



Nutritional Psychiatry Integrated Framework: Exploration of Nutrition and Co-occurring Bipolar Disorder and Post-traumatic Stress Disorder

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ABSTRACT

Nutritional psychiatry advancements are needed in understanding the effects of food nutrients on co-occurring psychiatric conditions particularly bipolar disorder and post-traumatic stress disorder (PTSD). Food nutrients contribute to the increase and decrease of symptoms in psychiatric conditions. Bipolar disorder and PTSD are frequently co-occurring and significantly impact moods, how the brain processes information, and psychological stressors. Individuals diagnosed with bipolar disorder and PTSD experience increased risks of suicide and are more likely to have unhealthy dietary habits. Understanding the appropriate nutrients to consume and avoid may contribute to promising outcomes for psychiatric conditions. Advancements in awareness of food nutrition are necessary to manage not only psychiatric conditions but also medical conditions. Omega-3 fatty acids, minerals (magnesium and zinc), pro-biotics, B vitamins, vitamins C and D, large neutral amino acids, specifically tryptophan and tyrosine, and branched-chained amino acids, antioxidants found in fruits and vegetables, and fatty acids have been linked to improved outcomes in the management of bipolar disorder and PTSD symptoms. Foods associated with poor prognosis

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have been linked to caffeine, alcohol, sugar, salt, processed foods, and artificial additives. This research contributes to the body of literature by exploring a link between food nutrients and bipolar disorder and PTSD because no known study has explored a co-occurring treatment intervention for such psychiatric conditions, and introduces the Nutritional Psychiatry Integrated Framework (NPIF) with a patient-centered focus which makes this research compelling. Advancements in understanding the effects of nutritional psychiatry associated with symptoms of bipolar disorder and PTSD may introduce innovative dietary and psychological treatment approaches.

Keywords: *Nutritional psychiatry; nutritional neuroscience; bipolar disorder; post-traumatic stress disorder (PTSD); dietary nutrients; vitamins; large neutral amino acids; omega-3 fatty acids.*

1. INTRODUCTION

In recent years, increasing attention has been focused on nutrition and nutrients in relation to medical conditions with few studies on nutrition associated with the treatment and management of various mental health disorders, particularly co-occurring psychiatric conditions. Nutritional psychiatry should be at the forefront of discussions when determining clinical and evidenced-based practice approaches for managing and treating co-occurring psychiatric conditions such as bipolar disorder and post-traumatic stress disorder. No studies have evaluated the prospective treatment of patients with co-occurring bipolar disorder and post-traumatic stress disorder in the literature reviewed [1] with a focus on nutrition. Though the prevalence of bipolar disorder diagnoses has increased, few studies have examined the relationship between diet and bipolar disorder [2]. Nutritional deficiency is a major contributor to metabolic electrolyte disturbances that may increase or decrease symptoms of neuropsychiatric conditions such as co-occurring bipolar disorder and post-traumatic stress disorder (PTSD).

This research is compelling because it may be the first study to introduce a comprehensive framework (Nutritional Psychiatry Integrated Framework) that presents nutritional psychiatry interventions beneficial in the treatment of co-occurring bipolar disorder and PTSD. The framework suggests that nutritional psychiatry and nutritional neuroscience interconnect and play a significant role in the treatment and management of dual psychiatric conditions. Nutritional neuroscience is an emerging discipline that focuses on the interconnection of nutritional components and human behavior, cognition, emotions, and biological functions [3,4]. One of the many benefits of nutritional neuroscience is the quest to increase awareness

of how nutrients and psychiatric disorders interconnect. The key to better mental health well-being for people diagnosed with bipolar disorder and PTSD may secretly exist in what nutritional foods people consume and what unhealthy foods people restrict from their diets. Consuming foods and supplements as complementary or alternative treatments for psychiatric disorders may contribute to bidirectional improved outcomes for bipolar disorder and PTSD.

There are 13 essential vitamins necessary for the body to function properly such as vitamins A, C, D, E, K, and the B vitamins (thiamin, riboflavin, niacin, pantothenic acid, biotin, B6, B12, and folate [5,6]. A growing body of research focuses on the negative effects of unhealthy food consumption and nutrient deficiencies that deprive the body of essential nutritional components necessary for healthy physical and mental health functions. Bipolar disorder and posttraumatic stress disorder are complex psychiatric conditions that significantly affect individuals, families, and support systems, [7] and advancement in understanding the interlinking of nutrition and treatment modalities for psychiatric conditions is necessary. Undeniably, there is a great need to shed light on nutritional factors that suggest that there is a connection with mental health conditions particularly bipolar disorder and PTSD.

Nutritional deficiency in people diagnosed with mental health conditions is commonly associated with a lack of dietary sufficiency of omega-3 fatty acids, B vitamins, and minerals which are precursors for neurotransmitters [8-12]. People with bipolar disorder and PTSD are at greater risk of nutritional deficiency because of fluctuations in moods, emotions, and thought processes that may result in poor appetite, skipping meals, and desires for unhealthy foods. Approximately 40% of people with bipolar

disorder also met the criteria for post-traumatic stress disorder [13,1]. Though there are several psychiatric conditions, it is not entirely surprising that many people diagnosed with bipolar disorder also have encountered primary or secondary traumatic experiences [7,14]. Healthy food nutrients are essential for the medical, physical, emotional, and psychological balance to minimize the risk of deteriorated physical and mental health. People diagnosed with bipolar disorder and post-traumatic stress disorder have a high risk of relapse and recurrence which continue to be a significant global burden, [15] and those with bipolar disorder and post-traumatic stress disorder experience more rapid cycling periods and increased risk of suicide attempts [16].

