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The Relationship Between Dietary Fiber Intake, Depression, and Quality of Life in Adults with Type 2 Diabetes: A Cross-Sectional Study from a Primary Health Care Center

Tip 2 Diyabetli Yetişkinlerde Diyet Posası Alımı ile Depresyon ve Yaşam Kalitesi Arasındaki İlişki: Birinci Basamak Sağlık Merkezinden Kesitsel Bir Çalışma

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ABSTRACT

Type 2 diabetes, a global health concern, may impact an individuals' quality of life (QoL) and the presence of depression. Despite the potential favorable role of dietary fiber on these issues, studies are limited. Hence, this study aimed to elecudiate association between dietary fiber intake and depression and QoL in adults with type 2 diabetes.

This cross-sectional study was performed on patients diagnosed with type 2 diabetes who applied to the Primary Health Care Center, İstanbul. Data including demographic variables, three-day food records, Beck Depression Inventory for Primary Care (BDI-PC), and short form-36 (SF-36) health related QoL instrument were collected through face-to-face interviews. Anthropometric measurements including weight and height were measured.

Among the 120 patients 68.3% were women, with a mean age of 56.5 years. The mean body mass index (BMI) was 31.3 kg/m^2, with the majority of participants classified as overweight (38.3%) or obese (50%). The average daily dietary fiber intake was 17.3 ± 6.7 g, while the mean depression scale score was 3.8. According to the SF-36, the mean general health domain was 49.9 ± 22.9, with vitality being the lowest at 45.0 ± 20.2. Significant negative correlations were noted between depression and all different domains of SF-36. However, no significant relationship was established between dietary fiber intake and QoL or depression.

While there is no evidence indicating a correlation between dietary fiber intake and QoL or depression in present study, further comprehensive studies using larger samples are needed to better understand this phenomenon.

Keywords: Quality of life, Type 2 Diabetes mellitus, Depression, Dietary fiber

ÖZ

Küresel bir sağlık sorunu olan Tip 2 diyabet, bireylerin yaşam kalitesini (QoL) ve depresyon durumunu etkileyebilmektedir. Diyet posasının bu konulardaki potansiyel olumlu rolüne rağmen yapılan çalışmalar sınırlıdır. Bu nedenle, bu çalışma tip 2 diyabetli yetişkinlerde diyet posası alımı ile depresyon ve yaşam kalitesi arasındaki ilişkiyi aydınlatmayı amaçlamıştır.

Bu kesitsel çalışma, İstanbul'da Birinci Basamak Sağlık Hizmeti sunan bir merkeze başvuran tip 2 diyabet tanısı olan hastalarda yürütülmüştür. Demografik veriler, üç günlük besin tüketim kayıtları, Birinci Basamak için Beck Depresyon Envanteri (BDI-PC) ve Kısa form-36 (SF-36) Yaşam Kalitesi Ölçeği gibi araçları içeren veriler yüz yüze görüşmeler yoluyla toplanmıştır. Antropometrik ölçümler kapsamında ağırlık ve boy ölçümleri alınmıştır.

120 hastanın %68,3'ü kadındı ve yaş ortalaması 56,5 idi. Ortalama beden kütle indeksi (BKİ) 31,3 kg/m^2 olup katılımcıların çoğunluğu fazla kilolu (%38,3) veya obez (%50) olarak sınıflandırılmıştır. Günlük ortalama diyet posası alımı 17,3 ± 6,7 g iken ortalama depresyon ölçeği puanı 3,8 idi. SF-36'ya göre ortalama genel sağlık puanı 49,9 ± 22,9 ve canlılık puanı 45,0 ± 20,2 ile en düşük puanlardı. Depresyon ile SF-36'nın tüm farklı alanları arasında anlamlı negatif korelasyonlar kaydedilmiştir. Ancak diyet posası alımı ile yaşam kalitesi veya depresyon arasında anlamlı bir ilişki gösterilmemiştir.

