subject to measurement error.



Biomarkers

Biochemical markers of dietary exposure – can provide measures of nutritional status and exposure to bioactive molecules in food.

Research has identified 100 biomarkers that correlate with dietary intake and can estimate intake of:

- Fruit and vegetable intake
- Intake of citrus fruits, cruciferous vegetables, salmon, red meat, soy, whole grains, coffee, tea, wine, food additives and food contaminants.

Biomarkers provide an objective and sensitive assessment of a wide range of dietary components.

Correlates of dietary exposure

| Dietary component | Biochemical marker |
|-------------------|-----------------------------|
| Polyphenols | |
| | Caffeic acid |
| | Gallic acid |
| | 4-O-Methylgallic acid |
| | 5-Heneicosylresorcinol |
| | Quercetin |
| | Resveratrol |
| Carotenoids | |
| | α -carotene |
| | β -carotene |
| | β -cryptoxanthin |
| | Leutein |
| | Zeaxanthin |
| | Lycopene |
| Cooking products | Acrylamide |
| | 1-Hydroxypyrene glucoronide |

Individual nutrients key to cognitive health

Observational studies suggest that select nutrients have beneficial effects on healthy aging. These include:

- Antioxidant nutrients: vitamins C, E and polyphenols
- Vitamins and minerals: A, B12, and D, calcium, zinc, selenium and chromium
- Omega-3 polyunsaturated fats and fiber

Despite strength of evidence, these findings have not all been consistently supported by randomized controlled trials.

These dietary factors individually and synergistically work to modulate synaptic plasticity via altered neurogenesis, inflammation, antioxidant defense mechanisms, and energy metabolism.

Types of studies used to evaluate relationship between nutrition and cognition

| Component | Physiopathology | Prospective Observational Studies | Systematic Review/Meta Analysis of Prospective Observational Studies | RCTs | Systematic Review/Meta Analysis of RCTs |
|---------------------|-----------------|-----------------------------------|--|------|---|
| Antioxidants | X | X | X | X | |
| Polyphenols | X | X | | X | |
| PUFA | X | X | X | X | X |
| B Vitamins | X | X | X | X | X |
| Vitamin D | X | X | X | | |
| Calorie restriction | X | | X | | |
| MEDI | X | X | X | X | |

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 Zamroziewicz MK, Barbey AK. (2016) Nutritional cognitive neuroscience: innovations for healthy brain aging. *Front Neurosci.* Jun 6;10:240. doi: 10.3389/fnins.2016.00240.

