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## Nutrition in mental and physical health

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**Abstract.** Eating habits are crucial for human health. People around the world have health problems due to their diet. Malnutrition combined with a lack of essential nutrients and obesity with overconsumption of sugar is significant problems. For the most part, the human daily diet should include foods rich in vitamins, fatty acids, minerals, and trace elements. On the other hand, the consumption of substances such as sugar and trans fats causes negative effects on the human body. Fish, vegetables, and nuts are some of the food that contributes to good health. Also, specific foods help the hormones of happiness to increase in our body. This has the effect of reducing stress and increasing happiness. New technologies are a tool that can help individuals to maintain proper nutrition and good health. For example, through the ICTs applications, everyone can individually control his weight, physical exercise, and find the right combinations to have a better and more quality life without diseases.

**Keywords.** nutrition, minerals, vitamins, sugar, ICTs applications, hormones, stress

### 1. Introduction.

Malnutrition and poor diets rank as risks factors for disability. In rich countries consumption of unhealthy food is regarded as a major risk factor for diseases. Therefore the lack of essential nutrients remains a risk factor of children mortality in poor countries. At the same time, other countries are characterized by obesity. So, poor diets are common and complex (Headey and Alderman, 2019).

The scientific activity of the last decades has contributed significantly to understanding the correlation of nutrition with health. Health and nutrition are emphasized as critical components of basic needs in developing countries. Nutrition is the determinant factor of health and productivity. The studies on health and nutrition in developing countries have provided some insights but they also raise important questions (Behrman, 1988).

There are many types of diets that have been assessed and contributed many benefits. Diets that are based on the blood group system claim that promote to improve health and decrease the risk of diseases (Cusack, et al, 2013). In addition to special diets, diets based on nutrients, minerals, and others are considered very effective and healthy. For example, dietary sources of vitamin K has multiple roles such as anti-inflammation, a ligand for the steroid, and a xenobiotic receptor (Fu et al, 2017).

## **2. Method**

This study utilized research sources and used scientific articles to gather information and record data related to nutrition and health. The study was a bibliographic review based on past and present articles on nutrition.

## **3. Results**

The aim of the paper was to explore the healthy nutrition and the benefits of individuals. The research resulted in most major themes describing the basic ingredients of daily intake for a healthy and strong body and mind.

**Trace elements and minerals.** Millichap and Yee (2012) make important iron deficiency children. Low levels of ferritin in children with cognitive and learning disabilities led to them being given ferritin serum during their admission to a neurological clinic. Ferritin supplements have shown some improvement in children's behavior. So its lack was related to attention, hyperactivity, and impulsivity. Most of the reports come from the countries of the Middle East, Turkey, Iran, and the USA. Another important trace element is zinc as it acts as a cofactor for dopamine metabolism. Two trials, one with iron supplements and the other with methylphenidate, report significant benefits.

Arnold, Hurt, Lofthous (2013) investigated the importance of amino acid and trace elements in the body. Children with Attention-Deficit/Hyperactivity Disorder (ADHD) have a lack of amino acids. More specifically, 34% of a sample of children with ADHD appeared to have a magnesium deficiency. Amino acids such as tryptophan, tyrosine, and phenylalanine are essential for the production of neurotransmitters. Insufficient iron is usual to children with ADHD and it is an important coenzyme for the production of catecholamine. In a survey, 73 girls with ADHD taking iron supplements improved in verbal learnings and memory.

The paper of Campbell (2021) dealt with the twelve most deficient essential minerals and five toxic ones. Essentially the researchers propose that the health and behavioral problems are related to a deficiency of essential minerals or the excess of toxic ones. The results emerged from hair analysis. The biggest deficiency in the analyzes was chromium. Good food sources of chromium are whole grain products, potatoes, wheat germ, green paper, eggs, and apples. The body loses chromium when under severe stress both mental and physical. Other minerals that are lacking in the body are magnesium, zinc, and calcium which exist in vegetables, nuts, seeds, whole grains, legumes, kelp, collard, sunflower seeds. Minerals like selenium, potassium, iron, copper, molybdenum, phosphorus, sodium are essential nutritional elements. While in toxic metals are included aluminum, cadmium, lead, arsenic, and mercury.