Bu çalışmada diyet posası alımı ile yaşam kalitesi veya depresyon arasında ilişki olduğunu gösteren bir kanıt bulunmamakla birlikte, bu olgunun daha iyi anlaşılması için daha büyük örneklemlerin kullanıldığı daha kapsamlı çalışmalara ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Yaşam kalitesi, Tip 2 Diabetes mellitus, Depresyon, Diyet posası

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INTRODUCTION

Type 2 diabetes is acknowledged as a severe public health concern with profound effects on the population's quality of life (QoL) and healthcare expenditure. According to the International Diabetes Federation (IDF), approximately 537 million people worldwide had diabetes in 2021, and if current trends prevail, more than 1.31 billion people will be living with diabetes by 2050, the majority of whom will have type 2 diabetes.[1] Type 2 diabetes is a leading cause of morbidity and impaired QoL attributable to microvascular (neuropathy, retinopathy and nephropathy) and macrovascular (stroke, coronary heart disease, and arterial disease) complications. In particular, microvascular dysfunction is a widespread phenomenon in people with diabetes that may have detrimental effects on the brain including increased burden of cognitive dysfunction and depression.[2] Supportively, people with type 2 diabetes are presumed to be twice as likely to suffer from depression as the general population.[3] A meta-analysis has been conducted that has indicated a 24% increased risk of depression incident in patients with type 2 diabetes mellitus compared with non-diabetic individuals.[4] The condition's etiology may be explained by an array of factors, including, but not limited to, chronic dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis, characterized by elevated cortisol levels and reduced insulin sensitivity. Alternatively, the condition may be attributed to an immune system activation, which can result in or contribute to ongoing inflammatory processes.[5]

A growing body of epidemiologic data has documented a significant relationship between depression and multiple dietary components, including fish, fruits, vegetables, and certain nutrients such as folate, zinc, and iron. These articles have highlighted dietary fiber as one of the major dietary factors that may contribute to the progression of depressive symptoms.[6] Dietary fiber consists of non-digestible forms of carbohydrate however, it can be fermented by gut microbial enzymes and augment the production of key metabolic byproducts, such as short-chain fatty acids (SCFAs).[7] The results from a multitude of studies demonstrate that increased fiber intake may serve as a mitigating or preventive factor against depressive symptoms, across diverse study populations.[8,9] The association between increased dietary fiber intake and a reduced risk of depression has been attributed to the capacity of dietary fiber to modify the composition of the gut microbiota. The gut microbiota, in turn, has been posited to regulate the function of the brain-gut axis, a bidirectional communication system between the central nervous system and the gastrointestinal tract.[8]

Another critical concern in individuals with diabetes is that factors such as disease prognosis, risk of depression, and the complexity of the treatment process have a significant impact on the QoL of patients.[10] QoL is a concept that encompasses individuals' perceptions of their overall health status across the trajectory of their lives, within the context of their cultural milieu. It incorporates dimensions of physical well-being, psychological well-being, and social support.[11] A plethora of studies have examined the relationship between dietary fiber intake and QoL in several chronic diseases.[12,13] However, the extant literature is scant regarding studies in individuals with type 2 diabetes.[14]

Therefore, this cross-sectional study aimed to address this gap by investigating whether dietary fiber intake is significantly associated with depression levels and QoL in adults with type 2 diabetes. By focusing on this understudied intersection, the present research seeks to contribute novel evidence to the existing literature, highlighting the potential psychosocial benefits of dietary fiber. The findings may inform more comprehensive dietary strategies that not only support metabolic control but also promote mental well-being and improved QoL in this population.

MATERIAL AND METHOD

Data Collection Tools

The study was performed between March and May of 2023 at a Primary Health Care Center in Istanbul, Türkiye. The study population comprised 120 adult volunteers with a diagnosis of type 2 diabetes, aged 18 years or older, who were registered with the aforementioned health center. A convenience sampling method was employed, whereby participants meeting the inclusion criteria were selected based on their availability and willingness to participate during the data collection period.

The hypotheses of the present study are formulated as follows:

H_0: There is no statistically significant association between dietary fiber intake and either depression levels or QoL among adults with type 2 diabetes.

H_1: There is a statistically significant association between dietary fiber intake and both depression levels and QoL among adults with type 2 diabetes.

A post hoc power analysis was conducted using G*Power software *(version 3.1.9.7),* based on a medium effect size (0.81), an alpha level of 0.05, and a statistical power of 0.95. The analysis indicated that a minimum of 70 participants would have been sufficient to detect medium effects. Since the present study included 120 participants, the sample size was considered adequate.

