Karbonhidrat Seçimleriniz Depresyon, Anksiyete ve Stresi Artırıyor mu? Diyet Kliniğine Başvuran Kadınlarda, Diyet ve Ruh Sağlığı Arasındaki Bağlantının Açığa Çıkarılması

Are Your Carbohydrate Choices Fueling Depression, Anxiety, and Stress? Unpacking the Link between Diet and Mental Health in Women Attending Diet Clinics

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ÖZ

Amaç: Karbonhidrat kalitesi ile ruh sağlığı sonuçları özellikle depresyon, anksiyete ve stres arasındaki ilişki yeterince araştırılmamıştır. Bu çalışma, karbonhidrat kalite indeksi'nin (CQI) kadınlardaki bu psikolojik parametreler üzerindeki potansiyel etkisini incelemektedir.
Gereç ve Yöntem: Bu kesitsel çalışma, Bursa'da bir diyet kliniğine başvuran yetişkin kadınları kapsamaktadır. Beslenme verileri temel alınarak; diyet lifi alımı, glisemik indeks (GI), tam tahıl/rafine tahıl oranı ve karbonhidratların fiziksel formu (katı-sıvı) gibi bileşenler doğrultusunda, karbonhidrat kalitesini yansıtan bileşik bir ölçüt olan CQI hesaplanmıştır. Ruh sağlığı durumu, Depresyon Anksiyete Stres Ölçeği (DASS-42) ile değerlendirilmiştir. Veriler uygun betimleyici istatistiklerle özetlenmiş ve grup farklılıkları verinin dağılımına göre uygun istatistiksel yöntemlerle analiz edilmiştir.
Bulgular: Çalışmaya toplam 140 kadın katılmış olup yaş ortalaması 34,3 yıl olarak belirlenmiştir. Ortalama CQI skoru 11,9 ± 3,2'dir. DASS-42 sonuçlarına göre katılımcıların çoğunluğu orta düzeyde depresyon (%76,4), anksiyete (%67,9) ve stres (%69,2) bildirmiştir. Katılımcılar CQI skorlarına göre beş gruba ayrıldığında anlamlı ters ilişki gözlenmiştir: CQI arttıkça (Q1'den Q5'e), depresyon skorları azalmış (ortalama: 11'den 2'ye; p = 0,007) ve benzer şekilde anksiyete (8,4'ten 3,9'a; p = 0,010) ile stres seviyeleri (15'ten 9'a; p = 0,007) düşmüştür.
Sonuç: Bu bulgular, yüksek karbonhidrat kalitesinin kadınlarda daha iyi ruh sağlığı ile ilişkili olabileceğini göstermektedir. Karbonhidrat kalitesini iyileştirmeye yönelik beslenme müdahaleleri; depresyon, anksiyete ve stres yönetiminde destekleyici bir strateji olabilir. Altta yatan mekanizmaların ve uzun vadeli etkilerin araştırılması için ileri çalışmalar gerekmektedir.
Anahtar Kelimeler: Anksiyete; depresyon; karbonhidrat kalite indeksi; mental sağlık; stres

ABSTRACT

Aim: The link between carbohydrate quality and mental health outcomes-specifically depression, anxiety, and stress-remains underexplored. This study investigates the potential impact of the Carbohydrate Quality Index (CQI) on these psychological parameters in women.
Method: This cross-sectional study included adult women attending a diet clinic in Bursa, Türkiye. Based on dietary data, the CQI-a composite measure reflecting carbohydrate quality-was calculated using components such as dietary fiber intake, glycemic index (GI), the ratio of whole to refined grains, and the physical form of carbohydrates (solid vs. liquid). Mental health status was assessed using the Depression Anxiety Stress Scale (DASS-42). Data were summarized using appropriate descriptive statistics, and group differences were analyzed with suitable statistical methods based on the data distribution.
Results: A total of 140 women participated, with a mean age of 34.3 years. The average CQI score was 11.9 ± 3.2. According to DASS-42 results, a majority reported moderate levels of depression (76.4%), anxiety (67.9%), and stress (69.2%). When participants were grouped into CQI quintiles, a significant

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inverse association was observed: as CQI increased from Q1 to Q5, depression scores declined (mean: 11 vs. 2; p = 0.007), as did anxiety (8.4 vs. 3.9; p = 0.010) and stress levels (15 vs. 9; p = 0.007).
Conclusion: These findings suggest that higher carbohydrate quality may be linked to better mental health in women. Dietary interventions aimed at improving carbohydrate quality could offer a supportive strategy for managing depression, anxiety, and stress. Additional studies are required to examine the primary mechanisms and prolonged outcomes.
Keywords: Anxiety; carbohydrate quality index; depression; mental health; stress.

