

Effects of the intake of processed and nutrient-rich foods on the negative emotional states and physiological systems of depression

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Abstract: Depression as a mood disturbance is a multifactorial disorder that affects millions of people all around the world. Within the area of nutrition, the literature has focused on the effects of certain nutrients such as zinc, magnesium, vitamin B, D and polyunsaturated acids as elements that may favour the control of emotional regulation in the case of depression. However, the literature on this is issue is not clear. The objective of this work was to address the existing literature regarding the specific effects of nutritional habits and their effects on depression. The methodology used consisted of a literature review in Scopus and Science Direct of the last five years. In conclusion, the review conducted reported that a change in eating habits, focused on a low use of processed products, and high in nutrient-rich foods, including multivitamin supplementation, were nutritional methods that prevented negative emotional states such as depression, and that they could maintain adequate levels of the neurotransmitters that are involved in depressive symptomatology.

Keywords: Depression, noradrenaline, nutrients, serotonin, immune system.

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I. Introduction

Depression as a disturbance of the general mood affects more than 300 million people worldwide, and continues to grow with an increase of 18% [1]. Specifically, each year, 25% of the population in Europe suffers from depression, corresponding to 50% of work absences. In addition, this situation causes a cost to the European Union of 170 million euros per year.

Depression, as pathology, is characterized by the presence of sadness, loss of interest in things once pleasurable, feelings of guilt, low self-esteem, sleep and appetite disorders, tiredness, difficulty concentrating in work or school. Furthermore, this emotional state hinders the ability to cope with daily life, and it is even related to suicide [1].

On one hand, its treatment is focused on psychotherapy, social skills therapy, self-control therapy, problem solving therapy, cognitive behaviour therapy, marital / family therapy and depression coping course, treatments that work on the cognitive distortions and over the stressful events and their cognitive maps, as well as in the increase of pleasant activities and decrease of unpleasant ones [2].

On the other hand, depression is also treated by pharmacotherapy, through the use of antidepressants such as: selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, norepinephrine-dopamine reuptake inhibitors, selective norepinephrine reuptake inhibitors, MAO inhibitors and tricyclic antidepressants [3]. Specifically, the decompensation of neurotransmitters such as serotonin, noradrenaline and dopamine is one of the factors involved in the development of depression [4].

However, the study of depression is of a high complexity due to its etiology and to the diversity of factors that influence it, as it does not have a single cause [5].

Apart from the above, the presence of biomarkers as a result of oxidative stress has also been studied in relation to the symptomatology of depression. In this line, diet is an important factor that influences this inflammation [6], by affecting the neurotransmitters and antioxidants, as well as causing anti-inflammatory effects in the body [7].

In relation of the effects of diet in depression, lower depression rates are presented by several authors in their meta-analysis [8]. Other authors reflect its relevance for the length and severity of the symptoms [9, 10].

In this sense, scientific literature reveals improvements in depression through the supply of multivitamins and minerals [11, 12]. In the same line, the administration of vitamins and minerals was considered of high importance by two clinical trials [13, 14]. The antidepressant effects obtained by the intake of zinc, magnesium and selenium supplements were also emphasized in the literature, considering this intake as an objective to improve the treatment with antidepressants [15].

Such antidepressant properties are responsible for the attenuation of the glutamatergic system of the NMDA receptor. This receptor is of highly importance in synaptic plasticity in areas as the hippocampus and amygdala [15].

Several studies have suggested an inverse association between magnesium intake and depression [16, 17]. In the same sense, vitamin B deficiency has been linked to several neurological diseases such as depression, anxiety, dementia and Alzheimer's. This deficiency can contribute to the dysregulation of the immune system and to the modification in the function and production of neurotransmitters. Vitamin B, it is very well known for its relevance in the good myelin maintenance and its anti-inflammatory effect and therefore, for avoiding psychiatric and neurological disorders [18].

In particular, folic acid or vitamin B9 is associated in the treatment of depression through numerous studies, and its deficiency has been related in a third of patients with psychiatric disorder [19]. Folic acid supplementation has been associated with improvements in antidepressant treatment [20]. Also vitamin B6 influences the neurotransmitters that control depression and anxiety, and its deficiency is related to seizures, migraines and depression. In the same way, vitamin B5 is involved in the formation of acetylcholine, which is linked to depression, its deficiency can lead to fatigue and depression [18]. In patients with depressive symptoms vitamin B12 supplements, produce a significant improvement. Similarly, another study reflects the importance of vitamin B12 supplementation to improve depressive symptomatology [18].

Vitamin D has also been linked to the prevention of depression. Omega-3 fatty acids also reflect the antidepressant benefits, which is to say, they promote synaptic plasticity, providing neuroprotection and improving neurotransmission and consequently, having an antidepressant and anti-inflammatory effect [19].