Participants meeting the following criteria were excluded from participation in the study: individuals under the age of 18 without a diagnosis of type 2 diabetes, individuals diagnosed with depression or other psychiatric diseases, pregnant or lactating women, and individuals unable to complete the food record. This study was conducted following the guidelines outlined in the Declaration of Helsinki, and all procedures were approved by the Noninvasive Research Ethics Committee of Yeditepe University with date and number 08.04.2022/E.83321821-805.02.03-59. Additionally, permission was granted by the Ministry of Health on February 16, 2023, to conduct the study at Kartal Family Health Center No. 3, the institution where the target population was accessible.

The demographic information of the participants, including gender, age, and educational status, was obtained through the data collection form. Anthropometric measurements of the participants, including height and weight, were collected by trained dietitan. The participants' weights were recorded with a digital scale suitable for medical use. Prior to the measurement, the participants were asked to remove their thick clothes and shoes. The participants' heights were measured using a height meter with an accuracy of 0.1 centimeters. The feet were positioned side by side, and the head was in the Frankfurt plane (eye triangle and auricle are at the same level, parallel to the ground). Based on the height and weight data obtained, Body Mass Index (BMI) was calculated and evaluated in accordance with the World Health Organization (WHO) classification: underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥30.0 kg/m²).[15]

A 3-days food record was collected from the participants during the interview, retrospectively covering two weekdays and one weekend day. Dietary fiber intake was analyzed using the Computer Assisted Nutrition Program, Nutrition Information System (BeBis 8.2), a software specifically developed for use in Türkiye.

Beck Depression Inventory for Primary Care (BDI-PC)

The scale assesses depression across seven categories, using symptoms of sadness, pessimism, past failures, self-dislike, self-blame, loss of interest, and suicidal ideation or desire inspired by the Beck Depression Inventory-II[16] and the Diagnostic and Statistical Manual of Mental Disorders, 4th ed. (DSM-IV).[17] The scale's items are rated on a 4-point scale with values ranging from 0 to

3. The total score is obtained by computing the sum of the highest ratings from the seven items. A maximum total score of 21 can be achieved. Although no cut-off score is reported, scores above 4 indicate a 90% probability of depression. The Turkish validity and reliability of the scale was conducted by Aktürk et al in 2005, with the Cronbach's alpha coefficient reported as 0.85.[18]

SF-36 Quality of Life Scale

The SF-36 health related QoL scale was developed by Ware et al. for use in clinical practice and research, health policy evaluation, and general population surveys.[19] The scale has 8 domains and 36 questions. The first 8 questions are about physical function, physical role difficulty, social functionalitty, pain, mental health, emotional role difficulty, vitality, and general health. The highest possible score is 100, and the lowest possible score is 0. The SF-36 was scored so that the higher the score for each health domain, the better well-being and QoL related to health. For example, a high score on the pain scale indicates reduced status of pain. The scale's Turkish version was validated and reliability tested by Bölükbaş to ensure its accuracy and consistency, with a Cronbach's alpha of 0.92.[20] The scale does not offer a single total score; it provides different total scores for each domains.

Permission to use all measurement scales utilized in this study was obtained from the original developers or copyright holders prior to data collection.

Statistics

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software, version 23 for Windows. Normality of the data was evaluated using the Kolmogorov-Smirnov test along with assessments of skewness and kurtosis, which confirmed the suitability of the data for parametric analyses. The characteristics of the study samples were reported as mean ± SD for continuous measures, and as percentages (%) and numbers (n) for qualitative measures. Because the data were presented in two groups, women and men, independent samples t-test was performed for univariate analysis of continuous outcomes. Pearson correlation analysis was conducted to examine the relationship between daily dietary fiber intake and scores on the QoL and depression scale. The confidence interval was set at 95% in all evaluations, and findings were regarded as statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

The present study's demographic profile reveals that the majority of the participants, constituting 68.3%, are women. A significant proportion of the sample are married (85%) and fall within the age range of 51 to 65 years (54.2%). Almost half of the participants are primary school graduates, and hypertension (52.5%), cardiac insufficiency (19.2%) and other diseases (55%) are the most common comorbidities. A significant majority of the participants, 79.1%, engage in moderate physical activity, and a notable proportion of the sample does not consume alcohol (95%) or smoking (82.5%). The mean BMI of the participants was 31.3 ± 6.5 kg/m^2, with 38.3% of the individuals categorized as overweight, 40.8% as obese, and 9.2% as morbidly obese (Table 2).

