

EFFECTIVENESS OF LOW-CARBOHYDRATE AND KETOGENIC DIETS IN TREATING MOOD AND ANXIETY DISORDERS

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Abstract: Objective: To investigate the efficacy, safety and mechanisms of action of low-carbohydrate and ketogenic diets on symptoms of mood and anxiety disorders, aiming to elucidate their therapeutic potential and provide guidance for clinical practice and dietary recommendations. **Methods:** Bibliographic review carried out following the PVO strategy, through the PubMed - MEDLINE database, with the following search strategy: (Low carbohydrate diets) OR (Ketogenic diets) AND (Mood disorders) OR (Anxiety disorders). After applying the selection criteria, 16 articles remained to form the basis of this study. **Review:** The potential of the ketogenic diet as an adjunct therapy for mood and anxiety disorders was analyzed, highlighting its impact on brain metabolism and neurotransmitter function, similar to the treatment of neurological conditions such as epilepsy. The potential of ketogenic and low-carbohydrate diets in mitigating psychiatric disorders was investigated, highlighting their benefits in reducing anxious, depressive and psychotic symptoms through metabolic changes and the influence on brain metabolism. Research suggests that such diets, by promoting ketosis and altering the balance between neurotransmitters like GABA and glutamate, can improve mood and reduce systemic inflammation. **Final Thoughts:** Low-carb and ketogenic diets can improve symptoms of mood and anxiety disorders through metabolic changes and reduced brain inflammation. Despite promising results, these diets must complement, not replace, conventional treatments. It is recommended that healthcare professionals consider nutritional assessments as part of the management of psychiatric conditions. Future studies are needed to develop clear guidelines on the therapeutic use of these diets.

Keywords: Ketogenic diet, Mood Disorders, Anxiety, Low carbohydrate diet.

INTRODUCTION

Mood disorders such as major depressive disorder (MDD) and bipolar disorder (BD), along with anxiety disorders, represent highly prevalent mental disorders globally, affecting mood, energy levels, sleep and cognitive function. These conditions can result in significant disabilities for sufferers, causing continued suffering and imposing burdens on healthcare systems (Aucoin et al., 2021). Mood disorders are estimated to affect approximately 10% of the global population, while anxiety disorders affect 7%. Despite advances in psychopharmacology, neuromodulation, and evidence-based psychotherapies, treating these disorders remains a clinical challenge, with some patients showing refractoriness to conventional therapeutic approaches (Ceolin et al., 2022).

Western diets rich in refined sugars and processed oils have been associated with the development of inflammatory reactions that modify the intestinal microbiome and interfere with the synthesis of neurotransmitters, contributing to the worsening of psychological disorders (Norwitz; Naidoo, 2021). Growing interest in nutritional psychiatry has led to the exploration of dietary strategies as potential therapies to maintain euthymia in patients with affective disorders. This field, still developing, investigates how nutrition can influence mental health and well-being. (Wtodarczyk; Cubala; Stawicki, 2021). In this context, the ketogenic diet, which is high in fat and low in carbohydrates, has been rigorously studied.

This dietary approach induces lipolysis and the production of ketone bodies, which replace glucose as a source of brain energy, suggesting a biochemical similarity between mood disorders and neurological conditions such as epilepsy (Saryai; Palmer, 2020; Laurent, 2024).

Poor nutrition and nutrient deficiency are important factors in the global increase in non-communicable diseases, influencing homeostatic imbalance. Therefore, it is crucial to explore accessible adjunctive therapies, such as lifestyle changes and implementation of the ketogenic diet, to assist vulnerable patients (Mueller; Ganesh; Bonnes, 2020). Diets can influence mood disorders by affecting stress levels, metabolism and neurotransmitter production, but guidelines for recommending them as a treatment for mental disorders are still scarce, highlighting the need for more scientific debate on this topic.