INTRODUCTION

The World Health Organization (WHO) conceptualizes health as "a state of complete physical, psychological and social well-being and not merely the absence of disease or infirmity" (1). Mental health, an integral part of this definition, is heavily influenced by depression, anxiety, and stress, which collectively impact the quality of life and public health systems. Depression alone affects over 264 million people globally and is considered one of the leading causes of disability (2,3). Depression, marked by ongoing unhappiness, exhaustion, diminished interest, and trouble focusing, is frequently linked to stress and anxiety. These interconnected conditions exacerbate psychological burdens, highlighting the need for preventive and therapeutic strategies (4). Among various risk factors, dietary habits have emerged as a significant modifiable component influencing mental health (5). For example, a Western dietary pattern, rich in refined carbohydrates and sugary beverages, has been associated with increased depression and anxiety scores (6). Conversely, a recent systematic review indicates that diets high in whole grains, vegetables, and fruits are connected to better mental health outcomes (7). Carbohydrates, the main fuel supply for the human body, have a key function in mood and cognitive function. The glycemic index (GI), a measure of carbohydrate quality, has shown a strong correlation with depression scores; high-GI diets are associated with elevated psychological distress, while low-GI diets appear protective (8,9). Additionally, glycemic load (GL), which accounts for the quality and quantity of carbohydrate intake, further underscores the relationship between carbohydrate consumption and mental health (10). Emerging research emphasizes the addictive properties of high-carbohydrate foods due to their influence on the brain's reward system via dopamine release. Low-GI and low-GL foods, such as whole grains and legumes, are increasingly recognized for their role in mood regulation and reducing symptoms of depression and anxiety (11,12) .

This study investigates the link between dietary carbohydrate quality, evaluated through a tool known as the carbohydrate quality index (CQI), and rates of depression, anxiety, and stress in women. It aims to enhance understanding of nutrition's role in mental health and support dietary interventions for psychological well-being.

MATERIAL AND METHOD

Study Design and Participants

This single-site cross-sectional study was undertaken with 151 women who applied to a diet outpatient clinic in Bursa, Türkiye, between April 2022 and September 2022. Individuals were excluded from the study if they were under 18 years of age, man, pregnant or lactating, had followed a medically prescribed diet (e.g., gluten-free or diabetic) during the last 12 months, or had been diagnosed with psychiatric conditions such as schizophrenia or bipolar disorder. Also, participants with zero refined grain consumption in their dietary records were discarded to ensure a valid refined grain/whole grain ratio, resulting in a final sample size of 140 women for analysis.

Dietary Assessment

The evaluation of participants' dietary intake was based on a three-day dietary record, covering both typical weekdays and one weekend day. A computerized nutrition software, BeBis 8.2, developed specifically for Türkiye, was used to analyze all dietary data.

Assessment of Carbohydrate Quality

The carbohydrate quality index (CQI) is a novel approach that was first introduced by Zazpe et al. and incorporates four dimensions of carbohydrate quality, such as dietary fiber intake (g/day), dietary GI, whole grain/total grain ratio, and solid carbohydrate/total carbohydrate ratio (13). In this study, all contents related to carbohydrates were obtained using BeBiS 8.2 and international database (14). Total grain intake was computed by summing the consumption of refined grains, whole grains, and food derived from these grains. Liquid carbohydrate intake consisted of sugary drinks, fruit juices, and soup. Solid carbohydrate consumption was defined as the total intake of all carbohydrate-containing foods in solid form.

For those components, participants were stratified into quintiles and received a score from 1 to 5 according to the quintile they were assigned to. The CQI was calculated by aggregating all these values, with the resulting score varying from 4 and 20, with higher values being indicative of better carbohydrate quality (Table 1).

