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YEDITEPE UNIVERSITY
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NUTRITION AND DIETETIC

THE EFFECT OF DIETARY CARBOHYDRATE QUALITY ON DEPRESSION, ANXIETY, AND STRESS LEVELS ON WOMEN APPLYING TO A PRIVATE DIET CLINIC IN BURSA

Master Thesis

Berre İNCEKARA

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DECLARATION

I hereby declare that this thesis is my own work, that I have not had any unethical behaviour at any stage from planning to writing, that I have obtained all the information in the thesis within academic and ethical rules, that I have referenced all information and comments not obtained through the thesis and included these sources in the list of references, that I have not violated patent and copyright rights during the thesis study and writing.

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LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	One-way analysis of variance
BMI	Body mass index
CHO	Carbohydrate
CQI	Carbohydrate quality index
DASS-42	Depression, Anxiety, stress Scale
FAO	Food and Agriculture Organisation
GI	Glycaemic index
GL	Glycaemic Load
HPA	Hypothalamic-pituitary-adrenal
LCFA	Long-chain (saturated) fatty acids
LNAA	Large neutral amino acids
MAO	Monoamine oxidase
MCFA	Medium-chain (saturated) fatty acids
MUFA	Mono-unsaturated fatty acids
NSPs	Non-starch polysaccharides
PUFA	Polyunsaturated fatty acids
REE	Resting energy expenditure
SCFA	Short-chain (saturated) fatty acids
SFA	Saturated fatty acids
SNRIs	Serotonin-norepinephrine reuptake inhibitors
SSRIs	Selective serotonin reuptake inhibitors
SUN	Seguimiento Universidad de Navarra
TNF-α	Tumor necrosis factor
TpH2	Tryptophan hydroxylase 2
Trp	Tryptophan
WHO	World Health Organization
5-HT	5-Hydroxytryptamine

ABSTRACT

Incekara, B (2023). The Effect of Dietary Carbohydrate Quality on Depression, Anxiety, and Stress Levels of Women Applying to a Private Diet Clinic in Bursa. Yeditepe University, Institute of Health Sciences, Department of Nutrition and Dietetics, MSc thesis, İstanbul.

This study was conducted with 140 women participants aged 18-60 to investigate the relationship between diet carbohydrate quality (CQI) and depression, anxiety, and stress. The Depression Anxiety Stress Scale (DASS-42) was used in our study to assess individuals' levels of depression, anxiety, and stress. CQI was calculated using the dietary intake of soluble fiber, dietary glycemic index (GI), the ratio of whole grains to total grains, and the ratio of complex carbohydrates to total carbohydrates. Statistical analysis was performed using IBM SPSS 20.0 software package. As a result of the study, a statistically significant possitive relationship was found between CQI and stress ($p=0.019$, $r=0.198$). But there is no a statistically significant relationship was found between CQI and depression scores ($p=0.172$, $r=0.116$), and anxiety scores ($p=0.081$, $r=0.148$). Howewer a statistically significant differences was found between CQI and depression score ($p=0.007$), anxiety scores ($p=0.010$), and stress scores ($p=0.007$). In addition, it was observed that saturated fat, total calorie, total carbohydrate intake, and dietary GI were positively correlated with depression, anxiety, and stress scores. A significant relationship was found between the intake of vitamins B2, B6, and beta-carotene and mental health. Insoluble fiber intake was inversely associated with symptoms, while soluble fiber intake was positively associated. This study may contribute to future research by identifying a link between certain nutrients and psychological health in women. It also emphasises the importance of focusing on types as well as amounts of nutrients. However, more research is needed to address the inconsistencies in the literature.

Keywords: Depression, anxiety, stress, nutrition, carbohydrate quality index

ÖZET

İncekara, B. (2023). Bursa'da Özel Bir Diyet Kliniğine Başvuran Kadınların Diyet Karbonhidrat Kalitesinin Depresyon, Anksiyete ve Stres Düzeylerine Etkisi.Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik Bölümü, Türkiye, Master Tezi. İstanbul.

Bu çalışma, diyet karbonhidrat kalitesi (CQI) ile depresyon, anksiyete ve stres arasındaki ilişkiyi araştırmak amacıyla 18-60 yaş arası 140 kadın katılımcı ile gerçekleştirilmiştir. Çalışmamızda bireylerin depresyon, anksiyete ve stres düzeylerini değerlendirmek için Depresyon Anksiyete Stres Ölçeği (DASS-42) kullanılmıştır. CQI, diyetle alınan çözünür lif miktarı, diyet glisemik indeksi (GI), tam tahılların toplam tahıllara oranı ve kompleks karbonhidratların toplam karbonhidratlara oranı kullanılarak hesaplanmıştır. İstatistiksel analiz IBM SPSS 20.0 yazılım paketi kullanılarak gerçekleştirilmiştir. Çalışma sonucunda, CQI ile stres arasında istatistiksel olarak anlamlı bir pozitif ilişki bulunmuştur (p=0.019, r=0.198). Ancak CQI ile depresyon puanları (p=0.172, r=0.116) ve anksiyete puanları (p=0.081, r=0.148) arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır. Bununla birlikte, CQI ile depresyon puanı (p=0.007), anksiyete puanı (p=0.010) ve stres puanı (p=0.007) arasında istatistiksel olarak anlamlı bir fark bulunmuştur. Ayrıca, doymuş yağ, toplam kalori, toplam karbonhidrat alımı ve diyet GI'nın depresyon, anksiyete ve stres puanları ile pozitif ilişkili olduğu görülmüştür. B2, B6 ve beta-karoten vitaminlerinin alımı ile ruh sağlığı arasında anlamlı bir ilişki bulunmuştur. Ayrıca, doymuş yağ, toplam kalori, toplam karbonhidrat alımı ve diyet GI'sinin depresyon, anksiyete ve stres skorları ile pozitif ilişkili olduğu görülmüştür. B2, B6 ve beta-karoten vitaminlerinin alımı ile ruh sağlığı arasında anlamlı bir ilişki bulunmuştur. Çözünmeyen lif alımı semptomlarla ters yönde ilişkiliyken, çözünür lif alımı pozitif yönde ilişkili bulunmuştur. Bu çalışma, kadınlarda belirli besinler ile psikolojik sağlık arasında bir bağlantı tespit ederek gelecekteki araştırmalara katkı sağlayabilir. Ayrıca, besin miktarları kadar türlerine odaklanmanın önemini de vurgulamaktadır. Bununla birlikte, literatürdeki tutarsızlıkları gidermek için daha fazla araştırmaya ihtiyaç vardır.

Anahtar kelimeler: Depresyon, anksiyete, stres, beslenme, karbonhidrat kalite indeksi

1. INTRODUCTION

The World Health Organization (WHO) defines health as "a state of complete physical, psychological and social well-being and not merely the absence of disease or infirmity" (1). Therefore, depression is cited as one of the leading causes of disability, affecting more than 264 million people of all ages worldwide (2). A recent study reported that the prevalence of depression, anxiety, and stress has increased (3). According to global estimates by the World Health Organisation, 4.4% and 3.6% of the general population are affected by depressive and anxiety disorders, respectively (4). At the core of depression lies a lack of interest and inability to derive pleasure from daily activities that individuals previously engaged in willingly and joyfully. In addition, over time, the person develops some changes accompanied by a sad mood. In this case, symptoms such as loss of energy, difficulty concentrating, loss of appetite, sleep problems, loss of interest, hopelessness, and suicidal thoughts often occur (5). One of the factors that push individuals to depression is stress. Stress is defined as the general response of individuals to various environmental stress factors (6). On the other hand, anxiety is characterized by non-specific psychological and physical symptoms accompanying worry, anxiety, and depression in individuals due to any stressor. In order for individuals to be considered in a state of complete well-being, depression, anxiety, and stress levels should be low (7).

Many biological, social, and environmental factors cause the development of psychological disorders. Dietary habits have also been recognized as a changeable risk factor that has an important place in mood, but the relationship between depression and diet quality factors has not been fully elucidated. (4,8). Studies have observed that the Western dietary pattern, characterized by refined carbohydrates, sugary drinks, and high fat intake, is associated with increased depression and anxiety scores (9-14). For example, in a study conducted on Australian women, it was observed that women who consumed a higher amount of healthy foods such as whole grains, unprocessed meat, vegetables, and fruits had lower rates of bipolar disorder, anxiety, or depression diagnoses compared to those with lower intake of healthy foods (15). Many nutrients determine diet quality; however, carbohydrates constitute the primary energy source for metabolism. Dietary carbohydrates play an essential role in the body's structural and functional processes and impact mood and behavior (16).

Some studies show that the amount of carbohydrates in the diet increases the risk of depression, anxiety, and stress. (17-21). The addictive effect exerted by high carbohydrate intake on the brain's reward system by stimulating dopamine secretion is recognized as the primary modulatory connection between dietary carbohydrates and mental disorders (22). However, the effect of carbohydrates on raising blood sugar is variable, and their effects on the body vary. This property is called the "Glycaemic index (GI)," a metric of the carbohydrate quality of food. (23). Dietary GI was discovered to be positively correlated with depression ratings in various research looking at the connection between nutrition and depression. (24,25).

For instance, a study of Iranian people found an inverse relationship between glycaemic load (GL) and mental illnesses, depression, and anxiety but a positive relationship between dietary GI and depression (26). Similarly, a study of senior citizens in the United States of America (USA) discovered a beneficial relationship between dietary GI levels and depression (25). From this point of view, it is concluded that the quality of carbohydrates is as vital as the quantity.

The goal of this study was to investigate the association between women's diet carbohydrate quality index (CQI) scores and levels of stress, anxiety, and depression.

2. GENERAL INFORMATION

2.1.Food and Nutrition

Foods are substances that contain the essential nutrients required by living organisms for growth, development, energy production, metabolism, and other vital activities to be sustained (27). Foods can be obtained from various sources, and factors such as nutrient content, production methods, storage conditions, processing, and cooking methods can change the nutritional values and, consequently, the effects of food on health (28). Therefore, it is important to choose and consume foods correctly so that the body receives the nutrients it needs and continues to function in a healthy way (29).

This process, which involves selecting and consuming appropriate foods, is called nutrition. Nutrition refers to the quantity, quality, and variety of foods and beverages consumed to meet the body's needs (30). Ensuring proper nutrition is essential for preventing diseases, promoting growth and development, gaining energy and endurance, enhancing mental and physical performance, and improving quality of life (31).

Factors such as age, gender, genetic background, level of physical activity, health status, and pregnancy influence individuals' nutritional needs; likewise, dietary habits vary greatly among individuals (32).

However, the past 50 years have witnessed stunning global changes in food production and dietary habits. In agriculture, the focus has been to boost crop yields and enhance production methods. This condition has lowered baby and child death rates, raised life expectancy, and decreased hunger. However, at the same pace, high-calorie, heavily processed, sugar-laden, and animal-derived foods have become increasingly included in the diet (33).

Due to increased consumption of processed and sugar-laden foods, there are 2.1 billion overweight or obese adults worldwide, and global diabetes prevalence has almost doubled in the past 30 years. Accordingly, diseases associated with unhealthy diets have become more prevalent. In addition, it has been reported that unhealthy diets constitute one of the most significant global disease burdens in morbidity and mortality (33,34).

Based on this, various studies have demonstrated that a balanced diet that includes nutrient-rich foods while avoiding processed meals and foods high in sugar can lower the chance of acquiring chronic diseases like hypertension, type 2 diabetes, and cardiovascular diseases (35-37). Fort this reason, the main purpose of nutrition is to ensure that the human body functions healthily by taking all the nutrients it needs in a balanced and sufficient amount (30). At this point, individuals need to be aware of their nutrient requirements.

2.1.1 General Information About Nutrients

Nutrients are substances necessary for the human body's normal growth, development, function, and general health. The nutrients required by the body are divided into macro and micronutrients. Macronutrients are essential nutrients found in large quantities in the body and provide energy. They include proteins, carbohydrates (CHOs), and fats; these nutrients are necessary for energy production, cell configuration, nervous system function, hormonal balance, and many other biological functions. Micronutrients are nutrients only the body requires in small quantities, usually including vitamins and minerals. These nutrients contribute to various biological functions such as immune system function, energy metabolism, bone health, and cell division. Although not classified as a nutrient, water is another vital component for the body's well-being and is essential for proper functioning (38).

It is crucial to provide these macro- and micronutrients for the metabolism to function correctly. Otherwise, malnutrition occurs. Malnutrition is a nutritional condition, which results in observable negative consequences on tissue/body form (body shape, size, composition), metabolism, and clinical outcomes due to a deficit, excess, or imbalance in calorie intake, protein intake, and other nutrients (39). As a result of this situation, disruptions in body functioning can occur, leading to various health problems. These problems include growth retardation, weakened immune system, anemia, cardiovascular diseases, osteoporosis, and impaired brain function. Additionally, when nutrient intake is inadequate, the body may use muscle tissue for energy, resulting in muscle loss and weakness (40).

A chemical classification is necessary to understand and evaluate the physiological consequences of macronutrients and to provide a consistent and applicable approach. Nutrients have also been classified within themselves. CHOs are the most important of these macronutrients that the body needs to provide energy. Basically, the division of dietary CHOs was suggested at the Joint FAO/WHO Expert Consultation on Human Nutrition with Carbohydrates, which took place in Rome in 1997 (FAO, 1998). As a result, the classification is based on the level of polymerization, the kind of linkage (α or non-α), and the molecular size, which is defined by the characteristics of the individual monomers (41).

This classification divides CHOs into three main groups: sugars, oligosaccharides, and polysaccharides. The word "sugars" has historically been used to refer to foods that include mono- and disaccharides. Polyols (sugar alcohols) are also included in this group. Glucose, fructose, and galactose, the building elements of naturally occurring di-, oligo-, and polysaccharides, are the three primary monosaccharides. The main disaccharides are formed from a combination of monosaccharides called maltose, sucrose, and lactose (42).

Oligosaccharides are malto-oligosaccharides (α-glucans), which are mainly formed from the hydrolysis of starch, and non-α-glucan raffinose and stachyose (galactosides), fructo- and galactooligosaccharides and other oligosaccharides. Polysaccharides can be categorized as starch or non-starch polysaccharides (NSPs), which include important substances like cellulose, hemicellulose, and pectin, which are the polysaccharides found in plant cell walls. However, they can also encompass plant gums, mucilages, and hydrocolloids. All of these classifications are of great importance for understanding the mechanisms of action of carbohydrates in the body (43).

Lipids, another macronutrient, are important energy substrates that contribute to approximately 30% of human energy intake and are essential for the solubilization of vitamins. In chemical terms, lipids are esters of fatty acids with organic alcohols like glycerol, sphingosine, and cholesterol. Depending on their structure, physiological functions, and biological effects, fatty acids can be divided into a number of categories. However, based on their structure, they can be classified as saturated and unsaturated fatty acids. Saturated fatty acids (SFAs) can be classified into subgroups based on chain lengths and do not include double bonds. Acetic (2:0), propionic (3:0), and butyric acids

(4:0), which are generated during fiber fermentation in the proximal colon, are examples of short-chain fatty acids (SCFAs). The liver converts acetic and partially propionic acids into glucose, propionic acid, and acetic acid once they are quickly absorbed in the portal circulation. The human body's resting energy expenditure (REE) can be attributed to this process to the extent of 10–20% (44).

