

LIFESTYLE GUIDE

Balanced food consumption as a preventive measure of cognitive deterioration.

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Title: Lifestyle Guide. Balanced food consumption as a preventive measure of cognitive deterioration.

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Course: SCI2034

Faculty: University College Maastricht

Number of words: 2388

Introduction

Following a healthy diet throughout life helps prevent many mental and body disorders. However, the industrial revolution, the increased range of processed foods, rapid urbanization, and indoor activities have led to a change in dietary patterns. People started to give preferences to less healthy nutritional options due to the availability of fatty foods and sugars. Therefore, the consumption of raw vegetables, fruits, unprocessed meat and fish has been minimized, causing a deficiency of vitamins, essential amino acids, and fibers in the modern diet. The result is an increased frequency of cardiovascular, mental, and digestive disorders. Although a healthy lifestyle can prevent these conditions, this article focuses on the importance of a balanced diet as a preventive measure of cognitive deterioration.

The article aims to briefly introduce the types and functions of carbohydrates, proteins, lipids, flavonoids, and vitamins, investigate the effect of their deficiency on the nervous system, and provide dietary recommendations. The most straightforward strategy to prevent brain dysfunction is to eat raw vegetables and fruits, unprocessed food, unsaturated lipids, and average amounts of meat.

Lipids and Fats: omega-3, saturated fats, and trans fats.

According to Lange (2020), lipids are involved in the formation of cell membranes, cellular transport, energy storage and can act as signaling molecules and modulators of transmembrane proteins. Brain functioning depends entirely on the consumption of polyunsaturated fatty acids (PUFAs), divided into two major groups: omega-3 and omega-6 PUFAs. Brain cell membranes are made mainly of long-chain PUFAs: docosahexaenoic acid (DHA) and arachidonic acid (AA).

The omega-3 fatty acid docosahexaenoic acid can affect cognitive abilities and synaptic functioning, making the membrane of the synaptic region fluid because more than 30% of a membrane phospholipid bilayer in the grey matter is composed of DHA (Lange, 2020). In the research by Gómez-Pinilla (2008), omega-3 fatty acids also play an essential role in activating

metabolic pathways that affect important brain functioning molecules, such as brain-derived neurotrophic factor (BDNF) and insulin-like growth factor 1 (IGF1). Both molecules influence learning and memory processes, as they act as presynaptic and postsynaptic receptors, facilitating synaptic transmission and long-term potentiation. Furthermore, IGF1 transfers diet and exercise messages from the liver and skeletal muscles to the brain and supports nerve growth and differentiation.

Although the brain is almost entirely made up of fat, saturated and trans fats are believed to be harmful to the brain. Diets high in saturated fats negatively affect brain functions and increase the risk of neurological diseases (Barnard et al., 2014). Saturated fats are animal fats that are solid at room temperature and have all fatty acid chains in single bonds. Trans fat (T-fat) is an unsaturated fat that was industrially modified. According to Barnard et al. (2014), T-fats have an adverse effect on the brain and nervous system by altering the ability of neurons to communicate. This can affect mental performance. Moreover, a relationship between T-fat intake and depression risk was observed (Barnard et al., 2014). Therefore, it is possible to assume that saturated and trans-fat consumption should be limited. This means that people should avoid frequent consumption of butter, ghee, cakes, biscuits, red meat, sausages, bacon, and cured meats.

The best sources of 'good' lipids are fish and other seafood, nuts, seeds, and plant oils. According to DeFilippis et al. (2010), the amount of DHA in mackerel in grams per 100 grams is 1.4 and in farmed and wild salmon is 1.3 and 1.1, respectively. For walnuts, the numbers are 7.2 grams per 100 grams, and for chia seeds 17.8 grams per 100 grams. Therefore, the basic recommendation is to eat products rich in omega-3 at least several times a week to maintain good cognition abilities

Carbohydrates

Carbohydrates are the main source of energy in a healthy, balanced diet. They occur in many different forms, like sugars and dietary fiber, in vegetables, fruits, sweets, and whole grains. In general, a significant part of long carbohydrate molecules is broken down in the digestive system into glucose, a monosaccharide. On the other hand, the dietary fibers cannot be digested, but they are still an essential part of a balanced diet. Therefore, this section discusses the influence of glucose and dietary fibers on brain functioning and body health.

Glucose

Carbohydrates are essential for normal brain functioning, especially glucose. 20% of the energy derived from glucose is consumed by the brain every day (Erbsloh et al., 1958). Glucose is used to synthesize ATP (adenosine triphosphate), an energy-carrying molecule used in all brain metabolic pathways. For example, ATP is necessary for the generation of neurotransmitters; it is used in the active transport mechanism to provide cross-membrane transport of ions after the action potential is done and to maintain the concentration gradient. In general, it is crucial to have a constant glucose inflow into the brain to prevent brain dysfunction and mental diseases.