Poor food nutrients with a lack of large neutral amino acids may contribute to the emergence of bipolar disorder and PTSD. The ingestion of large neutral amino acids, especially tryptophan, tyrosine, and the branched-chain amino acids, modifies tryptophan and tyrosine uptake into the brain and their conversion to serotonin and catecholamines, respectively affects mood, cognition, and hormone secretion (prolactin, cortisol) [17]. Such effects on the brain show that proper nutrition may be the hallmark of predictable dietary and psychiatric treatment outcomes. Treatment with the appropriate pharmacotherapy coupled with a healthy diet may reduce the prevalence of bipolar disorder and PTSD to help deter rapid mood swings, psychosis, self-harm, and self-destructive thoughts, behaviors, and actions. Healthy food nutrition consumption is a necessity for people diagnosed with psychiatric conditions to ensure the proper function of neurotransmitters, neuronal signal transduction systems, hormonal balances, and sequential bodily functions. A deficiency in nutrients is not uncommon in people with mood disorders such as bipolar disorder, [18] and post-traumatic stress disorder has been associated with greater levels of depression among people with bipolar disorder [19]. Some of the most common nutritional deficiencies associated with bipolar disorder and post-traumatic stress disorder exist in B vitamins, magnesium, and zinc [20]. B vitamins are essential for the proper function of the brain and are particularly important for the production of neurotransmitters, which help to communicate information throughout the body.

Unbalanced eating habits, coupled with eating disorders and the consumption of alcohol, exacerbate the psychological effects of bipolar

disorder and post-traumatic stress disorder. There is a 40 to 70% chance that individuals with bipolar disorder also have an alcohol use issue, [6,21,22] which complicates treatment approaches as well as creates risk factors with the usage of antipsychotic medications [7]. Those with bipolar disorder, post-traumatic stress disorder, and anxiety disorders are more likely to engage in unhealthy habits like tobacco usage, eating disorders, and binge drinking [7,23,24,25]. For optimal management of bipolar disorder and PTSD, avoiding alcohol is highly recommended, and the consumption of a healthy diet with nutrient-dense foods may contribute to improved mental and physical health.

2. EFFECTS OF FOOD NUTRIENTS ON THE HUMAN BODY AND BRAIN

The human body depends on specific food groups to function optimally with longevity. Poor food choices can lead to serious health issues and exacerbated psychiatric conditions. Nutrient deficiencies can adversely affect mood, temperament, short and long-term memory, physical and mental health, and how and when information is processed in the brain. The most powerful and complex organ in the body is the brain which requires a proper balance of nutrient intake for effective functioning. Understanding which foods have a positive and negative effect on the human body should be of great interest because diets play an important role in the way the human brain works. Polyunsaturated fatty acids of which roughly 33% are members of the omega-3 family make up 50% of the grey matter in the brain and are therefore obtained through diet [26]. Consumption of food nutrients that consist of omega-3 fatty acids contributes significantly to the pathophysiology management and treatment of bipolar disorder and PTSD and may greatly result in physical and mental health improvements.

Proper dietary consumption is essential for the multiple systematic and regulatory functions of the body. Nutritional neuroscience focuses on the effects of dietary intake on the neurochemistry and neurobiological factors of humans. Identifying a relationship between nutrition and psychiatric conditions may serve as the hallmark to pinpoint specific brain functioning, resulting in ground breaking treatment approaches. The brain and nervous system depend on proper nutrition for the development of proteins, tissues, and cells. Studies that compared traditional diets, such as the

Mediterranean diet and the traditional Japanese diet, to a Western diet revealed that people who eat a traditional diet have a 25% to 35% lower chance of developing depression [11]. Food nutrients are necessary for gut bacteria to perform the necessary processes for physical and mental health balance. Gut bacteria are thought to produce 95% of the body's supply of serotonin, a chemical that regulates mood, and produce hundreds of neurochemicals that the brain uses to regulate basic physiological processes as well as mental processes such as learning, memory, and mood [27]. Though many nutrients are essential for our bodies to function properly, there are some considered unhealthy for some people such as caffeine, alcohol, high-sugar intake, salt, processed foods, and artificial additives [21,28-31].

A. Food Insecurity and Co-occurring Bipolar Disorder and Post-traumatic Stress Disorder

Food security is a serious global issue that limits access to and availability of food to individuals. Food insecurity in the United States is experienced by nearly fifty million people which makes it one of the nation's leading health and nutrition issues [32]. Food insecurity results in deficiencies in essential vitamins, large neutral amino acids, carbohydrates, and protein with greater consideration of soybeans, nuts, and seeds. There are great concerns about the possibility of the rising number of people diagnosed with psychiatric conditions with increased food insecurity. There were 14.3% of Americans or over 50 million people who experienced food insecurity in 2013, [8] whereas there were 48.8 million cases of bipolar disorder globally in 2013, [33] and about 12 million adults in the United States reportedly have post-traumatic stress disorder during a given year in which about 6 out of every 100 people (or 6% of the population) will have post-traumatic stress disorder at some point in their lives [34]. Though there is no conclusive fact that pinpoints which specific food group directly affects mental health, there may be a link that suggests that poor dietary consumption increases the severity and chronicity of risk factors of psychiatric conditions, in particular bipolar disorder and PTSD.

B. Nutrition Associated with Gender and Co-Occurring Psychiatric Conditions

The clinical features of bipolar disorder and post-traumatic stress may differ based on gender. The onset of psychiatric conditions in men and

women may vary depending upon the quality of food nutrient consumption. Women of reproductive age are of great concern because unhealthy food consumption can adversely affect a fetus and may increase symptoms of a psychiatric condition. Not only is poor nutrition an issue for a pregnant mother and a growing fetus, but the controversial issues with the usage of antipsychotic medications may also complicate the treatment and management of co-occurring psychiatric diagnoses [14]. Women are more prone to experience posttraumatic stress disorder, which manifests between 5 and 10% of the time after the occurrence of traumatic exposure, [35,36] which may lead to depression and other mental health issues [16]. Though men's physical and mental health are of concern, women experience greater risk factors due to necessary prenatal and postnatal care, including hormonal balances and self-care practices. While men are also diagnosed with psychiatric conditions, women are at higher risk for developing an eating disorder, suffer from lower quality of life, and have significantly higher levels of psychosocial risk variables than men [25]. Men and women demonstrate differences in the clinical features of bipolar disorders such as the age of onset, seasonal changes, and clinical manifestations in the onset of bipolar disorder symptoms. Compared to women with no trauma exposure, women with post-traumatic stress disorder symptoms have poorer dietary habits and have less improvement in diet quality over time [2]. In addition to pharmacological formulations for the treatment of bipolar disorder, dietary interventions and psychotherapy with the implementation of trauma-informed care strategies can help improve the symptoms of bipolar disorder and PTSD while reducing the onset of adverse outcomes.