Sandstead (1986) presented a brief history of the influence of trace elements on brain development and function. Elevated levels of lead in the environment, such as water, have been shown to cause many problems in children and adults. Children exposed to lead had low IQ and attention deficits. Mercury is the second trace element that affect the nervous system. The fetuses of pregnant that ate fishes which are contained mercury were severely affected. Risk of injury from mercury include symptoms of ataxia, confusion, poor vision and hearing, violence even death. Iodine associate with brain injury because of deficiency. A typical example is maternal deficiency during gestation retards the development of the fetal brain. Cobalt is the fourth trace element (part of cobalamin – vitamin B12) which deficiency has been linked to anemia and brain dysfunction. Furthermore, iron and ferritin levels related to dopaminergic neurons and consequently their lack was related to bad mood. The lack of cooper associated with lack of myelin. For this reason there is Menkes syndrome. The last two trace elements whose lack acts negatively on the nervous system are manganese and zinc.

Keen et al. (2004) refers to the effects of minerals and trace elements on the immune system. A prolonged diet with a lack of essential trace elements causes morbidity and potentially death. The insufficiency of minerals can increase diseases like Menkes, multiple gene defects, and many more. Analyzing one by one the trace elements is obvious the multiple problems that can exist from their lack. Severe copper deficiency results in anemia, thymic hypoplasia, and low immunoglobulin. Besides, iron deficiency is the most common known mineral deficiency in the world and especially in children and pregnant women. The most recognized consequences are included anemia, impaired child development, impaired work performance, and multiple immunological abnormalities. Low intakes of these trace elements, as well as zinc, iodine, magnesium, manganese, and selenium, can affect problems to the immune system, resulting in susceptibility to infectious disease.

Torres-Vega et al. (2012) agree with the above findings. Lack of nutrients such as amino acids and trace elements have serious negative effects on the development of the parietal system that controls emotions, cognitive, and motor functions. Basic trace elements such as iron, zinc, copper, and selenium are cofactors in various enzymes involved in metabolic and antioxidant functions and are essential for the synthesis of catecholamines. They also help protect free radicals and reduce oxidative stress. Imbalances at these levels are associated with diseases such as Parkinson's and Alzheimer's as well as depression, anxiety, attention deficit, and poor memory.

**Vitamins and fatty acids.** Crucket, Lucero and Cornejo (2016) pointed to the encouragement of a healthy and balanced diet. More specifically,  $\beta$ 12 deficiency causes anemia, which leads to an increase in homocysteine and thus increases the risk of cardiovascular and cerebral diseases. Vitamin deficiency leads to damage to the nervous system. Vitamin B12 and omega 3 in combination with the restriction of the consumption of sugar, sweeteners, food with pigments are recommended to improve behavior.

Schleithoff et al. (2006) researched whether supplementation of vitamin D can help the patient with congestive heart failure. There was the hypothesis that low vitamin D status may contribute to pathogenesis and symptoms of this chronic disease. One hundred twenty-three patients who took place in the study were recruited at the Heart and Diabetes Center Nordrhein-Westfalen, Germany. They submitted in medical treatment was conducted for 9 months and they were divided into two groups (intervention group D+, control group D-). The results of the present clinical study showed that the supplement with vitamin D increased the cytokine as well as suppressed the parathyroid hormone. These findings are very important because the cytokine is an anti-inflammatory protein that seems to have important cardio protective actions and the increased serum levels of parathyroid hormone adversely affect heart problems.

Vitamin B12 is an important nutrient for health, something that Venkatramanan et al. (2016) analyzed in a literature review. This vitamin plays an integral role in DNA synthesis, methylation reactions, and the maintenance of genomic stability. The criteria are met for the collection of articles were human studies, data on vitamin B12 on maternal as well as a child on dietary intake and cognition. Therefore, after analysis of the literature, the results were distinct for the effect of Vitamin 12. More specifically, several studies talk about the significance of recruitment this particular vitamin during pregnancy. Of course, it is not enough as research clarifies the usefulness of Vitamin B12 in early childhood. Its lack causes problems in memory, attention, learning, and executive functions. Finally, the potential role of other micronutrients as folate, riboflavin, pyridoxine, and choline, need to be examined, as they may influence both vitamin B-12 metabolism and cognitive development.

In this framework, another very important vitamin, that is vitamin A, cannot be omitted. At this point the research of Jiang et al. (2018) made an experiment with the aim examine the

effects of retinoic acid on Hypoxic-ischemic brain damage (HIBD), the most common central nervous system disease in the neonatal period and has a poor prognosis. The experiments were performed on rats where the groups were either deficient in vitamin A or a normal value of vitamin A or supplemented with this vitamin. The target of the present study is the mechanism of apoptosis in the hippocampus to pathological damage of HIBD in newborns. The results of the research shed light on the fact that there are disorders in learning and spatial memory in the group that had a lack of vitamin A as well as there was greater apoptosis of the hippocampus in this group. The growth of mRNA protein in the group with sufficient vitamin A was also emphasized. The above data signal the direct correlation of the HIBD with the lack of vitamin A, thus making it necessary to administer an appropriate dose of vitamin A in this case.