Table 1. Parameters used to calculate carbohydrate quality index (CQI)

Component	**Scoring basis**	**Scoring range**
Dietary fiber intake (g/day)	Lowest to highest quintile of fiber intake	1-5
Glycemic index (GI)	Highest to lowest quintile of GI values	1-5
Whole grain/total grain ratio	Lowest to highest quintile of ratio	1-5
Solid carbohydrate/total carbohydrate ratio	Lowest to highest quintile of ratio	1-5

Depression Anxiety Stress Scale (DASS-42)

The DASS 42 scale has been used to determine depression, anxiety, and stress levels of participants. It was a self-report questionnaire developed by Lovibond & Lovibond in 1995 (15), and Turkish validation was performed by Bilgel & Bayram (16). This scale consists of three subscales classified as depression, anxiety, and stress, each composed of 14 items. The items are rated on a 4-point Likert-type scale with a range from 0 ("never/ did not apply to me at all") to 3 ("almost always/ applied to me very much"). The total DASS-42 score and the scores for each subscale are summed (Table 2).

Table 2. DASS-42 scale

	Depression	**Anxiety**	**Stress**
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28+	20+	34+

Anthropometric Measurements

Participants' weight, height, waist, and hip circumference were measured and evaluated following WHO guidelines (17). All measurements in the study were performed and recorded by a dietitian and were repeated twice. Body weight of participants was measured to the nearest 0.1 kg using a *Tanita NC780* scale. The participants' height was recorded barefoot and standing, using a stadiometer accurate to 0.1 cm. The body mass index (BMI) of each participant was determined by dividing their weight in kilograms by the square of their height in meters (kg/m²); these values were categorized as normal, overweight, obese, and morbidly obese (18).

Participants' waist circumference (WC) and hip circumferences were measured in a standing position using an inelastic tape measure. WC was assessed in the area between the iliac crest and the lower rib, whereas hip measurements were conducted at the broadest region of the hip aligned with the greater trochanter. After these measurements, the waist-hip ratio (WHR) was calculated. For WC, > 80 cm and > 88 cm were considered "increased metabolic risk" and "significantly increased metabolic risk," respectively. Also, WHR ≥ 0.85 in women was considered a "significantly increased metabolic risk" (18).

Ethical Consideration

The study was performed in line with the ethical standards outlined by the Helsinki Declaration. Ethical approval was obtained from the Noninvasive Research Ethics Committee of Yeditepe University (Approval Date: 11.03.2022; Approval No: 202203YO188). Signed consent forms were collected from all study volunteers before their participation in the research. The trial registration number is not required.

Statistical Analysis

Data analyses were performed utilizing IBM SPSS software v20.0 (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov method was used to determine whether the dataset conformed to normality. Variables with normal distribution were presented as mean ± standard deviation, while those not conforming to normal distribution were reported as median (interquartile range: 25th-75th percentile). The categorical data were expressed as numbers and percentages. For comparisons involving more than two groups, variables with normal distribution were analyzed using one-way ANOVA, and those without were analyzed using the Kruskal-Wallis test. Correlation analysis was used to examine associations between numerical variables. The *p*-value less than 0.05 was regarded as the criterion for determining statistical significance.

RESULTS

Among the 140 women enrolled in the study, there was a mean age of 34.3 years. The majority were aged 40 years and older (36.4%), non-smokers (57.1%), social drinkers (55.7%), active patients (78.6%), and non-menopausal (97.9%). When the anthropometric data of the women were examined, 62.9% had normal BMI. On the other hand, regarding WC and WHR, 15.1% and 15.7% of women, respectively, were at significantly increased metabolic risk (Table 3). The mean CQI score for women was 11.9 ± 3.2. When evaluating the DASS-42 scores, more than half of the women have moderate levels of depression (76.4%), anxiety (67.9%), and stress (69.2%) (Table 3). As demonstrated in Table 4, when the CQI was divided into quintiles, with carbohydrate quality increasing up to Q5, significant decreases were observed in depression (11 vs. 2; p = 0.007), anxiety (8.4 vs. 3.9; p = 0.010), and stress (15 vs. 9; p = 0.007) scores.