Nutrition-rich foods contribute significantly to the onset, severity, frequency, and duration of psychiatric conditions particularly bipolar disorder and PTSD. Some men and women both are diagnosed with co-occurring PTSD and bipolar disorder. Bipolar disorder and post-traumatic stress disorder commonly co-occur and result in a greater symptom burden than either condition alone [1]. A study showed that the prevalence of bipolar disorder among adults was 2.9% for males and 2.8% for females, [37] and women are more than twice as likely to develop post-traumatic stress disorder than men (10% for women and 4% for men) [4]. Men and women with bipolar disorder exhibit depressive and manic symptoms, while experiencing an impaired

quality of life, poor dietary habits, and other lifestyle characteristics. Men and women demonstrate differences in the clinical features of bipolar disorders such as the age of onset and seasonal changes in the onset of bipolar disorder symptoms. In addition to pharmacological formulations for the treatment of bipolar disorder, dietary interventions can help improve the symptoms of bipolar disorder while reducing the onset of adverse outcomes. Incorporating the Nutritional Psychiatry Integrated Framework may help streamline treatment processes to encourage the consumption of healthy dietary foods with necessary amino acids and vitamins and improvements in the quality of lifestyle choices to ameliorate psychiatric conditions.

Vitamins have supplemental benefits that help the body to sustain many systemic functions, including moods. A neuro psychobiology study showed that men's and women's moods improved in one year by taking daily supplements of nine vitamins that consisted of 10 times the recommended daily dose [38]. Though vitamin toxicity (hyper-vitaminosis) must be carefully evaluated, advancements in nutritional psychiatry are needed to identify potential associations between nutrition and psychiatric conditions while simultaneously ensuring safety and ethical measures. Though vitamins and minerals are often considered micronutrients because the body only needs small amounts for functional ability, insufficient amounts can lead to physical and mental health conditions. Food nutrients combined with vitamins may be the key to managing symptoms of psychiatric conditions, reducing chances of refractory psychosis, and preventing relapses and reoccurrences which may result in reduced health care burden, familial stressors, and patient instability with bipolar disorder and PTSD [39,40].

3. NUTRITION AND BIPOLAR DISORDER

Food nutrition is an important part of a daily diet and can have a profound effect on emotions, personalities, cognitive functioning, and moods. Bipolar disorder affects 5.7 million people or 2.6% of all people [41,24]. Many people diagnosed with bipolar disorder have rapid mood swings among other clinical symptomatology. Bipolar disorder is categorized into bipolar disorder I and bipolar II which involves recurrent episodes of depressive and manic symptoms [42-44]. A diagnosis of bipolar disorder is controversial and some people with bipolar disorder are originally misdiagnosed or

underdiagnosed [7,45]. There is an estimate of 80 to 90% of people diagnosed with bipolar disorder have a family member who either has the condition or depression, [18] and individuals with one parent diagnosed with the mood disorder are at an increased risk for the development of bipolar disorder [9]. Bipolar disorder affects 1% of adolescents with a greater prevalence in the female population and 0.2-0.4% of children, [46,47] and diagnosing the psychiatric condition in these groups is significantly controversial [7].

When compared to people with a body mass index (BMI) of normal weight, those with BMIs of 18.5 (underweight due to malnutrition) were roughly twice as likely to suffer from mental illness [23,48]. The presence of comorbid eating disorders may help explain poor physical and mental health outcomes in people with bipolar disorder whereby there are approximately 33% of those with bipolar disorder who have an eating disorder [24]. Individuals diagnosed with bipolar disorder may be at an increased risk of obesity, bulimia, anorexia, or other related eating-associated conditions due to poor dietary habits and nutrient intake during mania or hypomania phases as a result of increased or decreased food intake [49,50,25]. Eating disorders are persistently disturbed eating, self-negative bodily viewpoints, and related behaviors, including preoccupation with weight, shape, size, appearance, and/or diet which harms physical health, psychological and emotional and self-care [51,7].

People diagnosed with bipolar disorder are more likely to consume poorly prepared foods that are deficient in important vitamins, minerals, and omega-3 fatty acids [41]. Dietary foods are complementary components to help deter physical and psychological imbalance, malfunctioning, and deterioration of the human body, particularly for optimum brain function. Proper nutrition may aid in decreasing or eliminating psychosis, suicidal thoughts, and substance use, with consideration of psychotherapy, pharmacology, and support systems for individuals with bipolar disorder [52-54].

There are an estimated 200–400 suicides per 100,000 individuals with bipolar disorder each year [33]. According to the available studies, 20% or more people suffering from bipolar disorder (mainly untreated) take their own lives by suicide, and 20 to 60% make at least one

attempt during their lifespan [48]. Deficiencies in certain vitamins, amino acids, and minerals inconclusively suggest the possibility of an individual having an increased risk of developing bipolar disorder from biological, environmental, or other related factors [55,56]. A study of individuals with bipolar disorder found that 46% of them overused or abused alcohol and 41% also used narcotics consistently [45]. Though pharmacotherapy is effective in the treatment and management of bipolar disorder for some people, some individuals may experience adverse effects. Complementary treatments such as dietary interventions may be more well-tolerated and acceptable as well as successful in the treatment and management of symptoms of bipolar disorder. Adjunctive therapy with nutrient supplements may lead to an improvement in bipolar disorder and a reduction in the adverse effects [57].

