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Systematic Review

The Effect of Nutrition on the Autonomous Nervous System: A Systematic Review

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Abstract: Nutrition plays a key role in regulating the autonomic nervous system (ANS), which is responsible for controlling involuntary bodily functions such as heart rate, breathing, digestion and body temperature. Some nutrients, such as amino acids, vitamins and minerals, have a specific role in the ANS. For example, amino acids are necessary for the synthesis of neurotransmitters, such as serotonin and dopamine, which regulate mood and anxiety. Vitamins and minerals are important for the proper functioning of the ANS, such as vitamin B12, magnesium and zinc. A balanced diet can help reduce oxidative stress and inflammation, which can negatively affect ANS functioning. On the other hand, a nutrient-poor diet can lead to dysfunctions in the ANS, such as hypertension, changes in heart rate and digestive disorders. Digestive problems such as constipation, diarrhea, irritable bowel syndrome (IBS) and functional dyspepsia can occur when the ANS is not working properly. It is important to maintain a healthy and balanced diet to ensure the proper functioning of the autonomic nervous system.

Keywords: Autonomic Nervous System; Nutrition; Caffeine; Avocado; Beet

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1. Introduction

Nutrition plays an important role in regulating the autonomic nervous system (ANS), which is responsible for controlling involuntary bodily functions such as heart rate, breathing, digestion and body temperature. Some nutrients have a specific role in the ANS, such as amino acids, vitamins and minerals. Amino acids are the building blocks of protein and are necessary for the synthesis of neurotransmitters, such as serotonin and dopamine, which regulate mood and anxiety. Vitamins and minerals such as vitamin B12, magnesium and zinc are important for the proper functioning of the ANS. Vitamin B12 is involved in the production of myelin, which protects the nerves and helps transmit nerve impulses. Magnesium helps regulate neurotransmitter activity, while zinc is necessary for the synthesis of proteins and enzymes involved in the ANS. Additionally, a balanced diet can help reduce oxidative stress and inflammation, which can negatively affect ANS functioning. Foods rich in antioxidants, such as fruits and vegetables, and the omega-3 fatty acids found in fish are also beneficial for ANS health. On the other hand, a nutrient-poor diet can lead to dysfunctions in the ANS, such as hypertension, changes in heart rate and digestive disorders. Therefore, it is important to maintain a healthy and balanced diet to ensure the proper functioning of the autonomic nervous system [1].

HRV (Heart Rate Variability) is one of the main methods used to quantify the efforts of the cardiovascular system to maintain ANS-mediated homeostasis [2]. It is based on the measurement of the time between the R intervals (systoles of the ventricles) on the electrocardiogram and therefore shows a relationship with the sympathetic (SNS) and parasympathetic (PNS) nervous systems. The relationships that can be derived from the

values obtained include those with fatigue, biochemical tests, quality of life and the prognosis of an individual affected by a disease [2].

Despite the high frequency of cardiovascular autonomic dysfunction, studies evaluating ANS imbalances have been reported [3]. In this context, HRV analysis has emerged in recent years as a practical, reproducible, and non-invasive method for measuring ANS activity and integrity. Reduced HRV is an indicator of abnormal and inadequate ANS adaptation, a manifestation of increased SNS activity and decreased PNS activity, and is associated with an increased risk of cardiovascular events. One of the methods to quantify the ANS response in both departments, SNS and PNS, is HRV, which is based on quantifying the time between each ventricular contraction, which would be the R wave during ECG reading. The time between each R wave represents the data to be captured and translated by special software, which gives us the autonomic response in Hertz. This autonomic response can be defined as biofeedback and brings with it several factors that can be identified, such as the probability of a higher incidence of acute myocardial infarction and worse prognosis [4].