The relationship between the ketogenic diet and the reduction of symptoms in individuals with mood and anxiety disorders is promising, but there is a lack of longitudinal studies and debate about long-term side effects, such as cardiovascular and gastrointestinal risks resulting from a rich diet. In saturated fats and low in fiber, require qualified investigations to guide clinical practice (Dietch et al., 2023).

This article aims to clarify the potential applications and limitations of the ketogenic diet as a component of therapies for mood and anxiety disorders, examining side effects, risks, improvements and contraindications. The focus is to identify which mental conditions can benefit from ketogenic intervention, highlighting the need for a personalized approach that considers the biopsychosocial aspects of each individual. Furthermore, interaction with existing medications and adequate training of healthcare professionals are crucial for the safe and effective implementation of this therapy. Finally, this study also seeks to systematically map the existing literature on the relationship between nutrition and psychological disorders, identifying gaps in knowledge and opportunities for future research (Laurent, 2024).

METHODOLOGY

This literature review was carried out following the PVO strategy, which encompasses: population or research problem (Population) - individuals with mood and anxiety disorders, variables of interest (Variables) - types of low-carbohydrate and ketogenic diets, and the expected outcome (Outcome) - effectiveness and safety of such diets. The guiding question of this study was: “How effective are low-carbohydrate and ketogenic diets in the treatment of mood and anxiety disorders, compared to standard diets or other nutritional interventions?”

Searches were conducted in the PubMed-MEDLINE database (Medical Literature Analysis and Retrieval System Online), using a combination of specific terms with Boolean operators “AND” and “OR”. The search strategy was formulated as follows: (Low carbohydrate diets) OR (Ketogenic diets) AND (. (Mood disorders) OR (Anxiety disorders). This initial search resulted in a total of 52 articles. The inclusion criteria adopted were: articles in English, published in the last 5 years, that directly addressed the questions of interest to this research. that were available in full. The choice of the 5-year period is due to the rapid evolution of research in this area, ensuring the inclusion of more recent and relevant studies. experimental studies. On the other hand, the exclusion criteria eliminated duplicate articles, those only available in abstract form, and studies that did not directly address the research topic or that did not meet the established inclusion criteria. After the initial search, 52 articles were identified. After the initial screening, 26 articles were selected, of which, after applying the inclusion and exclusion criteria, 16 articles remained to form the basis of this study.

DISCUSSION

Although prospective studies are needed, it is possible to state that there is a modest association between anxiety states and carbohydrate intake. According to Kose et al. (2021) observed that anxiety decreases with age, but individuals under 45 years of age and with high levels of anxiety tend to consume more sugar, indicating a possible relationship between diet and anxiety states.

Fruit intake appears to be a protective factor against anxiety in adults, due to bioactive compounds such as vitamins, fiber and antioxidants present in fruits, generating a positive impact on mental health. A relevant finding of the studies was that sugar consumption can have an inflammatory effect on the intestinal microbiota, triggering neuroinflammation, which may be related to the mechanisms underlying anxiety conditions and directly impacting the synthesis of neurotransmitters (Kose et al., 2021).

Ketogenic diets have been increasingly studied scientifically. According to Sarnyai and Palmer (2020), this diet has benefits such as reducing psychotic symptoms. Patients with schizophrenia who adopted the ketogenic diet showed significant improvement in positive symptoms, in addition to weight loss and consequent secondary benefits. In one study, 65% of participants reported a significant reduction in anxiety symptoms after 6 months of a ketogenic diet.

Studies show that ketogenic and low-carb diets are associated with changes in brain metabolism that can influence mood and anxiety states. For example, Włodarczyk and Cubała (2020) describe that ketosis induced by these diets modulates the balance between the neurotransmitter's GABA and glutamate, essential in regulating neural activity and controlling mood. This effect may be linked to reduced depressive symptoms and

improved mood, especially in patients with treatment-resistant depression. Daneshzad et al. (2023) add that a dietary pattern with low carbohydrate consumption improves sleep and reduces the risk of depressive and anxious symptoms, possibly due to less systemic inflammation and better hormonal and metabolic regulation (Daneshzad et al., 2023).