A. Food Nutrients Beneficial for Bipolar Disorder

Nutritional psychiatry is necessary for identifying healthy foods beneficial for people with bipolar disorder. There is no doubt that mood disorders like bipolar disorder can be tough to treat. Healthy nutritional intake plays a significant role in the complementary management of psychiatric symptoms, along with pharmacological and psychotherapy approaches. There are specific nutrients that are especially important for people with bipolar disorder [13]. Certain nutrients help promote brain health, prevent inflammation, support neurotransmitter function, prevent the rapid deterioration of neurons, promote proper neuronal function, support brain circuitry, aid with brain chemicals and metabolic processes, and balance hormones that are necessary for the regulation of behaviors, moods, emotions, and cognitive functions [5,6,7,58]. A balanced diet that includes protein, fiber, and complex carbohydrates can improve mood stability. There is a notion that suggests that a Mediterranean-style diet high in nuts, olive oil, nutritious grains, fruits, fish, and vegetables may lessen the symptoms of psychiatric conditions. Foods containing appropriate dietary consumption of several nutrients, such as omega-3, B vitamins, folate, large neutral amino acids, magnesium, minerals, vitamin D, choline, inositol, plant-based antioxidants, fruits, and vegetables, are beneficial for people with psychiatric conditions, particularly bipolar disorders.

Omega-3 fatty acids are especially important for people with bipolar disorder because of their

beneficial effects on brain health and the body's systematic processes. Though omega-3 fatty acid is beneficial for proper brain function and structure, protecting nerve cells, and reducing inflammation, research shows that people with bipolar disorder are deficient with a lower level of omega-3 [58]. Omega-3 fatty acids are found in fish, nuts, and seeds, and can be taken in a supplement form. There is a need for routine monitoring of omega acid levels to ensure appropriate dietary recommendations to prevent adverse effects. While omega-3 fatty acid is recommended for individuals with bipolar disorder, there is a need to point out that maintaining a high omega-6 to omega-3 level may increase the body's inflammatory reaction which has a negative impact on general brain function [59].

Folate (vitamin B9) and omega-3 fatty acids complemented with other B vitamins, minerals (zinc, magnesium, and iron), and vitamins A, C, D, E, and K may provide a broader possibility for the improvement of psychiatric conditions such as bipolar disorder. Mania and depressive moods are major psychiatric symptoms associated with bipolar disorder and advancements in knowledge about appropriate dietary foods and supplements are necessary. Folate, minerals, and other vitamins help the body to produce new cells, support neurological functions and promote brain development. They can be found in leafy green vegetables, legumes, nuts, whole grains, pumpkin seeds, lean meat, and other food sources.

Minerals contribute to the neurological functions of the brain and help transport oxygen throughout the body to the brain. Mineral deficiencies are linked to increased depressive symptoms. There is emerging evidence for zinc supplementation with antidepressants to improve depressed moods [5]. Identifying the effectiveness and required dosages of folate and minerals are essential to ameliorate symptoms associated with bipolar disorder. Folate and mineral deficiencies have been reported in depressed populations, people with anxiety, and people who respond poorly to antidepressants [5]. Research shows that increased levels of folate in the human body point to an improvement in mental health conditions. Folic acid (a synthetic form of folate) has been shown in a study to have positive results in the response rate to antidepressants [5,6,58]. Determining the nutritional neuroscience of dietary requirements for people diagnosed with bipolar disorder will

introduce groundbreaking discoveries for the betterment of treatment approaches and quality of life for people diagnosed with the diagnosis.

B. Food Nutrients to Avoid with Bipolar Disorder

There is a significant need to understand nutritional psychiatry in terms of identifying foods that a person with bipolar disorder should avoid. Dietary factors play a key role in the development of physical and mental health conditions, especially for individuals with bipolar disorder who typically have poorer nutritional behaviors. Individuals with bipolar disorder are more likely to engage in unhealthy lifestyles which may include stress eating and consuming unbalanced food products. Proper diet helps facilitate appropriate pathophysiological processes throughout the body. Different factors can trigger psychosis, mood swings, mania, and depressive moods in a person with bipolar disorder, and one of those factors is diet. Foods that are likely to trigger symptoms in a person with bipolar disorder consist of sugar, caffeine, alcohol, processed foods, and artificial additives [21,30,31].

High consumption of refined sugars, saturated fat, and low dietary content of fruits and vegetables has been associated with the development of depression, [32] and people with bipolar disorder have depressive moods and mania episodes. Sugar can trigger a manic episode in a person with bipolar disorder and minimizing the consumption of excessive amounts of sugar may help prevent the onset of future episodes [60]. Sugar causes a spike in blood sugar levels which can lead to a feeling of euphoria. The euphoric feeling from sugar is short-lived and can quickly turn into a crash which is a highly possible trigger for depressive episodes. While there are many different trigger foods, there are also a variety of other factors that can trigger this mental illness. These other triggering factors include sleep deprivation, stress, hormonal imbalances, and genetic predisposition, all of which are highly associated with diet factors. A diet containing high levels of sugar and fat may lead to an impairment in the receptor signaling and expression of neurotransmitters [29].

Foods products containing caffeine may be beneficial for some people while serving as a precursor to trigger physical and mental health conditions in others. Acute increases in caffeine

consumption may precede the occurrence of manic symptoms in patients with bipolar disorder, potentially through a direct stimulant effect, affecting sleep patterns and/or the metabolism of lithium or other medications, although increases in caffeine intake could also be a consequence of an ongoing manic relapse or a prodromal sign [28]. Caffeine is a central nervous stimulant, and therefore, high usage is likely to trigger manic episodes, elevate moods, and alter hormones in a person with bipolar disorder. Though there are some health benefits from the consumption of caffeine, it is imperative to know that caffeine leads to behavioral changes including increased arousal, reinforcement, and psychomotor activation [28,31]. Caffeine is found in tea, chocolate, energy drinks, soft drinks (pop, soda, etc.), and dietary supplements that are all more likely to affect a person with bipolar disorder. Caffeine consumption may also affect the disruption of the metabolism of medications, [28] which may inhibit the mechanism of action of psychopharmacology medications needed for the treatment of bipolar disorder.

There is no doubt that poor nutrition intake affects mental health, including depressive and mania episodes in bipolar disorder. Though salt has some nutritional benefits, a sudden increase or decrease in salt intake can adversely affect lithium levels in people with bipolar disorder. Increased intake of processed foods with low nutrient benefits may also trigger symptoms in individuals with bipolar disorder due to processed foods being modified from their fresh or whole state with added chemicals, and preservatives. [23,48,3,31]. High glycemic load and consumption of processed foods may lead to an increase in the risk of the development of bipolar disorder [2,61,62]. Since the management of bipolar disorder is undoubtedly difficult and ongoing advancements are needed to conclusively determine specific foods to avoid in the entirety, an increased understanding of nutritional psychiatry that pinpoints dietary restrictions is needed which may result in the stabilization of depressive moods, prevention of mania episodes, and better treatment outcomes and compliance.