Berstein (1990) claims that pyridoxine helps to produce neurotransmitters that are related to children's behavior. The lack of vitamin B6 causes seizures and hyperactivity except for behavioral problems. Pyridoxine normalizes serotonin levels thus improving neurological diseases such as depression and many types of diseases. In addition, it is emphasized that pyridoxine supplements reduce aggressive behavior. However, the question arises as to whether long-term use of vitamin B6 is safe.

Lange (2007) agrees that vitamins function as essential nutrients involved in the normal development and functions of the central nervous system. It can even be assumed that vitamin deficiency could contribute to disorders such as Attention Deficit Disorder. Various vitamins have been suggested to be involved in the pathogenesis of this disorder, such as A, B2, B3, B6, B9, B12, D, E. The findings showed that B12 and D were low in children with hyperactivity disorder. Although several studies have not shown clearly whether the deficiency of vitamins plays an essential role in the etiology and the supplementation of ADHD.

Patrick and Ames (2015) point out that serotonin regulates attention deficit, hyperactivity disorder, impulsive behavior, social cognition, and decision making. Its reduction in typical individuals causes memory problems and reduced learning abilities. Research suggests mechanisms by which synthesis, release, and function of serotonin in the brain are regulated by vitamin D and omega 3 fats. The elements that are necessary for the symptoms of carelessness, impulsivity, and hyperactivity. More specifically, fatty acid species such as eicosapentaenoic acid (EPA) and eicosyxedenoic acid (DHA) inhibit depression, regulate serotonin levels and improve behaviors.

**Sugar.** Sugar is a highly palatable carbohydrate in which excessive consumption brings negative results to the human body. In recent years the danger of sugar intake has been highlighted by the World Health Organization and the American Academy of Pediatrics. Freeman et al. (2018) explored the different types of sugar like glucose and fructose. Furthermore explained sugar addiction and how sugar is metabolized. Looking at glucose and fructose separately it was observed that fructose is more dangerous than glucose due to the need to increase food intake and therefore fat as well as the increased risk of diabetes or Alzheimer's. About sugar, addiction seems to happen very often and is paralleled with drug addiction.

Sugars are found naturally in fruits, vegetables, some grains, milk, and milk product. On the other hand, the added sugars sweeten the food and are used to preserve food. It is well known that sugar consumption increases problems such as obesity, dental caries, and cardiovascular risk. The aim of this paper that was written by Fidler Mis et al. (2017) reviews the evidence on health effects in infants, children, and adolescents. There are many definitions of sugar so comparisons between studies are difficult. Studies show that children tend to consume sugars through drinks such as milk or smoothies. The preference for sweet taste is innate. More specifically sweet taste has a strong genetic component that decreases with age. Also, infants, as well as early childhood who intake sugars, are likely to consume the sweet

taste of food in childhood and adolescence. This fact is related to increased incidence of dental caries, adiposity, cardiovascular disease, and type 2 diabetes. According to World Health Organization, sugar consumption should be limited.

White and Wolraich (1995) reviewed the scientific evidence about the relationship between sugar, behavior, and cognitive function. The first hypothesis that sucrose hurts the behavior was in 1922. In the past, sugar was associated with fatigue syndrome. This article is considered the relation between sucrose, hyperactivity, and aggressive behavior. The first theory says that refined sugar challenged allergic response. The second theory explains that sugar functional reactive hypoglycemia. Nevertheless, clinical investigations have not demonstrated a significant effect of sucrose with hyperactivity because studies mostly used methods similar to those used in investigating the effects of food additives and preservatives. Secondly, the writers hypothesize that glucose can influence the central nervous system. More specifically the glucose seems to be related to the brain area that is responsible for memory. The hippocampus may be affected by glucose. The latest case of research is sedation in infants. Sugar increases the serotonin in the brain which can influence sleep induction.