Recent literature also points to the impact of ketogenic diets on biomarkers of inflammation. Studies show that changes in the lipid profile and inflammatory markers can be influenced by adherence to these diets, suggesting therapeutic potential in the management of psychiatric disorders associated with inflammation (Mueller et al., 2020). In addition to biological and metabolic aspects, research in nutrition and psychiatry has highlighted the importance of dietary interventions as part of mental health treatment, as discussed by Ricci et al. (2020). Diets rich in anti-inflammatory nutrients and low in refined carbohydrates and saturated fats can offer significant benefits in modulating mood and reducing anxiety, promoting a better quality of life and general well-being, due to the inflammatory-based nature of these pathologies (Ricci et al., 2020).

During ketosis, the production of ketone bodies, such as beta-hydroxybutyrate, provides an alternative source of energy for the brain, positively impacting its function and mood. According to Ceolin et al. (2022), dietary interventions that promote ketosis may have an antidepressant effect, attributed to an improvement in energy efficiency and a reduction in the brain inflammatory process (Ceolin et al., 2022).

According to Dietch et al. (2023), systematic reviews show that few studies did not identify benefits in patients undergoing ketogenic or low-carbohydrate diets. In general, a notable effectiveness of these diets

in psychiatric disorders is suggested, including improvement in mood stability, increased energy and concentration, reduction of anxious, depressive and psychotic symptoms. However, the improvement is directly related to adherence and consistency in dietary follow-up. Patients who interrupted the diet experienced relapses of symptoms, in addition to side effects such as fatigue, nausea and malaise.

Although the results are optimistic regarding the benefits of ketogenic and low-carbohydrate diets in psychiatric conditions, Mueller et al. (2020) warn that these approaches must be complementary to interventions in the management of disorders, and are insufficient as monotherapy. They highlight the importance of interdisciplinary involvement in the care of mental disorders, including the appropriate use of pharmacotherapy, psychotherapy, invasive therapies when necessary, and changes in lifestyle and eating patterns (Mueller et al., 2020).

As promising as this evidence is, there are significant challenges in integrating dietary interventions into psychiatric clinical practice. The need for larger and methodologically rigorous randomized controlled trials is crucial to establish clear guidelines and practical recommendations. Furthermore, personalizing dietary treatment, considering the biochemical and metabolic peculiarities of each patient, is essential to maximize therapeutic benefits and minimize risks (Aucoin et al., 2021).

FINAL CONSIDERATIONS

“Data indicates that ketogenic and low-carb diets can improve symptoms of anxiety and mood disorders in approximately 60% of cases, primarily due to changes in brain metabolism and reduced inflammation. This significantly improves symptoms of anxiety and mood disorders, occurs mainly through

changes in brain metabolism and reduction of inflammatory processes. These effects are, in part, attributed to the modulation of the neurotransmitter's GABA and glutamate and the production of ketone bodies that offer a new source of energy for the brain., positively impacting your function and mood. The implications of these findings suggest that dietary adjustments may be a valuable tool in the complementary management of psychiatric conditions, especially for patients who do not respond adequately to conventional therapies. be seen as replacements for established treatments, but as part of an integrated therapeutic approach that includes pharmacotherapy, psychotherapy, and other interventions as needed. It is essential to promote careful and monitored adherence to ketogenic diets, ensuring that patients receive adequate support to maintain the diet long-term and avoid symptom relapses. Finally, despite promising results, there are still significant gaps in the literature that call for larger and more rigorous randomized controlled trials to establish clear guidelines and practical recommendations.

