Exploration of Neuroprotective Therapy

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Vitactions: vitamins for the brain

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Academic Editor: Jesús Avila, Consejo Superior de Investigaciones Cientificas (CSIC), Spain

Received: April 8, 2024 **Accepted:** June 20, 2024 **Published:** July 1, 2024

Cite this article: Franco R. Vitactions: vitamins for the brain. Explor Neuroprot Ther. 2024;4:300–7. https://doi.org/10.37349/ent.2024.00084

Abstract

A novel concept has been recently put forward in the mind/body interface (https://doi.org/10.37349/ent.2024.00074). The new concept has led to a new word: vitaction. Vitactions offer benefits to the brain and mind comparable to the advantages vitamins provide for the body's overall health. The field of vitactions is as it was the vitamin field one century ago, i.e., without tools to make a complete classification. I propose to classify vitactions into five categories according to the behaviours necessary to maintain balanced brain functionality. A deficit of vitactions would contribute to the enormous prevalence in developed countries of diseases ranging from type 2 diabetes to neuropsychiatric diseases. The concept should help to identify which vitactions are deficient and to outline how they can be progressively implemented to improve the quality of life. The parallelism vitactions/vitamins also extends to overdosing; both hypervitaminosis and hypervitactinosis may be detrimental. This perspective article argues that vitactions should be considered at the practical and the scientific research levels, and that a balanced vitamin and vitaction supply is essential for a better life. In addition, reasons for proposing a synonym, "vitactin", are given.

Keywords

Vitactions, behaviour, neuropsychology, neuroprotection, neurodegenerative diseases, Alzheimer's disease, vitactin, vitamin

Introduction

A recent article in Exploration of Neuroprotective Therapy has proposed a new term, vitaction, to describe those actions that result in benefit for the brain [1]. "Vitaction" refers to essential behaviours whose deficiencies can trigger physiological problems similar to how vitamin deficiencies affect the body. The benefit for the brain would be like that conveyed by vitamins for the body, i.e., something that in appropriate doses leads to a better and healthier life. "Vitactin" is proposed as a synonym because it has a phonetic similarity that could make it an appealing alternative. It preserves the root "vit", suggesting a connection to "vital" or "vitamin", which aligns with the original term's implication of essential actions or behaviours. Despite the change from "action" to "actin" may slightly obscure the direct reference to action, potentially shifting the emphasis or interpretation, "hypervitactinosis" sounds more severe or concerning than "hypervitactionosis" when discussing excessive or detrimental levels of these essential behaviours. This aligns well with the term "hypervitaminosis", which denotes an excess of vitamins (see below).

According to Britannica Encyclopaedia vitamin is "any of several organic substances that are necessary in small quantities for normal health and growth in higher forms of animal life" (dated March 2023). Vitactions are defined as the "set of behaviours whose deficiency can potentially cause any kind of physiological problem" [1].

The discovery of vitamins was based on noticing strange diseases appearing in sailors that were several days on a ship without access to fresh food. Sailors suffered from scurvy (scorbutus in Latin, escorbuto in Spanish, or Skorbut in German), which is a deficit of vitamin C. In the XVIII century a physician, James Lind, studied the disease that reportedly affected 2 million sailors and tested different diets in 12 patients. He found that citrus fruits, lemons, and oranges, were effective. The structure of the vitamin, which is ascorbic acid, was solved by Walter Norman Haworth in 1933 who, together with Edmund Hirst succeeded in synthesizing it in the laboratory. Notably, the compound was the same as "hexuronic" acid, a molecule isolated in 1928 from adrenal glands by the great chemist Albert von Szent-Györgyi (see [2]). In 1937, both Haworth and Szent-Györgyi received a Nobel Prize in, respectively, Chemistry and Medicine. The field of vitamin research also flourished with the discovery of the structure of B vitamins. The causes of two prevalent and serious diseases were discovered in the first half of the XX century: beri-beri, caused by a deficiency of thiamine (vitamin B1), and pellagra, caused by a deficiency of niacin (vitamin B3) [3–9]. The vitamin research field led to more Nobel laureates in the thirties. In 1934, George Minot and William Murphy shared the Nobel Prize in Physiology or Medicine for their discovery of the effectiveness of liver in combating pernicious anemia; the breakthrough indirectly led to the understanding of the role of vitamin B12. Richard Kuhn in 1938, was recognized with the Nobel in Chemistry for his work on carotenoids and vitamins, especially vitamin B2 (riboflavin) and its structure.

Vitamins and vitactions through a human life

In childhood, healthy humans do not experience issues related to body and mind matters. In childhood, the intake of vitamins is correct if there is an adequate diet decided by parents and school nutritionists. Furthermore, children are happy as long as they receive nurture from their parents and caregivers, and learn, play, and learn by playing. By homology vitactions, i.e., "vitamins for the brain", would include care, games, learning, and physical exercise. In addition, vitactions would include competition and fight coming innately as behaviours developed by humans to survive.