Sugar has blamed for increasing hyperactivity behavior. This behavior is common in children and parents to worry about receiving healthy food that contributes to appropriate behavior. Milich et al. (1986) examined the effects of sugar ingestion on the behavior of normal and hyperactive children. The findings of this research have been contradictory concerning previous studies. Nevertheless, research is reluctant to rule out the link between sugar and hyperactivity. On the other hand, the adverse effects of sugar on tooth decay, obesity, and poor nutrition form are strong arguments against excessive sugar consumption in children.

Sleep disorders are common in children with Attention-Deficit Hyperactivity Disorder ADHD and diet affects the symptoms of this disorder. The research of Lee Blunden, Milte and Sinn (2011) examines the possible interaction of sleep, diet and hyperactivity. The study was conducted in South Australia and examined 91 children aged 6-13 years old. The tool used was the questionnaire of the frequency of food consumption by the Victorian Cancer Council. It should also be noted that energy and carbohydrate intake from soft drinks were calculated separately with Food Works Professional. Sleep was measured with the Sleep Disorder Scale for Children (SDSC). The main consumption of study was that the children with sleep disorders consumed more fat, carbohydrates and sugar. More specifically sugar consumption was associated with night sweats and respiratory disorders.

Additional research is consistent with the above findings. More specifically, Schnoll, Burshteyn and Cea-Aravena (2003) claim that eating habits are related to hyperactivity. Diet modification plays an important role in the management of the disorder and should be considered as part of the treatment protocol. One of the main nutritional factors that affect hyperactivity is sugar. Children in the USA consume 2 pounds of sugar per day. Hypoglycemia is associated with increased adrenal production which made triggers a nervous or anxious behavior. The susceptible individuals that intake high sugar may cause a nervous reaction. Finally, typical children who ate a lot of sugar had changes in their body movements and hyperactivity children showed destructive-anxious behaviors.

In a previous study, Jones et al. (1995) surveyed 25 children and 23 adults to access whether children are more vulnerable to neuroglycopenia. Blood glucose levels and increased susceptibility to neuroglycopenia may be important contributors to adverse behaviors and cognitive functions after consuming sugar in healthy children. The question of whether sugar negatively affects the behavior of healthy children is a source of constant controversy. The study was approved by the Yale University School of medicine Human Investigation Committee and assessed whether children are more sensitive to the adverse effects of reduced glucose

availability for cognitive function. The results of the research do not show that sugar is the cause of hyperactivity problems. On the other hand, the researcher emphasizes that children could benefit from consuming meals that include protein, fat, carbohydrates, and fiber. This type of diet helps to reduce postprandial reductions in plasma glucose levels and increases adrenal levels.

Kim and Chang (2011) investigated the relationship between consumption of sugar and attention. In the study participated 107 students, of which 8 boys and 1 girl had characteristics of hyperactivity. The results showed that children had an increased risk for the symptoms of the disorders because they consumed large amounts of sugar or consumed low vitamin C. However, no significant correlation was observed between the consumption of sugary snacks and the development of hyperactivity. The findings of this study agreed with previous studies regarding the fact that sugar had no effect on behavior, learning, and attention. But other theories contradict and prove the negative effect of sugar on children's behavior.

**Nutrition, hormones and ICTs applications.** Since ancient times, there are has been talking of the multiple benefits of diet and exercise in the physical and mental health of people. Gómez-Pinilla (2008) presented a study to which it refers that several gun hormones like leptin, ghrelin, and insulin enter the brain or are produced in the brain influence cognitive ability. It is not surprising that visceral signals are essential factors for the treatment of psychiatric disorders. The brain consumes an immense amount of energy relative to the rest of the body. Thus, the food that is taken is paramount. More specific there are specific components for the cognitive functions. Omega-3 fatty acids are essential for normal brain functions and the lack of them leads to reduced learning and memory. Epidemiological studies indicate that trans food and saturated fat adversely affect cognition. Folic acid in combination with vitamin B has been shown to be effective at preventing dementia and depression. The antioxidant food such as vitamin E, curcumin, and micronutrients that are contained in spinach, broccoli, and potatoes help to the homeostasis. Finally, the effects of diet on mental health can be transmitted across generations.

The neuroplasticity is very important for cognition and behavior during adolescence. The study of Reichelt and Rank (2017) highlighted the negative impact of junk food on brain function. The neurodevelopment processes are critical for brain synapses. For this reason the eating habits are very important during the adolescence. The adolescents used to costuming junk food. This habit causes specific neurobiological changes and impact the development of frontostriatal and frontotemporal neurocircuitry. This leads to the pronounced behavior and inhibits normal maturation process. The result is the poor behavioral inhibition and deficits in learning and memory.

