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Orthorexia Nervosa in Adult Celiac Patients and Caregivers: A Case–Control Study in Türkiye

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ABSTRACT

Objective: Celiac disease (CeD) is an autoimmune condition caused by gluten that negatively impacts the digestive system. The disease necessitates a strict dietary regimen, which may influence the eating habits of both patients and their meal companions.

Methods: The present study strives to explore the correlation between diet and orthorexia nervosa (ON) in individuals with CeD, with the ultimate goal of comprehending and fulfilling their health and psychological requirements. Thirty adults with CeD, 20 caring relatives, and 30 healthy controls were compared in the study. Participants were assessed using Orthorexia Nervosa Rating Scale (ORTO-15), Maudsley Obsessional-Compulsive Inventory (MOCI), Eating Attitudes Test (EAT-40), Health-Related Quality of Life Scale in Celiac Patients (HQLS), and Zarit Caregiver Burden Scale (ZCBS) scales.

Results: The study found that CeD patients and their meal companions were more orthorexic than healthy controls ($P = .042$). Celiac disease patients scored higher on eating attitudes, particularly on the diet and social pressure subscales, compared to both meal companions ($P = .002$) and healthy controls ($P < .001$). The duration of disease was positively correlated with cleanliness ($\beta = 0.074$, $R^2 = 0.204$, $P < .05$), and the age at diagnosis was positively correlated with dieting ($\beta = 0.073$, $R^2 = 0.239$, $P < .05$). Body mass index had a positive association with fat anxiety ($\beta = 0.215$, $R^2 = 0.183$, $P < .05$), while the duration of disease was positively associated with higher Zarit Total Scores ($\beta = 4.843$, $P < .05$, $R^2 = 0.628$).

Conclusion: The study discovered that patients with CeD and their meal companions display increased orthorexic tendencies, which may be due to the difficulties of managing the disease. The study also revealed links between orthorexia, OCD symptoms, and quality of life.

Keywords: Celiac disease, caregiver burden, disrupted eating behavior, eating attitude, obsessive-compulsive disorder

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INTRODUCTION

Celiac disease (CeD) is an immunological disorder triggered by the ingestion of gluten in genetically susceptible individuals.[1] The disease is characterized by villous atrophy of the small intestinal mucosa during autoimmune processes in genetically predisposed individuals. It is characterized by clinical heterogeneity and presents with a wide spectrum of gastrointestinal and extraintestinal symptoms and can be diagnosed at any age. Celiac disease primarily affects the small intestine and causes symptoms such as malabsorption, diarrhea, and abdominal discomfort.[2]

Orthorexia nervosa (ON) is characterized by a pathological obsession with healthy eating, leading to dietary restrictions, impaired social life, reduced psychological well-being, and severe malnutrition.[3] People with orthorexia are unusually fastidious about healthy eating and feel considerable tension and guilt if they do not behave accordingly. Its prevalence is controversial; while some studies suggest a high prevalence in certain groups such as young adults and athletes,[4] others highlight the lack of reliable data on its prevalence.[5] Studies indicate that females with ON, especially, experience poor body image and self-esteem.[6,7] Similarly, a study involving fitness participants with ON observed that these individuals internalized the ideal of thinness, experiencing social physique anxiety related to body image dissatisfaction and eating disorders.[8] It has been linked to psychological correlates such as emotion regulation, attachment, and anxiety–depression–stress symptomatology.[9]

As the primary treatment for CeD is a gluten-free diet, it can be said that this situation has a direct impact on eating attitudes. There is evidence of an association between CeD and the incidence of eating disorders.[10] Studies have shown that the prevalence of eating disorders is higher, especially in young women with CeD.[11] The impact of CeD on patient-reported outcomes and health-related QoL has also been investigated, highlighting the complex relationship between symptoms, disease risk, and treatment burden in CeD.[12] Patients with CeD also often experience somatization, depression, and anxiety before diagnosis. These psychological states are commonly associated with changes in appetite and weight.[13]

Caregiver burden is a significant aspect in the care of individuals with chronic diseases such as CeD. Studies have shown that caregiver burden encompasses various dimensions, including psychological distress, financial strains, stress, tension, and anxiety experienced by caregivers.[14] The burden on caregivers of patients with chronic diseases is associated with decreased quality of life (QoL) and can lead to depression.[15] It is crucial for healthcare providers to recognize caregiver burden and provide necessary support to alleviate this burden.[16] A study of the eating behaviors of people with CeD and their caregivers may facilitate an understanding of the difficulties encountered in disease management, dietary adjustment, and psychosocial effects. Furthermore, it may contribute to the development of more effective support mechanisms at both individual and societal levels.

The aim of this case-control study was to explore the correlation between diet and ON in individuals with CeD and their meal companions and to investigate a possible relationship with emotional and psychological factors.