According to the depression scale score, the average score of all participants was 3.8 ± 3.4, and although the average for women was higher than for men, the difference was not statistically significant. As indicated by the findings, the lowest score from the QoL scale was obtained in the vitality domain (45.0 ± 20.2) , while the highest score was attained in the pain domain (73.8 ± 30.4). All domains of QoL were documented as significantly higher in men than in women, with the exception of mental health and social functionality. The daily dietary fiber intake of the participants was measured at 17.3 ± 6.6, and the results indicated that men exhibited a higher daily fiber intake (20.3 ± 9.0 g/day) compared to women (15.9 ± 4.5 g/day) ($p = 0.006$) (Table 3).

As demonstrated in Table 4, the findings contradict our initial hypothesis, revealing no association between daily fiber intake and the depression scale or QoL scale. However, a statistically significant negative correlation was observed between all different domains of QoL and depression scale. Accordingly, significant negative relationship between depression scale and physical function (r: -0.436, $p < 0.001$), physical role difficulty (r: -0.418, $p < 0.001$), emotional role difficulty (r: -0.358, $p < 0.001$), vitality (r: -0.508, $p < 0.001$), mental health (r: -0.595, $p < 0.001$), social functionality (r: -0.236, $p = 0.009$), pain (r: -0.566, $p < 0.001$) and general health (r: -0.627, $p < 0.001$) (Table 4).

Table 1. Domains of the SF-36 scale

Domains	Low Score	High Score
Physical function	Limitation in performing all physical activities	The ability to perform all physical activities without any restrictions
Physical role difficulty	Problems in daily activities due to physical problems	No problems at work or other daily activities
Social functionality	Ordinary physical and emotional problems excessive and frequent interruptions in social activities	Their usual social activities without interruption executive
Pain	Extremely severe and limiting pain	Absence of pain or limitation due to pain absence
Mental health	Persistent feelings of irritability, anxiety, or depression	Feeling calm, happy, and comfortable all the time
Emotional role difficulty	The result of emotional problems at work or other daily problems at events	No problem
Vitality	Feeling constantly tired and exhausted	Feeling constantly alive and energetic
General health	Believing that health is bad and will get worse	Believing that health is perfect

Table 2. General characteristics of participants

Variables	Overall (n = 120)	n	%
Age	≤ 50 years	32	26.7
	51-65 years	65	54.2
	≥65 years old	23	19.1
Mean ± SD		56.5 ± 10.4	
Gender	Women	82	68.3
	Men	38	31.7
Marital status	Married	102	85.0
	Single	18	15.0
Education status	Literate	12	10.0
	Primary school	59	49.2
	Middle school	16	13.3
	High school	22	18.3
	University	11	9.2
Disease presence*	Hypertension	63	52.5
	Cancer	2	1.7
	COPD	4	3.3
	Cardiac insufficiency	23	19.2
	Chronic renal failure	2	1.7
	Other	66	55.0
Physical activity status	Active	8	6.7
	Moderately Active	95	79.1
	Inactive	17	14.2

Table 2 ***(continued)***

Smoking	Yes	21	17.5
	No	99	82.5
Alcohol use	Yes	6	5.0
	No	114	95.0
BMI (kg/m^2) mean ± SD		31.3 ± 6.5	
BMI classification	Normal	14	11.7
	Overweight	46	38.3
	Obese	49	40.8
	Morbidly obese	11	9.2

*Participants were allowed to select more than one option.
Categorical variables are presented as frequency (%), and continuous variables as mean ± standard deviation (SD).
BMI, Body mass Index; COPD; Coronary Obstructive Pulmonary Disease, SD; Standard deviation.

Table 3. Descriptive statistics of depression scale, the SF-36 quality of life scale, and daily fiber intake

		Gender			
Variables	**Overall (n = 120)**	**Women (n = 82)**	**Men (n = 38)**	**t**	**p**
Depression scale	3.8 ± 3.4	4.0 ± 3.5	3.4 ± 3.1	0.815	0.417
SF-36 QoL scale					
Physical function	67.3 ± 27.8	62.4 ± 28.1	77.8 ± 24.6	-2.892	**0.005****
Physical role difficulty	52.9 ± 46.3	44.5 ± 45.7	71.1 ± 43.0	-3.018	**0.003****
Social functionality	62.3 ± 21.0	62.8 ± 21.5	61.2 ± 19.9	0.391	0.697
Pain	73.8 ± 30.4	66.8 ± 31.0	88.8 ± 23.0	-4.355	**<0.001****
Mental health	57.6 ± 19.5	57.5 ± 19.2	57.8 ± 20.2	-0.085	0.932
Emotional role difficulty	56.4 ± 48.3	49.2 ± 48.4	71.9 ± 44.9	-2.519	**0.014***
Vitality	45.0 ± 20.2	42.3 ± 19.7	50.9 ± 20.4	-2.204	**0.029***
General health	50.0 ± 22.9	47.3 ± 24.1	55.8 ± 19.1	-2.089	**0.040***
Daily fiber intake (g/day)	17.3 ± 6.6	15.9 ± 4.5	20.3 ± 9.0	-2.872	**0.006****