Humans, in childhood or adult life, with care/love and other "vitaction" deficits may develop neuropsychiatric diseases which may be relatively mild but can become serious. Lack of gaming may result in limited social interaction, isolation, and the sensation of loneliness. Experience tells us that learning deficits upon aging can be the result of a lack of interest that inevitably leads to self-isolation, lack of interactions and/or toxic interactions. The last resort is television or radio, but as depression appears and progresses it can lead the individual to total isolation and a lack of desire to continue living; this situation can occur even in older people without symptoms of dementia. As one ages, ad hoc behaviours would prevent accelerated senescence and/or the appearance of neurodegenerative diseases such as Parkinson's and Alzheimer's.

The best example of a behaviour that is essential in both health and disease is exercising. The brain benefits from exercise for at least two main reasons. First, exercise facilitates the transport of glucose to the brain, with glucose being the main and preferred fuel for neurons. It has been hypothesized that dementia associated with diabetes does not come from the disease but from the medication that chronically decreases the amount of glucose entering the brain [10]. Another hypothesis, more daring and difficult to prove is that type 2 diabetes is due to a deficit in glucose transport from blood to brain; that is, the lower the consumption by a big consumer (the brain), the more glucose in the blood and the more neurodegeneration chances if neurons die due to the low availability of the main nutrient [11]. Second, exercise offers benefits in terms of well-being, which implies that central mechanisms are in action leading to long-term brain plastic changes. Brain reward circuits are involved in the exercise-mediated sense of well-being, with dopamine being the main neurotransmitter involved. Recent positron emission tomography studies in humans undergoing acute cardiovascular exercise show a release of dopamine in the brain that correlates with a reduction in reaction time, that is, with faster responses [12]. It is also possible that exercise increases neuropeptides involved in pain mitigation. Exercise-mediated hypoalgesia has been demonstrated in animal models and evidence of mediation has been provided through, among others, opioid peptides, neurotrophins, and cytokines ([13], see [14] for review). Watve and Keskar Sardeshmukh consider that "the behavioural component of exercise … has crucial effects on brain health through multiple signalling pathways" [1]. They also consider that deficits in specific behavioural components of human life (vitactions) "can potentially trigger multiple health problems".

Vitactions and disease

The current urban lifestyle is the cause of the mismatch between the behaviours that shaped human physiology and current behaviours [1]. Another factor that influences the need for vitamins is life expectancy. Human physiology is not prepared to live that long. A longer life requires adaptations that have not yet been achieved. In this scenario, the longer the life expectancy, the greater the mismatch between ancestrally acquired behaviours (vitactions) and current human behaviours. Diabetes and neurodegenerative diseases are among those ailments that could not have occurred in prehistoric times. These diseases are much less common in less developed societies or in tribes that maintain ancient behaviours. The main risk factor of the most prevalent dementia, sporadic Alzheimer's disease, is age. Regardless of the causes and triggers of the disease, sedentarism, lack of exercise, and lack of socialization may accelerate the onset of cognitive deficits. Motor impairments may be detected earlier than cognitive deficits in Alzheimer's disease patients and animal models of the disease [15]. It should be noted that exercise reduces the risk of suffering from the disease and that exercise can reverse some alterations in the neurophysiology of patients [16]. Interesting in terms of understanding the different aspects of vitactions is that reduction of dementia risk is associated more with leisure-time physical activity than with any other type of "behavioural" exercise [17]. Among the molecular mechanisms potentially involved, exercise-induced increased levels of brain-derived neurotrophic factor (BDNF) may lead to protecting neuronal structure and, accordingly, prevent neuronal death [18]. Exercise may lead to angiogenesis that likely extends into the human brain. Angiogenesis would indeed provide higher blood flow and nutrients to keep neurons alive [19–22].

Modelling food consumption in terms of minimizing mortality and considering activities that differ in predating and weight gain suggested in 2016 that famines are unlikely to be the reason behind the need to accumulate body fat for use during periods of starvation [23]. The loss of ancestral behaviours and the acquisition of new ones are behind the marked increase in obesity in some developed countries. Obesity is of great concern because it already occurs in children and, over time, almost inevitably leads to type 2 diabetes. An interventional study in 142 adults with type 2 diabetes and overweight/obesity and type 2 diabetes was undertaken to assess the behavioural factors that can lead to weight loss. Conclusions were that lifestyle programs to reduce weight and the associated risks require "strategies to promote autonomous motivation, flexible dietary self-regulation, and habituation of low-fat eating habits" [24]. Another way to convey this information is this: vitactions can lead to weight loss. Additionally, vitactions are likely to reduce the risk of obesity and type 2 diabetes.