Table 3. General characteristics of participants

Variables	
Age (years) (mean SD)	34.3 ± 10.3
Age classification n(%)	
18-24	42(30.1)
25-40	47(33.5)
40≥	51(36.4)

Cigarette Smoking n(%)	
None	80(57.1)
Smokers	60(42.9)
Alcohol Consumption n(%)	
None	55(39.3)
Often	7(5.0)
Social Drinker	78(55.7)
Physical Activity n(%)	
Sedentary	30(21.4)
Active	110(78.6)
Menopause n(%)	
Yes	3(2.1)
No	137(97.9)
BMI (kg/m^2) (mean SD)	23.1 ± 4.6
BMI classification n(%)	
Underweight	15(10.7)
Normal	88(62.9)
Overweight	27(19.3)
Obese	10(7.1)
WHR (mean SD)	0.78 ± 0.06
WHR classification	
Normal	118(84.3)
Significantly increased metabolic risk	22(15.7)
WC (cm)(mean SD)	76.7 ± 11.5
WC classification	
Normal	97(69.8)
Increased metabolic risk	21(15.1)
Significantly increased metabolic risk	21(15.1)
CQI (mean/SD)	11.9 ± 3.2
Depression level n(%)	
Normal	17(12.2)
Mild	11(7.9)
Moderate	107(76.4)
Severe	2(1.4)
Extremely severe	3(2.1)
Anxiety level n(%)	
Normal	14(10.0)
Mild	20(14.3)
Moderate	95(67.9)

Severe	9(6.4)
Extremely severe	2(1.4)
Stress level n(%)	
Normal	26(18.6)
Mild	12(8.6)
Moderate	97(69.2)
Severe	4(2.9)
Extremely severe	1(0.7)

Variables are shown as means ± standard deviations (SD). Categorical variables are expressed as frequency (%).

BMI, Body mass index (Underweight: <18.5 kg/m^2; Normal: 18.5-24.99 kg/m^2; Overweight: BMI 25.0-29.99 kg/m^2; Obesity: BMI ≥ 30 kg/m^2) CQI, Carbohydrate quality index; DASS-42, Depression anxiety stress scale; WC, Waist circumference; > 80 cm: increased metabolic risk; ≥ 88 cm: significantly increased metabolic risk; WHR, Waist-hip ratio; ≥ 85 cm: significantly increased metabolic risk

Table 4. Difference between CQI and depression, anxiety, and stress

Variable	Q1	Q2	Q3	Q4	Q5	*p*
Depression	11 (3-14)	5.5 (3.3-8.0)	4 (2.0-7.5)	3 (1-9)	2 (0.5-7.0)	0.007[a]
Anxiety	8.4 ± 5.8	7.5 ± 5.0	6.1 ± 4.6	5.5 ± 5.1	3.9 ± 3.7	0.010[b]
Stress	15.0 ± 7.0	13.6 ± 7.3	11.0 ± 5.7	10.3 ± 6.6	9.0 ± 5.6	0.007[b]

[a]Kruskal Wallis Test (median (25th -75th percentil)

[b]One-Way Analysis of Variance (mean ± standard deviation)

*p < 0.05 **p < 0.01

According to the correlation table, significantly positive associations were reported between each of the components of the DASS-42 and total energy, total carbohydrate, insoluble fiber, liquid carbohydrate, and saturated fat. Moreover, each of the components of the DASS-42 was significantly negatively correlated with whole grain/refined grain and protein percentage. Considering the sub-dimensions of the DASS-42 scale, a significantly negative correlation was detected between depression score and total fiber (p = 0.041; r: -0.173), soluble fiber (p = 0.009; r: -0.221), beta carotene (p = 0.023; r: -0.192), and vitamin B6 (p = 0.033; r: -0.180). Furthermore, significantly negative relationship was demonstrated between anxiety score and soluble fiber (p = 0.038; r: -0.176), vitamin B2 (p = 0.022; r: -0.193), and vitamin B6 (p = 0.049; r: -0.167) levels; and between stress score and cholesterol, vitamin A, beta carotene, and vitamin B2 levels. A positive association was found between stress scores and PUFA (p = 0.010; r: 0.217) and total fat (p = 0.046; r: 0.169); and between GI and depression (p = 0.036; r: 0.178) and stress scores (p = 0.004; r: 0.241) (Table 5).

Furthermore, the effect of the CQI on depression, anxiety, and stress scores was examined through linear regression analysis (Table 6). The results demonstrated that higher CQI scores were significantly associated with lower levels of all three psychological symptoms. Specifically, CQI significantly predicted depression (B = -0.596, β = -0.306, t = -3.773, p < 0.001), anxiety (B = -0.476, β = -0.303, t = -3.730, p < 0.001), and stress (B = -0.614, β = -0.292, t = -3.587, p < 0.001). Each one-unit increase in CQI was associated with a reduction of approximately 0.60, 0.48, and 0.61 points in depression, anxiety, and stress scores, respectively. The models accounted for 9.3%, 9.2%, and 8.5% of the variance in depression, anxiety, and stress scores, respectively.