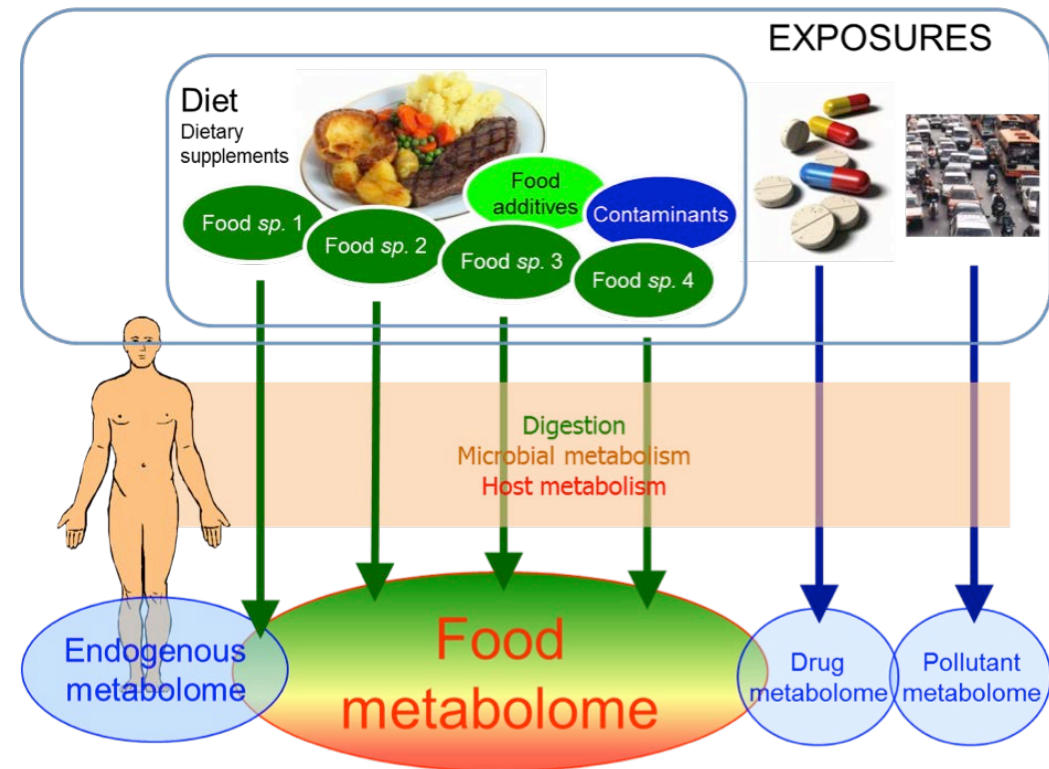
Dietary patterns and cognitive health

Dietary patterns may be more predictive of cognitive function and brain health than individual foods or nutrients.

Emerging approaches to the characterization of dietary patterns and the analysis of biomarkers have led to new nutritional epidemiological methods – measurement of **nutrient biomarker patterns** via :

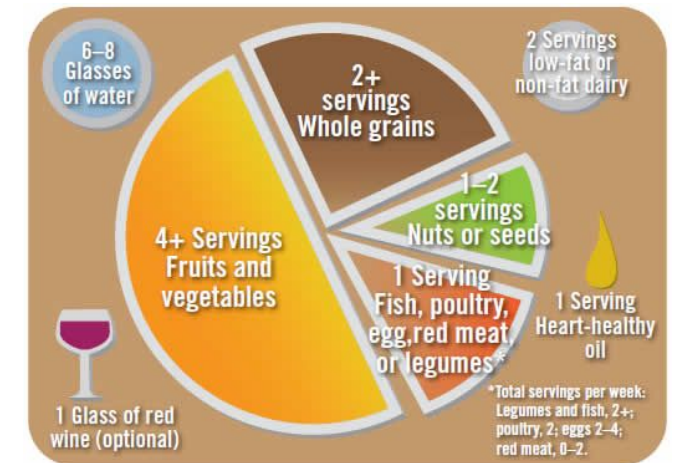
- Principal Component Analysis
- Metabolomics

These techniques, combined with neuroimaging methods that evaluate the changing structure and function of the brain will provide important opportunities for personalized nutritional interventions.

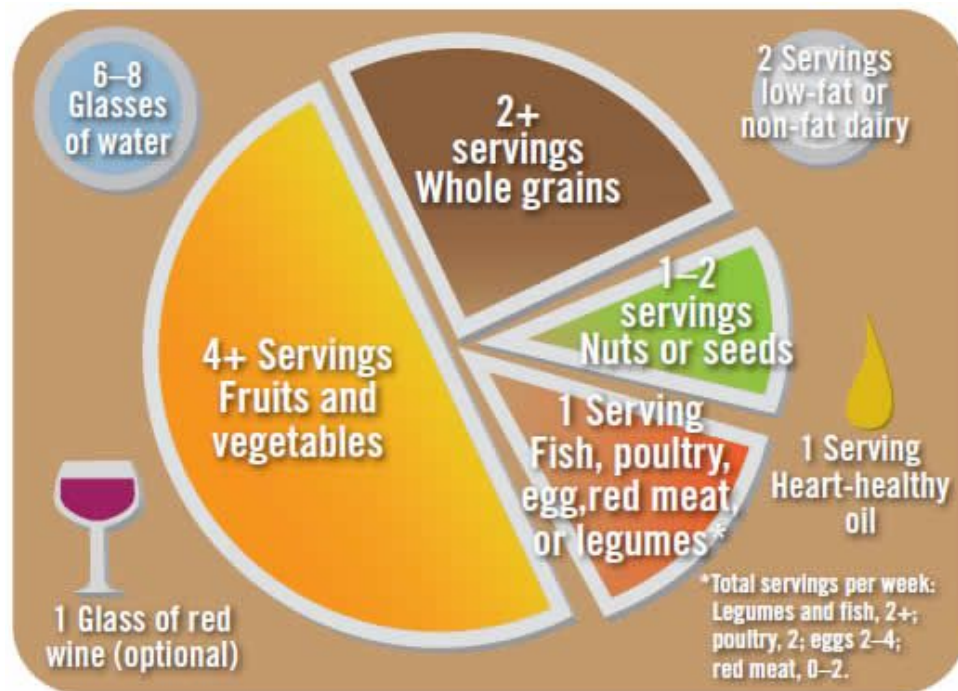


Dietary patterns and cognitive health

Several dietary patterns have been associated with improved cognitive health and function, and share many of the same components.