Medawar et al. (2019) present bibliographic research with papers from PubMed. The study explains the beneficial effects of plant-based on the body and the brain. The vegan/vegetarian diet seems to have positive results for health and disease. More specifically this type of diet contributes to weight and metabolic status, glucose, insulin, plasma lipids as well as inflammatory markers. However, the evidence for the mental effects of a plant-based diet is not clear. Although in recent surveys 80% of women found a direct relationship between a vegan diet and a balanced mood. The nutrients that are taken are vitamin K, C, magnesium, and others. On the other hand, there is the risk of nutrient deficiencies such as vitamin B12 - iron and ferritin which are very important for cognition, memory, and homocysteine. Finally, plant-based are linked to a specific microbial profile. Some vegan gut microbial characteristics have been found in obese people, which improve lipid metabolism and intestinal inflammation.

Apart from the above, another important element that helps the health is homemade food. This study tried to analyze Vozoris and Tarasuk (2002) with data from the public use

microdata health file household survey in Canada. The households most likely to report food insufficiency have more chances for health problems. Malnourished people present more often poor health, restricted activity, and multiple chronic conditions. Bad mental health such as depression or distress is often observed in these individuals. In addition to heart disease, diabetes, high blood pressure, obese as well as food allergies are many of the effects of malnutrition.

According to Peper (2015), our diet has changed radically in the last 50 years. The foods we eat contain herbicides and pesticides. The USA Department of Health reports a very large percentage of wheat has been treated with herbicides. These negatively affect health by killing the beneficial bacteria in the gut and leading to a sharp increase in diseases such as allergies, celiac disease, diabetes, hyperactivity and autism. It is noteworthy that many people when they changed their eating habits noticed the elimination of the symptoms of the disease.

In addition, many studies have reported on the relationship between children's behavior and food coloring. The research of Stevens et al. (2013) report that in the USA 9 species of food coloring have been blamed for adversely affecting children's behavior, as well as 6 species, have been blamed for aggressive behavior in the United Kingdom. Color toxicity can cause damage to the human brain. These pigments are contained in water, with the result that it causes depressive behavior in people who consume it. Aromatic amines in soft drinks and azodyes lead to oxidative stress. Chronic intake of aluminum in food causes asthma, migraines, seizures, and hyperactivity.

Stevens et al. (2011) report that in the 70's the allergist Feingold suggested a diet free of natural salicylates and preservatives (AFC). Two years later he proposed diets free of extra preservatives which have been accused of aggressive behavior. Over the next 35 years, research expanded to include additional diets, and the results showed that typical children developed aggressive behaviors after eating preservatives, while children with a diagnosis did not have improved behaviors on preservative-free diets. Sensitivity to dyes and benzoic acid is a public health problem that needs to be addressed.

Schnoll, Burshteyn and Cea-Aravena (2003) explain that allergies occur in 70% of the population who are hyperactive. These people have more frequent asthma, stomach upsets and various infections than the rest of the population. Allergies can manifest in a variety of ways such as allergic rashes, respiratory problems, headaches, stomach aches and muscle problems. Their effects are learning and behavioral problems. In the case of skin allergies most of the previous studies have investigated that the role of colors in food and sugar consumption play an important role in behavior.

Ritz and Lord (2005) report that the role of food sensitivities was introduced decades ago in ADHD. The effects of drugs direct many parents to alternative therapies. These therapies include dietary modification. This research was performed on a 7-year-old boy with a diagnosis of this disorder. The child developed severe antibody detection and intolerance to certain foods. He was given a daily dietary supplement for 6 months in combination with hydrolyzed fish protein, bovine colostrum, vitamin d. After 6 months of re-testing the antibodies were improved. The result was a drastic improvement in the child's behavior. More specifically the boy was more focused and attentive and carried out the orders given to him more easily.

A year later Niederhofer and Pittschieler (2006) are dealing with celiac disease which has been linked to psychiatric and psychological disorders. This study examined 132 people aged 3-57 years with celiac disease. The means used were the behavioral scale and the control was done before and after the special diet. On this diet, the patients received a gluten-free diet and 6 months later reported a significant improvement in their attention span and the completion of the work given to them. It is also important that 74% willingly want to continue this treatment

ICTs are powerful tools for many sectors. Drigkas and Kariotaky (2013) mention that ICTs have become a strong ally in nutrition science too. Nutrition applications are cost-effective innovations that provide the means of consumption food and energy expenditure measurements. Dietary intake and physical activity are very important for a healthy lifestyle so the nutrition application must be interesting to keep individuals' long-term engagement in the intervention program. Mobile nutrition systems like "CHAT" offer food and energy measurement services as well as frequent communication with a specialist. Educational tools are attempted for dieticians, epidemiologists, nutritionists, food scientists, and doctors. These tools offer distance learning in nutrition intending to acquire knowledge in this field. In addition, obesity applications help in weight loss and in adopting a better lifestyle. Finally, there are applications for diabetics with which patients can learn to manage the disease.