Table 5. 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 fiber (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
Insoluble fibre (g)	**0.001****	0.271	**0.009****	0.222	**0.006****	0.233
Whole Grain/Refined Grain	**<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	0.948	0.006	0.592	-0.046	0.513	-0.056
GI	**0.004****	0.241	0.219	0.105	**0.036***	0.178
Protein (%)	**<0.001****	-0.450	**<0.001****	-0.413	**<0.001****	-0.365
Fat (%)	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	0.177	-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

CHO, Carbohydrate; GI, Glycemic index; MUFA, Monounsaturated fatty acid; PUFA, Polyunsaturated fatty acid; SFA, Saturated fatty acid

r, Pearson's rank correlation coefficient; Correlation is significant at *p < 0.05 **p < 0.01

Table 6. Linear regression analysis of CQI on depression, anxiety, and stress

CQI	B (95% CI)	R^2 (%)	β	t	*p*-value
Depression	-0.596 (-0.908, -0.283)	9.3	-0.306	-3.773	< 0.001**
Anxiety	-0.476 (-0.729, -0.224)	9.2	-0.303	-3.730	< 0.001**
Stress	-0.614 (-0.952, -0.275)	8.5	-0.292	-3.587	< 0.001**

CQI, Carbohydrate quality index; B (95% CI), linear regression coefficient and 95% confidence interval; β, standardized coefficient; R^2, model determination coefficient; t, test statistic calculated as B divided by the standard error (SE); p-values generated from linear regression models **p < 0.01

DISCUSSION

To the best of the authors' knowledge, this is the pioneering study to examine the relationship between the CQI and depression, anxiety, and stress scores in women. The CQI is a composite measure that integrates a number of crucial nutritional parameters, including dietary fiber, GI, the solid or liquid form of carbohydrates, and the processing level of carbohydrate-rich food items, such as whole or refined grains. Although some studies have not identified a link between CQI and depression, anxiety, and stress levels (19), evidence from other studies suggests that an enhanced carbohydrate quality may have a favorable impact on these mental health outcomes (20). The findings of the present study also lend support to the hypothesis that the quality of carbohydrates may exert a significant contribution to the attenuation of depression, anxiety, and stress scores.

The dietary fiber content of an individual's diet plays a pivotal role in determining the quality of carbohydrates consumed. The negative relationship between total dietary fiber and depression was notable finding of the present study. Increased fiber intake has been linked to improved gut microbiota diversity and modulation of the gut-brain axis, which play a critical role in regulating mood (21,22). Cheng et al. demonstrated that individuals with depression exhibited a lower consumption of dietary fiber compared to those without depression (23). Also, a recent systematic review and meta-analysis documented a significant inverse correlation between dietary fiber consumption and the odds of developing depression (2). In contrast, a divergent study concluded that there was no statistically significant correlation between dietary fiber intake and the anxiety category (24).

An inverse relationship was detected between CQI scores and depression, anxiety, and stress measures. This finding aligns with previous studies, such as Sanchez-Villegas et al., which reported that adherence to a high-quality carbohydrate diet was associated with reduced depression risk (25). Conversely, Yuksel et al. did not observe a significant relationship between CQI and psychological outcomes (26), which may be attributed to differences in sample characteristics or methodological approaches.

Higher intake of liquid carbohydrates was significantly associated with increased depression, anxiety, and stress scores in the present study. This finding is consistent with evidence suggesting that sugar-sweetened beverages, due to their rapid absorption and subsequent blood sugar fluctuations, are linked to poorer mental health outcomes (25,27). Similarly, high GI diets, characterized by rapid postprandial glucose spikes, were associated with higher DASS scores. These findings align with prior research demonstrating that high-GI diets exacerbate mood disorders through neurobiological mechanisms involving insulin and glucose regulation (14,28).

Total carbohydrate intake and its association with mental health outcomes have produced mixed results in the literature. For example, Daneshzad et al. found that lower carbohydrate intake was linked to reduced depression, anxiety, and stress scores (29). The results of our study also support these findings. On the other hand, other studies reported no significant relationship between total carbohydrate intake and mental health, possibly due to variations in dietary patterns and the quality of carbohydrates consumed (25,27).