Ultimately, the multidisciplinary and variety of vitamin substances that have a protective role in depression is wide and diverse. Therefore, the objective of this work is to analyze through a literature review, the relationship between nutrition and depression, with the aim of outlining and clarifying the components that have a greater effect and relevance due to their positive intervention.

II. Method

The literature review was focused on the search of Science Direct and PubMed databases. Of all the articles found in the database, a total of 17 articles were selected. The search criteria were the following keywords: "nutrition" and "depression". The time interval of the publication (last 5 years) was established as inclusion criteria.

After the search was carried out, the data were processed and collected in a table for their representation (Table 1).

III. Results

Table 1. Articles focused on the effects of nutrition on depressive symptomatology.

Objective	Sample	Variables	Method	Conclusion
Evaluate the relationship between diet patterns and the risk of suffering from depression	It was a meta analysis.	Healthy dietary pattern: high intake of fruits, vegetables, unrefined flours, fish, olive oil, low-fat dairy products and antioxidants and low intake of animal foods. Unhealthy dietary pattern: high consumption of red and / or processed meat, refined flours, sweets, high-fat dairy products, butter, and high-fat sauces, and low intake of fruits and vegetables.	Meta analysis. Twenty-one studies from 10 different countries were chosen from the MEDLINE and EMBASE databases.	Healthy dietary pattern: it was associated with a lower risk of depression. Unhealthy dietary pattern: it was associated with an increased risk of depression.
Bibliographic review on the antidepressant effects of nutritional supplements.	Children and adolescents aged between 7 and 15 years diagnosed with major depression.	Supplement administration: omega-3 and 6 polyunsaturated fatty acids, vitamin C, vitamin D, zinc, iron and B vitamins.	Bibliographic review, review studies, cases of randomized designs, double blind, and placebo controlled. 4 studies of cross-sectional and longitudinal evaluations of PubMed, Google Scholar and PsycInfo databases were included.	There are no sufficient data to obtain significant results due to the small sample size and an incorrect diagnosis of major depression.
If the inflammatory	Sample based on the health and nutrition	Mental health and potential	Cross-sectional study with data from NHANES,	Inflammatory potential of the diet is associated with

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index of the diet is associated with depression and other measures of mental health.	survey (NHANES 2007-2012) that includes adults from the USA. UU (≥ 20 years of age, N = 11,592)	inflammatory degree of the diet. Covariates: lifestyle, sex, comorbid health conditions, age, socio-economic level, marital status, body mass, smoking, use of vitamin supplements, daily caloric intake and physical activity.	included: an interview, a health examination and a complementary survey of nutrition, dietary components and mental health. Depression measured through the Questionnaire (PHQ-9).	greater probabilities of depression.
To evaluate the relationship between the dietary intake of zinc, folic acid and magnesium and the symptoms of anxiety disorders and depression.	1046 women of 20 to 93 years.	Adequate dietary intake of zinc, folic acid and magnesium. Deficit of zinc, folic acid and magnesium and mental disorders. Covariates: socio-economic status.	Transversal study. The structured clinical interview for the DSM-IV-TR was used to evaluate depression and anxiety disorders. Psychiatric symptoms were measured with the general health questionnaire (HQG-12).	The results support the claim that the consumption of nutrient-rich foods plays a role in depression, but not in anxiety. Nutritional guidelines for healthy eating, such as green leafy vegetables, nuts, legumes and whole grains, lean meats and seafood, are important for greater consumption of magnesium, folic acid and zinc and may be a useful strategy in the prevention and treatment of depression.
To analyze the relationship between magnesium intake and the risk of suffering from depression.	2320 East Finnish men between 42 and 61 years of age.	Depression, magnesium intake in the diet, age, alcohol consumption, smoking, marital status, physical activity, cardiovascular status, BMI, history of diabetes.	Longitudinal study with a follow-up time of 21.3 years. Depression scale: Human Population Laboratory. Dietary intake was assessed by feeding registration for 4 days and by using theNutrikcal software (from The Social Insurance Institution of Finland).	Inverse association between magnesium intake and the risk of obtaining a diagnosis of depression among Finnish middle-aged men.
Analyze the participation of zinc, magnesium, lithium, iron, calcium and chromium in depression and anxiety.		Deficit of zinc, magnesium, lithium, iron, calcium and chromium and its relationship with pathophysiology and treatment of depression and anxiety.	Bibliographic review.	Depression is a multifactorial disorder that can arise through an imbalance of numerous trace elements and vitamins. Deficient element supplementation combined with antidepressants can help reduce unwanted side effects of antidepressants.
Establish the prevalence and severities of depression and anxiety symptoms, before and after one year of exposure to nutritional supplements and determine if there is a benefit of this supplementation.	16,020 participants (60% women). Average age 54.2 ± 16.0 (range 18-95) years. 16% had mental health problems or previous diagnoses of depression, anxiety, stress, or other mental health disorders. 20% took medication for depression and anxiety.	Supplementation: multivitamin and multimineral formula, Omega-3 fatty acids; Vitamin C, vitamin B12, and vitamin D. Biometric data (blood pressure, height, weight, BMI). Diseases involved in poor absorption of nutrients: H. pylori infections, medications, Crohn's disease.	European Quality Assessment of Five Dimensions (EQ-5D), standardized instrument to measure health status in a wide range. It was used to investigate depression and anxiety. List of specific symptoms (TSL), an internally developed welfare assessment tool. The TSL evaluates 16 mental and physical health outcomes: it is a score composed of depression, anxiety and moodiness. Blood tests to measure levels of nutrients involved.	The general mood can benefit from an improved nutritional status. Broad-spectrum supplements with a focus on optimizing vitamin D status can provide a new paradigm for the treatment and prevention of mental illness.