Drigkas and Drigka (2019) report that neurological disorder Attention deficit hyperactivity disorder (ADHD) is characterized by lack of attention and impulsivity. ADHD is a complex and multifactorial disorder. First of all the eating habits of the pregnant woman are crucial for the baby. More specifically, smoking and alcohol consumption during pregnancy carries risks for the development of the fetal brain. Another factor associated with this disorder is preterm birth has been correlated with neurological and cognitive risks. Another subject that is interlinked with ADHD is low birth weight. The socioeconomic factors, the overuse of electronics are two factors that have been implicated in increasing the chances of developing symptoms of the disorders. The patients receiving alternative therapies like brain training as well as mindfulness and meditation showed higher progress than patients on medication.

Drigkas and Mitsea (2021) examine the importance of hormones. The hormones of happiness are serotonin, oxytocin, and dopamine. Serotonin is found in the gastrointestinal tract and maintains the chemical balance in the brain. Oxytocin synthesized in the hypothalamus and helps the hippocampus and amygdala function. Dopamine is the hormone of pleasure, reward, and motivation. On the other hand, the stress hormones are cortisol, adrenaline, and noradrenaline. Exercise and diet play a very important role in the balanced functioning of hormones and consequently in maintaining homeostasis. More specifically fish, green vegetables, fruits, nuts have strong anti-stress benefits that improve brain function.

#### **4. Conclusion**

Vitamins have anti-inflammatory action and protect against heart problems. Also, they help to enhance memory and attention. Children on a vitamin-rich diet have better cognitive and executive functions. Unlike sugary foods which have been accused of being addictive and causing problems in the mind and body.

Nutrition with a variety of trace elements and minerals contributes to increasing memory, verbal learning and reducing the chances of hyperactivity and parsimony. It also reduces the incidence of disease, anemia, anxiety, and memory loss. In general, good nutrition builds a strong body and mind and improves overall health and behavior.

Omega-3 fatty acids are essential for brain functions and the lack of them leads to poor learning and memory. Epidemiological studies indicate that trans food and saturated fat adversely affect cognition. Some vegan food has been found that improve lipid metabolism intestinal inflammation. Epidemiological studies indicate that trans-fat adversely affect cognition. Therefore, the antioxidant food help to the homeostasis.

Nowadays people can learn to control their diet through ICTs apps and thus maintain good physical and mental health. In addition, the balance of hormones, relaxation, stress, and metacognition are achieved through diet and are important factors for overall health.

The findings of this study contribute to the research literature in terms of the health with help of nutrition. Moreover, these may provide baseline data for adopting a good lifestyle through eating habits.