Medium-chain fatty acids (MCFAs) include caproic (6:0), caprylic (8:0), and capric (10:0) acids, which are directly absorbed and transported by the portal vein. Long-chain fatty acids (LCFAs) are lauric (12:0), myristic (14:0), palmitic (16:0), and stearic (18:0) acids with significant atherogenic and thrombogenic potential. Another group is unsaturated fatty acids, and this group is divided into two; monounsaturated fatty acis (MUFAs) and polyunsaturated (PUFAs). MUFAs are molecules with a single double bond, and the prominent representatives are oleic (18:1n-9c), waxenic (18:1n-7c), and palmitoleic (16:1n-7c) acids (45).

PUFA molecules have two or more double bonds. The majority of endogenous PUFAs, such as linoleic acid (LA) and alpha-linolenic acid (ALA), are members of the n-9 family and are generated in greater quantities when essential fatty acids are insufficient. These fatty acids are regarded as the parent fatty acids for the n-3 and n-6 PUFA families and are needed because humans cannot produce them. The main metabolic products are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The n-6 PUFA family's main fatty acid is LA. Arachidonic acids (AA), -linolenic (GLA; 18:3n-6), and dihomo--linolenic (DHGLA; 20:3n-6) acids are metabolic products (46).

Another important macromolecule, especially for muscle building, is protein. Proteins are key biomolecules of structure and function in cells. Proteins, formed by a specific sequence of amino acids, fulfill structural and catalytic functions (47). They are in charge of many tasks, including signaling and molecular motors. They traverse membranes to construct controlled channels, catalyze processes, carry out transport, serve as the building blocks of virus capsids, and transmit data from DNA to RNA. The widespread recognition of their participation in all cellular functions has led to focussed efforts to predict the function of proteins from their sequence or structure (48).

The proteins obtained through food can be classified as animal and vegetable proteins. However, proteins in the body can be categorized according to their structural, functional, or chemical properties. This classification is usually based on the amino acid sequence of the protein. For example, there are different classes of proteins, such as globular proteins, fibrillar, and membrane proteins. Likewise, proteins classified according to their function are enzymes, transporters, antibodies, hormones, and structural proteins. Lastly, proteins can also be classified according to their chemical properties. These include different types, such as acidic, basic, polar, nonpolar, and hydrophobic proteins (49).

Research emphasizes the importance of micronutrients as much as macronutrients for human health. In addition, micronutrients, to the many functions they perform in the body, are essential for the continuity of metabolic processes. Because minerals act as co-factors and vitamins act as co-enzymes, they play a role in the activity processes of all enzymes. Examples of important minerals for the human body include iron, zinc, magnesium, calcium, selenium, iodine, phosphorus, and chromium. In parallel, there are different groups of vitamins; A, B, C, D, E, and K are examples (50).

As mentioned above, ensuring adequate and balanced nutrition is only possible by taking all the macro and micronutrients in the amounts required by the body. In this way, metabolic processes proceed at the optimum level.

2.1.2.General Effects of Carbohydrates

Dietary CHOs are a class of organic substances with a range of physiologic, physical, and chemical characteristics. CHOs primarily act as energy metabolism substrates, but they also have an effect on satiety, blood sugar, insulin levels, and lipid metabolism. They actively contribute to numerous metabolic activities, such as colon function, bowel habits, the transit process, the balance of commensal flora, and the wellbeing of the big intestine epithelial cells, through fermentation. Additionally, they can have immunomodulatory effects and impact calcium absorption. These characteristics affect overall health, especially weight control, diabetes, cardiovascular diseases, bone mineral density, resistance to colorectal cancer, constipation, and intestinal infections (51).

CHOs start to be broken down by the digestive system into glucose molecules, which are then used as fuel. The process of breaking down CHO begins in the mouth with salivary amylase. Following digestion, the monosaccharides are broken down and absorbed into the bloodstream. The blood then carries the absorbed glucose to the cells, where it is oxidized to provide energy for cellular usage. The oxidation of glucose involves steps such as glycolysis, the Krebs cycle, and oxidative phosphorylation. As a result of these processes, adenosine triphosphate (ATP) is produced, fulfilling the energy requirements of the cells (52).

Furthermore, any additional glucose produced by CHO metabolism is stored as glycogen in the liver and muscle tissue until a greater demand for energy arises. Cells can convert glycogen back to glucose and use it as energy when needed. In summary, as CHOs are ingested, blood sugar levels rise, boosting pancreatic insulin secretion. Insulin tells cells in the body to take up glucose for energy or storage. When blood sugar levels decrease, the pancreas secretes glucagon, which signals the liver to release stored glucose (53).

CHOs are responsible for many functional properties of the foods they are found in. Sweetness is primarily associated with mono- and disaccharides, and these sugars' relative sweetness has been determined as fructose > sucrose > glucose > lactose. Sugars can also act as thickeners, whipping agents, stabilizers, fermentation agents, or emulsifiers in processed foods. The browning of cooked foods is produced by the Maillard reaction between a CHO and an amino group, while the caramelization of sugars with intense heat provides characteristic flavor and color formation in many different foods. Starches, another type of CHO, give volume and texture to foods, and their gelatinization is responsible for many desirable properties such as viscosity, texture, and clarity. In addition to their function in the cell wall structure of naturally occurring foods, gums (natural polysaccharides of plant origin) and other NSPs are used as thickeners, stabilizers, and gelling agents in food processing. These indigestible carbohydrates can contribute significantly to the volume and structure of the foods in which they are present (53,54).

CHOs provide about 4 kcal/gram of energy. Although individual needs vary, healthy adult diets should include 45% to 65% CHOs as part of the daily consumption, which equates to around 200 g to 300 g per day (55).

As mentioned above, a diet should be nutritionally balanced, including the appropriate types and amounts of CHOs. Excessive or inadequate intake of CHOs can impact both physiological and metabolic functions. Obesity, which increases the risk of various conditions such as cardiovascular disease, can be exacerbated by an increase in simple CHOs (56). Similarly, higher CHO consumption leads to the growing epidemic of insulin-dependent diabetes (type 2 diabetes). On the other hand, foods high in NSPs and low in GI protect against diabetes. At this point, the quality of the CHOs consumed comes to the fore (56).

2.1.3.Carbohydrate Quality Index

CHOs are the only nutrient that directly increases blood sugar levels. However, community-based studies indicate that the type of CHOs is more important than the proportion of CHOs in the diet regarding the risk of chronic diseases. Refined grains, potatoes, and sugary beverages are associated with an increased risk of chronic diseases, while unprocessed grains, legumes, and whole fruits are associated with a decreased risk. This distinction may partially explain the differences in the post-meal effects of specific CHOs on hyperglycemia and hyperinsulinemia, which are linked to cardiovascular disease, diabetes, and obesity (57,58).

Dietary CHOs, as stated, include compounds that are digestible or can be directly converted into glucose metabolically or compounds that undergo oxidation in the form of pyruvate, including certain sugar alcohols (e.g., sorbitol). At this point, various systems with varying levels of relevance to health outcomes are used to classify and determine the type of CHOs (59).

In this general classification, CHOs are divided into simple and complex CHOs. Simple CHOs have a simple chemical structure comprising one or two sugar molecules (monosaccharides or disaccharides). They are easily used for energy because of their basic structure. They are quickly absorbed and induce a spike in blood sugar levels. They are often consumed due to their sweet taste but are generally not nutritious. Simple CHOs include fructose, lactose, maltose, sucrose, glucose, and galactose.

Confectionery, soft drinks, corn syrup, fruit juice, honey, and table sugar are among the food sources of these CHOs (60).

They are indigestible complex CHOs that serve as bulk-forming agents. Complex CHOs are molecules composed of three or more sugars (oligosaccharides and polysaccharides) linked with a more complex chemical structure. Complex CHOs are digested over a longer period of time, providing a prolonged feeling of satiety and exerting a more gradual effect on blood sugar levels. Complex CHOs include cellobiose, amylose, cellulose, dextrin, and raffinose (61). Food sources of complex CHOs include whole grains, vegetables, legumes, and brown rice. Starch is one of the complex carbohydrates consisting of many glucose molecules arranged in long chains. It is referred to as the primary form of nutrient storage produced by plants. Food sources of starch include potatoes, corn, wheat, and pasta.

Another beneficial complex carbohydrate often mentioned for health is fiber. Fiber contains components such as cellulose, hemicellulose, and pectin, which promote the growth of healthy bacteria in the colon and facilitate easier bowel movements (62). Fiber is classified as soluble or insoluble. Soluble fiber absorbs water and is slowly broken down by the digestive system. It helps lower blood cholesterol and LDL levels and prevents rapid spikes in post-meal blood sugar levels. Examples of soluble fiber include beta-glucan, pectin, and inulin. On the other hand, insoluble fiber does not dissolve in water and passes quickly through the digestive system. This type of fiber enhances bowel mobility, reducing the risk of constipation. In the intestines, it absorbs water, softening and thickening the stool. Insoluble fiber includes cellulose, lignin, and hemicellulose (63).

According to epidemiological research, lower intakes of dietary fiber and whole grains are related to an increased risk of being overweight or obese. One probable mechanism for this link is that low-energy diets high in dietary fiber provide a longer feeling of satiety than highly processed foods. The feeling of satiety allows for better control of food intake, which in turn reduces energy intake (64,65).

Most naturally occurring foods contain a variety of CHO species, both simple and complex, as well as other macro- and micronutrients and a variety of non-nutritive compounds. Many carbohydrate-rich meals high in CHOs are also high in protein, fiber, and micronutrients, and they fit dietary requirements for moderate fat intake. On the other hand, there are a few carbohydrate-rich foods that include largely complex CHOs but have a poor nutritional density and/or a high fat content and may be considered less "nutritious." Clearly, judging a food's nutritional worth based on the structural form of CHOs is flawed, and the introduction of foods containing considerable amounts of both simple and complex CHO types complicates matters even further (54). For this reason, only having simple or complex CHOs is an insufficient distinction in determining CHO quality.

At this point, the GI, determined by the effect of nutrients on the postprandial glucose response, appears as an alternative system for classifying carbohydrate-containing foods. Low GI: 0-55, Medium GI: 56-69, High GI: 70 and above. GL, a similar concept, is a product of GI and carbohydrate content. The GI compares foods based on a standard amount of available carbohydrates. GL multiplies the GI by the amount of carbohydrates in a typical serving, allowing the glycemic impact of foods, meals, and entire diets to be realistically compared as consumed (66).

Studies have shown that low GI or GL foods reduce levels of being overweight or obese (67,68). The GI or GL's satiating effect has been considered as a probable mechanism at this time (69).

Short-term dietary studies in adolescents (70) and adults (71) reveal that eating high GI test meals promotes food intake at subsequent meals and that eating low GI meals may prolong fullness. Based on this, the association of dietary low GI intake with obesity is noted to be inversely related. Generally, refined grains are reported to have higher glycemic indices. Therefore, refined or whole grains can also be a criterion for determining the carbohydrate quality of food. Refined grains are products obtained during the processing of whole grains and are lower in fiber, vitamins, and minerals than whole grains (72). This process is called the refining of grains and reduces their nutritional value as they lose much of their fiber, vitamin, and mineral content during processing (73). Products such as white flour, white rice, white bread, and pasta are examples of refined grains.

However, the effects of the physical form of CHOs (solid or liquid) on satiety and total energy intake have been the main focus of the latest research and have been characterized as a discriminating factor in determining CHO quality. The consumption of sugar-sweetened, high-calorie beverages with added sugar by adults and adolescents has increased over the last decade. Increased intake of sugary beverages has been linked to an increase in the obesity pandemic in both children (74) and adults (75). At this point, the beverage sector also contributes to the obesity epidemic by increasing the consumption of fructose and high fructose corn syrup, which are widely used as sweeteners.

According to one study, energy ingested in liquid form may result in less satiety than the energy consumed in the solid form of the same foods. Rapid passage of liquids through the stomach and intestines may result in less stimulation of satiety signals, changes in thirst and hunger management, and a decreased cognitive awareness of the calorie content (76).

As a result, the carbohydrate quality index (CQI) varies depending on the CHOs digestibility and nutritional value. Fiber content, refined grain content, whole grain content, GI, and physical form are among the characteristics that affect CQI.

2.1.4.Carbohydrate Intake in Women

CHOs are essential for normal brain function and glucose homeostasis (77). The brain depends on glucose as the primary energy source, and CHOs are the body's main glucose source. CHOs are also involved in brain metabolism. They are required in various events, including regulation of insulin release, neurotransmitter synthesis, and serotonin concentration (78). Therefore, adequate daily CHO intake is important for all individuals.

The recommended daily CHO intake for women depends on age, level of physical activity, and health status. According to the Northern European Dietary Guidelines 2004 (79), adults' recommended daily CHO intake is 45-60% of total energy intake. Exceeding or falling below these levels may lead to various health problems. For example, a study of Australian women footballers revealed that some women athletes might be at risk of low energy availability due to inadequate CHO intake (80).

However, high CHO intake in women has been associated with an increased risk of obesity. Obesity develops due to excessive fat accumulation in the body due to high energy intake (81). The spread of urbanization, changing modes of transportation, sedentary lifestyle adoption, and high-fat and high-calorie food consumption have contributed to the rising obesity rates. According to the WHO data, the number of individuals with obesity exceeded 650 million worldwide and 16 million in our country in 2016 (82). Turkey has become the country with the highest prevalence of obesity in Europe, with a prevalence of 29.5% (83). When the prevalence is evaluated according to gender, it is reported that it is more common in women (11% in men and 15% in women) (81-83). Unhealthy eating behaviors such as high fat, sweet/salty snacks, consumption of carbonated drinks, foods with high GI, and low consumption of fruits and vegetables are directly related to obesity (84). In a study conducted in Canada with 4,451 participants investigating the relationship between carbohydrate intake and obesity, it was noted that individuals in the highest CHO intake category consisted of more women compared to those in the lowest intake category. The same study also mentioned that obesity is more prevalent among women (85).

Similarly, higher carbohydrate intake is linked to an increased risk of metabolic syndrome in women. In 1998, the WHO defined metabolic syndrome as the occurrence of at least two of the following: diabetes, impaired fasting glucose, impaired glucose tolerance or insulin resistance, hypertension (>160/90 mmHg), hyperlipidemia, central obesity, and microalbuminuria (86). The prevalence of metabolic syndrome in our country has been noted to be higher in women compared to men (40% in women, 28% in men). When providing recommendations for medical nutrition therapy in metabolic syndrome, the importance of consuming 50-60% of calories from carbohydrates and a daily intake of 20-30 grams of fiber has been emphasized. Therefore, it is highlighted that carbohydrate intake, which is the primary source of energy, should be sufficient to avoid increasing energy intake and to reduce the risk of obesity and metabolic syndrome (87).

Carbohydrate intake has been the subject of research in many fields besides obesity and metabolic syndrome. For example, in a study on the relationship between emotional eating behaviors and carbohydrate consumption, women had higher scores in emotional and uncontrolled eating behaviors than men. When all participants were analyzed, a significant negative correlation was found between lean mass and emotional eating behavior. For women, a positive correlation was noted between uncontrolled eating behavior and the percentage of carbohydrate intake. The only significant correlation for men was between fat intake as a percentage of total calorie intake and uncontrollable eating behavior. Women's higher emotional eating and uncontrollable eating scores supported the theory that women are more affected by emotional factors than men and therefore have more difficulty maintaining body weight than men (88).