Glucose enters the brain from the blood by crossing the blood-brain barrier, and then molecules of glucose are distributed between brain cells. According to Mergenthaler et al. (2013), glucose supply is maintained by neurovascular coupling, and specialized centers in the brain detect glucose levels and regulate them via neuroendocrine signals.

Glucose is mainly consumed for neuronal development and information processing in the brain. It also may play a huge role in long-term memory formation and learning (Suzuki et al., 2011). Furthermore, controlled regulation of glucose metabolism protects neurons from apoptosis (Vaughn & Deshmukh, 2008).

Dietary fiber

Dietary fiber is a category of carbohydrates that cannot be absorbed and digested enzymatically by the human digestive system. Besides this, dietary fiber is crucial for health, as it provides nutrients for gut microbiota. Fiber consumption is associated with a reduced inflammatory response, increased cognitive performance, and long-term memory creation. According to Tengeler et al. (2018), gut microbiota can also influence hippocampal cognition. During neurogenesis, disruption of gut microbial composition can lead to mental and body problems, including depressive disorder, anxiety, and autism spectrum disorder.

Good sources of dietary fibers are raw vegetables and fruits. If fruit's integrity is violated, the dietary fiber is broken down, therefore it is recommended to eat whole fruits and vegetables.

Polyphenols

Polyphenols are not carbohydrates, lipids, or proteins but are essential for normal body functioning. Polyphenols are secondary metabolites of plants and can be divided into phenolic acids, flavonoids, lignans, and stilbenes (Tengeler et al., 2018). They protect neurons from degeneration, influence cerebrovascular blood flow, and interact with neuronal and glial signaling pathways. Polyphenols are also believed to positively impact long-term memory formation and cognitive performance. Cloves, dried peppermint, blueberries, olives, and olive oil are the best sources of polyphenols.

Vitamins

Vitamins are organic compounds with various chemical compositions needed for normal body functioning. Thirteen vitamins are essential for mental health and metabolic processes. Unfortunately, most vitamins cannot be synthesized by human cells, so they must be obtained from the diet. The list of important vitamins includes vitamins of group B (niacin, thiamine, riboflavin, pantothenic acid, vitamin B6, biotin, vitamin B12, folate), vitamins A, D, E, K, and C.

Vitamin A (retinol) is involved in neuronal plasticity and plays a crucial role in vision, immune response, and the development of the nervous system. Colorful fruits and vegetables, such as carrots and peppers, are good sources of retinol (National Institutes of Health, 2021).

Vitamin B is also essential for normal brain development and function and prevents muscle weakness, increasing cell growth, energy generation, and enzyme functioning. According to Kennedy (2016), vitamin B deficiency can cause photosensitivity, inflammation, neuropathy, neurodegeneration, and other neurological disorders. To avoid such problems, meat consumption is recommended.

Vitamin D deficiency causes cardiovascular diseases, increases the risk of bacterial infection, and the development of depression, schizophrenia, and Alzheimer's disease (Kenney & Butterfield, 2015). This vitamin can be found in oily fish, liver, and egg yolks, but mainly the human body generates it while a person spends time in the sun.

Vitamin E acts as an antioxidant, helping to protect cells from free radicals. It widens blood vessels and increases the immune response. Consuming nuts, spinach, broccoli, and seeds can maintain a good vitamin E balance in the body (National Institutes of Health, 2021).

Vitamin K is essential for blood clotting and healthy bones. To avoid bruising and bleeding problems, it is necessary to consume enough blueberries, vegetable oils, and green leafy vegetables (National Institutes of Health, 2021).

Vitamin C is required for the biosynthesis of collagen and several neurotransmitters. Therefore, its reduced consumption can influence brain performance and connective tissue health. The best sources of vitamin C are citrus fruits, tomatoes, grains, broccoli, kiwifruit, strawberries, and Brussels sprouts (National Institutes of Health, 2021).

Proteins

Proteins are essential macromolecules made of amino acids that help repair and build tissues, accelerate metabolic reactions, and coordinate body functions. Proteins are used as enzymes, building blocks of the cells, and hormones in the human body. They can be found in four structures: primary, secondary, tertiary, and quaternary. Primary proteins consist of sequences of amino acids joined by the peptide bond. Such sequences can be made from 21 different amino acids, and nine of them are essential, meaning they cannot be synthesized by the human body, so humans must receive them with food. They are histidine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Quinoa, eggs, turkey, chicken, mushrooms, and fish are healthy sources of essential amino acids. Secondary proteins are polypeptide chains arranged into a regular, repeating 3D structure held by hydrogen bonds. Such proteins are known as fibrous proteins that are insoluble in water. Examples are collagen, which is responsible for the extracellular matrix in connective tissues, and keratins essential for healthy hair and nails. Tertiary proteins are polypeptide chains held together by ionic, hydrogen bonds, and disulfide bridges. They are soluble in water and have a globular shape, meaning they can act as enzymes. Quaternary proteins are several globular proteins with a prosthetic group. Hemoglobin is an example of a quaternary protein made of 4 peptide chains and an ion of iron as a prosthetic group. It is involved in transporting oxygen and carbon dioxide among the tissues.