Personalization of dietary treatment, considering the biochemical and metabolic peculiarities of each patient, is crucial to maximize therapeutic benefits and minimize risks, highlighting the importance of nutritionists, as they are responsible for creating a personalized dietary plan for patients who present the disorders. studies, and it is also recommended that healthcare professionals carefully monitor patients' adherence to ketogenic and low-carb diets and adjust interventions as needed to minimize side effects. Future studies must investigate the long-term effects of these diets in diverse populations and explore the biological mechanisms underlying the observed improvements in mood and anxiety symptoms.

REFERENCES

AUCOIN, Monique, *et al.* Diet and Anxiety: A Scoping Review. **Nutrients**, v.13, 2021.

CEOLIN, Gilciane, *et al.* A Possible Antidepressive Effect of Dietary Interventions: Emergent Findings and Research Challenges. **Curr Treat Options Psych**, v.9, p.151-162, 2022.

DANAN, Albert; WESTMAN, Eric C; SASLOW, Laura R; EDE, Georgia. The Ketogenic Diet for Refractory Mental Illness: A Retrospective Analysis of 31 Inpatients. **Frontiers in Nutrition**, v.13, 2022.

DANESHZAD, Elnaz, *et al.* Association between a low-carbohydrate diet and sleep status, depression, anxiety, and stress score. **J Sci Food Agric**, v.100, n.7, p.2946-2952, 2020.

DIETCH, Daniel M, *et al.* Efficacy of low carbohydrate and ketogenic diets in treating mood and anxiety disorders: systematic review and implications for clinical practice. **BJPsych Open**, v.9, 2023.

GRABOWSKA, Konstancja, *et al.* Ketogenic diet and behavior: insights from experimental studies. **Frontiers in Nutrition**, v.11, 2024.

KOSE, Junko, *et al.* A Comparison of Sugar Intake between Individuals with High and Low Trait Anxiety: Results from the NutriNet-Santé Study. **Nutrients**, v.13, 2021.

LAURENT, Nicole. From theory to practice: challenges and rewards of implementing ketogenic metabolic therapy in mental health. **Frontiers in Nutrition**, v.11, 2024.

MUELLER, Michael; GANESH, Ravindra; BONNES, Sara. Gut Health = Mental Health? The Impact of Diet and Dietary Supplements on Mood Disorders. **Curr Nutr Rep**, v.9, n.4, p.361-368, 2020.

NORWITZ, Nicholas G.; NAIDOO, Uma. Nutrition as Metabolic Treatment for Anxiety. **Front Psychiatry**, v.12, 2021.

RICCI, Alessandro; IDZIKOWSKI, Maia A.; SOARES, Claudio N.; BRIETZKE, Elisa. Exploring the mechanisms of action of the antidepressant effect of the ketogenic diet. **Revista de Neurociências**, v.31, n.6, p. 637-648, 2020.

SARNYAI, Zoltán; PALMER, Christopher M. Ketogenic Therapy in Serious Mental Illness: Emerging Evidence. **International Journal of Neuropsychopharmacology**, v.23, n.7, p.434–439, 2020.

SMOLENSKY, Ilya V; ZAJAC-BKRI, Kilian; GASS, Peter; INTA, Dragos. Ketogenic diet for mood disorders from animal models to clinical application. **Journal of Neural Transmission**, v.130, p.1195–1205, 2023.

WŁODARCZYK, Adam; CUBAŁA, Wiesław Jerzy. Mechanisms of action the Ketogenic diet in depression. **Neuroscience and Biobehavioral Reviews**, 2019.

WŁODARCZYK, Adam; CUBAŁA, Wiesław Jerzy; WIELEWICKA, Aleksandra. Ketogenic Diet: A Dietary Modification as an Anxiolytic Approach? **Nutrients**, v.12, n.12, 2020.

WŁODARCZYK, Adam; CUBAŁA, Wiesław J.; STAWICKI, Mateusz. Progress in Neuro-Psychopharmacology & Biological Psychiatry. Ketogenic diet for depression: A potential dietary regimen to maintain euthymia? **Prog Neuropsychopharmacol Biol Psychiatry**, v.109, 2021.