Moreover, according to a different study, women prefer desserts such as ice cream, chocolate, and cake to cope with stress, while men prefer salty snacks such as pizza and meat. Therefore, it is critical to maintain control of women's carbohydrate intake and diagnose the effect of carbohydrate types on women (89).

2.1.5.The Effect of Carbohydrates on Mood

A condition of total physical and mental well-being is defined as being healthy. As a result, research on mental health has increased in recent years. Mental health refers to the state of an individual's mental well-being and being free from mental illnesses. This condition is related to the individual's emotional, social, and psychological well-being. Mental health enhances an individual's quality of life and increases functionality in daily life (90).

Psychological well-being encompasses traits such as feeling good, having positive thoughts, self-confidence, coping with stress, and establishing positive relationships (91). Mental disorders associated with stress, such as mood disorders or anxiety disorders, have long been recognized as the most prevalent and burdensome psychological disorders, affecting approximately 10% to 25% of women and 5% to 12% of men annually. In summary, achieving psychological well-being is possible through the control of emotions. Emotion generally refers to how an individual feels and the impact of those feelings on the individual. In this regard, the concept of "emotion" is considered in terms of its positive and negative aspects and the crucial importance of its influence on individuals (92).

Many environmental and physical factors can affect one's mood, and research (93,94) has shown a relationship between nutrition and emotions. Mood can influence individuals' food choices. The relationship between dietary behaviors and mood is thought to be bidirectional. Therefore, using foods that promote resilience or enhance mood is highly valuable. However, surprisingly little is known about food's effects on mood and cognition. It is believed that there may be foods that make individuals more resilient to mood fluctuations. For example, in a study investigating carbohydrate consumption in young adults in New Zealand, participants who followed a diet rich in fruits and vegetables reported feeling calmer, happier, and more energetic (95).

As a result of studies focussing on carbohydrate consumption, the term "comfort food" emerged. These foods refer to foods that are believed to alleviate negative emotions and strengthen positive emotions. Consuming stress-reducing foods is a type of response to the experienced mood. While stress-reducing foods may vary depending on culture, they generally contain high carbohydrate content (96). At this point, serotonin theory appears as an explanatory mechanism for the relationship between carbohydrates and mood. Selective serotonin reuptake inhibitors and monoamine oxidase (MAO) inhibitors that raise serotonin levels in the brain are the most commonly defined medications in the treatment of mood disorders. However, with the medication side effects that have been reported, the idea of using nutrients as a therapeutic emerges. Since serotonin levels in the brain depend on the accessibility of food-derived precursor tryptophan, tryptophan levels in food seem to play a major part in the relationship between food consumption and our mood. Accordingly, foods high in tryptophan, such as chicken, soybeans, tuna, almonds, and bananas, may be beneficial for enhancing mood and cognition. (97).

Various Pharmacological trials have established that products that boost tryptophan (Trp) are effective levels in the body and also increase serotonin levels in the brain and modulate the processing in mood-regulating neural circuits, thereby improving mood (98, 99). Therefore, controlling the intake of Trp through food significantly affects mood regulation and well-being. Serotonin, also known as 5-hydroxytryptamine (5-HT), is an ancient monoamine that can be synthesized even by some single-celled organisms. Besides its functions in the cardiovascular and gastrointestinal systems, serotonin is a significant neurotransmitter with many actions occur in various regions of the brain. As a hydrophilic molecule, 5-HT cannot cross the

blood-brain barrier, so it is synthesized in the brain, particularly in the raphe nuclei where serotonergic neurons are located, by the enzyme tryptophan hydroxylase 2 (TpH2). The raphe nuclei are clusters of nuclei that project to regions involved in processing emotions and stress. In the brain, 5-HT synthesis occurs in the axon terminals of serotonergic neurons, where TpH2 carries out the rate-limiting step. TpH2 hydroxylates L-tryptophan to form 5-hydroxytryptophan, which is then decarboxylated by aromatic L-amino acid decarboxylase to produce 5-HT, that are stored in vesicles within serotonergic neurons (100).

The intake of Trp through food is necessary for all these mechanisms to occur. The precursor molecule Trp is absorbed from food into the bloodstream. When a meal containing protein is consumed, a large portion of the Trp entering the portal vein is metabolized in the liver, which does not occur with other large neutral amino acids (LNAA). Therefore, compared to other LNAA, the amount of Trp entering circulation is much lower when consumed in the same quantity. At this point, consuming a high-protein meal would reduce the amount of Trp entering the brain, thus decreasing serotonin synthesis. However, in response to CHO intake, insulin secretion allows most amino acids in the blood, except Trp, to be absorbed by muscle tissues and reduces plasma concentrations of LNAA. As a result, the level of Trp in the blood relatively increases compared to other amino acids. Therefore, Trp binds to albumin and is transported to the brain in this form. Once inside the brain, Trp is taken up by the serotonergic cells of the raphe nuclei and converted to 5-HT through the two enzymatic reactions described above. In summary, Trp must compete with other LNAAs to pass through cell membranes for serotonin synthesis from dietary Trp. In this case, whether a meal increases plasma Trp levels relative to other LNAA plasma levels depends on the amount of protein digested and insulin release (101,102).

Considering these mechanisms, the consumption of carbohydrates increases Trp input to the brain, thus creating an instant effect of happiness and comfort. However, it should be kept in mind that this may lead to a vicious circle, and foods high in carbohydrates may cause drops or rises in blood sugar accompanied by fluctuations in adrenaline or epinephrine, often called the "stress hormone." Accordingly, increased consumption of refined carbohydrates and sugars may worsen the stress response (96).

2.1.6.Relationship Between Stress and Nutrition

In recent years, stress levels have been increasing due to changing global conditions, natural disasters, and pandemics. According to estimates by the WHO, approximately 33% of the worldwide population is dealing with stress. It has been reported that this rate may be slightly higher in women compared to men. Similarly, these estimates can vary from country to country due to differences in data for each country (103).

Stress is a term used to describe emotionally and physiologically demanding situations. When making definitions, "good stress" typically refers to experiences with a limited duration and can be managed by an individual, leaving a sense of vitality and achievement. On the other hand, "bad stress" or "being stressed" refers to experiences that lack a sense of control and mastery and are usually long-lasting or repetitive, emotionally draining, physically exhausting, or potentially dangerous. The prominent characteristic of the stress response is the activation of the autonomic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis. The conventional way of characterizing the behavioral and physiological reaction to a threat from a dangerous circumstance, such as a predatory animal, a robber, an accident, or a natural disaster, is the "fight or flight" response. Severe and prolonged exposure to stress disrupts homeostatic processes, which can impair the functioning of multiple organ systems and lead to a variety of diseases. In addition, stress is important in the pathophysiology of practically all psychological diseases, particularly depressive disorders. (104).

When the effects on food intake are analyzed, it has been shown that stress increases the consumption of "comfort food." For example, it has been reported that individuals with binge-eating or night-eating syndrome are generally defined as chronically stressed and have a higher incidence of obesity. The foods that these individuals consume in high amounts are comfort foods with high fat and carbohydrate content (105,106)

However, it is not necessary for a diagnosed eating disorder or psychiatric problem for individuals to exhibit a tendency to turn to high-carbohydrate comfort foods during periods of low mood. This phenomenon is particularly common in developed countries and contributes to the obesity epidemic. High-carbohydrate foods, as described above with the serotonin theory, can uplift people's moods and make them

feel better. However, the habitual use of these foods, perhaps as a result of underlying stress factors stimulated by abnormally high cortisol concentrations, leads to abdominal obesity. In acute stress conditions, increases in brain serotonin may promote stress adaptation, thereby contributing to the initiation and termination of cortisol responses through different serotonergic pathways in the brain (107).

Increased activity of serotonergic neurons in the brain is an established consequence of stress, and decreased activity of these serotonergic neurons has been shown to be effective in mood disorders and depressive disorders. Increased activity of the central serotonergic system is therefore considered a biological condition for coping with stress and preventing stress-induced depression. Since higher serotonergic activity during stress results in increased serotonin breakdown, its expenditure at the time of ongoing stress exceeds its synthesis and may lead to a functional deficiency in the supply of this neurotransmitter. As a result, mood and cognitive performance disorders begin, and the tendency to depression increases. Depletion of Trp, a precursor of serotonin production, has been shown to promote depressed mood in both healthy and depressed subjects (108).

Accordingly, in the short term, during acute stress or in societies where there is no immediate and continuous access to comfort foods, relieving stress with occasional sweet or fatty foods with rapid serotonergic activity may be a good effect. On the other hand, trying to relieve the effects of stressors in the central chronic stress response network controlled by Corticotropin Releasing Factor (CRF) with high-carbohydrate foods may be detrimental to health in the long term (107).

Previous research has demonstrated that stress increases neuropeptide Y, which triggers hunger. Additionally, stress-sensitive adrenal steroids specifically modulate neurotransmitters such as neuropeptide Y and galanin, which affect appetite through noradrenergic systems (109). The following research has revealed that those who are under chronic stress tend to acquire weight over time due to an increase in appetite. It has been hypothesized that this effect may be attributed to the increased reactivity of cortisol, commonly known as the stress hormone, which can lead to post-stress eating (110).

With the increase in stress levels, medical treatment solutions have started to increase, and alternative ways have started to be searched. At this point, functional foods come to the fore instead of instant comfort foods. The aim of functional foods is to improve or maintain the quality of life in mental health before medical treatment is required. Probiotics and prebiotics are among the functional foods that have come to the fore in recent years (111). Probiotic and prebiotic foods act by improving the microbiota of individuals. It has been observed that the disruption of the gut microbiota can negatively affect the gut-brain axis and trigger various psychiatric disorders. Similarly, it has been noted that stress can also disrupt the gut microbiota (112, 113).

Therefore, the effects of probiotics and prebiotics on psychological disorders have been the subject of research. For example, in a study investigating the effect of probiotic supplementation on healthy individuals with stress-related nausea and abdominal pain, it was concluded that the stress-induced digestive problems of individuals improved. For this reason, it is thought that probiotics, prebiotics, which generally contain complex carbohydrates, and other functional foods may have a preventive effect on the development of emotional disorders and that those who eat a balanced diet are less likely to suffer from emotional illnesses. (114)

2.1.7.Relationship Between Anxiety and Nutrition

Stress, fear, and anxiety have been among the most critical problems of human beings throughout the ages. As stated by Maslow (1970), security is one of the most basic needs in the hierarchy of needs. People want to feel safe. Therefore, they are afraid of things that are unfamiliar and unknown to them (115). In past lives, people could not be protected from earthquakes, floods, fires, droughts, severe cold and storms, wild animals, and epidemics. They have experienced great fear when faced with these situations.

With the advancement of medicine and technology in modern times, people have been able to protect themselves from many dangers that primitive humans faced. However, they have now started to encounter new problems. Especially with the increase in population, natural resources have begun to deplete, and a portion of the world's population is facing hunger and malnutrition. Additionally, the emergence of chemical waste has led to the contamination of drinking water and oceans, surpassing the limits that threaten the lives of all organisms living in these environments. The

depletion of natural resources and human-caused fires in the Amazon rainforest and many parts of the world contribute to air pollution.

On the other hand, uncontrolled use of greenhouse gases leads to global warming, posing a threat to the lives of all living beings. With the influence of mass media, individuals aware of all these problems facing humanity often experience fear and anxiety about the future. As a result, the prevalence of anxiety in society is increasing (116).

Anxiety is a complex emotion characterized by difficult-to-define feelings of fear and worry. It may be accompanied by sensations such as a tightness in the chest, rapid heartbeat, sweating, headaches, a sense of emptiness in the stomach, and an immediate urge to use the restroom. Restlessness and the desire to pace around are also common symptoms of anxiety. When anxiety is experienced without any tangible threat, occurs frequently and severely, and begins to impact a person's daily life, it indicates an anxiety disorder. The clinical manifestations of anxiety vary significantly from person to person. Some individuals primarily experience muscle tension and complain of stiffness, headaches, and neck pain.

Similarly, jaw pain due to clenching of teeth can also be seen. Anxiety disorders include panic attacks, panic disorder (with or without agoraphobia), agoraphobia without panic disorder, specific phobia, social phobia, obsessive-compulsive disorder, posttraumatic stress disorder, acute stress disorder, generalized anxiety disorder, anxiety disorder due to a general medical condition and anxiety disorders caused by substance abuse (117).

In the general approach to anxiety, a medical cause, the effect of substances, toxins, or medication, whether it occurs in specific situations, the characteristics of the problem, the losses it causes, current and past coping mechanisms, triggers, consequences, factors that exacerbate or alleviate the problem, the patient's interpretation of the problem, and the patient's lifestyle should all be evaluated (118).

However, anxiety is often associated with depression. According to research, it has been found that 75% of patients with depression also have an anxiety disorder. Therefore, while depression and anxiety disorders are frequently observed together, they cannot be treated independently of one another. Treatment approaches for depression accompanied by anxiety disorder are very similar to those utilized for depression

patients. But in patients with depression accompanied by an anxiety disorder, the medication dosage should be higher than what is typically used for depression alone. The medication used in these patients should effectively alleviate symptoms of both disorders. During therapy, a coordinated and solution-focused approach should be taken for depression and anxiety disorder. If therapy only focuses on treating one of the disorders, complete recovery may not be achieved (119).

In addition, the presence of anxiety is thought to be associated with eating habits. According to Elfhag et al., women often prefer sugary foods to justify psychological aspects and a sense of comfort. Anxiety, one of the most common emotions in society, contributes significantly to increased Emotional Eating behavior (120). Reports indicate that approximately 50% of women have some form of eating disorder, which is often associated with anxiety symptoms (121).

In recent years, it has been observed that the pandemic, which the whole world has been fighting as a common problem, has also increased anxiety levels. Accordingly, it was stated that during the pandemic, the fondness for sugary foods increased, and the tendency towards high carbohydrate-containing foods was higher (122).

Another study conducted during the Covid-19 pandemic examined the relationship between anxiety and nutrition. In this study, 452 people aged 20-65 living in Istanbul were surveyed using the Beck Anxiety Scale and the Dutch Eating Behaviour Questionnaire. As a result of the study, women's anxiety rates were higher than men's. Individuals with high levels of anxiety have been found to have fewer meals but a higher tendency towards consuming high-sugar foods. This study did not find a relationship between emotional eating and anxiety. However, a significant relationship was found between anxiety and external eating behavior. External eating behavior is driven by stimuli such as the smell and appearance of food, even without physiological hunger. In fact, while eating behavior is not planned, the perceived characteristics of the food in the environment initiate eating. Foods that trigger external eating behavior are typically energy-dense foods high in fat, sugar, and refined grains (123). In another study on the relationship between food groups and anxiety, the anxiety rate was lower in groups fed a Mediterranean diet, had higher fruit and vegetable consumption, and drank less alcohol (124).

According to the findings of a study investigating the relationship between nutrition habits and depression, anxiety, and stress levels of high school women students, it was observed that fast food consumption and high salt intake parallel anxiety levels. Therefore, it has been suggested that healthy eating habits can reduce anxiety and support a healthier mental state (125).