4. NUTRITION AND POST-TRAUMATIC STRESS DISORDER

Post-traumatic stress disorder is associated with less healthy changes in overall diet quality and poor diet may be one pathway linking post-traumatic stress disorder with a higher risk of

chronic disease development [2]. Around 5.2 million adult Americans or 3.6% of Americans have post-traumatic stress disorder each year, [63] and 1 in 11 people are thought to develop the condition at some point in their lives [64]. A person may experience PTSD from stressful exposure to war, accident, sexual or physical assault, natural disaster, victimized crime, fatalities, or other severe and prolonged exposure that can result in flashbacks, nightmares, and other stress-provoking psychological symptoms. The U.S. Department of Veterans Affairs found that between 71 to 96% of people with post-traumatic stress disorder may have nightmares [34,65]. The ability to manage many symptoms of post-traumatic stress disorder may significantly depend on a healthy nutritional intake and psychotherapy, and in some cases, medication.

Proper nutritional balance is essential because PTSD can have prolonged effects on a person's body, especially the function and structure of the brain. Unhealthy dietary patterns can lead to physical health problems such as headaches, stomach problems, and heart disease [2,16]. Consuming proper foods has the propensity to balance neurological and pathophysiological processes to regulate the body to manage health conditions. A lack of knowledge of foods beneficial for individuals with PTSD may contribute to some individuals' poor quality of dietary consumption and inability to manage psychologically distressful reactions to traumatic exposures. According to a study, 4.0% of Asians and 8.7% of Black people had a much lower lifetime prevalence of post-traumatic stress disorder than Whites 7.4%, [62] and quality of nutrition intake may contribute to people's tolerance and endurance of traumatic exposure. Appropriate dietary interventions should be recommended to help reduce physical and mental health conditions. Post-traumatic stress disorder has been associated with many risk factors of obesity, diabetes, and cardiovascular disease which are linked to diet [15,66,2]. Recognizing and understanding the signs and symptoms of PTSD are essential to ensure that people who are suffering from this psychiatric condition can receive the necessary treatment, support, and dietary recommendations.

A. Food Nutrients Beneficial for Post-Traumatic Stress Disorder

The relationship between diet and mental health is complex, especially considering PTSD. Unhealthy lifestyle choices such as smoking,

substance use, alcohol use, absence of exercise or physical activities, and poor dietary habits may exacerbate symptoms of PTSD. While there is no one perfect diet for mental health conditions, certain nutrients are particularly important for people with post-traumatic stress disorder. Omega-3 fatty acids, magnesium, probiotics, antioxidants, and vitamin C have all been linked with improved symptoms of post-traumatic stress disorder because they have anti-inflammatory and neuroprotective effects [5,6,41]. Omega-3 fatty acids have been associated with improving symptoms of PTSD. Omega-3 fatty acids are found in fish, nuts, and seeds, while vitamin C is found in fruits and vegetables [24]. Increasing the consumption of foods beneficial for the body may help reduce or eliminate symptoms associated with PTSD.

Post-traumatic stress disorder is associated with reduced healthy eating and physical activity and increased obesity and smoking [65]. Poor dietary patterns can contribute to complex medical conditions which are likely to affect those with PTSD. Obesity, diabetes, and cardiovascular diseases are increased risk factors for those with post-traumatic stress disorder [65]. Nutritional psychiatry may serve as the driving force to help professionals to identify healthy foods beneficial not only to prevent medical co-morbidities but also to reduce the risk of co-occurring mental illnesses of those with PTSD. Certain food nutrients that include minerals may help to improve symptoms of post-traumatic stress disorder [32]. Minerals are one of the supplemental components that have beneficial effects to reduce symptoms of PTSD. Minerals such as magnesium and zinc are essential for the body and magnesium is involved in over 300 biochemical bodily reactions. Magnesium is found in dark chocolate, green leafy vegetables, and legumes. Minerals are beneficial in reducing hyper arousal effects, reducing anxiety, improving sleep quality, having a calming effect on the nervous system, and offsetting the effects of stress in people with post-traumatic stress disorder [2,10,26]. Vitamins and antioxidants are also essential for the nutritional health of people with PTSD. Vitamin D, especially, is suggested as a necessity for people diagnosed with PTSD. Research suggests that an altered vitamin D metabolism may be involved in the pathophysiology of post-traumatic stress disorder [64]. Foods with vitamin D, including vitamin D supplements as well as direct sunlight exposure for vitamin D absorption, may contribute to a reduction of PTSD symptoms.

Daily fiber intake is suggested for people with PTSD. People who consume two or more sources of fiber daily have significantly lower odds of post-traumatic stress disorder [23]. There are several food sources with fiber such as lentil beans, broccoli, wheat grains, berries, popcorn, fruits, potatoes, and nuts. People whose diets consist of various sources of fiber are less likely to have post-traumatic stress disorders than those who eat less fiber [6,24,67]. Consumption of fiber is deemed to have a positive effect on the brain, which is beneficial for psychiatric disorders, particularly PTSD. Research asserts that fiber encourages the production of short-chain fatty acids which are powerful molecules that originate in the gut and communicate with other cells to impact brain function [6]. Proper brain function is essential for effective communication throughout the neurological pathways which is necessary for processing information, including applying coping mechanisms to heal from traumatic experiences.

B. Food Nutrients to Avoid with Post-Traumatic Stress Disorder

There are some foods deemed as triggering factors for those with PTSD. Triggering factors may consist of increased symptoms, relapse potential, reoccurrence of traumatic flashbacks, or pseudo effects. Consumption of pastries, chocolate, pulses, nuts, and ultra-processed foods daily is associated with a higher prevalence of post-traumatic stress disorder risk [6,21,23,28,2,67,3]. Though certain foods are identified to be avoided by those who suffer from PTSD, some are healthy sources for others to consume such as nuts which provide a great source of protein and other nutrients. Avoiding triggering foods while still ensuring the consumption of a balanced meal and exercising may promote healthy cognition functioning to reduce symptoms such as nightmares, flashbacks, and hyper vigilance in people diagnosed with PTSD. Since there is a need to identify foods to avoid, interventions aimed at treatment and best practices should incorporate interdisciplinary input from psychiatrists, dieticians, mental health psychotherapists, and other qualified professionals for the betterment of patient care.