The autonomic nervous system (ANS) is responsible for regulating the digestive system and ensuring its correct function. When the ANS is not functioning properly, digestive problems such as constipation, diarrhea, irritable bowel syndrome (IBS) and functional dyspepsia can occur. Constipation can occur when the ANS cannot properly coordinate the muscle contractions that move food through the intestinal tract. On the other hand, diarrhea can occur when the ANS is not able to control the amount of water that is absorbed by the intestine. IBS is a gastrointestinal disorder characterized by symptoms such as abdominal pain, bloating, diarrhea and constipation. Although the exact cause of IBS is unknown, the ANS is thought to play an important role in its pathogenesis. People with IBS often have a more sensitive ANS, which can lead to gastrointestinal symptoms. Functional dyspepsia is another digestive condition that may be related to the ANS. It is characterized by symptoms such as abdominal pain, nausea and a feeling of fullness after meals, without an obvious organic cause. Although functional dyspepsia is not fully understood, it is believed that the ANS may play a role in its development. To analyze how nutrition affects the autonomic nervous system, analyzed through heart rate variability, this systematic review was carried out.

PEDro scale was used for a more objective analysis of the evaluation criteria of the selected articles in order to collect the results, which were translated into Portuguese and validated [5]. In short, COCHRANE-style reviews have higher levels of evidence than non-COCHRANES reviews due to the greater external and internal validity of such reviews [6].

2. Materials and Methods

This review is considered a systematic review of secondary research, which includes primary research such as randomized controlled trials, case reports, and other experimental studies. The data analysis methodology involved the creation of a table to compare the studies, which, once collected, were evaluated on the PEDro scale, which is based on the consensus of specialists and measures the quality of methodological treatment choices, instead of the effectiveness or quality. The search strategy that was used on the PUBMED site was with the following descriptors "autonomic nervous system" and "Nutrition ".

Inclusion factors: Articles that address the sympathetic and parasympathetic aspects of nutrition, experimental articles that address the above topic. Exclusion Factors: Animal studies of articles, duplicate articles, exclusions after reading the title, in which you could already identify if it is consistent with what is being researched, articles that were not obtained in full, literature reviews. Articles excluded after reading that fall into question on any of the exclusion factors listed above that failed to be observed so far.

3. Results

Were identified in searches in the databases described. After the first phase of exclusion, 454 articles were withdrawn due to research carried out with animals. Of the remaining articles, 39 articles were removed after reading the title. As soon as the 5 articles were collected for the final comparison. All articles were evaluated using the PEDro scale, obtaining an average of 7.

After analyzing all the data, it was found that several foods can directly affect heart rate variability, as shown in Table 1.

Table 1. Foods that alter the functioning of the Autonomic Nervous System.

Food	Amount	Effect on the recovery of the state of homeostasis
Caffeine (Benjamin et al., 2020)	300mg	Has become the slowest recovery
L-Citrulline (Kameda et al., 2011)	3.2mg	Has become the fastest recovery
Caffeine (Bunsawat et al., 2015)	400mg	Has become the slowest recovery
Avocado (Sousa et al., 2020)	600mg of avocado pulp	Has become the fastest recovery
Beet extract (Benjamim et al., 2020)	600mg of beetroot extract	Has become the fastest recovery

Source: Own authorship (2023).

4. Discussion and conclusions

From this review, it is understood that foods containing caffeine can make the recovery of the homeostasis of the autonomic nervous system state slower, since at lower doses it has a high selective affinity for adenosine receptors, an inhibitory neuromodulator in systems implicated in the neurobiology of anxiety while foods which contains L-Citrulline, avocado pulp and beetroot extract, optimize your recovery, as depolarization or that is, the exchange of Na and K is carried out with energy electrical, and considering that the repolarization is carried out under the influence of a sodium pump that requires ATP. Therefore, if ATP is insufficient after depolarization, repolarization no it will be carried out without problems. Being like this, a good one flow blood is indispensable for the production of ATP to provide oxygen. In other studies, the authors gauge, the depolarization -repolarization interval cardiac using a CM5 lead ECG in disease patients, cardiac ischemic stroke (IND) and found that the recovery -activation interval heart rate and recovery time increased significantly at DCI comparing study group with control. Being thus, the ECG QT interval is the time required for complete depolarization and repolarization of the myocardium. According to these findings he has been suggested that a rate corrected QT prolongation heart rate (QTc) has been a marker of death cardiac sudden in patients with myocardial infarction. There is also evidence that a prolonged QTc is predictive of mortality per illness coronary in populations healthy, well like this study indicated that the flow improvement sanguine he can decrease the time of the depolarization-repolarization interval cardiac. This may demonstrate a causality of the stimulation of sympathetic and parasympathetic receptors arising from the chemoreceptors that these foods provide [7].