MATERIAL AND METHODS

Participants and Procedures

This case–control research was carried out in partnership with the Psychiatry and Gastroenterology Clinics of a tertiary college hospital in compliance with the 1975 Declaration of Helsinki. All individuals provided informed consent, and no incentives were given for their participation. Information from both subjects and healthy controls was gathered between February 1 and December 31, 2021. The study administered the Orthorexia Nervosa Rating Scale (ORTO-15), Maudsley Obsessive Compulsive Questionnaire (MOCI), Eating Attitude Test-40 (EAT-40), Zarit Carer Burden Scale (ZCBS), and Health-Related Quality of Life Scale in Celiac Patients (HQLS) to consenting CeD patients and their meal companions, ensuring systematic administration and objective outcomes.

A control group of healthy individuals with characteristics matching those of the cases in terms of age, education, and economic status was incorporated into the study. The chosen sample was unbiased and comprised of hospital personnel, their relatives, and individuals without psychiatric disorders who sought a medical board report at the psychiatry outpatient clinic. Informed consent was obtained from the healthy control cohort, and participation was not encouraged (Figure 1).

Inclusion and Exclusion Criteria

Individuals with CeD were eligible for inclusion in the study if they had been diagnosed with the disease for a minimum of 1 year and consented to participate. For the relatives of the patients, it was necessary for them to live with an individual diagnosed with CeD, eat together regularly, and agree to participate in the study. The exclusion criteria for patients, their relatives, and the control group were as follows: the individual must have been younger than 18 years of age or older than 65 years of age, illiterate, visually impaired, or must have a known psychosis, mental retardation, or dementia that affects decision-making ability.

Ethical Considerations

Approval for this study was obtained from the Bezmialem Vakıf University Non-Interventional Research Ethics Committee (Approval no: E-54022451-050.01.04-3204, Date: January 19, 2021).

Data Collection Tools

Orthorexia Nervosa Rating Scale-15

The initial iteration of the ON assessment scale consisted of 10 self-assessment items.[17] Subsequently, the scale was expanded to comprise 15 questions through the revision of statements, introduction of new items, and reordering of existing content.[18] Respondents rate all items using a 4-point scale, with certain items (2, 5, 8, and 9) being scored in reverse. It should be noted that items 3, 5, 6, 7, 11, 13, and 15 carry significant importance. This tool examines individuals' habitual food-related actions involving selection, purchase, preparation, and consumption, which mirror their perception of healthy eating. Scores range from 15 to 60, with a lower score indicating a less orthorexic attitude. Factor and internal consistency analyses of the ORTO-15 have been conducted in Turkey, and as a result of the factor analysis, the eigenvalue of the test was determined to be 3 factors over 1.0.[19] Factor analysis has disclosed 3 distinct factors—emotion, behavior, and cognition—each of which captures unique aspects of attitudes toward healthy eating.

Maudsley Obsessional-Compulsive Inventory

The initial scale for assessing obsessive-compulsive symptoms included 4 specific scales—cleanliness, slowness, suspicion, and control—each containing 30 true/false items.[20] Each true statement scored 1 and each false statement 0. Following adaptation and the inclusion of 7 MMPI items, the Turkish version developed