Dietary patterns supportive of cognitive aging



Mediterranean Diet (MEDI)

Comprised of foods known to deliver beneficial nutrients from foods such as fish and nuts, moderate alcohol consumption (red wine), and fresh fruits and vegetables

Beneficial effects of the diet are mediated through multiple mechanisms:

- Lower serum cholesterol – associated decrease in CVD risk and metabolic syndrome
- Prevention of insulin/glucose metabolism that can result in type-2 diabetes mellitus (increasing the risk of AD and cognitive impairments)
- Omega-3 fatty acids contribute to neurogenesis, and maintenance of low oxidative state.
- Polyphenols similarly, support the regulation of oxidative stress.

Dietary patterns supportive of cognitive aging

Dietary Approach to Stop Hypertension (DASH)

- Provides nutrient-dense, low sodium foods (emphasizing high consumption of fruits, vegetables, low-fat dairy, whole grains, lean meats, nuts, and beans) that support cardiometabolic risk factors.
- Beneficial effects of the diet are mediated through
 - The DASH diet has been shown to lower blood pressure, increase insulin sensitivity, and reduce weight, serum cholesterol level, inflammation, and oxidative stress.



Dietary patterns supportive of cognitive aging



Mediterranean-Dietary Approach to Systolic Hypertension Diet Intervention for Neurodegenerative Delay (MIND)

- Emphasizes 10 brain healthy food groups: green leafy vegetables, other vegetables, nuts, berries, beans, whole grains, seafood, poultry, olive oil and moderate intakes of (preferably) wine.
- A combination of the MEDI and DASH diets, modified in line with compelling findings from the diet-dementia field:
 - Green leafy vegetables and berries emphasized
 - Dairy, potato, fish intakes – deemphasized



Components of main dietary patterns associated with cognitive health

| | MEDI Diet | DASH Diet | MIND Diet | Healthy Eating Index | French Nat'l Nutrition & Health Program |
|------------------|------------------------|---------------------------|--------------------------|----------------------|---|
| High Consumption | Fruits | Fruits | Berries | Fruits | Fruits |
| | Vegetables | Vegetables | Vegetables (green leafy) | Vegetables | Vegetables |
| | Legumes | Whole grains | Whole grains | Whole grains | Whole grains |
| | Nuts | Poultry | Poultry | Low-fat dairy | Vegetable fats |
| | Fish | Fish | Seafood | Fish | Seafood |
| | Seafood | Nuts | Nuts | Lean meats | Water |
| | | | Beans | | |
| | | | Wine | | |
| | | | Olive oil | | |
| | | | | | |
| Low Consumption | Dairy products | Fats (low-far diet) | Red meat | | Soda |
| | Meat (processed meats) | Red meat | Fast food (friend foods) | | Sweets |
| | | Sugar sweetened beverages | Cheese | | Salt |
| | | Desserts | Butter | | |
| | | | Margarine (solid) | | |
| | | | Sweets | | |
| | | | Pastries | | |



Beneficial lifestyle interventions

Caloric restriction (CR) and intermittent fasting (IF)

- Defined as a reduction in energy intake well below the amount of calories that would be consumed *ad libitum*.
- Within the context of the consumption of sufficient nutrients, there is increasing evidence that suggests that CR confers cognitive lifespan and healthspan benefits.
- Animal and supported epidemiological studies have demonstrated that caloric restriction can modulate brain plasticity and exert neuroprotective effects (i.e., increase synaptic resilience and function, and increased cellular repair).
- The mechanisms that mediate these positive effects include:
 - Reductions in oxidative stress
 - Improved glucose metabolism
 - Increased levels of stress proteins
- Despite these findings, there is no conclusive evidence that CR or IF protect against cognitive decline.

Additional lifestyle interventions

Past research suggests that high levels of self-reported wellbeing in any of the six dimensions of wellbeing are considered neuroprotective.