SF-36; Short Form-36, QoL; Ouality of life
Continuous variables are presented as mean ± standard deviation (SD). p-values were calculated using the independent samples t-test. Values lower than 0.05 were considered statistically significant. *p < 0.05 **p < 0.01

Table 4. Relationship between daily fiber intake and quality of life scale and depression scale

		Depression Scale Score	**Daily Fiber Intake (g/day)**
Depression scale score	**r**	-	-0.021
	p	-	0.816
Physical function	**r**	-0.436	0.069
	p	**<0.001****	0.452
Physical role difficulty	**r**	-0.418	0.081
	p	**<0.001****	0.378
Social functionality	**r**	-0.236	-0.054
	p	**0.009****	0.559
Pain	**r**	-0.566	0.065
	p	**<0.001****	0.477
Mental health	**r**	-0.595	0.013
	p	**<0.001****	0.889
Emotional role difficulty	**r**	-0.358	0.005
	p	**<0.001****	0.959
Vitality	**r**	-0.508	0.074
	p	**<0.001****	0.425

Table 4 ***(continued)***

General health	**r**	-0.627	0.021
	p	**<0.001****	0.819
Daily fiber intake (g/day)	**r**	-0.021	-
	p	0.816	-

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

Dietary fiber has been identified as a pivotal element in the management of type 2 diabetes, owing to its various physiological functions, including reducing plasma glucose levels, promoting satiety, thereby contributing to weight management and enhancing disease outcomes.[7] The American Diabetes Association (ADA) suggests that patients with diabetes should adhere to dietary fiber intake recommendations that are in alignment with those of the general population. This recommendation entails an increase in total fiber intake to 14 grams per 1,000 calories, or 25 grams per day for women and 38 grams per day for men.[21] Studies have demonstrated that the intake of dietary fiber in patients with diabetes is suboptimal, falling below the recommended daily values.[2,22,23] Consistent with the literature, the present study documented a lower level of dietary fiber intake (17.3 g/day) than the recommended guideline, while a significantly higher intake was recorded in men (20.3 g/day). Beyond its contributions to overall health, dietary fiber exhibits beneficial effects in the prevention of mental disorders, including depression. Despite the absence of a comprehensive understanding of the underlying mechanisms, a hypothesis has been postulated that inflammation may mediate the association between dietary fiber and depression. This hypothesis suggests that the consumption of a high-fiber diet, which is associated with a reduction in inflammatory compounds, may alter the concentrations of specific neurotransmitters that could potentially reduce the risk of developing depression.[7] The high prevalence of depression in patients with diabetes, reaching up to 32.1%,[24] has underscored the necessity to examine the relationship between dietary fiber intake and depression. Supportively, a randomized clinical trial in patients with type 2 diabetes has demonstrated that alterations in intestinal microbiota, induced by a high-fiber diet, can enhance patients' serum metabolism and emotional mood and depression.[25] In our study, the mean depression score in diabetic patients was recorded close to 4 points, which is the cut-off point for the diagnosis of depression, however no relationship was found between dietary fiber intake and depression scores. Our findings are congruent with the results of a recent study demonstrating that dietary fiber intake did not affect the prevalence of depression in individuals with type 2 diabetes.[2]