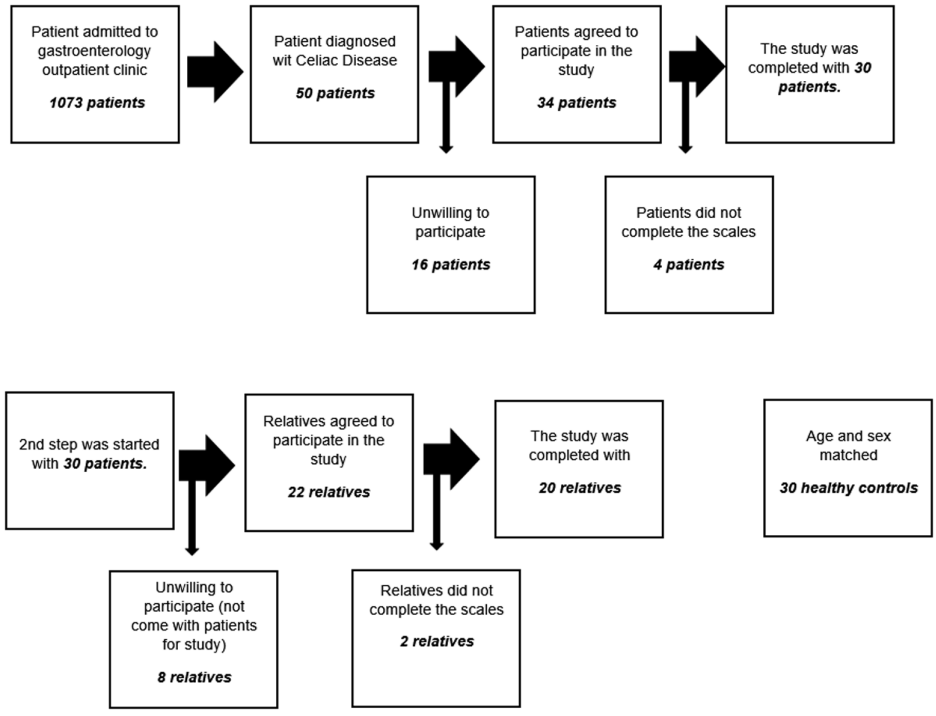

Figure 1. Flow-chart showing the celiac patients and caregivers included in the study.

further, expanded to 37 items.[21] Scores increased in line with symptom severity. The reliability analysis indicated a Cronbach's alpha of 0.86 for the comprehensive scale, with a test–retest reliability of $r = 0.88$. The subscale reliabilities ranged from 0.61 to 0.65 and $r = 0.59$-0.84. All correct items contribute to the overall score except the 11th item, which is reverse scored. The highest possible scores are 37 for total obsession, 9 for control, 11 for cleanliness, 7 for slowness, and 7 for suspicion. Notably, the following items pertain to behavioral skepticism: 3, 7, 10, 11, 12, 18, and 30. The following items relate to behavior that is controlling: 2, 6, 8, 14, 15, 20, 22, 26, and 28. Items 1, 4, 5, 9, 13, 17, 19, 21, 24, 26, and 27 encompass cleanliness. Lastly, the following items signify slowness: 2, 4, 8, 16, 23, 25, and 29.

Eating Attitudes Test

The scale functions as a self-assessment tool that objectively measures symptoms of anorexia nervosa and bulimia nervosa.[22] It consists of 40 items, each rated on a 6-point Likert scale from "always" to "never." Extreme responses are excluded from scoring, resulting in a score range of 0 to 3. Scores are allocated based on responses to specific questions, with a set discrimination score of 30 for anorexia. Scores exceeding 30 correspond to higher levels of psychopathology, with a maximum attainable score of 120. Risk profiles categorize total scores into low risk (<21), medium risk (21-30), or high risk (>30). The reliability and validity of the Turkish version were assessed.[23] The findings revealed a Cronbach's alpha and Kuder Richardson of 0.87 and 0.79, respectively, for the original version's reliability and construct validity. The Turkish version demonstrated satisfactory internal consistency with a test–retest reliability of 0.65 and a Kuder Richardson alpha of 0.70, without altering the original meaning.

Zarit Caregiver Burden Scale

The survey contains 22 statements that aim to evaluate stress, distress, family-related challenges, communication issues, and emotional struggles experienced by individuals who care for patients.[24] It measures the effects of caregiving on different aspects of life, and it can be accomplished by meal companions or researchers. The scale's reliability and validity were established through a Turkish study which demonstrated an internal consistency coefficient of 0.83.[25] The survey items cover various aspects, including mental and physical well-being, social and emotional interactions, financial circumstances, and interpersonal relationships, using a 5-point Likert-style scale. The scores can range from 19 to 95, with higher scores indicating heightened distress. Factor analysis revealed 5 categories: interference with personal life and psychological tension, irritability and self-restraint, social bond strain, financial hardship, and reliance. The aforementioned factors exhibit a substantial and affirmative correlation with the composite score. The Zarit Caregiver Burden Scale corresponds with 5 distinct subfactors: psychological stress and disruption to personal life, irritability and restriction, deterioration in social relations, financial burden, and dependence.

Health-Related Quality of Life Scale in Celiac Patients

In order to assess health-related QoL in people with CeD, Häuser and colleagues developed the "Health-Related Quality of Life Questionnaire in Celiac Patients" in 2007.[26] The Turkish validity and reliability study of the questionnaire was published by Aksan and colleagues in 2015.[27] This questionnaire determines how adults with CeD have felt in the last 2 weeks, their symptoms related to the disease, and their well-being and mood with questions. The responses to this questionnaire, which consists of 28 questions, are scored with four subscales: emotional (7 questions), social (7 questions), gastrointestinal (7 questions), and worry (7 questions). Each question is scored on a Likert scale from 1 to 7. A minimum score of 0 and a maximum score of 49 can be obtained for each subscale. The result of the questionnaire is a total score between 0 and 196. A low total or subscale score indicates a low health-related QoL, while a high score indicates a high health-related QoL.