Similar to the research on stress mentioned above, it has been suggested that probiotic consumption can also improve anxiety levels. A study has supported the positive effects of probiotics on anxiety by their impact on the gut-brain axis and central nervous system, as well as their ability to modulate neurotransmitter activity. The findings of this study indicate that both probiotics and prebiotics have alleviating or preventive effects on both anxiety and depressive symptoms (126). Therefore, it is believed that balanced nutrition and the consumption of functional foods can reduce the prevalence of anxiety in society. However, more research is needed in this field.

2.1.8.Relationship Between Depression and Nutrition

Depression is a type of psychological disease that has been the research subject for many years. However, it has been observed in recent years that the prevalence of depression is increasing parallel to stress and anxiety. Classification efforts for depression date back to the 4th century BC, and Hippocrates introduced the term "melancholia" (black bile) (127).

Until the 170s AD, melancholia was mainly described as a broad-spectrum mental illness until Galen, a Bergama physician, and philosopher, defined it. However, Galen defined melancholia as depression, fear, hatred towards others, and dissatisfaction with one's life. In addition to Galen, Ibni Sina, in the 11th century, defined melancholia as different moods and stated that different depressive states occur due to the combination of fluids in the individual's body at different rates. With this idea, he is considered a precursor to the modern neurotransmitter hypothesis. By the 21st century, advancements in technology and the research conducted by various scientists led to an increased understanding of monoamines. Consequently, depression is now grounded in physiological foundations rather than mere assumptions (128).

In general, depression is defined as a loss of confidence in themselves that lasts for days, months, or even years, inability to enjoy what they do and life, reduced energy, decreased concentration, feelings of guilt, pessimism, thoughts of self-harm or suicide, disruption in sleep patterns, changes in appetite and decreased libido. Social and occupational functioning is impaired in depressed individuals. To be diagnosed with depression, the picture must last at least two weeks. Each episode of depression can be of different severity. The number, type, and intensity of symptoms determine the severity of depression. DSM-IV-TR classifies the severity of depression into three groups mild, moderate, and severe (129).

In summary, depression is a mood disorder, and according to research, it is one of the most prevalent psychological disorders. Epidemiological data indicate that approximately 13% of women and 8% of men experience depression in any year (130). The Turkey Mental Health Profile Study reported a prevalence rate of 2.3% in men, 5.4% in women, and an overall rate of 4% for depressive episodes (130). As observed, the rate of depression is twice as high in women compared to men. The emergence of depressive symptoms in individuals can be attributed to various factors such as medical illnesses, low socioeconomic status, living alone, divorce, unemployment, loss of a parent, spouse, or child, childhood trauma, stressful work or family environment, and substance or alcohol use (131).

Depression is also the subject of many physiological studies. Norepinephrine and serotonin neurotransmitters are important biogenic amines emphasized in the physiopathology of depression. Dopamine is noted as another biogenic amine involved in the physiopathology of depression. Adrenal, thyroid, and growth hormone axes are the main neuroendocrine mechanisms involved in depression. Therefore, neuroendocrine regulation is very important in depression. In addition, excessive cortisol release is known to occur in depression (132).

As mentioned in the relationship between anxiety and nutrition, it is observed that many individuals exhibiting symptoms of depression also have anxiety disorders. According to a previous study, it was found that the risk of developing anxiety disorder increased by 3.3 to 8.2 times in individuals diagnosed with major depression (133). Conversely, it has been calculated that individuals diagnosed with an anxiety disorder have an increased risk of experiencing depression within one year ranging from 7 to 62

times. From this, it can be inferred that psychological disorders can trigger each other, and an integrated approach to treatment can lead to overall recovery (134).

While treating depression, selective serotonin reuptake inhibitors (SSRIs), serotonin-norepinephrine reuptake inhibitors (SNRIs), and drugs that act on dopamine and other serotonin receptors are commonly used. However, in recent years, the increasing use of antidepressants has led to an approach to exploring the therapeutic effects of foods. While further research is needed in this area, the potential of different nutrients to reduce depressive symptoms is not overlooked (135). Recent studies have suggested new therapeutic applications for omega-3 PUFA in the treatment of mental illnesses, including depression (135-137). It has been shown that in major depressive disorder, interleukin, tumor necrosis factor (TNF)-α, C-reactive protein and inflammatory biomarkers are increased. At this point, the positive effect of omega-3 PUFA on depression is thought to be related to their abundant presence in the human nervous system and their anti-inflammatory capacities, which may help counteract the inflammatory processes that occur in depression (135-137).

According to a study on older adults, poor quality of life is closely associated with adverse outcomes such as frailty, cognitive decline, and increased risk of death. It has been proposed that the anti-inflammatory and antioxidative qualities of diet can lower inflammatory cytokine release, inflammation in the brain, oxidative stress in the specific brain region, and thereby alleviating depression (138).

Similarly, it has been determined that poor-quality nutrition, prevalent in the United States, is identified as a modifiable risk factor for depression. Balanced dietary patterns like the Mediterranean diet and specific foods like fish, fresh vegetables, and fruits have been associated with a lower risk of depression or depressive symptoms (139).

Positive effects of probiotics, such as anti-inflammatory foods, on depressive symptoms are observed. The consumption of probiotics with neurotransmitter activity, such as gamma aminobütirik asit (GABA), 5-HT, and dopamine, has been observed to have therapeutic effects on some metabolic diseases, depressive disorders, and anxiety disorders (126).

Additionally, specific nutrient compounds such as calcium, chromium, folate, polyunsaturated fatty acids, vitamin D, vitamin B12, zinc, and magnesium have been suggested as adjunctive treatment strategies in antidepressant therapy (139). Recently, a study investigating findings from two Australian cohorts has shown that high dietary zinc intake is associated with a reduced incidence of depression in both men and women (140).

In a study focusing on oral magnesium supplementation for depression treatment in elderly individuals with type 2 diabetes, according to reports, magnesium reduces depressive symptoms and has a comparable effect to the antidepressant medication imipramine. A study has also suggested that chromium, similar to zinc and magnesium, may improve symptoms of depression (141).

Nutrients are thought to have healing effects as well as triggering depression. For example, a study by Sánchez-Villegas et al. (2017) found that higher consumption of added sugars and sugary drinks was associated with an increased risk of depression in Spanish university graduates. The study also found that a higher dietary carbohydrate quality index was associated with a reduced risk of depression (14). In contrast, research by Krikorian et al. concluded that a very low carbohydrate diet improved verbal memory performance in older adults with mild cognitive impairment but had no effect on depressive symptoms (142).

According to the findings of a study conducted with 3654 participants of advanced age, individuals with high consumption of vegetables and fruits have reported reduced symptoms of depression. The same study also noted an inverse correlation between total fiber intake, plant fiber intake, cereal/grain fiber intake, and the prevalence of depressive symptoms (143).

In summary, there is a definite relationship between nutrients and depression. However, the results of all these studies are insufficient to reach a clear conclusion about the mechanisms involved and which nutrients play a prominent role. More research is needed to understand the relationship between food and mood fully. This study aims to observe the relationship between carbohydrate quality and depression and contribute to scientific understanding. Similarly, the impact on anxiety and stress will also be investigated.

3. MATERIAL AND METHODS

3.1.Population

The participants of this study were volunteer women aged 18 years and over who applied to the Bursa Neslihan Gönder-Aesthetic Center/diet outpatient clinic in Bursa. According to the sample size calculation for 5 months between April 2022 and September 2022, the targeted 152 participants were reached with a %95 confidence interval and %50 effect level. Participants under 18 years of age, men, pregnant and lactating women, and women with psychological diagnoses such as schizophrenia or bipolar disorder were excluded from the study. After collecting the data, participants whose refined grain consumption was determined as 0 g in the food consumption records were excluded from the study to avoid an undefined refined grain/whole grain ratio. Analyses continued with over 140 participants. Data were collected face-to-face from volunteer women aged 18-60. A data collection form was used to determine the age, occupational status, educational status, marital status, and cigarette-alcohol use of the women participating in the study. Depression Anxiety Stress Scale (DASS-42) was applied face-to-face to measure depression, anxiety, and stress levels.

The DASS-42 scale was used to determine the depression, anxiety, and stress levels of individuals. Lovibond & Lovibond invented it in 1995. The scale was validated in Turkish by Bilgel & Bayram in 2010 (30). It has been concluded that the Turkish version of the DASS-42 scale can be used to evaluate depression, anxiety, and stress as a highly valid and reliable scale in populations that do not consist of clinical cases (144). Items marked with D (14 items) indicate depression, items marked with A (14 items) indicate anxiety and items marked with S (14 items) indicate stress. The scores corresponding to the answers to these questions were shown on the scale. Depression, anxiety, and stress scores were collected separately, and total depression, total anxiety, and total stress scores were found and evaluated as indicated in table 3.1.

Table 3.1. DASS-42 Scale

	DEPRESSION	ANXIETY	STRESS
NORMAL	0-9	0-7	0-14
LIGHT	10-13	8-9	15-18
MEDIUM	14-20	10-14	19-25
HIGH	21-27	15-19	26-33
VERY HIGH	28+	20+	34+

Body weight and body fat ratio were measured with the TanitaMc780 device as an anthropometric measurement. Height, waist circumference, and hip circumference were measured in accordance with the guidelines of the WHO. Body mass index (BMI) (kg/m^2) was calculated as weight in kilograms divided by height in meters squared. Food consumption records of the participants for 3 days (2 days on weekdays and 1 day on weekends) were collected in written form. The dietary carbohydrate quality index of the participants was calculated from the food consumption records collected.

3.1.1.Carbohydrate quality index

Dietary carbohydrate quality was estimated using dietary crude fiber consumption, dietary GI, whole grain/total grain ratio, and solid carbohydrate/total carbohydrate ratio.

The intake of crude fiber is primarily a measure of cellulose and lignin concentration. It is the residue of plant materials that remain after solvent extraction and subsequent digestion with diluted acid and alkali. Fruit and vegetable fiber intake accounts for a greater proportion of dietary fiber than grain and legume fiber intake. (145). Since the crude fiber content of foods could not be determined precisely, and there was insufficient data, the fiber ratio was taken as a basis for the study. The fiber contents of foods were calculated using Nutrition Information System (BeBiS). Total grain intake was calculated by summing the consumption of whole grains, refined grains, and food derived from these grains.

In the study, liquid carbohydrate intake consisted of sugary drinks and fruit juices. All carbohydrate-containing solid foods were included in the solid carbohydrate consumption (Solid carbohydrates/Liquid carbohydrates + solid carbohydrates). While calculating the dietary GI, various sources, such as international tables (146) and BeBiS, were used.

For the CQI calculation, participants were divided into quintiles for each of the four factors. In the second stage, the first quintile (Q) received one point, while the fifth quintile received five points. The scoring for the Dietary GI worked in reverse. So the first quintile got 5 points, and the fifth quintile got 1 point. For example, participants with the lowest GI in their diets received 5 points, while participants with the highest GI received 1 point. Finally, the points in all values were totaled.

In summary, the participants were given a value according to the quintile for each group, and after summing all the values of each group, the CQI was determined by dividing the individuals into quintile groups according to the total score. Q1 represented the group with the lowest dietary carbohydrate quality, and Q5 represented the group with the highest. The carbohydrate quality score range is shown in Table 3.1.1.

Table 3.1.1. Carbohydrate quality score range

	Score
Q1	4-8
Q2	9-10
Q3	11-12
Q4	13-14
Q5	15-20

3.1.2.Antropometric Measurements

According to the WHO classification [147], a waist circumference of 80 cm in women was considered an increased metabolic risk; 88 cm in women was considered a significantly increased metabolic risk. Waist-hip ratio ≥0.85 in women was considered a significantly increased metabolic risk. BMI values are shown in Table 3.1.

Table 3.1.2. Body Mass Index Values:

	BMI
Underweight,	18.50 kg/m^2
Normal Weight	18.50-24.99 kg/m^2
Overweight	25.00-29.99 kg/m^2
Obese	30.00-39.99 kg/m^2
Severe Obese	≥40.00 kg/m^2

3.1.2.Statistical Analysis

Statistical evaluation was performed with IBM SPSS 20.0 (SPSS Inc., Chicago, IL, USA) package program. The test for conformity to normal distribution was evaluated by the Kolmogorov-Smirnov test. Numerical variables showing normal distribution were expressed as mean +/- standard deviation, numerical variables not showing normal distribution were expressed as median (25th-75th quartile), and categorical variables were expressed as frequency (percentages). When the number of groups was two, the Student t-test was used for numerical variables with normal distribution, and Mann Whitney U Test was used for numerical variables without normal distribution. When the number of groups was more than two, one-way Analysis of Variance (ANOVA) was used for numerical variables with normal distribution, and Kruskal Wallis Test was used for numerical variables without normal distribution. The relationships between numerical variables were obtained by correlation analysis. $p<0.05$ was considered sufficient for statistical significance.

4. RESULTS

In this study, out of the analyzed data from 140 women participants, 30% were in the age range of 18-24, 33.5% were in the age range of 25-40, and 36.4% were over 40 years old. It was determined that only 3 participants over 40 years old were in menopause. Table 4.1 shows the general characteristics of the participants.

Table 4.1. General characteristics of participants

Variable	n(%)
Age	
18-24	42(%30)
25-40	47(33.5)
40≥	51(36.4)
Cigarette Smoking	
None	80(57.1)
Smokers	60(42.9)
Alcohol Consumption	
None	55(39.3)
Often	7(5.0)
Social Drinker	78(55.7)
Physical Activity	
Sedentary	30(21.4)
Non-sedentary	110(78.6)
Chronic Disease	
Healthy	115(82.1)
Patient	25(17.9)
Medication Use	
None	110(78.6)
Uses	(30(21.4)
Menopause	
Yes	3(2.1)
No	137(97.9)

When evaluating the participants' chronic disease status, it was noted that a large majority (82.1%) did not have any chronic diseases, while a group of 25 participants (17.9%) had chronic diseases. Among these diseases, hypothyroidism, iron deficiency anemia, migraines, high cholesterol, hypertension, and asthma were reported. Of the participants, 78.6% (110 individuals) did not use medication, while 21.4% (30 individuals) reported medication use. The medications mentioned included antidepressants that enhance serotoninergic system activation, iron supplements such as ferminen and derivatives, alpha-glucosidase inhibitors like glucobay used for type 2 diabetes treatment, euthyrox for hypothyroidism treatment, and general painkillers.

The participants' smoking and alcohol consumption status was also examined in the personal information form. It was observed that the majority belonged to the non-smoking group. Among the women participants, 57.1% were non-smokers, while 42.9% were smokers.

Alcohol consumption was analyzed into three groups: non-drinkers, regular drinkers, and social drinkers. A group of 39.3% reported not consuming alcohol at all, with over half of the group (55.7%) being social drinkers and only 5% falling into the category of regular drinkers. It was observed that a physically active lifestyle not only provided various benefits for physical health but also for mental and emotional well-being, as it activates the serotoninergic system. Therefore, the participants' physical activity status was evaluated. Notably, 21.4% of the group did not engage in any physical activity and had a sedentary lifestyle, while 78.6% had an active lifestyle and participated in physical activities.