Parallelism between vitamins and vitactions in terms of excesses and deficits

Theoretically, developed countries should be free of vitamin deficits. Unfortunately, poor dieting habits, which may occur at all ages, lead to deficits in some vitamins. Conceptually, similar deficits may occur in vegetarian diets that do not include enough essential amino acids or in diets that do not include enough essential ω-3 fatty acids. In parallel with poor/unbalanced diets, there is a deficit in behaviours that are important to maintaining a healthy mind, that is, there is a deficiency in vitactions/vitactins. A sedentary lifestyle, isolation, poor social life, lack of interest in learning, etc. are factors that contribute to vitaction deficiency.

Vitamin supplementation is a profitable market and helps to cope with poor diet habits. However, the risks of hypervitaminosis should not be underestimated. Fortunately, the most consumed vitamin, whether naturally or in supplements, vitamin C, is safe because it is hydrophilic, and the excess is eliminated through urine. Completely different is the case of the so-called hydrophobic vitamins, which are poorly soluble in water. Although the most dangerous vitamin when consumed in excess is probably vitamin A, excessive consumption of vitamin D is a cause for concern. Excess vitamin A (hypervitaminosis A) causes a variety of symptoms, from reduced bone density, dizziness, and irritability to birth defects [25]. Hypervitaminosis D (vitamin D toxicity) causes kidney stones but also a wide variety of physiological alterations, mainly resulting from severe hypercalcemia [26].

Does "hypervitactinosis" cause unwanted effects? A simple example is gaming. Composing the pieces of a puzzle, playing chess against the computer, or playing solitaire is fine unless it becomes an obsession. Obsessions lead to unwanted plastic changes in the brain that are similar to those that occur in drug addiction. There are fewer risks and more advantages when playing with other partners. Playing billiards, cards, etc. with friends makes it difficult to obsess, it has mental benefits in addition to the much appreciated and healthy social interaction, which is one of the oldest human behaviours.

Exercise can also become an obsession that comes with physical and physiological consequences. Even in the absence of lesions and lesion-derived pain, excess exercise may be dangerous. Addiction to strenuous exercise without recovery time can end up being a serious condition for the individual, causing nutritional imbalances and accumulation of proteins in the muscles that disappear from other organs/tissues.

Classification of vitactions

On classifying vitactions (I suggest a synonym: vitactins) we face the same problem that scientists had one century ago when attempting to classify vitamins. In his 1927 article, Larenzini, wrote that it was advisable to divide them into "three original groups, Group A promoting growth and bone calcification and preventing xerophthalmia, Group B promoting growth and preventing polyneuritis and Group C preventing scurvy" [27]. The classification evolved with the resolution of the chemical structure of vitamins and with advances in the identification of the mechanism of action (see [28]). Classifying vitactions is not easy since there is no defined material substrate on which to sustain it; in the field of vitamins, it took a while to make a good classification, something that was only possible after solving the chemical structure of the vitamins.

Table 1 lists proposed vitaction categories and the actions related to each. In this first attempt to categorize something new, there are the most straightforward behaviours that one might think of, but also behavioural components involved in hunting/fighting. i.e., those in the realm of the underlined by Watve and Sardeshmukh [1] argument and that is also prevalent in sports competitions. Scientific research is needed to improve classification and to detect behaviours associated with every vitaction. Difficult but not impossible would be to adjust vitaction and dosage in a personalized manner, i.e., adjusted to the individual's genetic, epigenetic, and social status.

Vitaction-centered research

The vitaction concept goes beyond what is known as psychosomatic diseases. In fact, it would be the lack of vitactions that causes or aggravates diseases. Often overlooked is the fact that humans have evolved over millennia, yet there has not been sufficient time to adapt to modern lifestyles. Essential behaviours ancestrally acquired have shaped human physiology, and centuries are required for the implementation of "new" behaviours. In contrast, the deficit of essential behaviours, alters homeostasis in different ways that can be associated with a variety of diseases.

Table 1. Proposal of vitaction classification including the (mainly) active or the (mainly) passive character for each action

Types	Actions	Active/passive
Nature exposure	Sunbathing	Active
	Forest promenade	
	Swimming in river/lake/ocean	
Body contact	Couple	Passive
	Children/parents	
	Pets	
Hunting/fighting attitudes	Aggression, agility	Active
	Precision aiming	
	Competition, combat, risk-taking	
Learning/entertainment	Books	Passive
	Movies	
	Theatre	
	TV/radio	
Counselling	Advice (counsellor/mentor)	Active/passive
	Therapy (psychologist)	

Vitaction-oriented research likely requires putting together and analyzing data obtained by a wide range of technologies used in genetics, biochemistry, clinical chemistry, physiology and psychological research. Another requirement is to put humans at the center. The molecular consequences of a given behaviour can be studied in animals, but the effect of a given vitaction on human life can only be studied in humans.