According to these scientific articles that deal with the relationship between nutritional habits and depression, the effects found can be summarized in three areas: depending on the type of the diet, the deficiency of a particular nutrient or of a set of nutrients. In addition, within these causes, several explanations can be distinguished on the way how nutrition intervenes in depression, such as: the inflammatory power of some types of diet, the anti-inflammatory power of particular nutrients, the relationship between an optimal level of specific nutrients and the production of neurotransmitters, as well as the influence between an optimal level of certain nutrients and the homeostasis of the serotonergic, noradrenergic and dopaminergic systems.

IV. Conclusion

The purpose of this work was to review the effects of nutrition on the negative symptomatology of depression. In relation to this objective, research found in this regard, confirms that nutrition has an effect on depression since it affects the production of certain hormones and neurotransmitters [25]. One way to intervene on depression is through vitamin supplementation, thus facilitating the intake of necessary nutrients [24], but it is also possible to intervene, following a diet rich in nutrients, healthy and low in processed foods.

All biochemical pathways require vitamins and minerals that work as cofactors for an adequate enzymatic function; therefore, insufficient levels of nutrients can negatively affect a wide range of metabolic processes involved in depression [26]. There are many nutrients that influence neuronal transmission, and in consequence they affect the serotonergic, noradrenergic, dopaminergic, glutamatergic and gabaminergic circuits that are involved in depression [27]. Among this range of nutrients implicated on the function of neurotransmitter, the action of the B vitamins must be highlighted [18], as well as polyunsaturated fatty acids, zinc and magnesium, vitamin D, selenium, lithium, iron, chromium and calcium [7].

Nutrients have an increasingly important role, in the medicine field, because of the way they interact on the immune and nervous system [18]. In fact, the B vitamins, or polyunsaturated fatty acids, have an anti-inflammatory power that counteracts the harmful effects in the production of noradrenaline, serotonin and dopamine [18, 28].

Specifically, a full range of vitamins and minerals are required cofactors involved in the production of neurotransmitters, for example, in the production of serotonin, the main neurotransmitter involved in depressive disorders [24].

Several authors proved that the multivitamin and multimineral supplementation improves depressive symptoms [29, 30]. Therefore, the evidence suggests that nutritional supplements can be effective in reducing and preventing depression [24].

However, we must take account that nutrients are also influenced by a multitude of factors. As for example, the amount of solar radiation that can affect the synthesis of vitamin D [31], the diseases of the digestive system that cause less absorption of nutrients, the infection by bacteria *helicobacter pylori* [32], food intolerances, celiac disease, and Crohn's disease [33]. Also highly modified foods and the contaminated environment can cause deficiency of trace elements, which often have to be added to the diet in the form of supplements [7].

Nevertheless, this review has some limitations, since there are other nutrients involved in mood alterations that have not been included in this review. An example of this is vitamin C [34], choline, iron, amino acids such as taurine and probiotics [35], as well as tryptophan and manganese [15]. Account has to be taken that the symptomatology of depression must be addressed from a broad approach and not from a single isolated nutrient [24].

Nutrition is a fundamental key as it generates a multitude of effects in our organism as physical and biochemical benefits for our organs and their survival. The components of food exert a protective factor against certain psychic symptoms, as is the case of depression. The scientific evidence represented in the present review reflects the importance that is currently given to food, for its antidepressant effects in the maintenance of the neurotransmitters involved. Considering this, the study of the effects of the diversity of nutrients that exist, as well as their effects at the psychic level, could help to improve the moods of certain disorders. The study and treatment of depression should be carried out from an interdisciplinary perspective.

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