According to the WHO standards, when individuals' anthropometric measurements were evaluated, it was observed that 10.7% were underweight, 62.9% were normal weight, 19.3% were overweight, 5.7% were obese, and 1.4% were morbidly obese based on BMI. Similarly, considering the waist-to-hip ratio, it was noted that 84.3% were within the normal range, while 15.7% were at metabolic risk. When only waist circumference was taken into account, it was found that 69.8% of the participants were in the normal range, 15% were at metabolic risk, and 15.1% were at very high metabolic risk. Anthropometric measurements of the participants were demonstrated in Table 4.2.

Table 4.2. Anthropometric measurements of the participants:

Variable	n(%)
Body Mass Index	
Weak	15(10.7)
Normal	88(62.9)
Overweight	27(19.3)
Obese	8(5.7)
Morbidly Obese	2(1.4)
Waist Hip Ratio	
Normal	118(84.3)
Risky	22(15.7)
Waist Circumference	
Normal	97(69.8)
Increased Risk	21(15.1)
Significant Risk Increase	21(15.1)

Maximum, minimum and mean CQI values of all individuals are given in table 4.3. The mean CQI score for all individuals is 11.8929.

Table 4.3. Mean CQI value of individuals

N	**Valid**	140
Mean		11.8929
Median		12.0000
Std. Deviation		3.15703
Minimum		5.00
Maximum		19.0
Percentiles	25	10.0000
	50	12.0000
	75	14.0000

According to the participants' dietary intake records, carbohydrate quality index scores were determined and divided into quintiles (Table 4.4). The lowest quintile, Q1, included individuals who scored less than 9 points on the carbohydrate quality index, with 23 participants in this group. Q2 included participants who scored between 9 and 10 points, with 24 individuals. It was noted that a higher majority of participants had a carbohydrate quality index between 11 and 12 points, and they were included in the Q3 quintile. The Q4 quintile consisted of 27 participants who scored between 13 and 14 points. The Q5 quintile included 29 individuals who achieved the highest scores of 15 points or above regarding carbohydrate quality.

Table 4.4. Distribution of participants across the quintiles

	Frequency (n)	Percent %
Q1(<9)	23	16.4
Q2(9-10)	24	17.2
Q3(11-12)	37	26.4
Q4(13-14)	27	19.3
Q5(>15)	29	20.7
Total	140	100.0

Individuals' levels of stress, anxiety, and depression were evaluated based on the scores they obtained (Table 4.5). Regarding stress levels, it was concluded that 69.2% of individuals were at a normal level, 18.6% had mild stress, 8.6% had moderate stress, 2.9% had high stress, and 0.8% had very high-stress levels. Similarly, when looking at anxiety levels, it was observed that 67.9% of participants had normal anxiety levels, 10% had mild anxiety, 14.3% had moderate anxiety, 6.4% had high anxiety, and 1.4% had very high anxiety levels. The same analysis was repeated for depression levels. As a result of this analysis, it was found that 76.4% of participants had normal depression levels, 12.2% had mild depression, 7.9% had moderate depression, 1.4% had high depression, and 2.1% had very high depression level.

Table 4.5.DASS-42 distributions of the participants

	Stress Level n(%)	**Anxiety Level** n(%)	**Depression Level** n(%)
Normal	26(18.6)	14(10.0)	17(12.2)
Light	12(8.6)	20(14.3)	11(7.9)
Medium	97(69.2)	95(67.9)	107(76.4)
High	4(2.9)	9(6.4)	2(1.4)
Very High	1(0.7)	2(1.4)	3(2.1)

In line with these data, the difference between the scores of individuals for stress, anxiety, and depression and their dietary carbohydrate quality was analyzed. The results are shown in Table 4.6.

Table 4.6. Difference between CQI and depression, anxiety, and stress

Variable	Q1	Q2	Q3	Q4	Q5	p
Stress	14.96±7.00	13.58±7.30	10.97±5.74	10.26±6.63	9.03±5.57	0.007*
Anxiety	8.43±5.75	7.46±4.96	6.08±4.57	5.48±5.09	3.90±3.72	0.010*
Depression	11(3-14)	5.50(3.25-8)	4(2-7.5)	3(1-9)	2(0.5-7)	0.007**

*One-Way Analysis of Variance (mean±standard deviation), **Kruskal Wallis Test (median(25th -75th percentil

A statistically significant difference exists between stress scores and dietary carbohydrate quality (p=0.007). When pairwise comparisons were made between carbohydrate quality scores, there was a statistically significant difference between Q5 and Q1 (p=0.010).

There is a statistically significant difference between carbohydrate quality scores in terms of anxiety scores (p=0.010). When pairwise comparisons were made between carbohydrate quality scores, there was a statistically significant difference between Q5 and Q1 (p=0.008).

There is a statistically significant difference between carbohydrate quality scores in terms of depression scores (p=0.007). When pairwise comparisons were made between carbohydrate quality scores, there was a statistically significant difference between Q5 and Q1 (p=0.005).

In addition, correlation analyses were conducted to clarify the relationship between CQI and depression, anxiety and stress. The results are shown in the table 4.7.

Table 4.7. Relationship between CQI and depression, anxiety and stress

Variable	CQI	
	p	**r**
Stress	0.019	0.198
Anxiety	0.081	0.148
Depression	0.172	0.116

- There is a statistically significant positive relationship between CQI and stress level (p=0,019, r=0,198).
- There is no statistically significant relationship between CQI and anxiety level (p=0,081).
- There is no statistically significant relationship between CQI and depression level (p=0,172).

In addition, the nutrient intakes of the participants are shown in Table 4.8.

Table 4.8. Nutrient intake of the participants

Variable	n(%)	Variable	n(%)
Total Calorie (kcal)	1138.28±284.98	**Cholesterol (g)**	301.94±158.00
Total CHO (g)	107.46±38.74	**A Vit. (µg)**	786.43±414.37
Total Protein (g)	51.31±12.97	**D Vit. (µg)**	4.69±11.71
Total Fat (g)	53.38±17.48	**E Vit. (mg)**	8.48±4.91
Total Fibre (g)	12.71±4.54	**K Vit. (µg)**	65.95±56.90
Insoluble Fibre (g)	8.35±3.29	**Beta Carotene (mg)**	2.45±2.29
Soluble Fibre (g)	0.38±0.08	**C Vit.(mg)**	51.11±25.87
Whole Grain/Refined Grain (g)	2.14±5.64	**B1 Vit.(mg)**	0.58±0.18
Liquid CHO (g)	40.69±29.55	**B2 Vit.(mg)**	1.09±0.32
Solid CHO/Total CHO (g)	0.86±0.07	**B6 Vit.(mg)**	0.90±0.36
GI	165.64±67.29	**B12 Vit. (µg)**	4.49±3.03
Protein (g)	0.19±0.05	**Magnesium(mg)**	187.06±56.12
Fat (g)	0.41±0.08	**Potassium(mg)**	1544.06±413.23
MUFA (g)	18.53±7.64	**Calcium(mg)**	525.05±186.26
PUFA (g)	9.53±5.72	**Folate (µg)**	182.27±55.51
SFA (g)	21.25±6.61	**Iron (mg)**	7.10±2.12
Zinc (mg)	7.42±2.20	**Alcohol (g)**	1.75±6.07

When examining the difference between different nutrient components and diet carbohydrate quality, no significant difference was found between individuals' diet and total calorie intake (p=0.161), total CHO intake (p=0.152), total fat intake (p=0.294), total protein intake (p=0.922), total zinc intake (p=0.402), total monounsaturated fatty acids (MUFA) intake (p=0.329), total PUFA intake (p=0.535), total saturated fatty acid intake (p=0.290), total cholesterol intake (p=0.698), total vitamin D intake (p=0.399), total vitamin E intake (p=0.060), total vitamin K intake (p=0.593), total vitamin C intake (p=0.139), total vitamin B12 intake (p=0.920), and total calcium intake (p=0.912). These comparisons are shown in Table 4.9.

Table 4.9. Difference between different nutrient components and CQI

Variable	Q1	Q2	Q3	Q4	Q5	p
Total Calorie(kcal)	1215.2 (982.2-1348.5)	994.3 (886.7-1349.3)	1073.5 (923.5-1323.8)	1104 (1059.7-1247.4)	1010 (914.8-1271.9)	0.164**
Total Fat (g)	55(42.5-62.3)	44.4(39.7-57.7)	54.2(41.1-63.3)	55.2(48.9-62.5)	48(40.6-58.8)	0.294**
Total Protein(g)	49.7±13.75	50.15±17.46	51.97±12.55	52.64±8.68	51.49±12.580	0.922*
Protein %	0.16(0.14-0.20)	0.18(0.14-0.21)	0.18(0.16-0.21)	0.19(0.17-0.21)	20(0.17-0.24)	0.158**
CHO %	0.41±0.09	0.38±0.09	0.38±0.08	0.37±0.05	0.37±0.09	0.341*
Fat %	0.38±0.09	0.41±0.07	0.42±0.06	0.41±0.07	0.41±0.09	0.433*
Zinc (mg)	6,62±2.18	7.49±3.34	7.42±1.93	7.64±1.52	7.77±1.88	0.402*
MUFA (g)	17.1(13-19.7)	15.3(13.5-18.3)	18.2(14.5-22.3)	18.8(15.5-21.5)	16.4(12.8-21.6)	0.329**
PUFA (g)	8.8(4.8-12.6)	7.1(5.1-9.6)	8(6.3-11.2)	9.3(6.5-11.8)	7.2(6.1-12.6)	0.535**
SFA (g)	21.6(17.8-26.3)	19.7(15.7-24.6)	22.6(15.4-27.1)	21.5(19.9-23.7)	18.6(16.9-22.6)	0.290**
Cholesterol (g)	276.7(174.1-471.8)	245.4(163.6-446.6)	285.5(187-432.3)	333.6(230.2-444.3)	270.2(134.8-394.5)	0.698**
D Vit. (µg)	3(1.7-4.2)	2.1(1.5-3.2)	3.1(1.5-3.6)	3.3(2.2-4.4)	3.3(1.6-4.5)	0.399**
E Vit. (mg)	6.6(4.2-10.7)	6.1(3.9-8.3)	7.6(5.8-11.2)	8.2(6.7-11.3)	6.7(5.7-10.8)	0.060**
K Vit. (µg)	41.1(25.1-72)	43.6(29-66.2)	48.3(30.1-64.9)	52(35.6 106.3)	53.4(28.7-80.7)	0.593**
C Vit. (mg)	38.6(28.8-51.1)	43.9(31.6-60.5)	50.7(34.2-77.7)	49.8(33.5-72.8)	52.7(38.5-66.7)	0.139**
B12 Vit. (µg)	3.4(2.9-4.6)	3.9(2.6-7.1)	3.4(2.3-5.2)	3.6(3.3-4.6)	4(2.7-4.8)	0.920**
Calcium (mg)	514.2 (382.3-588.9)	539.1 (394.7-611.5)	494.4 (398.5-684.4)	529 (408.9-638.1)	504.6 (410.2-591.2)	0.912**

*One-Way Analysis of Variance (mean±standard deviation), **Kruskal Wallis Test (median(25th -75th percentile)

Table 4.10. Difference between different nutrient components and CQI

Variable	Q1	Q2	Q3	Q4	Q5	p
Potassium (mg)	1326.49±259.49	1375.62±344.7	1575.01±487.64	1726.26±410.29	1646.90±357.07	0.001*
Liquid CHO (g)	62.7(45.9-96.7)	41.9(20.6-57.8)	33.3(25.4-50.7)	36.4(23.7-44.2)	19.7(12.7-27.1)	<0.001**
A Vit. (µg)	543.9(382.2-811.8)	562.8(461.0-833.1)	641.8(486.7-907.2)	1133.7(586.7-1349.6)	766.7(521.2-1047.9)	0.004**
Beta Car. (mg)	0.9(0.7-1.6)	1.1(0.8-1.95)	1.7(0.9-3.1)	3.1(1.1-5.8)	2.4(1.3-4.0)	0.001**
B1 Vit. (mg)	0.5(0.4-0.6)	0.5(0.4-0.67)	0.6(0.5-0.7)	0.6(0.5-0.7)	0.6(0.5-0.75)	<0.001**
B2 Vit. (mg)	0.9(0.8-1.0)	1.0(0.7-1.2)	1.1(0.9-1.4)	1.2(1.0-1.4)	1.1(0.9-1.25)	0.001**
B6 Vit. (mg)	0.8(0.6-0.9)	0.8(0.62-0.97)	0.9(0.75-1.0)	0.9(0.8-1.1)	1.0(0.7-1.1)	0.006**
Magnessium(mg)	147.1(130-177.4)	144.2(129.7-194.1)	167.1(149.1-222.7)	195.5(178.9-240.7)	209.8(170.25-245.9)	<0.001**
Folate (µg)	138.5(106.2-182)	152.0(119.1-211.6)	176.6(158.0-227.4)	192.2(173.3-209.4)	179.7(164.1-226.9)	<0.001**
Iron (mg)	6.1(5.4-6.7)	6.0(4.82-7.95)	6.7(5.5-8.1)	7.4(6.3-9.1)	7.7(6.7-8.95)	0.001**

*One-Way Analysis of Variance (mean±standard deviation), **Kruskal Wallis Test (median(25th -75th percentile

The same analysis revealed significant difference between specific nutrient components and CQI. Table.4.10 summarizes the results of these analyses.

There is a statistically significant difference in the following nutrients and CQI;

- Potas*sium values and CQI scores (p=0.001).* When pairwise comparisons of potassium with CQI scores were examined, there was a statistically significant difference between Q4 and Q1 (p=0.004), Q4 and Q2 (p=0.015), and Q5 and Q1 (p=0.032).
- *Vitamin A values and CQI scores (p=0.004).* When pairwise comparisons of Vitamin A with CQI scores were examined, there was a statistically significant difference between Q4 and Q1 (p=0.006) and Q4 and Q2 (p=0.020).
- *Beta Carotene values and CQI scores (p=0.001).* When pairwise comparisons of Beta Carotene with CQI scores were examined, there was a statistically significant difference between Q1 and Q4 (p=0.006) and Q1 and Q5 (p=0.007).
- *Vitamin B1 values and CQI scores (p<0.001).* When pairwise comparisons of Vitamin B1 with CQI scores were examined, there was a statistically significant difference between Q1 and Q4 (p=0.001), Q1 and Q5 (p=0.005), and Q2 and Q4 (p=0.019).

- *Vitamin B2 values and CQI scores (p=0.001).* When pairwise comparisons of Vitamin B2 with CQI scores were examined, there was a statistically significant difference between Q1 and Q3 (p=0.032) and Q1 and Q4 (p=0.001).
- *Vitamin B6 values and CQI scores (p=0.006).* When pairwise comparisons of Vitamin B6 with CQI scores were examined, there was a statistically significant difference between Q1 and Q4 (p=0.001).
- *Magnesium values and CQI scores* (p<0.001). When pairwise comparisons of Magnesium with CQI scores were examined, there is a statistically significant difference between Q1 and Q4 (p<0.001), Q1 and Q5 (p=0.002), Q2 and Q4 (p=0.002), and Q2 and Q5 (p=0.006).
- *Folate values and CQI scores* (p<0.001). When pairwise comparisons of Folate with CQI scores were examined, there was a statistically significant difference between Q1 and Q3 (p=0.007), Q1 and Q4 (p=0.004), and Q1 and Q5 (p=0.004).
- *Iron values and CQI scores* (p=0.001). When pairwise comparisons of Iron with CQI scores were examined, there was a statistically significant difference between Q1 and Q4 (p=0.011) and Q1 and Q5 (p=0.002).