There is no doubt that the lack of proteins is harmful and unsafe. According to Dickerson (1980), a protein deficit causes the body to lack building blocks and slows all metabolic, growth, and mental processes. For example, amino acids function as precursors of neurotransmitters and neurotransmitters are used to generate the action potential and transfer nerve impulses between neuron cells. Therefore, it can be deduced that deficiency of proteins in a diet leads to mental disorders, slowness, and motor weakness.

Food recommendations

This section aims to provide a list of healthy products to improve both the reasoning processes and the overall health situation. It must be clear why high-quality food consumption is essential for good brain performance. All reactions are interconnected in the body; therefore, it is impossible to only enhance mental health without shifting the overall body situation. Therefore, the section 'Food recommendations' will explain the benefits of eating healthy food in the entire body, not just the brain.

If the goal is to gain muscles, it is crucial to consume as much protein as possible; otherwise, muscle catabolism will start. Then it is rational to limit the consumption of red meat and eggs since eating red meat, and animal-based protein activates mTOR, a protein responsible for accelerating aging (Kitada et al., 2019). Processed sausages contain carcinogens and trans-fat, so people should avoid them.

The list of products with high protein percentages:

- Beans, broccoli, spinach, mushrooms, asparagus, lentils, and quinoa can be used as a source of vegetable protein.
- Yogurt and cottage cheese can be consumed to decrease visceral fat and inflammation.
- Salmon, mackerel, trout, and shrimp are consumed as healthy sources of fish proteins. Fish, such as tuna, may have a considerable concentration of mercury and heavy metals; therefore, the advice is to limit their consumption.
- Animal protein sources are cheese, eggs, chicken, and red meat.

The brain's elasticity requires omega-3 and olive oil due to its high concentration of monounsaturated fatty acids. Using extra virgin olive oil and coconut oil as the main ingredient in cooking speeds up the fat burning process and supplies the brain with essential lipids every day.

The products mentioned below are known as healthy sources of lipids and fats.

- Extra virgin olive oil (nativ extra), avocados, nuts, and dark chocolate contain chemicals that inhibit mTOR activation. They are sources of monounsaturated fatty acids.

- Whole grains, walnuts, salmon, herring, mackerel, and trout are good sources of omega-3, the essential lipid for cognitive performance.
- Coconut oil is a good source of medium-chain triglycerides that increase fullness, weight loss, and potentially improve the gut microbiome.

Carbohydrates are still one of the most controversial groups of products. Many investigations contradict each other; therefore, only basic recommendations can be given.

- Dark chocolate (90% dark chocolate has only 7 grams of sugar). Flavonoids in dark chocolate relax blood vessels and increase insulin sensitivity.
- Fresh fruits. They contain both fructose and fiber, which slows the absorption of fructose into the liver, thus neutralizing harmful effects. For example, blueberries and apples increase insulin sensitivity.
- Fresh vegetables and groats. Bulgur, quinoa, lentils, vegetables are better in their food ratio than potatoes, rice, and pasta because they have fibers that slow down the absorption of carbohydrates in the blood. Legumes reduce inflammation.

Overall, a high-level intake of raw fruit, vegetables, nuts, complex carbohydrates, low intake of saturated fat, red meat, processed food, trans fats, and moderate consumption of fish and olive oil are the best recommendations to maintain a healthy body and brain.

Conclusion

Healthy body functioning and brain performance are based on balanced food consumption. A well-planned diet with a wide variety of foods provides good taste and essential chemical compounds, such as flavonoids and vitamins. Buying groceries, people should give preferences to unsaturated oils, high-fiber carbohydrates, and unprocessed meat. It is recommended to keep in mind that the carbohydrates grocery list must include healthy sources of glucose and fiber. Moreover, vegetable

oils should prevail over animal-based fats. Additionally, the shopping list should include unprocessed meat or dairy products to provide enough building material for the organism. The main food recommendations are raw vegetables and fruits, olive oil, whole grains, nuts, salmon, and poultry meat. Overall, balanced meals are crucial for brain performance and preventing cardiovascular and brain diseases.

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