- **Physical**
- **Social**
- Emotional
- Intellectual
- Vocational/occupational
- Spiritual
- Environmental





Physical activity and cognitive decline

Physical activity maintained over the lifespan is associated with a decreased prevalence of chronic diseases, particularly the improvement of cardiorespiratory fitness.

Despite the wealth of literature on the impacts of physical movement or structured activity on cognitive function, the rate mechanism of this benefit remains under investigation.

More studies are needed to better understand the type, intensity, duration and dose-response relationship between physical activity and cognitive function.

Bherer L, Erickson KI, Liu-Ambrose T (2013). A review of the effects of physical activity and exercise on cognitive brain functions in older adults. J Aging Res., 2013:657508. Epub 2013 Sep 11.
Phillips, C. Lifestyle modulators of neuroplasticity: how physical activity, mental engagement and diet promote cognitive health during aging. Neural Plast. 2017;2017:3589271. doi: 10.1155/2017/3589271.
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Williams K, Kemper, S. (2010) Exploring interventions to reduce cognitive decline in aging. J Psychosoc Nurs Ment Health Serv, 48(5): 42-52. doi:10.3928/02793695-20100331-03.

Social engagement and cognitive aging

Published research on the impact of social support and engagement in social activities, on cognition in aging.

These positive effects are specifically mediated through social network density, social integration, and receipt of emotional support.

Research suggests that increased levels of cognitive engagement, professionally and socially, create an 'enriched' environment that is cognitively challenging.

Such environment support neuroprotective morphological changes in the brain - the formation of new neurons, dendritic branches and synapses.





Recommendations for action:

Healthcare providers

In 2014, the Institute of Medicine convened a committee on Committee on the Public Health Dimensions of Cognitive Aging.

Based on the resulting report, *Cognitive Aging: Process in Understanding and Opportunities for Action*, a series of action guides were created for all stakeholders – individuals, families, communities and healthcare providers.

This report recommends that health professionals focus their efforts on the prevention of **delirium** (given its relationship to cognitive decline) and **medication monitoring**, particularly during transitions of care.

Meetings with patients, such as the Annual Wellness Visit for older adults, is an opportunity to discuss concerns with cognition, provide related patient education, and nutrition education.

What's a nutrition educator to do?

Educating your clients - use age-appropriate, client-centered, culturally sensitive approaches - about the role diet, nutrition, and lifestyle behaviors play in maintaining cognitive health

For all clients with concerns about cognitive aging, encourage them to take preventative actions to protect their health:

- Be physically active.
- Reduce and manage cardiovascular disease risk factors (including hypertension, diabetes, and smoking).
- Regularly discuss and review health conditions and medications that might influence cognitive health with a health care professional.
- Be socially and intellectually active, and continually seek opportunities to learn.
- Get adequate sleep and seek professional treatment for sleep disorders, if needed.

What's a nutrition educator to do?

For *younger* adult clients, with concerns about cognitive aging, encourage them to take preventative actions to protect their health – be sure to emphasize that it is the accumulation of healthy lifelong habits that provide the most robust neuroprotection.

For *older* adult clients with similar concerns, here are some targeted messages and tactics:

- Prioritize food over supplements (except for vitamin B₁₂)
- Determine food access limitations and preferences, so that dietary recommendations can be aligned with available resources
 - Provide referrals to community based nutrition and food assistance programs if additional support is needed
- Assess available social supports and recommend active engagement in cognitively stimulating environments
 - Senior centers can provide access to both social engagement, and balance nutrition
- Encourage appropriate physical activity to support cognitive health (i.e., walking, dancing, and strength training)

Key messages on cognitive aging (Public)

The brain ages, just like other parts of the body

- The brain is responsible for cognition: memory, decision making, processing information and learning. These function may change with age – cognitive aging.

Cognitive aging is not a disease

- It is not the same as Alzheimer's disease or other dementias. It is a natural, lifelong process that happens for everyone.

Cognitive aging is different for every individual

- Some may experience few effects, others very profound changes that effect daily life and tasks such as driving, etc.

Some cognitive functions improve with age

- Wisdom and knowledge increase with age, leading to greater levels of happiness and satisfaction in older adults compared to younger adults.

There are steps that all can take to protect their cognitive health.