The oxide nitric oxide (NO) is a well-known mediator of vessel relaxation blood vessels that help maintain blood pressure blood. It is generated by the conversion of L-arginine into L-citrulline by the enzyme oxide nitric feel. Being thus, oral supplementation with L-arginine demonstrated increase vasodilation mediated by ON in several studies clinical, being thus treatment with L-arginine is impaired by extensive elimination presystemic due to intestinal arginase activity. In In contrast, L-citrulline is readily absorbed and by any less in part, converted in L-arginine. A little study clinical recent suggested that oral L-citrulline may, in true, lead to greater increases in concentrations

plasma levels of L-arginine than administration of L-arginine itself. The current component ongoing and trends linear they were completely eliminated by digital filtering for bandpass between 0.035–0.5 Hz. After passing through the Hamming type data window, the analysis power spectral using one transformed Fast Fourier was carried out in one series consecutive 1024 seconds of RR interval data taken during the test to evaluate. The ANS activity, the authors analyzed a low component frequency (LF) (0.035–0.15 Hz) adjusted jointly for both. Therefore, ECG data were obtained from derivation CM5 and digitized per means of a converter 13-bit analog -digital (Model 420, Trans Era, Utah) at a sample rate of 1024 Hz. In then the digitized RR interval time series he was aligned in one 2 Hz sequence for analysis power spectrum. Procedures experimental and data analysis individuals they were educated. The any medicines or drinks containing alcohol or capsaicin the day before study. The measurements they were performed in the morning. On test day, the subjects ate two rice balls and drank 500 ml of water for the least 2 hours before coming to the lab, and other foods or drinks had to be stopped before testing. the measurements they were made in a cross procedure so that each individual ingested in order Random placebo pills (cornstarch) or L-citrulline tablets (3.2 g, KYOWA HAKKO BIO CO., LTD) with 100 ml of water. The ECG was done before, 60 min and 90 min after ingestion of L-citrulline for a period of 4 min. During all measurements, the individuals they were asked to breathe in sync with a metronome set to 30 beats /min. Thus, the objective of this study he was investigate whether the intake of L- citrulline affected or not the depolarization and repolarization of the myocardium (ECG QTc interval) and the activity of the nervous autonomous in men young people healthy, as determined per analyzes frequency variability power spectra heart, respectively. Nine young people healthy people from Kyoto University participated of this study (age 23.40.5 years, body mass: 57.75.64 kg, mean EE). None individual he had history previous illness cardiovascular. The QT interval was measured at CM5 derivation. The QTc data were presented using the formula Bazett's traditional (QTcQT / øRR). The normal range of the QTc interval is usually considered less than 440ms and not there was individuals observed with abnormal QTc intervals (440ms) in the resting condition. ECG data obtained from lead CM5 were displayed continuously in one computer screen to monitor the quality of records. The exit analog of the ECG monitor was digitized per means of a converter 13-bit analog digital (HTB410; Trans Era, Beyond addition, Schwedhelm et al. (2008) showed that oral L-citrulline supplementation increases the concentration plasma L- arginine and increases the signaling dependent on in a way dose dependent. So, the oral administration of L citrulline he can increase efficiently dilate blood vessels mediated by ON in humans healthy. However, the effect of L- citrulline ingestion on the ECG QTc interval, which reflects the total duration of ventricular depolarization and repolarization [8], remained undefined [9-13].

In summary, the ANS plays an important role in regulating the digestive system. Problems in the ANS can lead to digestive disorders such as constipation, diarrhea, IBS and functional dyspepsia. It's important to see a healthcare professional if you have persistent digestive symptoms to determine the underlying cause and the best treatment.

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/fm/a/9c55NMRqWCxRRsWpgpBjQTC/abstract/?lang=pt., https://pubmed.ncbi.nlm.nih.gov/32612186/, https://www.tandfonline.com/doi/abs/10.1080/13696998.2018.1470519.

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