## References

- [1] ARNOLD, L., E., HURT, E., & LOFTHOUSE, N., (2013). Attention-Deficit/hyperactivity Disorder: dietary and nutrition treatments. *Elsevier*, 22(3), 381-402. doi.org/10.1016/j.chc.2013.03.001.
- [2] BEHRMAN, J., R., & DEOLALIKAR, A., B. (1988). Health and Nutrition. *Elsevier Science Publishers*.
- [3] BERNSTEIN, L., A. (1990). Vitamin B in clinical neurology. *Annals of the New York Academy of Sciences*. <https://doi.org/10.1111/j.1749-6632.1990.tb28058.x>.
- [4] BLUNDEN, L., S., MILTE, M. C., & SINN, N. (2011). Diet and sleep in children with ADHD: Preliminary data in Australian children. *Journal of Child Health Care*, 15(1), 14-24. doi.org/10.1177/1367493510385020.
- [5] CAMPBELL, J.D. (2001). Lifestyle, minerals and health. *Elsevier*, 57(5), 521-531. doi.org/10.1054/mehy.2001.1351.
- [6] CRUCHET S., LUCERO Y., & CORNEJO V., (2016) Truths, Myths and Needs of special diets: Attention deficit disorder, autism, non-celiac gluten sensitivity and vegetarianism. *Ann Nutr Metab*, 68(1), 43-50. doi.org/10.1159/000445393.
- [7] CUSACK, L., BUCK, E., COMPERNOLLE, V., & VANDEKERCKHOVE, P., (2013). Blood type diets lack supporting evidence: a systematic review. *Am J Clin Nutr*, 98(1), 99-104. doi: 10.3945/ajcn.113.058693.
- [8] DRIGA, A., M., & DRIGAS, A. (2019). ADHD in the Early Years: Pre-Natal and Early Causes and Alternative Ways of Dealing. *Ijoe*, 15(13). doi.org/10.3991/ijoe.v15i13.11203.
- [9] DRIGAS, A., & KARYOTAKI, M. (2013). E-learning and ICTs Applications in Nutrition Science. *iJES*, 1(2). doi.org/10.3991/ijes.v1i2.3279.
- [10] DRIGAS, A., & MITSEA, E., (2021). Metacognition, Stress – Relaxation Balance & Related Hormones. *iJES*, 9(1):4-15. doi: 10.3991/ijes.v9i1.19623.
- [11] FIDLER M., N., BRAAGER, C., BRONSKY, J., CAMPOY, C., DOMELLÖF, M., EMBLETON, N., D., HOJSKAK, I., HULST, J., INDRIIO, F., LAPILLONNE, A., MIHATSCH, W., MOLGAARD, C., VORA, R., & FEWTRELL, M. (2017). Sugar in Infants, Children and Adolescents: A Position Paper of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition*, 65(6), 681-696. doi.org/10.1097/MPG.0000000000001733.
- [12] FREEMAN, C., R., ZEHRA, A., RAMIREZ, V., WIERS, C., VOLKOW, N., D., & WANG, J-G. (2018). Impact of sugar on the body, brain, and behavior. *Frontiers In Bioscience, Landmark*, 23, 2255-2266.
- [13] FU, X., HARSHMAN, G., S., SHEN, X., HAYTOWITZ, B., D., KARL, J., P., WOLFE, E., B., & BOOTH, S., L. (2017). Multiple Vitamin K Forms Exist in Dairy Foods. *Current Developments in Nutrition*, 1(6). doi: 10.3945/cdn.117.000638.
- [14] GÓMEZ-PINILLA, F., (2008). Brain foods: the effects of nutrients on brain function. *Nat Rev Neurosci*, 9(7). 568–578. doi: 10.1038/nrn2421.
- [15] HEADEY, D., D., & ALDERMAN, H., H. (2019). The Relative Caloric Prices of Healthy and Unhealthy Foods Differ Systematically across Income Levels and Continents. *The Journal of Nutrition*, (149)11, 2020-2033, doi.org/10.1093/jn/nxz158.