5. NUTRITIONAL PSYCHIATRY INTEGRATED FRAMEWORK

This research introduces the Nutritional Psychiatry Integrated Framework (NPIF) with

descriptive interventions and best practice strategies for each component as delineated in Table 1 and Fig. 1. There is a need for an integrated framework to utilize as a mainstream continuum of care approach in the treatment and management of co-occurring psychiatric disorders such as bipolar disorder and PTSD. Co-occurring psychiatric disorders are challenging to treat and pose many constraints on treatment processes, resources, and availability of interventions. The reality is limited interventions may exist due to a lack of awareness of the benefits associated with nutrition and psychiatry, reluctance to adapt to an alternative treatment approach, limited nutritional and behavioral health education programs, lack of community/statewide initiatives advocating for policy development for the inclusion of nutritional psychiatry services, lack of accreditation requirements for interventions for the integration of nutrition and psychiatric conditions within service delivery provisions, insurance requirements, managed care organizations/local management entities' stipulations, and financial constraints to accessing required care. As a result, there are no known interventions designed specifically for the integration of nutrition and co-occurring psychiatric disorders which hinders treatment options for individuals dually diagnosed. Single interventional models may be less effective to satisfy the increased needs of a person with co-occurring disorders. A comprehensive, integrated approach with a multi-disciplinary focus on treatment resiliency, recovery, relapse prevention, trauma-informed care, trauma-informed legal advocacy for patients involved in the legal system, and achievable outcomes for the betterment of people with co-occurring psychiatric disorders is needed such as the innovative development of the Nutritional Psychiatry Integrated Framework proposed in this research.

The NPIF serves as a comprehensive interdisciplinary and practical roadmap in the treatment process of dually diagnosed individuals, particularly those suffering from bipolar disorder and PTSD. The NPIF aims to encourage the utilization of integrated best practices and encourage nutritional and behavioral health standards of care, realistic treatment expectations, culturally and linguistically driven concepts, a continuum of care, quality assurance and quality improvement, data-driven outcomes, and interdisciplinary team collaboration with a patient-centered approach. The NPIF may prove to be an advancement in

the nutritional psychiatry field that increases treatment compliance/commitment, management of psychiatric symptoms, improvements in eating habits, decrease comorbidity, decrease relapses and psychosis, and increase goal attainment while ensuring cost-effective and efficient treatment methods.

The NPIF consists of seven components that serve as interconnected interventions for the ‘whole person’ to achieve optimal treatment outcomes and help empower the patient to actively engage in the treatment decision-making processes. Professionals should use the NPIF in a manner beneficial for a patient wherein only resources necessary within a specific component are coordinated to help the patient to achieve a quality of life and better management of overall mental health well-being. The nutritional and

psychiatric treatment approaches can be useful in-person or via telehealth/telemedicine and guided by medical and clinical necessity with consideration of an individual’s therapeutic needs for services beyond a treatment authorization such as but not limited to emergencies, suicide prevention, relapse prevention, stabilization, hospitalization, and other clinical relevancy that supports the need for the initiation or continuation of treatment. Effective and efficient integrated interventions are necessary to produce promising short-term and long-term treatment outcomes. A well-balanced diet with psychiatric treatment compliance may be an alternative to psychiatric pharmacological regimes. The NPIF recommends best practice components and interventions/strategies that are beneficial in the development of a treatment partnership with patients.

Table 1. Nutritional psychiatry integrated framework

Nutritional Psychiatry Integrated Framework	
Patient-Centered Focus	
Component	Intervention/Strategy
Nutrition	<ul style="list-style-type: none"> • Nutrition evaluation, diagnosing, and monitoring • Integration of nutrition and psychiatric behavioral health treatment plans • Nutrition care processes • Nutrition care approaches • Nutrition counseling • Nutrition coaches • Nutrition education • Nutrition meal education, preparation planners/calendars/etc.
Psychiatry	<ul style="list-style-type: none"> • Psychiatric assessment, diagnosing, and monitoring • Integration of nutrition and psychiatry plans • Medication evaluation and management • Telemedicine • Trauma-informed care approaches • Treatment monitoring • Interdisciplinary team involvement in mental health, substance use, and intellectual/development disability treatment • Psychiatric behavioral health treatment teams • Integrated evidence-based nutritional and behavioral health psychotherapy • Crisis/emergency on-call access • Treatment plan with achievable goals, strategies, and time frames • Development of Safety Plans, Suicide Prevention Plans, Crisis Intervention Plans, and Relapse Prevention Plans • Psychosocial/Psycho education • Access to psychiatric hospitals/crisis centers/behavioral health agencies and organizations for treatment
Self-Care	<ul style="list-style-type: none"> • Engagement in self-care and wellness activities • Participate in nutritional and psychiatry appointments,

Nutritional Psychiatry Integrated Framework	
Patient-Centered Focus	
Component	Intervention/Strategy
	<ul style="list-style-type: none"> events, workshops, etc. • Active involvement in treatment planning and decision-making • Practice emotional and behavioral self-regulation • Development of self-awareness, self-motivation, and self-accountability • Self-monitoring of symptoms and triggers • Detection of symptoms Engage in psycho education and psychosocial activities • Participation in self-help resources
Family Engagement	<ul style="list-style-type: none"> • Family assessment • Treatment involvement • Advocacy initiatives • Participation in family psychotherapy • Psycho education and psychosocial resources • Engagement in behavioral health events
Support System	<ul style="list-style-type: none"> • Family support system • Peer recovery support system • School support system • System navigator support system • Social, personal, and emotional support system (friends/associates, advocates, sponsors, buddy system, pets, companionship, religion, etc.) • Treatment team support system
Continuum of Care	<ul style="list-style-type: none"> • Coordination of care • Promote an integrated system of care with the inclusion of nutritional psychiatry • Streamline referral processes • Medical screening, treatment, and follow-up • In-person and telehealth treatment services
Statewide Community Initiatives	<ul style="list-style-type: none"> • Advocacy efforts for statewide/community initiatives on policy development promoting the integration of nutritional psychiatry treatment approaches • Promote anti-stigma outreach efforts • Development of programs, services, training, resources, and events • Stakeholders' meetings related to treatment, services, and programs • Accreditation requirements for nutritional psychiatry within service delivery provisions • Promote cultural and linguistic concepts • Encourage opportunities to participate in events related to trauma-informed care and trauma-informed legal advocacy • Coordinate events to educate legal officials about nutritional psychiatry, behavioral health disorders, trauma exposure, and re-traumatization • Development of crisis response teams (e.g., licensed clinical therapists/counselors, police, psychiatrists, psychiatric nurses, psychologists, support systems, nutritionists/dieticians with psychiatric crisis response training, etc.) • Crisis response debriefing