Reduced activity of serotonin-producing neurons has been implicated in the development of mood and depressive disorders. A decrease in Trp, the amino acid precursor for serotonin synthesis, has been found to induce depressive symptoms in both individuals with depression and those without. As a result, heightened functioning of the central serotonergic system is believed to serve as a biological mechanism that helps buffer stress and protect against stress-related depression (30). Therefore, higher percentages of protein in the diet have been associated with lower DASS scores, possibly due to the role of amino acids in the synthesis of neurotransmitters such as serotonin and dopamine (31,32). The results of the present study support this idea and DASS scores decreased as the percentage of dietary protein increased.

The proportion of whole grains to refined grains was inversely correlated with DASS scores, emphasizing the importance of whole grains in improving mental health outcomes. Similar findings have been reported in studies showing that diets rich in whole grains are protective against mood disorders due to their higher nutrient density and lower GI (4,33).

Emerging research has indicated that omega-3 PUFAs may have promising therapeutic roles in managing mental conditions such as depression. In individuals with major depressive disorder, elevated levels of inflammatory markers-including interleukins, tumor necrosis factor (TNF)-α, and C-reactive protein-have been observed. It is believed that the antidepressant potential of omega-3 PUFAs may stem from their high concentration within the human nervous system and their anti-inflammatory properties, which could counteract the inflammation associated with depressive states (34-36). While no significant association was found between PUFA intake and DASS scores in our study, saturated fat intake was positively associated with higher DASS scores, possibly due to its pro-inflammatory effects as previously documented (26,37). Similar to these results, a cohort study found that trans fatty acid intake was positively associated with depression risk (20).

Interestingly, insoluble fiber intake showed a positive association with DASS scores in this study. While this finding diverges from the general benefits of dietary fiber reported in prior research (21), it may reflect the influence of specific dietary patterns or confounding variables unique to this population. For instance, the present study focused on a subset of women whose dietary habits might differ in ways that amplify the observed association. The overall health benefits of dietary fiber are well-documented; however, the current findings highlight the complexity of its impact on mental health, suggesting that not all fiber types or dietary contexts exert similar effects (21,38). Additionally, total energy intake was positively correlated with DASS scores, supporting evidence that excessive caloric intake, particularly from low-quality foods, can negatively impact mental health (25,27). The inverse relationship observed between CQI and stress scores highlights the potential role of high-quality carbohydrates in mitigating stress. Improved blood sugar regulation and increased serotonin production may underlie this effect, consistent with findings from studies on dietary interventions for stress reduction (26,39).

This study makes a valuable contribution by addressing an important topic within a specific population of women. However, several limitations should be considered. The cross-sectional design prevents establishing causal relationships and limits the generalizability of the findings. The relatively small sample size may reduce statistical power and affect the robustness of the results. Additionally, dietary intake data were self-reported, which may introduce recall bias and reporting inaccuracies. Similarly, depression, anxiety, and stress levels were assessed through self-administered questionnaires, potentially leading to subjective bias and limiting the objectivity of the measurements. Furthermore, the study was conducted at a single site, which may limit the representativeness of the sample. Measurements were taken at a single time point, potentially overlooking long-term dietary habits and mental health status. Potential confounding factors such as physical activity and socioeconomic status were not fully controlled. Finally, the absence of objective biomarkers for dietary intake and psychological stress may affect the validity of the results. These methodological constraints should be taken into account when interpreting the study's findings.

Conclusion

The findings of this study underscore the importance of carbohydrate quality in influencing mental health outcomes. Higher CQI scores, characterized by increased dietary fiber, lower GI, and greater whole grain consumption, were associated with lower depression, anxiety, and stress scores. These results contribute to a growing body of evidence supporting the role of diet in psychological well-being and highlight the need for further research to address inconsistencies and elucidate underlying mechanisms. Importantly, the study reinforces the potential of dietary interventions as a strategy for improving mental health, particularly among women. By utilizing the CQI as a multidimensional tool, this research offers novel insights into how the quality-rather than merely the quantity-of carbohydrate intake may affect psychological distress. Overall, dietary patterns rich in fiber and whole grains, and low in added sugars and high-glycemic foods, may contribute to improved mental health and well-being. From a practical perspective, dietitians are encouraged to incorporate the concept of carbohydrate quality into their nutritional counseling. Emphasizing the consumption of fiber-rich, low-GI, and whole grain carbohydrate sources may serve as a valuable component of holistic strategies aimed at enhancing mental well-being.

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