- [16] JIANG, W., GUO, M., GONG, M., CHEN, L., BI, Y., ZHANG, Y., SHI, Y., QU, P., LIU, Y., CHEN, J., & LI, T. (2018). Vitamin A bio-modulates apoptosis via the mitochondrial pathway after hypoxicischemic brain damage. *Molecular Brain*, 11(14).
- [17] JONES, T., W., BORG, P., W., BOULWARE, S., D., MCCARTHY, G., SHERWIN, R., S., & TAMBORLANE, V. W. (1994). Enhanced adrenomedullary response and increased susceptibility to neuroglycopenia: Mechanisms underlying the adverse effects of sugar ingestion in healthy children. *The Journal of Pediatrics*, 126(2), 171-177.
- [18] KEEN, C., L., URIU-ADAMS, Y., J., ENSUNSA, L., G., & GERSHWIN, E., M. (2004). Trace Elements/Minerals and Immunity. *Handbook of Nutrition and Immunity*, 117-140.
- [19] KIM, Y., & CHANG, H. (2011). Correlation between attention deficit hyperactivity disorder and sugar consumption, quality and dietary behavior in school children. *Nutr Res Pract*, 5(3). 236-45. doi: 10.4162/nrp.2011.5.3.236.
- [20] LANGE, K., W. (2017). Dietary factors in the etiology and therapy of attention deficit/hyperactivity disorder. *Current Opinion in Clinical Nutrition and Metabolic Care*, 20(6), 464-469. doi.org/10.1097/MCO.0000000000000415.
- [21] MEDAWAR, E., HUHN, S., VILLRINGER, A., & WITTE, V., A. (2019). The effects of plant-based diets on the body and the brain: a systematic review. *Translational Psychiatry*, 9(226). 2-17. doi.org/10.1038/s41398-019-0552-0.
- [22] MEDAWAR, E., HUHN, S., VILLRINGER, A. & WITTE, V., A. (2019). *Translational Psychiatry*, 9(226).
- [23] MILICH, R., WOLRAICH, M., & LINDGREN, S., (1986). Sugar and hyperactivity: a critical review of empirical findings. *Elsevier*, 6 (6), 493-513. doi.org/10.1016/0272-7358(86)90034-6.
- [24] MILLICHAP, J., G., & YEE, M., M. (2012). The diet factor in attention deficit hyperactivity disorder. *Pediatrics*, 129(2), 330-7. doi: 10.1542/peds.2011-2199.
- [25] NIEDERHOFER, H., & PITTSCHIELER, K. (2006). A preliminary investigation of ADHD symptoms in persons with celiac disease. *Journal of Attention Disorders*, 10(200). doi.org/10.1177/1087054706292109.
- [26] PATRICK, P., R., & AMES, B., N. (2015). Vitamin D and the omega 3 fatty acids control serotonin synthesis and action, part 2: relevance for ADHD, bipolar, schizophrenia, and impulsive behavior. *The FASEB journal*, 29. doi: 10.1096/fj.14-268342.
- [27] PEPER, E. (2015). Allergies, asthma, ADHD: Is it the food we eat? *Research Gate*.
- [28] REICHEL, C., A., & RANK, M., M. (2017). The impact of junk foods on the adolescent brain. *Birth Defects Research*, 109, 1649–1658. doi: 10.1002/bdr2.1173.
- [29] RITZ, W., B., & LORD, S., R. (2005). Case study: the effectiveness of a dietary supplement regimen in reducing IgG-mediated food sensitivity in ADHD. *Alternative therapies*. *Altern Ther Health Med*, 11(3), 72-75.
- [30] SANDSTEAD, H., H. (1986). A brief history of the influence of trace elements on brain function. *The American Journal of Clinical Nutrition*, 43, 293-298.
- [31] SCHLEITHOFF, S., S., ZITTERMANN, A., TENDERICH, G., BERTHOLD, K., G., STEHLE, P., & KOERFER, R. (2006). Vitamin D supplementation improves cytokine profiles in patients with congestive heart failure: a double-blind, randomized, placebo-controlled trial. *Am J Clin Nutr*, 2006(83),754 –9.
- [32] SCHNOLL, R., BURSHTEYN, D., & CEA-ARAVENA, J. (2003). Nutrition in the treatment of attention-deficit hyperactivity disorder: a neglected but important aspect. *Applied Psychophysiology and Biofeedback*, 28, 63–75.

- [33] STEVENS, L., J., KUCZEK, T., BURGESS, R., J., HURT, E., L., ARNOLD, E., L. (2010). Dietary sensitivities and ADHD symptoms: Thirty-five years of research. *Clin Pediatr*, 50(4), 279-293. doi.org/10.1177/0009922810384728.
- [34] STEVENS, L., J., KUCZEK, T., BURGESS, J., R., STOCHELSKI, M., A., ARNOLD, L., E., & GALLAND, L. (2013). Mechanisms of behavioral, atopic, and other reactions to artificial food colors in children. *Nutrition Reviews*, 71(5), 268–281, doi.org/10.1111/nure.12023.
- [35] TORRES-VEGA, A., PLIEGO-RIVERO, F., B., OTERO-OJEDA, A., G., GÓMEZ-OLIVÁN, M., L., & VIEYRA-REYES, P. (2012). Limbic system pathologies associated with deficiencies and excesses of the trace elements iron, zinc, copper, and selenium. *Nutrition Reviews*, 70(12), 679–692. doi:10.1111/j.1753-4887.2012.00521.x.
- [36] WHITE, J., W., & WOLRAICH, M. (1995). Effect of sugar on behavior and mental performance. *The American Journal of Clinical Nutrition*, 62(1), 242S–247S. doi.org/10.1093/ajcn/62.1.242S.
- [37] VENKATRAMANAN, S., ARMATA, E., I., STRUPP, J., B., & FINKELSTEIN, L., J. (2016). Vitamin B-12 and Cognition in Children. *Advances in Nutrition*, 7(5), 879–888. doi.org/10.3945/an.115.012021.
- [38] VOZORIS, N., T., TARASUK, V., S. (2003). Household Food Insufficiency Is Associated with Poorer Health. *The Journal of Nutrition*, 133(1), 120–126. doi.org/10.1093/jn/133.1.120.