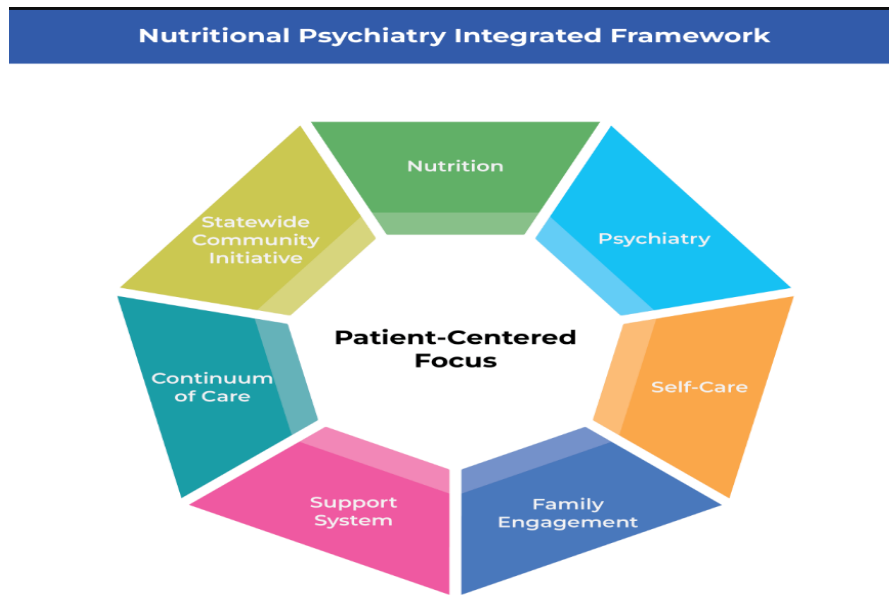


Fig. 1. Nutritional psychiatry integrated framework

6. METHODOLOGY

The methodology consisted of a systematic approach to analyzing nutrition associated with co-occurring bipolar disorder and post-traumatic stress disorder. A literature review search of qualitative and quantitative studies was conducted by using Saint James School of Medicine’s library resources as well as PsycINFO, PubMed, and Google Scholar. The text words “nutritional neuroscience,” “nutritional psychiatry,” “bipolar disorder,” “post-traumatic stress disorder,” “PTSD,” “vitamins,” “minerals,” “omega-3,” “food insecurity,” “eating disorders,” with use of the Boolean operator “AND” the term “foods” was used to identify qualitative and quantitative studies on nutrition, bipolar disorder, and post-traumatic stress disorder. The inclusion criteria consisted of a) scholarly or peer-reviewed sources; b) articles published in the English language only; c) males and females diagnosed with bipolar disorder; d) males and females diagnosed with post-traumatic stress disorder; e) males and females diagnosed with co-occurring bipolar disorder and post-traumatic stress disorder; and f) males and females diagnosed with eating disorders, bipolar disorder, and post-traumatic stress disorder. Though there was limited literature focusing specifically on nutrition and co-occurring psychiatric conditions such as bipolar disorder and post-traumatic stress disorder, available relevant literature was considered.

7. DISCUSSION

The exploration of nutrition associated with co-occurring bipolar disorder and post-traumatic stress disorder revealed that dietary factors may be one of the contributing links to the management and treatment of such psychiatric conditions. Though many opinions have been offered regarding the impact of food on mental health and what should be done to help those suffering from psychiatric conditions, [68] there is a lack of literature on the effects of food nutrients on co-occurring bipolar disorder and PTSD. No known other study has identified a co-occurring treatment intervention for bipolar disorder and PTSD by considering foods to consume and avoid. Though there are few treatment strategies for individuals with both conditions, [1] no previous study focused on nutritional interventions for dual psychiatric disorders. While other studies have explored nutrients associated with bipolar disorder or PTSD individually, this study may be the first to focus on the dietary foods to consume and avoid for people with dual diagnoses of bipolar disorder and PTSD to minimize relapse and recurrences of symptoms.

The Nutritional Psychiatric Integrated Framework (NPIF) is presented to offer a patient-centered interactive approach with integrated best practice nutritional and psychiatry components to achieve realistic treatment processes, engagement, and measurable outcomes. The NPIF may prove to be an effective framework because it takes into

account patients' self-care, self-perception, and self-management with the hopes of patients establishing and maintaining an invested interest in their treatment process and recovery phase while simultaneously learning achievable ways to manage symptoms of their co-occurring psychiatric disorders and identifying healthy foods to consume. Consumption of certain foods may increase or decrease the severity of psychiatric symptoms which may benefit or complicate brain functions. Brain health is an essential factor that must be considered not only for identifying vitamins, minerals, and nutritional deficiencies but also for identifying foods to improve physical and co-occurring psychiatric disorders. A compelling finding was that bipolar disorder and post-traumatic stress commonly co-occurred and resulted in greater symptom burden than either condition alone and individuals with co-occurring bipolar disorder and post-traumatic stress disorder experienced high symptom burden and low quality of life [1]. Though the exact quantity of foods needed to ensure effective mental health functioning is continuously explored, understanding how dietary products interact with brain functions helps to identify how nutrients may affect psychiatric symptoms.