In summary, there is a significant difference between the dietary intake of total potassium, total vitamin A, total beta-carotene, total vitamin B1, total vitamin B2, total vitamin B6, total magnesium, total folate, total iron, and carbohydrate quality scores.

To have a better understanding of the link between nutrition and mood, correlation analyses of the relationship between all these nutrients and anxiety, stress, and depression were also performed. As a result of the analyses, positive relations were found between various nutrients and dietary variables. Correlation analyses between nutrients and mental health are shown in Table.4.11.

Table 4.11. The relationship between nutrients and mental health

Variable	Stress Score		Anxiety Score		Depression Score	
	p	r	p	r	p	r
Total Calorie (kcal)	0.001	0.277	0.010	0.217	0.003	0.246
Total CHO (g)	<0.001	0.354	0.001	0.280	<0.001	0.313
Total Protein (g)	0.089	-0.144	0.155	-0.121	0.682	-0.035
Total Fat (g)	0.046	0.169	0.093	0.143	0.148	0.123
Total Fibre (g)	0.149	-0.123	0.126	-0.130	0.041	-0.173
Soluble Fibre (g)	0.060	-0.159	0.038	-0.176	0.009	-0.221
Unsoluble Fibre (g)	0.001	0.271	0.009	0.222	0.006	0.233
Whole Grain/Refined Grain (g)	<0.001	-0.424	<0.001	-0.471	<0.001	-0.441
Liquid CHO (g)	0.027	0.186	0.011	0.215	0.012	0.211
Solid CHO/Total CHO (g)	0.948	0.006	0.592	-0.046	0.513	-0.056
Glycaemic Index	0.004	0.241	0.219	0,105	0.036	0.178
Protein Percentage (%)	<0.001	-0.450	<0.001	-0.413	<0.001	-0.365
Fat Percentage (%)	0.240	-0.100	0.352	-0.080	0.081	-0.149
MUFA (g)	0.321	0.085	0.203	0.108	0.522	0.055
PUFA (g)	0.010	0.217	0.112	0.135	0.327	0.083
SFA (g)	0.019	0.199	0.030	0.183	0.045	0.170
Cholesterol (mg)	0.037	-0.176	0.235	-0.101	0.540	-0.052
A vitamin (µg)	0.014	-0.206	0.642	-0.040	0.058	-0.160
D vitamin (µg)	0.985	0.002	0.755	-0.027	0.867	-0.014
E vitamin (mg)	0.728	0.030	0.748	0.027	0.387	-0.074
K vitamin (µg)	0.406	-0.071	0.505	-0.057	0.236	-0.101
Beta Carotene (mg)	0.010	-0.216	0.250	-0.098	0.023	-0.192
C Vitamin (mg)	0.807	-0.021	0.844	-0.017	0.060	-0.159
B1 Vitamin (mg)	0.853	-0.016	0.262	-0.095	0.335	-0.082
B2 Vitamin (mg)	0.024	-0.191	0.022	-0.193	0.051	-0.165
B6 Vitamin (mg)	0.209	-0.107	0.049	-0.167	0.033	-0.180
B12 Vitamin (µg)	0.134	-0.127	0.381	-0.075	0.173	-0.116
Magnesium (mg)	0.300	-0.088	0.052	-0.165	0.166	-0.118
Potassium (mg)	0.645	-0.039	0.353	-0.079	0.1779	-0.114
Calcium (mg)	0.228	-0.102	0.147	-0.123	0.507	-0.057
Folate (µg)	0.299	-0.088	0.850	-0.016	0.117	-0.133
Iron (mg)	0.839	-0.017	0.451	-0.064	0.677	0.036
Zinc (mg)	0.339	-0.81	0.384	-0.074	0.675	-0.036
Alcohol (g)	0.565	-0.049	0.109	-0.136	0.644	0.040

There is a statistically significant relationship in the following nutrients and depression, anxiety, or stress scores;

- A statistically significant positive relationship exists between total calories and stress score ($p=0.001$, $r=0.277$), anxiety score ($p=0.010$, $r=0.217$), and depression score ($p=0.003$, $r=0.246$).
- A statistically significant positive relationship between total CHO, and stress score ($p<0.001$, $r=0.354$), anxiety score ($p=0.001$, $r=0.280$), and depression score ($p<0.001$, $r=0.313$).
- A statistically significant positive relationship between total fat and stress score ($p=0.046$, $r=0.169$).
- Total fiber has a statistically significant negative connection with depression score ($p=0.041$, $r=-0.173$).
- A statistically significant negative relationship between insoluble fiber and, anxiety score ($p=0.038$, $r=-0.176$), and depression score ($p=0.009$, $r=-0.221$).
- A statistically significant positive relationship between soluble fibre and stress score ($p=0.001$, $r=0.271$), anxiety score ($p=0.009$, $r=0.222$) and depression score ($p=0.006$, $r=0.233$).
- A statistically significant positive correlation between GI and stress score ($p=0.004$, $r=0.241$) and depression score ($p=0.036$, $r=0.178$).
- A statistically significant negative correlation between the percentage of dietary protein and stress score ($p<0.001$, $r=-0.450$), anxiety score ($p<0.001$, $r=-0.413$), and depression score ($p<0.001$, $r=-0.365$).
- A statistically significant positive relationship between SFA and anxiety score ($p=0.030$, $r=0.183$), depression score ($p=0.045$, $r=0.170$), and stress score ($p=0.019$, $r=0.199$).
- A statistically significant positive relationship between PUFA and stress score ($p=0.010$, $r=0.217$).
- A statistically significant negative relationship between dietary cholesterol intake and stress score ($p=0.037$, $r=-0.176$).
- Vitamin A has a statistically significant negative connection with stress score ($p=0.014$, $r=-0.206$).
- A statistically significant negative correlation between beta carotene and stress score ($p=0.010$, $r=-0.216$) and depression score ($p=0.023$, $r=-0.192$).

- Vitamin B2 has a statistically significant negative connection with stress ($p=0.024$, $r=-0.191$) and anxiety ($p=0.022$, $r=-0.193$).
- Vitamin B6 has a statistically significant negative connection with anxiety ($p=0.049$, $r=-0.167$) and depression ($p=0.033$, $r=-0.180$).

In order to explain which factors of carbohydrate quality are more explicit, the correlations between whole grain/refined grain, liquid carbohydrate, solid carbohydrate/total carbohydrate, and GI intakes, which are determinants of this index, and stress, anxiety, and depression were also examined. There is a statistically significant;

- Negative correlation between Whole Grain/Refined Grain and stress score ($p<0.001$, $r=-0.424$)
- Negative correlation between Whole Grain/Refined Grain and anxiety score ($p<0.001$, $r=-0.471$).
- Negative correlation between Whole Grain/Refined Grain and depression score ($p<0.001$, $r=-0.441$).
- Positive correlation between Liquid CHO and anxiety score ($p=0.011$, $r=0.215$).
- Positive correlation between Liquid CHO and depression score ($p=0.012$, $r=0.211$).

However, the relationships with many nutrients were not statistically significant. There is no statistically significant relationship between total protein ($p=0.089$), total fiber ($p=0.149$), insoluble fiber ($p=0.060$), dietary fat percentage ($p=0.240$), MUFA ($p=0.321$), Vitamin D ($p=0.985$), Vitamin E ($p=0.728$), Vitamin K ($p=0.406$), Vitamin C ($p=0.807$), Vitamin B1 ($p=0.853$), Vitamin B6 ($p=0.209$), B12 ($p=0.134$), magnesium intake ($p=0.300$), potassium ($p=0.645$), calcium ($p=0.228$), folate ($p=0.299$), iron ($p=0.839$), zinc ($p=0.339$), liquid CHO ($p=0.027$, $r=0.186$), Solid CHO/Total CHO ($p=0.948$), alcohol ($p=0.565$) and stress score.

There is no statistically significant relationship between total protein (p=0.155), total fat (p=0.093), total fiber (p=0.126), GI (p=0.219), dietary fat percentage (p=0.352), MUFA (p=0.203), PUFA (p=0.112), dietary cholesterol intake (p=0.235), Vitamin A (p=0.642), Vitamin D (p=0.755), Vitamin E (p=0.748), Vitamin K (p=0.505), beta carotene (p=0.250), Vitamin C (p=0.844), Vitamin B1 (p=0.262), Vitamin B2 (p=0.051), Vitamin B12 (p=0.381), magnesium (p=0.052), potassium (p=0.353), calcium (p=0.147), folate (p=0.850), iron (p=0.451), zinc (p=0.384), alcohol (p=0.109), Solid CHO/Total CHO (p=0.592) and anxiety score.

There is no statistically significant relationship between total protein (p=0.682), total fiber (p=0.148), dietary fat percentage (p=0.081), MUFA (p=0.522), PUFA (p=0.327), cholesterol intake (p=0.540), Vitamin A (p=0.058), Vitamin D (p=0.867), Vitamin E (p=0.387), Vitamin K (p=0.236), Vitamin C (p=0.060), Vitamin B1 (p=0.335), Vitamin B12 (p=0.173), magnesium (p=0.166), potassium (p=0.179), calcium (p=0.507), folate (p=0.117), iron (p=0.677), zinc (p=0.675), alcohol (p=0.644), Solid CHO/Total CHO (p=0.513) depression score.

The same correlation analysis was repeated for anthropometric measurements. The analyses revealed that there is no statistically significant relationship between body fat percentage and stress score (p=0.483), body fat percentage and anxiety score (p=0.558), and body fat percentage and depression score (p=0.809). Similarly, there is no statistically significant relationship between BMI and stress score (p=0.391), BMI and anxiety score (p=0.198), and BMI and depression score (p=0.439). Additionally, there is no statistically significant relationship between the waist-to-hip ratio and depression score (p=0.624), anxiety score (p=0.240), and stress score (p=0.629). The results are summarized in Table 4.12.

Table 4.12. Relationship between anthropometric measurements and depression, anxiety, and stress scores

Variable	Stress Score		Anxiety Score		Depression Score	
	p	**r**	**p**	**r**	**p**	**r**
Waist/Hip	0.629	-0.041	0.240	0.100	0.624	0.042
Fat Ratio	0.483	-0.060	0.558	0.050	0.809	0.021
Body Mass Index	0.391	-0.073	0.198	0.110	0.439	0.066

When the relationships between the data in the personal information collection questionnaire and stress, anxiety, and depression were analyzed, no significant differences were found. No significant difference was found between the stress scores between sedentary and non-sedentary (p=0.736). There was no significant difference in anxiety scores between sedentary and non-sedentary (p=0.495). There was no significant difference in depression scores between sedentary and non-sedentary (p=0.090). Table 4.13 is an overview of the findings.

Table 4.13. Relationship between physical activity status and depression, anxiety, and stress scores

	Sedentary(n=30)	**Non-sedentary(n=110)**	**p**
Stress Score	11.90±6.87	11.44±6.59	0.736*
Anxiety Score	6 (2.75-10.25)	5 (2-9)	0.495**
Depression Score	6 (3-12)	4 (1-9)	0.090**

*Studen t test(ort±s.s), **Mann Whitney U test (median (25. -75. Percentile)

No significant difference was found in the stress scores between individuals with chronic illnesses and those without chronic illnesses (p=0.486). Similarly, there was no significant difference in anxiety scores between individuals with chronic illnesses and those without chronic illnesses (p=0.468), as well as no significant difference in depression scores (p=0.056). The summary of the results is shown in Table 4.14.

Table 4.14. Relationship between the presence of disease and depression, anxiety, and stress scores

	Without chronic illnesses (n=115)	**Chronic illnesses (n=25)**	**p**
Stress Score	11(7-16)	11(5-16.5)	0.486**
Anxiety Score	5(2-9)	6(3-8.5)	0.468**
Depression Score	4(1-9)	7(4-11)	0.056**

**Mann Whitney U test (median (25. -75. Percentile)

No significant difference was found in the stress scores between individuals who use medication and those who do not use medication (p=0.885). Similarly, there was no significant difference in anxiety scores between individuals who use medication and those who do not use medication (p=0.385), as well as no significant difference in depression scores (p=0.488). The summary of the results is shown in Table 4.15.

Table 4.15. Relationship between medication use and depression, anxiety, and stress scores

	No Medication Use (n=110)	**Medication Use (n=30)**	**p**
Stress Score	11(7-16)	11.5(6-16.25)	0.885**
Anxiety Score	5(2-9)	6(3-9)	0.385**
Depression Score	4(1-9)	6(2-10.25)	0.488**

**Mann Whitney U test (median (25. -75. Percentile)

5.DISCUSSION

In this study, the relationship between diet CQI and depression, stress, and anxiety scores in women was investigated. When analyzing the mood scores of the participant group, it was observed that the majority had normal mental health. However, each individual's depression, stress, and anxiety scores varied. Previous studies have reported associations between high consumption of refined carbohydrates, sugary beverages, and high fat intake with increased depression and anxiety scores (9-14). Similar findings were obtained in the analyses of this research. According to the results of the study, as the amount of CHO intake in the diet increases, depression, anxiety, and stress scores also increase. However, the analyses revealed that CQI is equally important as the quantity consumed. As the quality of CHOs in the diet improves stress scores decrease. The correlation between CQI and depression and anxiety is not significant. However, the difference between the groups was significant. It was observed that women with high consumption of refined CHOs had higher depression, anxiety, and stress scores. Various studies examining the effects of CQI on depression have yielded parallel results with this research (148,149).

For example, the results of the Seguimiento Universidad de Navarra (SUN) prospective cohort study, initiated in Spain in 1999, were reported in 2018. In the study, the diets of 15,546 university graduates were evaluated using a validated 136-item semi-quantitative Food Frequency Questionnaire at baseline and during a 10-year follow-up. The CQI was determined using the same methods as our study, and participants were divided into quintiles. Analyses revealed that high consumption of added sugars and low-quality carbohydrates was associated with an increased risk of depression. However, no significant relationship was found between depression risk and consumption of sugar-sweetened beverages (148).

These findings support the difference between carbohydrate quality and emotional well-being in our study. However, the correlation between depression and CQI was not significant in our study. In addition, when examining the correlation analyses with liquid carbohydrate consumption in this study, it was concluded that as liquid carbohydrate intake increased, depression and anxiety scores also increased. Based on this, it seems that the result between beverage consumption and emotional well-being in this study is inconsistent with the result of our study.

In another study investigating the relationship between healthy and unhealthy dietary habits and depression, a case-control group of 330 individuals was formed. The study found that a diet characterized by high consumption of sweets, non-alcoholic beverages, and industrial fruit juices, which are sources of low-quality carbohydrates, was associated with the highest adherence to an unhealthy dietary pattern, as well as a higher depression risk (149).