Statistical Analysis

The Statistical Package for Social Sciences version 26.0 software (IBM Corp.; Armonk, NY, USA) was employed for data analysis in this study. To determine whether the data distribution is normal, a Kolmogorov-Smirnov normality test was applied. When analyzing categorical variables, the chi-square test was used with Monte Carlo correction. A one-way ANOVA test was used for the analysis of non-categorical variables. Bonferroni correction was applied to post-hoc analysis of variables. Pearson test was used to analyze normally distributed data. In the study, multiple linear regression and partial regression analyses were applied to determine the relationships between independent variables and dependent variables. Regression analyses were used to assess the effect of each independent variable on the respective dependent variable. The effects of variables such as disease duration, age at diagnosis, and BMI on cleanliness level, dietary behavior, QoL, and psychological factors were analyzed with a multiple linear regression model. The multiple linear regression model was used to examine the effect of multiple independent variables on a dependent variable simultaneously. In these analyses, regression coefficients (β), coefficients of determination (R^2), SDs, and 95% CIs were calculated. In addition, partial regression analysis was applied to more precisely determine the effect of eating time with the patient on meal companion stress levels. Partial regression analysis allowed us to assess the effect of a particular independent variable by controlling for the effects of other independent variables. In all analyses, $P < .05$ was accepted as the level of statistical significance.

RESULTS

Sociodemographic Characteristics

Sociodemographic comparisons between CeD patients, meal companions, and healthy controls revealed different patterns. The proportion of women was significantly higher in CeD patients (90.0%) compared with healthy controls (86.7%) and meal companions (55.0%). There was a significant difference in educational level, employment status, and living arrangements, with a higher rate of unemployment and a tendency to live with spouse and children in CeD patients. Smoking was more common in meal companions (55.0%), whereas alcohol consumption did not differ significantly between groups. Details are shown in Table 1.

Clinical Characteristics

Celiac patients were found to be shorter than meal companions in height ($P = .004$) and lower in weight ($P = .003$) than both meal companions and healthy controls. There was no significant difference between body mass indexes. Celiac disease patients and their meal companions were found to have lower orthorexia scores than healthy controls. A statistically significant difference was found between these 3 groups in terms of orthorexia score ($P = .042$). This difference was due to the difference between the patients and the healthy control group. When these three groups were compared in terms of obsession-compulsivity, a statistically significant difference was observed between them ($P = .046$), particularly on the

Table 1. Sociodemographic Comparison of Celiac Disease Patients, Caregivers, and Healthy Controls

		Patient		Caregiver		Healthy Control		
		n	%	n	%	n	%	*P*
Sex	Female	27	90.0	11	55.0	26	86.7	**.005**
	Male	3	10.0	9	45.0	4	13.3	
Marital status	Married	22	73.3	14	70.0	18	60.0	.422
	Single	8	26.7	4	20.0	9	30.0	
	Divorced	0	0.0	2	10.0	3	10.0	
Educational status	Primary School	19	63.3	6	30.0	7	23.3	**.002**
	High School	7	23.3	7	35.0	5	16.7	
	University	4	13.3	7	35,0	18	60.0	
Working status	Not working	20	66.7	8	40.0	8	26.7	**.024**
	Regular working	5	16.7	11	55.0	19	63.3	
	Irregular working	2	6.7	1	5.0	0	0.0	
	Retired	1	3.3	0	0.0	1	3.3	
	Student	2	6.7	0	0.0	2	6.7	
Living with	Alone	0	0.0	3	15.0	6	20.0	**.045**
	With partner	0	0.0	1	5.0	4	13.3	
	Partner and children	22	73.3	12	60.0	15	50.0	
	With parents	4	13.3	0	0.0	1	3.3	
	Parents and siblings	4	13.3	4	20.0	4	13.3	
Childhood place	Village	9	30.0	4	20.0	7	23.3	.561
	Town	4	13.3	2	10.0	1	3.3	
	City	17	56.7	14	70.0	22	73.3	
Smoking	No	21	70.0	9	45.0	24	80.0	**.033**
	Yes	9	30.0	11	55.0	6	20.0	
Alcohol using	No	29	96.7	18	90.0	25	83.3	.227
	Yes	1	3.3	2	10.0	5	16.7	
Age (mean ± SD)		39.13 ± 10.21		38.95 ± 11.28		39.73 ± 13.13		.968
Child number (median/min/max)		2 - 0 - 7		2 - 0 - 4		1 - 0 - 4		.410
Sibling number (median/min/max)		5 - 2 - 11		3 - 2 - 6		3 - 1 - 6		**<.001**

P<.05 values were considered statistically significant.

Cleanliness subscale ($P=.004$). When the groups were compared on eating attitudes, the patient group scored higher than both meal companions ($P=.002$) and healthy controls ($P < .001$). It can be seen that this situation is mainly due to the diet ($P < .001$) and social pressure ($P < .001$) subscales. Comparison of the three groups in terms of clinical characteristics and post-hoc analysis is presented in Table 2. Orthorexia Nervosa Rating Scale-15, MOCI, and EAT comparison between groups is represented in Figures 2 and 3.