Moreover, the presence of depression in patients suffering from type 2 diabetes has the potential to result in a diminished QoL and inadequate diabetes self care.[5] The main issues identified by patients that negatively impacted their QoL were included a disease-centered medical approach, lack of information, limited involvement in decision-making processes, and the administrative and bureaucratic challenges inherent in the healthcare system.[26] The International Diabetes Federation (IDF) has also highlighted the issue of the QoL, underscoring it as a critical component of diabetes care, together with metabolic control and prevention.[27] In the present study, we found lower mean scores in virtually all domains of the SF-36 scale, with the exception of the pain. In parallel with our findings, studies employing the same scale have identified similarly low QoL domains.[28,29] On the other hand, higher subdomain scores were found in another study conducted in the Netherlands with primary care diabetic patients,[30] sample that mirrors our own. These differences between studies may be attributed to demographic and cultural differences in the sample studied, access to health resources such as medications and regular medical check-ups, and possible differences in disease management. Furthermore, the current study

revealed that the QoL scores of men were significantly higher than those of women, with the exception of the mental health and social functionality domains. The diminished QoL experienced by women may be linked to an increased prevalence of diabetes-related concerns and a concomitant diminution in coping abilities, as reported in a recent systematic review.[31]

Dietary factors are also a crucial component of the factors affecting the QoL. Because diet is a daily source of pleasure; therefore, the implementation of dietary restrictions as part of a comprehensive dietary therapy regimen can potentially impact the patient's overall QoL. High dietary fiber intake may also contribute to high satisfaction with the diet, promote satiety and contribute to glycemic control.[14] In accordance with the aforementioned hypothesis, it was anticipated that a positive correlation would be observed between dietary fiber intake and the QoL of individuals with diabetes. However, this relationship was not substantiated in the findings of the study. Contrary to the results of our study, a study conducted by Takahashi et al. reported that dietary fiber intake was associated with diet-related QOL in patients with type 2 diabetes.[22] On the other hand, in a meta-analysis of 18 studies involving a total of 57109 type 2 diabetes patients, identified no significant association of dietary control with QoL in type 2 diabetes patients.[32]

CONCLUSION AND RECOMMENDATIONS

In conclusion, the evidence from this study suggests that patients with diabetes had a low intake of dietary fiber, falling below the recommended levels. While the study did not identify a relationship between dietary fiber intake and depression scores as well as QoL, the findings emphasize the need for further research on the role of dietary fiber in this population. The importance of dietary fiber in this sample should not be overlooked, and the need for multicenter, large-sample studies is evident to further investigate this relationship. Furthermore, based on the study findings, several practical recommendations are warranted. These include integrating nutrition counseling into routine care for individuals with type 2 diabetes, implementing regular depression screening in primary healthcare settings, developing tailored nutrition education and support programs, and promoting the consumption of fiber-rich foods through community-based interventions. Such strategies may contribute to improved dietary habits, better psychological well-being, and enhanced overall disease management.

Limitation of the study

This study is pioneering in its examination of the relationship between dietary fiber intake and depression as well as the QoL in patients with type 2 diabetes; to the extent of the authors' knowledge, this is the first study to simultaneously undertake this examination. Moreover, it represents one of the few studies conducted within the primary healthcare setting, providing valuable insights applicable to frontline diabetes management. Importantly, the data were collected from a Turkish population, highlighting the study's unique contribution by addressing this topic within a local and national context where such evidence remains limited.

On the other hand, the study has some limitations. These are the situations such as the relatively small sample size, the cross-sectional study not providing a cause and effect relationship, misunderstanding the questions or recall bias due to the scales used being based on self-report statements. More comprehensive studies with larger samples are warranted. Furthermore, this study did not differentiate between diabetic patients based on their treatment type, such as oral medication, insulin, or dietary therapy, nor was treatment adherence assessed. These factors may act as confounding variables influencing depressive symptoms and QoL, but their potential confounding effects were not examined. Future research should consider these variables as confounders to better understand their impact on psychological outcomes and QoL

A further limitation of this study is the use of three-day dietary records, which are subject to participant underreporting or misreporting and may affect the accuracy of dietary intake data. Due to daily, seasonal, and cultural variations in dietary fiber intake, the three-day dietary records may not fully capture habitual consumption, potentially limiting the study's ability to detect true associations.

In addition, dietary fiber intake was assessed solely in terms of quantity, without distinguishing between types or sources (e.g. soluble vs. insoluble, natural vs. synthetic), which represents a content-related limitation. Finally, the sample included a higher proportion of women, which may limit the findings' ability to capture gender-related differences.

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Conflict of Interest

The authors declared no conflict of interest.

Author Contributions

GDB Conceptualization, Methodology, Writing–original draft, Visualization. AMD Conceptualization, Investigation, Data curation, Writing-original draft, Visualization.
All authors have critically reviewed and agreed with the final version of the manuscript and are responsible for all aspects of the study.

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