- Although aging is inevitable, it is possible to promote and support cognitive health and adapt to age-related changes in cognitive function.

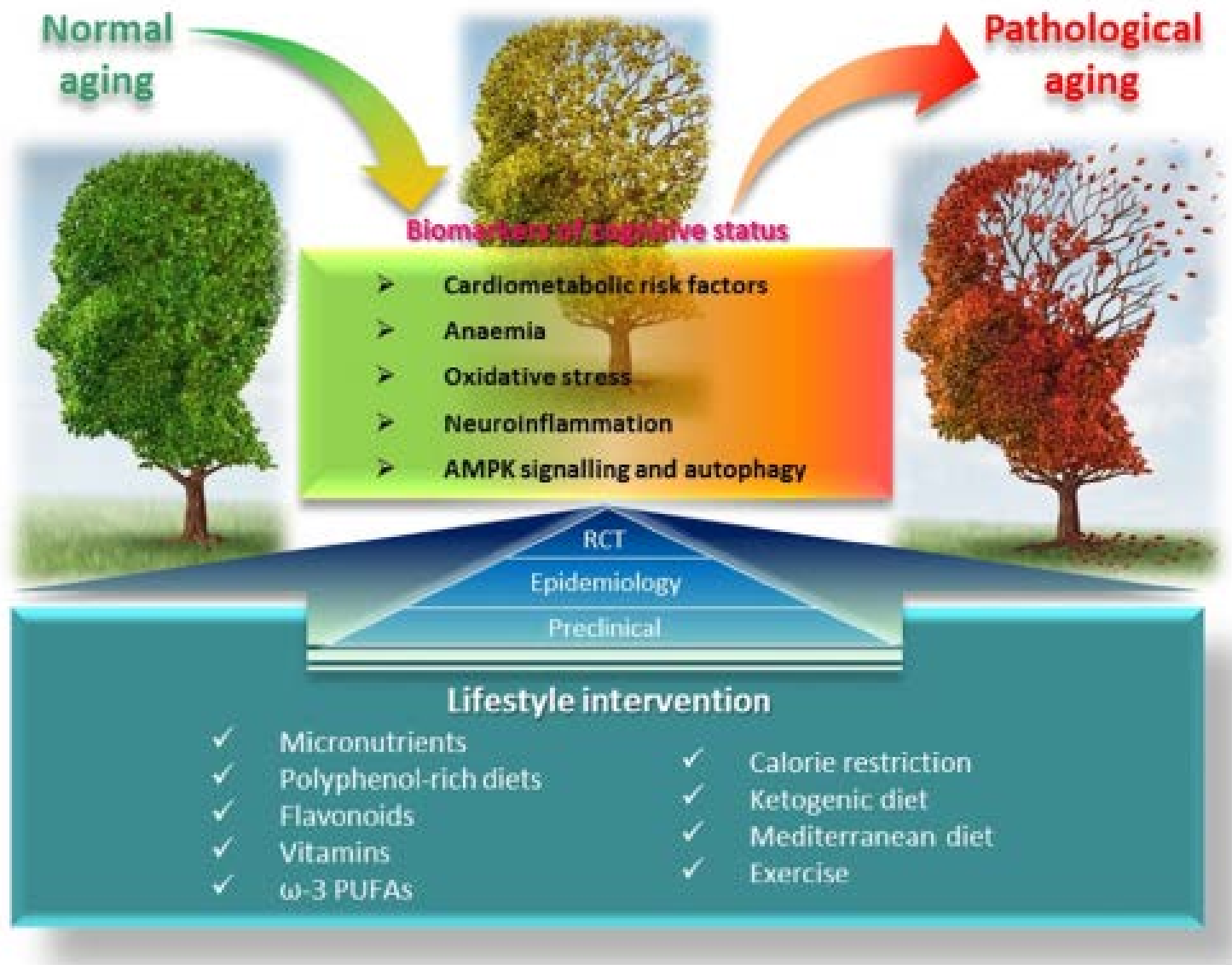


Fig. 1. Overview of links between lifestyle interventions on cognition and healthy brain function during ageing.

Take home messages

- Awareness of, and interest in, cognitive aging is growing.
- Lifestyle interventions to prevent or attenuate the effects of cognitive aging abound.
- Nutrition educators can apply practical approaches to communicate, support and educate the public on cognitive aging.

References

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