Correlations

Correlation analysis revealed a weak positive correlation between age at diagnosis and disease duration, cleanliness, social pressure, and dieting subscales, a moderate positive correlation with EAT-40, and a strong positive correlation with QoL. There is a weak positive correlation between the duration of disease and the cleanliness subscale and EAT, a weak negative correlation with the orthorexia score, and a moderate positive correlation with the social pressure subscale and QoL.

Table 2. Clinical Comparison of Celiac Disease Patients, Caregivers, and Healthy Controls

	Patient		Caregiver		Healthy Control				Post-Hoc Analyses		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	*P*	*F*	(I) Group	(J) Group	*P*
Height (cm)	160.80	6.41	169.50	10.99	164.60	8.87	**.004**	6.076	Patient	Caregiver	**.002**
										Healthy control	.279
									Caregiver	Healthy control	.160
Weight (kg)	62.20	9.98	72.20	14.46	72.07	12.47	**.003**	6.246	Patient	Caregiver	**.017**
										Healthy control	**.007**
									Caregiver	Healthy control	1000
BMI (kg/m$^{2)}$	24.26	4.72	24.95	3.23	26.84	5.66	.107	2.298	Patient	Caregiver	1000
										Healthy control	.120
									Caregiver	Healthy control	.525
Orto15	38.27	4.35	38.45	5.99	41.27	4.69	**.042**	3.317	Patient	Caregiver	1000
										Healthy control	.063
									Caregiver	Healthy control	.154
Maudsley OCI	15.13	8.48	14.75	8.64	10.63	5.16	**.046**	3.207	Patient	Caregiver	1.000
										Healthy control	.066
									Caregiver	Healthy control	.178
Control	4.07	2.98	4.30	3.03	3.83	2.10	.834	0.182	Patient	Caregiver	1.000
										Healthy control	1.000
									Caregiver	Healthy control	1.000
Cleanliness	4.73	3.08	4.05	3.55	2.37	1.22	**.004**	6.058	Patient	Caregiver	1.000
										Healthy control	**.003**
									Caregiver	Healthy control	.100
Slowness	2.83	2.35	2.90	2.13	1.67	1.45	**.040**	3.359	Patient	Caregiver	1.000
										Healthy control	.079
									Caregiver	Healthy control	.106
Suspicion	3.80	2.09	3.60	2.11	2.70	1.88	.093	2.451	Patient	Caregiver	1.000
										Healthy control	.114
									Caregiver	Healthy control	.380
Eating Attitude Test	25.63	10.81	16.30	8.52	13.50	7.00	**<.001**	14.738	Patient	Caregiver	**.002**
										Healthy control	**<.001**
									Caregiver	Healthy control	.848
Fat anxiety	1.70	2.51	1.60	1.85	2.53	2.70	.304	1.211	Patient	Caregiver	1.000
										Healthy control	.570
									Caregiver	Healthy control	.567
Diet	4.23	3.15	2.55	2.19	1.60	1.89	**<.001**	8.478	Patient	Caregiver	.067
										Healthy control	**<.001**
									Caregiver	Healthy control	.576
Social pressure	2.83	2.44	1.05	1.10	0.40	0.72	**<.001**	17.140	Patient	Caregiver	**<.001**
										Healthy control	**<.001**
									Caregiver	Healthy control	.531
Deal with weakness	1.40	2.18	0.95	1.43	0.83	1.46	0.433	0.845	Patient	Caregiver	1.000
										Healthy control	.648
									Caregiver	Healthy control	1.000

$P < .05$ was considered statistically significant. One-way ANOVA test was applied for non-categorical variables.

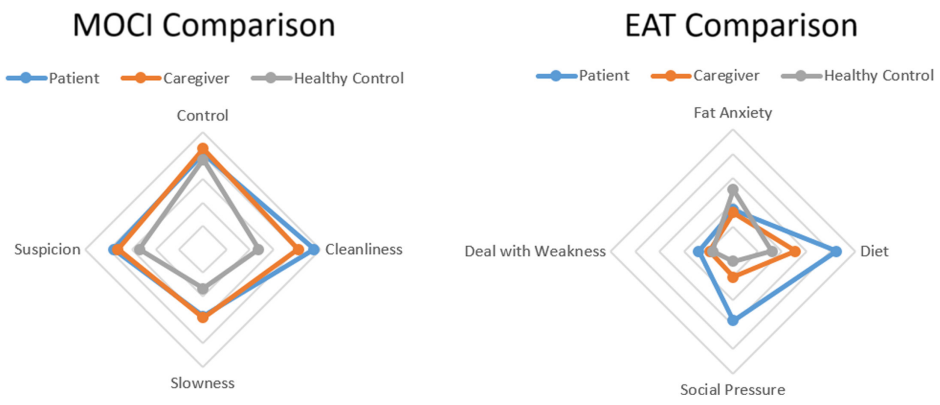

Figure 2. MOCI and EAT comparison between groups.