However, the results of a similar study conducted in Turkey in 2022 differ. The study aimed to determine the relationship between carbohydrate quality and sleep quality, depression, anxiety, stress, and anthropometric measurements. At the end of the study, it was noted that the consumption of higher-quality carbohydrates by adults was associated with better sleep quality and certain micronutrients (potassium, magnesium, vitamins A, D, K, C, B1, B6, folate), but there was no significant relationship with anxiety, depression, and stress scores (150). Additionally, in the study by Yüksel et al., it was found that the group with the highest CQI had the lowest carbohydrate and energy intake, while as the CQI score decreased, carbohydrate and energy intake increased. However, no significant association was detected between CQI and carbohydrate intake in our study. When exploring the similarities between the two studies, it was found that carbohydrate quality was associated with magnesium, potassium, vitamins A, B1, B6, and folate. In our study, the relationship between depression and anxiety and CQI was parallel to this study. However, unlike the study conducted in 2022, our study did not find a statistically significant relationship between carbohydrate quality and vitamins D, K, and C but a statistically significant relationship between CQI and stress (150).

The relationship between CQI and mental health has not been the subject of many studies. However, the relationship between CQI and hypertension, obesity, menopausal symptoms in women, and breast cancer risk has been examined in various studies. For example, in 2019, a study investigating general and abdominal obesity in women found an inverse relationship between dietary CQI and both general and abdominal obesity (151). Similarly, the quality of carbohydrate intake was connected with the incidence of obesity and hypertension in research on 12,027 people aged 18-64 years (152).

A different study in type 2 diabetes mellitus subjects also supports these results. According to the results, there is an inverse relationship between the CQI of the diet and the probabilities of metabolic syndrome and obesity (153). The results of another study, again focussing on women, are in parallel. This study investigated the relationship between CQI and cardiovascular disease risk factors among overweight and obese women. An inverse association was noted between CQI and body fat percentage, BMI, blood pressure, and waist circumference (154). In summary, many studies have shown that low carbohydrate quality increases metabolic risk and obesity (155-157). However, no significant relationship was found between BMI, body fat percentage and waist circumference, and CQI in our study.

Women's risk of developing psychological illnesses increases after menopause. The results of a study examining the relationship of CQI with menopausal symptoms in postmenopausal women are also of interest. According to this study of 349 women, higher CQI was associated with lower somatic and psychological symptoms of menopause. This study suggests a relationship between mood and CQI (158). But unfortunately, the existing literature on the effects of CQI on mood is limited. Studies have primarily focused on the effects of carbohydrate quantity and nutrient composition on mood (9-14, 159-161). For example, in a study involving 265 individuals investigating the impact of low carbohydrate intake on sleep and mental state in individuals with diabetes, it was reported that individuals included in the group with the lowest carbohydrate intake had better sleep quality and experienced fewer symptoms of depression and anxiety (159). However, in several small cross-sectional epidemiological studies analyzing the hypothesis that carbohydrate intake increases depression, carbohydrate consumption was not found to be related to depression. However, these studies overlooked the types of carbohydrates and only investigated intake quantities (160,161). A different analysis conducted by Sanchez et al. noted that consuming commercially processed baked goods was also associated with a higher risk of depression (162). It was observed that participants who consumed a higher amount of commercially processed baked goods had a 40% higher risk of depression compared to those who consumed them rarely or not at all. The high content of pro-inflammatory trans fatty acids in commercially processed baked goods is assumed to contribute to the increased risk of depression. Trans fatty acid intake was found to be positively linked with depression risk in another SUN cohort study. However, the presence of sugar and

other carbohydrates in baked goods and pastries should also be taken into account (163).

In our study, the total fat and PUFA intake were not significantly associated with depression and anxiety. However, they were positively correlated with stress scores. The relationship between total MUFA intake and the outcomes was not found to be significant. However, when correlation analyses were performed with saturated fat, results supporting the aforementioned study were obtained.

When examining the effect of protein, another macronutrient, in our study, we did not observe a significant relationship between total protein intake and mental disorders. However, a different result was found regarding the percentage of protein in the diet, showing a negative association with anxiety, stress, and depression. Similar to carbohydrates, it is believed that the types of proteins can have different effects on the body, as suggested by previous studies in the literature. Based on this, a study conducted in 2023 among Iranian women investigating the relationship between animal and plant protein sources and mental state found that a high intake of animal protein was associated with a higher likelihood of experiencing depression and anxiety symptoms, while no significant relationship was found between symptoms and plant protein sources. At this point, it is also suggested that saturated fat intake may play a role alongside protein intake (164). Another study investigating the relationship between protein intake and mental health in adolescents noted that protein intake is associated with depression and anxiety. Specifically, individuals who consumed milk protein during breakfast reported lower symptoms. Additionally, this study also highlighted the difference between animal and plant proteins. It was emphasized that the beneficial effects of protein intake vary based on age, gender, physical activity level, protein quality in the diet, and processing methods. Mainly, harmful metabolites can be produced during cooking methods applied to animal foods such as meat and chicken, which is why plant proteins are currently recognized as an important component of the human diet. In the effects of plant proteins on mental health, it is believed that dietary fiber and plant bioactives, considered essential modulators for the development and prevention of chronic diseases and have beneficial effects on gut health, play a role (165).

The analysis between fiber content and mental health in our study supports this idea. As a result of our analyzes, it has been observed that the effects of soluble and insoluble fibers are different. A statistically significant negative relationship was found between insoluble fiber intake and anxiety and depression scores, but there was a statistically significant positive correlation between total soluble fiber intake and stress depression and anxiety scores. In addition, a negative correlation was found between total fiber intake and depression in our study. At this point, the results of various studies in the literature are similar (166-170).

In a cross-sectional study investigating the impact of carbohydrate/fiber ratio on moderate-to-severe depressive symptoms, the importance of fiber content was emphasized. According to the study's findings, it was reported that 8.3% of the 9,728 participants had moderate-to-severe depressive symptoms. The group with the highest depressive symptom scores was found to have the highest carbohydrate/fiber ratio. Consequently, a higher carbohydrate-fiber diet intake ratio was noted to increase the likelihood of depressive symptoms (166). A larger study with a larger sample size of 16,807 people found similar results, demonstrating a lower risk of depression in people who consumed the most total fiber, vegetable fiber, and fruit fiber (167).

A study by Kim et al. examined the relationship between dietary habits and depression among Korean girls aged 12-18. The results of the study are similar to those found in adults. The likelihood of depression was lower in the group with the highest dietary fiber intake compared to the group with the lowest intake (168). In a study conducted in 2015 on postmenopausal women with a sample size of 69,954, the results showed that the likelihood of depression during a 3-year follow-up was lower in the highest quintile of fiber intake compared to the lowest quintile (169). In a study on Japanese adults, no significant relationship was found between dietary fiber intake and depressive symptoms. However, people in the 2nd quartile of total fiber and vegetable fiber intake and the 3rd quartile of cereal fiber intake had lower depressive symptoms than those in the 1st quartile (170).

Another determinant of carbohydrate quality has been shown as GI. It has been reported in various studies that consumption of foods with high glycaemic index increases the risk of Type 2 diabetes and is a risk factor for other chronic diseases (171-173). Therefore, many analyses exist on the relationship between GI and GL and mood

(25-26,175-176). At this point, the results of the studies are different. For example, according to the results of a study with 10,000 people published in 2022, consumption of foods with a higher GL was associated with a lower likelihood of stress; however, no significant association was found between the GI or GL and the risk of depression and anxiety (175). Another study with a crossover clinical trial design examined the effects of a high GL diet on mental health. The results showed that consuming a 28-day high GL diet did not change tension anxiety compared to a low GL diet (176).

There are studies that contradict the findings mentioned above. For example, a study on Iranian adults investigating the relationship between diet GI and depression found a positive association between GI and depression but an inverse relationship between GL and mental disorders, depression, and anxiety (26). Similarly, an analysis conducted on elderly individuals in the United States found a positive association between dietary GI levels and depression (25). The present study supports these studies.

However, all research has shown that vitamins and minerals play a crucial role in health and that deficiencies are linked to symptoms of psychiatric disorders. For example, vitamin deficiencies can affect memory function, cognitive impairment, and dementia. Vitamins B1, B3, B6, B9, and B12, in particular, are essential for neuronal function, and deficiencies have been linked to depression. B-group vitamins are thought to play a role in the development of depression through the metabolism of neurotransmitters (177).

In one of the studies conducted in this field, it was observed that inadequate intake of B vitamins and folate increased depressive symptoms in children. Lower intakes of vitamins B1, B2, B3, B5, B6, and folate were associated with higher externalizing behavior scores. Lower vitamin B6 and folate intake were associated with higher internalizing behavior scores. In summary, according to the study, low vitamin B intake is linked to adolescent mental health and behavioral problems (178).

A similar study on children was also undertaken. In this study, children with depressive symptoms consumed less carbohydrate than children without depressive symptoms. According to the data that school children with depressive symptoms generally had lower vitamin intake compared to those without depressive symptoms. According to the Dietary Reference Intakes (DRIs), 42.16% of children with depressive symptoms had inadequate folate intake (179). Similarly, a study conducted on

depressive patients has identified low levels of folate and vitamin B12, and a general-population study has found depression, and low levels of these two vitamins have been linked (180).

At this point, the importance of folate intake has been emphasized because folate, as the active metabolite, plays a role in homocysteine methylation and the production of methionine, which is necessary for several critical signaling pathways involving monoamine neurotransmitters. Therefore, it is believed that folate deficiency may contribute to elevated homocysteine levels associated with depression (180). However, in our study, dietary folate intake was not associated with depression, anxiety, and stress in women.

However, various minerals are also thought to have effects on mental health. For example, in a study conducted with 2089 Japanese workers investigating the relationship between zinc, copper, and manganese with depression and anxiety, a significant association was found between zinc, copper, and manganese intake and anxiety. According to the study, mental disorders increased in individuals with the lowest zinc, copper, and manganese intake (181).

Some studies have shown that zinc may also affect neural transmission involved in depression, such as the serotonergic, dopaminergic, and glutamatergic systems (182, 183).

A study on the impact of minerals on depression symptoms found an inverse association between magnesium, calcium, iron, and zinc consumption and the prevalence of depressed symptoms (184). Similarly, it was noted that dietary iron intake was inversely associated with depression in adolescents (167).

However, in another study, intake of vitamins B2, B3, A, and C and fiber was inversely associated with depression scores, whereas the relationship between iron and depression was insignificant (185).

Recently, various dietary supplements have been suggested as additional treatment strategies in antidepressant therapy. Magnesium is among the key nutrients in this regard. Numerous studies have shown that a high dietary intake of magnesium is associated with reduced symptoms of depression and anxiety (186-189). In a cohort

study by Derom et al., the relationship between magnesium and depression was not significant (190).

But, additional research is needed to investigate the impact of minerals on mental health. According to the results of our study, no significant relationship was found between zinc, magnesium, and iron intakes and depression, anxiety, and depression. When reviewing the literature, it is evident that the results of studies investigating the relationship between nutrient intake and mental well-being are inconsistent, and explanations for possible mechanisms are not yet sufficient.

However, our study has some limitations. The tools used to assess depression, anxiety, and stress are only screening measures and may not reflect the condition in individuals clinically diagnosed with the disorders. The study design is cross-sectional and cannot establish a cause-and-effect relationship. Additionally, it is believed that the relationship may be bidirectional. For example, individuals with high depressive symptoms may have a tendency towards lower-quality carbohydrate intake.

Similarly, suboptimal nutrient intake can also contribute to poorer psychological health. Furthermore, determining nutrient quantities was based on self-reported statements from individuals and is only approximate. The values were not obtained through chemical analysis of repeated meals.

At this point, it is seen that the average calorie intake of the participants in our study is quite low. When the dietary intakes of the participants are evaluated, it is possible that they are already able to pay attention to healthy eating.

The strengths of the study lie in the appropriateness of the screening tool and the accuracy of the dietary intake records. The screening tool used in the study focuses on the participants' psychological state in the past week. In line with this, dietary intake records for the preceding three days were obtained from individuals, followed by administering the screening tool. Therefore, this study is valuable for observing the direct effects of nutrient intake.

Despite the limitations, the study provides insights into the relationship between various nutrients and psychological health, independent of other confounding factors in the women population. This opens the way for longer-term or intervention studies to shed light on the cause-effect relationship.

6. CONCLUSION

In summary, this study confirms our hypothesis that stress levels decrease as carbohydrate quality decreases. However, the relationship between depression and anxiety was not significant. At this point, the difference between CQI groups and depression, anxiety and stress is significant. This supports the starting point of our hypothesis. Additionally, the analysis revealed the significance of dietary GI, as a higher GI in the diet was associated with higher depression, anxiety, and stress scores.

It has been observed that the fiber content of the diet is influential on symptoms. Insoluble fiber consumption was found to be inversely related to symptoms, but soluble fiber consumption was found to be positively related. Higher consumption of whole grains in individuals supported the decrease in depression, anxiety, and stress scores. In parallel, individuals with a higher intake of refined grains were found to be at greater risk for poor mental health and had higher tendencies for depression. Certain nutrients were also found to be associated with mental health. The relationship between dietary intake of B2, B6 vitamins, and Beta-carotene and mental health was significant.

Similarly, the importance of dietary fat content was revealed. As saturated fat intake increased, depression, anxiety, and stress scores increased. Analyses of total calorie and total carbohydrate intake yielded the same results. Lastly, no relationship was found between individuals' anthropometric measurements and depression, anxiety, and stress score.

Additionally, as mentioned earlier, it is necessary to increase the number of studies conducted in this field to address the inconsistency in the results of studies in the literature. Depression and anxiety are increasingly prevalent in society, posing a threat to the overall health of communities. The factor of stress serves as a risk factor for many chronic diseases. It is predicted that increased stress levels will also lead to a deterioration in the physical health of populations. Consequently, the emergence of individuals with unhealthy development is inevitable. Currently, the number of individuals using antidepressants is steadily increasing, and the search for alternative approaches to mental health treatment continues. This is where nutrients play a crucial role. It is essential to investigate the mechanisms by which nutrients affect mental health and to uncover the physiological effects of foods that can alleviate symptoms. This way, in the future, antidepressant usage can be reduced, and an alternative treatment pathway

can be established through foods. This study can pave the way for further research on the relationship between nutrients and mental health. Furthermore, highlighting the importance of focusing not only on the quantities but also on the types of foods can contribute to filling the gaps in the literature on this subject.

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4. APPENDICES

APPENDIX 1: GENERAL INFORMATION FORM

KATILIMCIYA AİT GENEL BİLGİLER FORMU

Ad:

Soyad:

Yaş:

Cinsiyet:

Kadın ☐ Erkek ☐

Sigara tüketimi:

Var ☐ Yok ☐

Alkol tüketimi

Sık sık ☐ Sosyal içici ☐ Yok ☐

Fiziksel aktivite durumu:

Düzenli spor yapıyor ☐ Haftada …….. gün

Hareketli yaşam ☐

Hareketsiz ☐

Herhangi bir kronik hastalık :

Var ☐ Hastalığı belirtiniz……..