Although the most effective strategies remain unknown, it is reasonable to speculate that longitudinal studies will be crucial for determining: i) whether a given vitaction yields measurable benefits in healthy individuals or patients with a specific disease, ii) which vitaction deficits contribute to the onset or worsening of a disease, and iii) which vitactions enhance quality of life as one ages.

The most classical example in longitudinal studies related to Alzheimer's disease is the "nun" study [29, 30]. It could even be considered the first research conducted of vitactions. The challenge is to extend this type of study to the general population, i.e., not to a population with similar lifestyles. Deriving conclusions despite the variability associated with studies in humans may appear an illusion. However, the potential of genomics, proteomics, metabolomics, bioinformatics, statistics, and psychosocial research tools coupled with proper management and analysis of big data gives hope.

Finally, a word of an idea that underlies the "nun" study, i.e., the triggers of neuronal degeneration leading to Alzheimer's disease (in late-onset non-inherited cases). Looking at it from another perspective, what prevents the development of the disease in some individuals with similar genetic and social backgrounds? In other words, which vital actions prevent the development of Alzheimer's disease? To answer these questions, one may consider the activities that occupy 8 or more hours of daily life. When thinking of jobs, is a professional musician less prone to suffer from Alzheimer's disease than a bank clerk?

Another unknown is the factors that impact the rate of Alzheimer's disease progression. Can vitactions delay disease progression?

Curated databases and early biomarkers

The amount of data from all kinds of approaches that can be generated to underscore the role of vitactions in a healthy life and in preventing diseases is vast. Databases would be needed for scientists to access and make analyses and correlations. Data in such databases must be reliable and, therefore, curation is required. Equally important is the proper design of the basic individual information that should be collected, including race, age, job, size of the city, etc. Questions that may require answering through database data retrieval may include: Does living with pets prevent Alzheimer's disease? Or does living in large cities correlate with a higher risk of Alzheimer's disease?

The physiological consequences of each vitactin can be multivariate and the challenge is to find which molecular mechanism is behind the main benefit. Virtually, all vitactions may be affecting the glucose consumption by the brain. Functional magnetic resonance imaging (fMRI) detects changes in blood flow and brain activity, allowing researchers to observe which areas of the brain are activated while playing the instrument. This can provide insights into neural mechanisms involved in musical training and performance. Assuming that playing an instrument may reduce disease risk, fMRI alone would not suffice. It is necessary to correlate the activity with a disease marker, specifically a biomarker whose concentration changes before clinical symptoms appear. Identifying such "early" biomarkers is challenging. Even for type 2 diabetes, a prevalent disease, diagnosis relies on blood glucose levels. However, there is no consensus on any "early" biomarker that could, for instance, determine whether diabetes is advancing or reversing. While it is known that prediabetic states can be reversed through exercise and proper nutrition, there is no biomarker that can predict reversal or progression. The discovery of early biomarkers of the disease is required for understanding the molecular basis of an action producing a specific disease-related benefit. In summary, vitaction research and disease biomarker discovery can advance synergistically.

Conclusions

Ancestral behaviours are imprinted in our genes and our social interactions. There has not been time to modify behaviours to get used to the current lifestyle in developed societies. While diseases associated with vitamin deficits were discovered a long time ago, health problems associated with psychological deficits had not been appropriately addressed. A recent paper proposes that some specific actions/behaviours, are needed to improve quality of life [1]. The authors introduce the term "vitaction" to describe behaviours essential for preventing physiological and psychological imbalances, drawing a parallel between vitamins and vitactions. Vitaction deficits are likely behind a variety of diseases that did not exist in ancient times, such as depression and anxiety, but also obesity. A first classification of vitactions is here proposed with examples of their behavioural correlates. Finally, vitactin is proposed as a synonym for vitaction (reasons are provided early in this Perspective article, in the Introduction).

Declarations

Acknowledgments

In memory of Antonia Fernández, mother of RF, who recently left us. You remain in the hearts of the daughter, son, granddaughters, and great-grandchildren.

Author contributions

RF: Conceptualization, Investigation, Writing—original draft, Writing—review & editing.

Conflicts of interest

Rafael Franco is the Editor-in-Chief of Exploration of Neuroprotective Therapy, but he had no involvement in the journal review process of this manuscript.

Ethical approval

Not applicable.

Consent to participate

Not applicable.

Consent to publication

Not applicable.

Availability of data and materials

Not applicable.

Funding

Not applicable.

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