A significant positive correlation between the duration of eating with the patient and Zarit Total scores. Additionally, a weak positive correlation was observed between BMI and fat anxiety and dieting, while a weak negative correlation was found between BMI and social pressure and dealing with weakness. The study found a moderate negative correlation between Maudsley OCI and Orthorexia scores, and a weak positive correlation with EAT. Additionally, there is a weak positive correlation between the control subscale and fat anxiety subscale as well as between the cleanliness subscale and EAT scores and the QoL social subscale. Finally, there is a weak positive correlation between the slowness subscale and EAT scores and between the suspicion subscale and EAT scores.

There is a moderate negative correlation between orthorexia and MOCI cleanliness subscale and EAT. Additionally, a weak positive correlation was observed between dieting and QoL scales as well as a weak positive correlation between social pressure and dealing with weakness. Details are presented in Table 3.

Regression

The regression analyses conducted revealed significant associations between various independent variables and their respective dependent variables within the studied sample. The table presents the regression coefficients (β), determination coefficients (R2), SDs, and the lower and upper bounds of the 95% CIs for each relationship.

Especially, the relationship between disease duration and cleanliness was analyzed. A correlation was found between disease duration and cleanliness ($\beta = 0.074$, $R^2 = 0.204$, $P < .05$). The study indicates that there is a positive correlation between disease duration and reported cleanliness levels within the 95% CI (CI: 0.042-0.367). The R^2 value of 0.204 shows that disease duration explains 20.4% of the variation in cleanliness.

Additionally, diagnostic age showed varying associations with multiple dependent variables. It was found that there is a positive correlation was found between the age of diagnosis and dieting behavior ($\beta = 0.073$, $R^2 = 0.239$, $P < .05$), suggesting that individuals who are diagnosed at an older age are more likely to engage in dietary practices. However, there was a negative correlation between diagnosis age and QoL ($\beta = -0.228$, $R^2 = 0.011$, $P > .05$), suggesting a potential decrease in QoL with delayed diagnosis age, although the CI spans zero (95% CI: −1.065 to 0.608). The relationship between diagnosis age and engaging in dieting explains 23.9% of the variation ($R^2 = 0.239$).

Additionally, BMI and psychological factors were also considered. The study found significant associations between Body Mass Index (BMI) and psychological factors. Specifically, higher BMI was positively correlated with fat anxiety ($\beta = 0.215$, $R^2 = 0.183$, $P < .05$) and negatively associated with coping with weakness ($\beta = -0.129$, $R^2 = 0.128$, $P < .05$). These results suggest a potential link between higher BMI and increased concerns related to body fat while also indicating a decreased ability to handle perceived weaknesses. The relationship between BMI and fat anxiety explains 18.3% of the variation in fat-related anxiety ($R^2 = 0.183$).

Significant relationships were found between the duration of eating with the patient and various meal companion stress-related factors. For example, a longer duration was found to be positively associated with higher Zarit total scores ($\beta = 4.843$, $P < .05$, $R^2 = 0.628$), indicating an increase in meal companion burden within the established CI (95% CI: 3.762-5.925). The R^2 value of 0.628 suggests that the

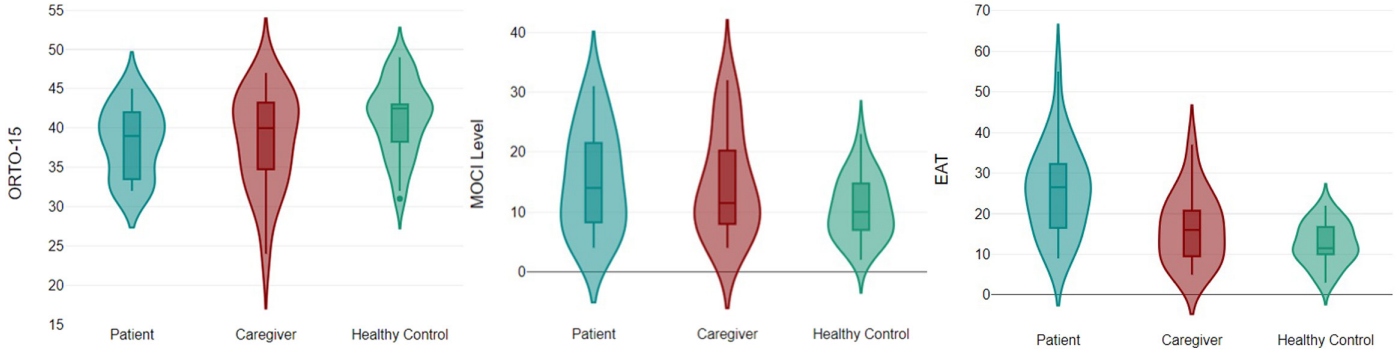

Figure 3. ORTO-15, MOCI and EAT comparison between groups.