Healthy food selections may influence several biological processes in the brain for the management of psychiatric conditions. A compelling finding revealed that a daily intake of omega-3 fatty acids was recommended for people diagnosed with bipolar disorder and post-traumatic stress disorder [23,48,67,58]. An interesting finding was that taking omega-3 supplements was beneficial for relieving symptoms of depression, bipolar disorder, and post-traumatic stress disorder and could potentially help prevent psychosis [8,6]. Routine monitoring of omega-3 levels is suggested to prevent adverse effects. While omega-3 fatty acid is recommended for individuals with bipolar disorder and post-traumatic stress disorder, a high omega-3 level may increase the body's inflammatory reaction [59]. Nutritional psychiatry components are essential to understand the quantity and quality of dietary consumptions necessary for the body to function properly and manage bodily inflammatory reactions. Healthy foods help produce necessary body energy, repair cells, generate wound healing, promote neurological and biological functions, maintain healthy organs, proper brain function, and other beneficial bodily functions.

Advancements in nutritional psychiatry may help identify foods that may induce or inhibit biological processes. For instance, nuts are great sources of protein, omega-3, and other health benefits. A compelling counterargument suggests that people with post-traumatic stress disorder should avoid consuming nuts daily to reduce inflammatory reactions, [5,6,48,3,58,59] whereas research shows that nuts have an abundance of magnesium that is beneficial for co-occurring bipolar disorder and post-traumatic disorder for the management of symptoms [6,20,69]. Balancing the benefits of omega-3 and magnesium while limiting the amount of nut consumption may provide promising outcomes for people with bipolar disorder and PTSD.

A significant finding revealed that people who eat two or more sources of fiber daily are less likely to have post-traumatic stress disorder than those who eat less fiber [6,23,70]. Supplemental vitamins, minerals, antioxidants, fruits, and vegetables are also beneficial for comorbidity and co-occurring conditions. A noteworthy finding was that B vitamins, in particular, folate (B9) contributes to better results and improvement in people with bipolar disorder, [5,6,20,26,58] whereas vitamin D was suggested as beneficial in the pathophysiology of people with post-traumatic stress disorder [13].

Eating disorders are factors of great concern associated with co-occurring psychiatric disorders. An increased understanding of healthy nutritional effects on the physical body and mental health may prove to be key to significantly reducing eating disorders. An important finding revealed that individuals diagnosed with bipolar disorder, post-traumatic stress disorder, and anxiety disorders were more likely to partake in unhealthy habits such as eating disorders [7,23,24,25]. Individuals with co-occurring bipolar disorder and PTSD, including an eating disorder, may benefit from nutritional rehabilitation psycho education to increase awareness of eating disorders while improving their overall mental and physical health.

Large neutral amino acids and branched-chain amino acids have contributing effects on the brain. A remarkable finding revealed that large neutral amino acid, notably tryptophan and tyrosine and the branched-chain amino acids, had significant effects on the brain and their conversion to serotonin and catecholamines, respectively, which contribute to mood, cognition, and secretion of prolactin and cortisol [17].

Tryptophan may contribute to positive effects on sleep patterns, [70] in which a healthier sleep pattern may benefit individuals with bipolar disorder who experience mania episodes of deprived sleep and those with PTSD who have nightmares. Though amino acids have nutritional benefits for individuals with psychiatric conditions, dietary treatment strategies are necessary to monitor certain amino acids that may compete to transport across the blood-brain barrier. For example, a commendable finding asserted that raising blood tryptophan or tyrosine levels raises their uptake into the brain while raising blood branched-chain amino acid levels lowers tryptophan and tyrosine uptake which results in serotonin and catecholamine synthesis in the brain paralleling tryptophan and tyrosine changes [17]. Proper ingestion of amino acids may lead to appropriate conversions and effects within the brain that contribute to predictable neuropsychological functions, dietary psychopathological functions, and treatment outcomes.

The Nutritional Psychiatric Integrated Framework may be the solution to identify and close knowledge gaps about healthy and unhealthy foods associated with psychiatric conditions as well as enhance understanding of interdisciplinary treatment approaches to lessen the frequency and duration of psychiatric symptoms and reduce or prevent relapse. A notable finding revealed that a healthy relationship between nutrition and bipolar disorder and post-traumatic stress disorder exists in the consumption of omega-3 fatty acids, minerals (magnesium and zinc), probiotics, B vitamins, vitamins C and D, large neutral amino acids, antioxidants (fruits and vegetables), fiber, and fatty acids, [5,6,21,71,3,30] while limiting or eliminating unhealthy consumptions of caffeine, alcohol, sugar, salt, processed foods, and artificial additive is recommended [6,21,23,2,24,3,22,62]. High glycemic load and consumption of processed foods may lead to an increase in the risk of the development of bipolar disorder. Though some dietary sources have been identified that may increase or decrease psychiatric symptoms, continued research is needed to advance the understanding of nutrition associated with co-occurring psychiatric conditions to identify effective treatment interventions.

8. CONCLUSION

Nutritional psychiatry advancements are necessary to understand nutrients healthy and

unhealthy for people diagnosed with bipolar disorder and post-traumatic stress disorder. Determining what dietary sources and nutrients are healthy and unhealthy coupled with psychotherapy and psycho pharmacology may result in improved treatment and management outcomes, reduced relapses and reoccurrence of symptoms, and in some cases, prevention of psychiatric conditions. There is no single nutritional solution to eliminate medical or psychiatric conditions that fits everyone. Some dietary components should be considered to improve physical and mental health conditions rather than compromising mood, human behavior, cognition, emotions, sleep patterns, and biological functions. Several food sources may be beneficial for some people while worsening others' conditions. Though dietary components contribute significantly to brain development and functions, ongoing advancements in research are needed to determine a cause-and-effect relationship between nutrition and co-occurring psychiatric conditions such as bipolar disorder and PTSD to identify continuous dietary and psychiatric treatment interventions. The Nutritional Psychiatric Integrated Framework may become the mainstream framework in the field of nutritional neuroscience that guides forward-thinking in the right direction to advance systematic nutritional and psychiatry treatment modality outcomes for co-occurring disorders.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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