Yok ☐

Kullanılan ilaçlar:

Belirtiniz**…….**

Tarih-İmza

APPENDIX 2: FOOD INTAKE RECORD

	SABAH	1.ARA	ÖĞLE	2.ARA	AKŞAM	3.ARA
Hafta içi 1. gün						
Hafta içi 2. gün						
Hafta sonu 1 gün						

APPENDIX 3: INFORMED CONSENT FORM

BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU

ÇALIŞMANIN ADI:

Bursa'da Özel Bir Diyet Kliniğine Başvuran Kadınların Diyet Karbonhidrat Kalitesinin Depresyon, Anksiyete ve Stres Düzeylerine Etkisi

Aşağıda bilgileri yer almakta olan bir araştırma çalışmasına katılmanız istenmektedir. Çalışmaya katılıp katılmama kararı tamamen size aittir. Katılmak isteyip istemediğinize karar vermeden önce araştırmanın neden yapıldığını, bilgilerinizin nasıl kullanılacağını, çalışmanın neleri içerdiğini, olası yararları ve risklerini ya da rahatsızlık verebilecek yönlerini anlamanız önemlidir. Lütfen aşağıdaki bilgileri dikkatlice okumak için zaman ayırınız. Eğer çalışmaya katılma kararı verirseniz, **Çalışmaya Katılma Onayı** *Formu'nu imzalayınız. Çalışmadan herhangi bir zamanda ayrılmakta özgürsünüz. Çalışmaya katıldığınız için size herhangi bir ödeme yapılmayacak ya da sizden herhangi bir maddi katkı/malzeme katkısı istenmeyecektir.*

ÇALIŞMANIN KONUSU VE AMACI:

Bu araştırmanın amacı kadınlarda diyet karbonhidrat kalitesinin depresyon, anksiyete ve stres üzerine etkisinin araştırılarak bilimdeki açığa katkı sağlanmasıdır. Elde edilen sonuç doğrultusunda tıbbi beslenme tedavisinde karbonhidrat miktarı ve kalitesine yapılan müdahaleler sonucunda depresif semptomların iyileştirilmesine yönelik adımlar atılabilir.

ÇALIŞMA İŞLEMLERİ:

42 soruluk DASS-42 ölçeği doldurulacaktır. Ölçekte bireylerin depresyon, anksiyete ve stres durumlarını saptamaya yönelik sorular bulunmaktadır. 2 hafta içi, 1 hafta sonu olmak üzere 3 günlük besin tüketim kaydı alınacaktır. Kilo, vücut yağ oranı, bel ve kalça oranı ölçümleri mezura ve TanitaMc780 cihazı yardımıyla alınacaktır.

ÇALIŞMADA YER ALMAMIN YARARLARI NELERDİR?

Toplumda giderek artan depresyon prevelansının beslenmeyle ilişkisinin anlaşılmasına katkı sağlanacaktır. Bu sayede bilimde beslenme ve depresyon alanındaki boşluğun doldurulması yönünde bir adım atılmış olacaktır.

ÇALIŞMA SÜRESİ VE ÖNGÖRÜLEN KİŞİ SAYISI

Çalışma katılımcılar için 3 günlük bir periyodu içerecektir. Beslenme kayıtları toplanan katılımcılara uygulanacak DASS-42 formu ve antropometrik ölçümlerin alınmasıyla birlikte araştırmanın kişiden toplanan veri kısmı sona erecektir. Çalışmaya katılması öngörülen 151 kişilik örneklem verileri elde edildikten sonra araştırma verilerinin incelenmesi ve tez yazım sürecine başlanacaktır.

ÇALIŞMA RİSKLERİ

Araştırma süresinde gönüllülerin maruz kalacağı herhangi bir risk veya rahatsızlık bulunmamaktadır.

BU ÇALIŞMAYA KATILMAMIN MALİYETİ NEDİR?

Çalışmaya katılmakla parasal yük altına girmeyeceksiniz ve size de herhangi bir ödeme yapılmayacaktır.

ÇALIŞMAYA KATILMALI MIYIM?

Bu çalışmada yer alıp almamak tamamen size bağlıdır. Şu anda bu formu imzalasanız bile istediğiniz herhangi bir zamanda bir neden göstermeksizin çalışmayı bırakmakta özgürsünüz. Eğer katılmak istemez iseniz veya çalışmadan ayrılırsanız, bilgileriniz hiçbir şekilde kullanılmayacaktır.

KİŞİSEL BİLGİLERİM NASIL KULLANILACAK?

Araştırma yürütücüsü Dyt.Berre İncekara kişisel bilgilerinizi, araştırmayı ve istatiksel analizleri yürütmek için kullanacaktır ancak kimlik bilgileriniz gizli tutulacaktır. Yalnızca gereği halinde, sizinle ilgili bilgileri etik kurullar ya da resmi makamlar inceleyebilir. Çalışmanın sonunda, kendi sonuçlarınızla ilgili bilgi istemeye hakkınız vardır. Çalışma sonuçları çalışma bitiminde literatürde yayınlanabilecektir ancak kimliğiniz açıklanmayacaktır. Bununla birlikte çalışmada kullanılacak verilerinizin tamamının toplanamaması durumunda toplanan verileriniz hiçbir yerde kullanılmayacak ve araştırmadan hiçbir yükümlülük altına girmeden çekilmiş sayılacaksınız.

SORU VE PROBLEMLER İÇİN BAŞVURULACAK KİŞİLER :

ADI : Berre İncekara

GÖREVİ: Çalışma yürütücüsü

TELEFON : 05343700726

ÇALIŞMAYA KATILMA ONAYI

Yukarıdaki bilgileri ilgili araştırmacı ile ayrıntılı olarak tartıştım ve kendisi bütün sorularımı cevapladı. Bu bilgilendirilmiş olur belgesini okudum ve anladım. Bu araştırmaya katılmayı kabul ediyor ve bu onay belgesini kendi hür irademle imzalıyorum. Bu onay, ilgili hiçbir kanun ve yönetmeliği geçersiz kılmaz. Araştırmacı, saklamam için bu belgenin bir kopyasını çalışma sırasında dikkat edeceğim noktaları da içerecek şekilde bana teslim etmiştir.

Gönüllü Adı Soyadı:		*Tarih ve İmza:*
Telefon:		

Görüşme Tanığı Adı Soyadı:		*Tarih ve İmza:*
Telefon:		

Araştırmacı Adı Soyadı:	Berre İncekara	*Tarih ve İmza:*
Telefon:	05343700726	

APPENDIX 4: DEPRESSION-ANXIETY-STRESS SCALE 42

NO	SON 1 HAFTADAKİ DURUMUNUZ	Hiçbir zaman (0)	Bazen ve arasıra (1)	Oldukça sık (2)	Her zaman (3)
1 S	Oldukça önemsiz şeyler için üzüldüğümü farkettim				
2 A	Ağzımda kuruluk olduğunu farkettim				
3 D	Hiç olumlu duygu yaşayamadığımı farkettim				
4 A	Soluk almada zorluk çektim (*örneğin fizik egzersiz yapmadığım halde aşırı hızlı nefes alma, nefessiz kalma gibi)*				
5 D	Hiçbir şey yapamaz oldum				
6 S	Olaylara aşırı tepki vermeye meyilliyim				
7 A	Bir sarsaklık duygusu vardı *(sanki bacaklarım beni taşıyamayacakmış gibi)*				
8 S	Kendimi gevşetip salıvermek zor geldi				
9 A	Kendimi, beni çok tedirgin ettiği için sona erdiğinde çok rahatladığım durumların içinde buldum				
10 D	Hiçbir beklentimin olmadığı hissine kapıldım				
11 S	Keyfimin pek kolay kaçırılabildiği hissine kapıldım				
12 S	Sinirsel enerjimi çok fazla kullandığımı hissettim				
13 D	Kendimi üzgün ve depressif hissettim				
14 S	Herhangi bir şekilde *geciktirildiğimde (asansörde, trafik ışıklarında, bekletildiğimde)* sabırsızlandığımı hissettim				
15 A	Baygınlık hissine kapıldım				
16 D	Neredeyse herşeye karşı olan ilgimi kaybettiğimi hissettim				
17 D	Birey olarak değersiz olduğumu hissettim				
18 S	Alıngan olduğumu hissettim				
19 A	Fiziksel egzersiz veya aşırı sıcak hava olmasa bile belirgin biçimde terlediğimi gözledim *(örneğin ellerim terliyordu*)				
20 A	Geçerli bir neden olmadığı halde korktuğumu hissettim				
21 D	Hayatın değersiz olduğunu hissettim				
22 S	Gevşeyip rahatlamakta zorluk çektim				
23 A	Yutma güçlüğü çektim				
24 D	Yaptığım işlerden zevk almadığımı farkettim				
25 A	Fiziksel egzersiz söz konusu olmadığı halde kalbimin hareketlerini hissettim *(kalp atışlarımın hızlandığını veya düzensizleştiğini hissettim)*				
26 D	Kendimi perişan ve hüzünlü hissettim				
27 S	Kolay sinirlendirilebildiğimi farkettim				
28 A	Panik haline yakın olduğumu hissettim				
29 S	Bir şey canımı sıktığında kolay sakinleşemediğimi farkettim				
30 A	Önemsiz fakat alışkın olmadığım bir işin altından kalkamayacağım korkusuna kapıldım				
31 D	Hiçbir şey bende heyecan uyandırmıyordu				
32 S	Birşey yaparken ikide bir rahatsız edilmeyi hoş göremediğimi farkettim.				
33 S	Sinirlerimin gergin olduğunu hissettim				
34 D	Oldukça değersiz olduğumu hissettim				
35 S	Beni yaptığım işten alıkoyan şeylere dayanamıyordum				
36 A	Dehşete düştüğümü hissettim				
37 D	Gelecekte ümit veren birşey göremedim				
38 D	Hayatın anlamsız olduğu hissine kapıldım				
39 S	Kışkırtılmakta olduğumu hissettim				
40 A	Panikleyip kendimi aptal durumuna düşüreceğim durumlar nedeniyle endişelendim.				
41 A	Vücudumda *(örneğin ellerimde)* titremeler oldu.				
42 D	Bir iş yapmak için gerekli olan ilk adımı atmadazorlandım				

APPENDIX 5: CV

Kişisel Bilgiler

Adı	BERRE	**Soyadı**	İNCEKARA

Öğrenim Durumu

Derece	Alan	Mezun Olduğu Kurumun Adı	Mezuniyet Yılı
Yüksek Lisans	BESLENME VE DİYETETİK	**YEDİTEPE ÜNİVERSİTESİ**	2020-
Lisans	BESLENME VE DİYETETİK	**BAHÇEŞEHİR ÜNİVERSİTESİ %100 BURSLU**	2020
Lise	MF-3	**BURSA ANADOLU LİSESİ**	2016

Bildiği Yabancı Dilleri	**Yabancı Dil Sınav Notu (#)**
İNGİLİZCE	YÖKDİL: 59

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Görevi	**Kurum**	**Süre (Yıl - Yıl)**
DİYETİSYEN	BERRE İNCEKARA BESLENME VE DİYET DANIŞMANLIK MERKEZİ	08/2022-HALEN
CONTENT EDİTÖR	DİYETKOLİK	02/2020-HALEN
DİYETİSYEN	NESLİHAN GÖNDER ESTETİK	02/2021-08/2022

Bilgisayar Bilgisi

Program	**Kullanma becerisi**
MİCROSOFT OFFİCE	İYİ
BEBİS	ÇOK İYİ

*Çok iyi, iyi, orta, zayıf olarak değerlendirin

Diğer (Görev Aldığı Projeler/Sertifikaları/Ödülleri)

2018-2021 Yılları arasında Bahçeşehir Üniversitesi BES-İN Dergisi Editörü olarak görev yaptı.
2017 Bahçeşehir Üniversitesi BES-İN Dergisi'nde yazar olarak görev yaptı.

APPENDİX 6: Ethical Approval

KARAR FORMU

ETİK KURUL BİLGİLERİ	Etik Kurulun Adı	Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu
	Açık Adres	Yeditepe Üniversitesi Kayışdağı Kampüsü, Tıp-Mühendislik Binası, Sağlık Bilimleri Enstitüsü, İnönü Mah. Kayışdağı Cad. 326A, 26 Ağustos Yerleşimi 34755 Ataşehir, İstanbul
	İnternet Sayfası	http://goetik.yeditepe.edu.tr/
	Telefon	0216 578 00 00
	E-posta	goetik@yeditepe.edu.tr

DEĞERLENDİRİLEN BELGELER	Islak imzalı başvuru dosyası, CD'si ve elektronik başvuru	☒
	Araştırma başlığı ve araştırmacıların isimleri	☒
	Başvuru dilekçesi	☒
	Başvuru Formu- Araştırmanın;	☒
	• Niteliği	☒
	• Önemi ve özgün değeri	☒
	• Amaç ve hedefleri	☒
	• Yöntemi	☒
	• Yönetimi	☒
	• Yaygın etkisi	☒
	• Araştırma bütçesi (Mevcutsa)	☒
	• Süresi ve uygunluğu (Zaman cetveli)	☒
	• Kaynakları	☒
	Bilgilendirilmiş Gönüllü Olur Formu (yapılan araştırmaya özel olarak hazırlanmış)	☒
	Taahhütname-1 Araştırmanın yapılacağı kurumdan izin alma sorumluluğunun araştırmacılara ait olduğuna dair taahhüt	☒
	Taahhütname-2 Dünya Tıp Birliği Helsinki Bildirgesinin son versiyonunun ve Sağlık Bakanlığı'nın ilgili tüm kılavuzlarının okunmasına dair taahhüt	☒
	Taahhütname-3 Daha önce yapılmış etik kurul başvuruları mevcut olup olmadığına dair taahhüt	☒
	Taahhütname-4 Araştırma sırasında araştırma bütçesinde yer almayan ve gönüllünün kendisine veya Sosyal Güvenlik Kurumuna ek yük getirecek hiçbir işlem uygulanmayacağına dair taahhüt	☒
	Taahhütname-5 COVID-19 hastalarında tedavi yaklaşımları ve bilimsel araştırmalar genelgesi okunmasına dair taahhüt	☒
	Taahhütname-6 Milli Eğitim Bakanlığı Araştırma Uygulama İzinleri konulu yazının okunmasına dair taahhüt	☒
	Araştırmacıların her birisine ait özgeçmiş formu	☒
	Ek belgeler (Varsa kullanılan ölçek izinleri vb.)	☒

KARAR BİLGİLERİ	Başvuru Numarası	202203YO188
	Toplantı Tarihi	11.03.2022
	Toplantı Yeri	Çevirim içi (Google Meet)
	Karar No	3

BAŞVURU NUMARASI: 202203YO188

15.03.2022

KARAR

☒ **KABUL**	☐ **RET** ☐ *KAPSAM DIŞI (GİRİŞİMSEL)* ☐ *BİLİMSEL VE/VEYA ETİK KURALLARA AYKIRI* ☐ *BİR SORUMLU ARAŞTIRMACININ (TEZ İSE DANIŞMAN), BİR TOPLANTIYA **İKİ (2) ADETTEN FAZLA ÇALIŞMA BAŞVURUSUNDA** BULUNMASI* ☐ *KURUM İÇİ BAŞVURULARINDA **KURUMSAL E-POSTA HESABI** İLE GİRİŞ YAPILMAMIŞ OLMASI* ☐ *ŞARTLI KABULDE BELİRTİLEN REVİZYONLARIN ZAMANINDA VE/VEYA İSTENİLDİĞİ ŞEKİLDE YAPILMAMIŞ OLMASI*

Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu adına
Prof.Dr.Didem Özdemir ÖZENEN

Başkan