Table 3. Correlation Table of Clinical Characteristics of Celiac Disease Patients and Caregivers

	Diagnosis Age	Disease Duration	Duration of Eating	BMI	Maudsley OCI	Control	Clean liness	Slowness	Suspicion	Orto15	EAT	Fat Anxiety	Dieting
Diagnosis Age	1	**0.378****	−0.357	−.0024	0.122	−0.007	**0.232***	0.132	0.082	−0.154	**0.530****	−0.064	**0.489****
Disease Duration	**0.378****	1	−0.230	−0.118	0.171	−0.006	**0.273***	0.122	0.200	**−0.245***	**0.384****	0.004	0.217
Duration of Eating	−0.357	−0.230	1	−0.003	0.146	0.092	0.108	0.140	0.135	−0.129	−0.036	−0.007	0.027
BMI	−0.024	−0.118	−0.003	1	−0.163	−0.084	−0.070	−0.127	−0.195	−0.050	0.061	**0.428****	**0.259***
Maudsley OCI	0.122	0.171	0.146	−0.163	1	**0.781****	**0.808****	**0.791****	**0.756****	**−0.574****	**0.483****	**0.308****	**0.292****
Control	−0.007	−0.006	0.092	−0.084	**0.781****	1	**0.559****	**0.523****	**0.526****	**−0.395****	0.218	**0.287****	0.142
Cleanliness	**0.232***	**0.273***	0.108	−0.070	**0.808****	**0.559****	1	**0.599****	**0.443****	**−0.548****	**0.479****	**0.265***	**0.256***
Slowness	0.132	0.122	0.140	−0.127	**0.791****	**0.523****	**0.599****	1	**0.416****	**−0.396****	**0.440****	**0.278***	**0.291****
Suspicion	0.082	0.200	0.135	−0.195	**0.756****	**0.526****	**0.443****	**0.416****	1	**−0.410****	**0.375****	0.134	**0.245***
Orto15	−0.154	**−0.245***	−0.129	−0.050	**−0.574****	**−0.395****	**−0.548****	**−0.396****	**−0.410****	1	**−0.460****	**−0.333****	**−0.372****
EAT	**0.530****	**0.384****	−0.036	0.061	**0.483****	0.218	**0.479****	**0.440****	**0.75****	**−0.460****	1	**0.472****	**0.654****
Fat Anxiety	−0.064	0.004	−0.007	**0.428****	**0.308****	**0.287****	**0.265***	**0.278***	0.134	**−0.333****	**0.472****	1	**0.309****
Dieting	**0.489****	0.217	0.027	**0.259***	**0.292****	0.142	**0.256***	**0.291****	**0.245***	**−0.372****	**0.654****	**0.309****	1
Social Pressure	**0.366****	**0.543****	−0.069	**−0.311****	**0.355****	0.151	**0.385****	**0.271***	**0.343****	**−0.311****	**0.554****	0.051	0.117
Deal with Weakness	0.136	0.071	−0.022	**−0.357****	0.064	0.116	0.060	−0.037	0.000	−0.125	0.117	−0.159	−0.201
Quality of Life	**0.881****	**0.596****	-	−0.182	0.085	−0.053	0.206	0.060	0.114	−0.145	**0.409****	−0.175	**0.338****
Emotion	**0.841****	**0.612****	-	−0.172	0.059	−0.049	0.187	0.67	0.066	−0.122	**0.364****	−0.174	**0.347****
Social	**0.886****	**0.587****	-	−0.170	0.139	−0.040	**0.269***	0.125	0.156	−0.177	**0.442****	−0.147	**0.359****
Anxiety	**0.880****	**0.521****	-	−0.192	0.065	−0.039	0.190	0.033	0.075	−0.106	**0.402****	−0.169	**0.324****
Gastrointestinal	**0.835****	**0.632****	-	−0.179	0.099	−0.030	0.195	0.055	0.144	−0.161	**0.389****	−0.173	**0.299****
Zarit	-	-	**0.826****	−0.049	0.117	0.042	0.121	0.158	0.043	−0.100	−0.103	−0.100	−0.025
Psyc. Stress	-	-	**0.804****	−0.055	0.143	0.071	0.136	0.174	0.065	−0.120	−0.088	−0.085	−0.017
Irritability	-	-	**0.843****	−0.032	0.104	0.064	0.079	0.159	0.035	−0.088	−0.099	−0.063	−0.004
Det.	-	-	**0.759****	−0.041	0.064	−0.021	0.112	0.104	−0.006	−0.047	−0.125	−0.140	−0.050
Economic Burden	-	-	**0.813****	−0.032	0.085	0.004	0.104	0.131	0.023	−0.085	−0.106	−0.089	0.011
Dep.	-	-	**0.678****	−0.071	0.123	0.048	0.119	0.155	0.058	−0.098	−0.088	−0.124	−0.095

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). Sig.: (2-tailed), Pearson Correlation performed. Duration of Eating: Duration of Eating with Patient, Det.: Deterioration in Social Relation, Zarit: Zarit Total Score, Psyc. Stress: Psychological Stress, Dep.: Dependency.

duration of eating with the patient explains 62.8% of the variation in Zarit total score. The details are presented in Table 4.

DISCUSSION

This study provides insights into the intricate relationship between CeD, dietary restrictions, and psychological manifestations, specifically regarding ON. To the best of our knowledge, our study is the first to look at orthorexic behavior in CeD and meal companions. The results indicate a strong correlation between CeD patients and their meal companions displaying higher orthorexic tendencies compared to healthy controls, suggesting a potential psychological impact associated with managing the disease. The increased orthorexic behavior observed among individuals with CeD and their meal companions highlights the psychological impact of adhering to strict dietary regimens required by CeD. Of particular note are the high scores on eating attitude scales, particularly in the areas of diet and social pressure, emphasizing the multifaceted challenges faced by those with CeD in managing their dietary requirements within social contexts. Furthermore, this study reveals associations between orthorexic behaviors, OCD symptoms, eating disorders, and QoL indicators. A positive correlation was established between increased orthorexic behavior and heightened OCD symptoms, specifically within the cleaning subtype, alongside a decrement in overall QoL. The correlation between disease-related factors, such as disease duration and age at diagnosis, with specific orthorexic behaviors suggests that disease duration and age of diagnosis may impact the development or exacerbation of certain psychological patterns in CeD patients. Furthermore, the associations of BMI, anxiety related to fat, duration of eating, and meal companion burden highlight the complex network of psychological and social implications involved in managing CeD.

In our study, there are more women in the CeD patient group. It can be argued that this situation is due to the fact that the disease is more common in women. It is noteworthy that meal companions are mostly men. This may be explained by the fact that the people with whom married women with CeD eat are mostly their husbands. The significant difference between the meal companion and control groups in terms of education and employment status is due to the fact that the patient group consisted mainly of unemployed patients with a low level of education. In a recent study, in contrast to our findings, a significant proportion of female CeD patients had a high level of education, with 58.9% having a graduate or postgraduate degree. Another study highlighted that health-related QoL in CeD disease is associated with factors such as gender, age, marital status, and educational level. This suggests that educational status may play a role in the QoL of people with CeD disease.[28]

Table 3. Correlation Table of Clinical Characteristics of Celiac Disease Patients and Caregivers (*Continued*)

	Social Pressure	Deal with Weakness	Quality of Life	Emotion	Social	Anxiety	Gastro intestinal	Zarit	Psyc. Stress	Irritability	Det.	Economic Burden	Dep.
Diagnosis Age	**0.366****	0.136	**0.881****	**0.841****	**0.886****	**0.880****	**0.835****	-	-	-	-	-	-
Disease Duration	**0.543****	0.071	**0.596****	**0.612****	**0.587****	**0.521****	**0.632****	-	-	-	-	-	-
Duration of Eating	−0.069	−0.022	-	-	-	-	-	**0.826****	**0.804****	**0.843****	**0.759****	**0.813****	**0.678****
BMI	**−0.311****	**−0.357****	−0.182	−0.172	−0.170	−0.192	−0.179	−0.049	−0.055	−0.032	−0.041	−0.032	−0.071
Maudsley OCI	**0.355****	0.064	0.085	0.059	0.139	0.065	0.099	0.17	0.143	0.104	0.064	0.085	0.123
Control	0.151	0.116	−0.053	−0.049	−0.040	−0.039	−0.030	0.042	0.071	0.064	−0.021	0.004	0.048
Cleanliness	**0.385****	0.060	0.206	0.187	**0.269***	0.190	0.195	0.121	0.136	0.079	0.112	0.104	0.119
Slowness	**0.271***	−0.037	0.060	0.067	0.125	0.033	0.055	0.158	0.174	0.159	0.104	0.131	0.155
Suspicion	**0.343****	0.000	0.114	0.066	0.156	0.075	0.144	0.043	0.065	0.035	−0.006	0.023	0.058
Orto15	**−0.311****	−0.125	−0.145	−0.122	−0.177	−0.106	−0.161	−0.100	−0.120	−0.088	−0.047	−0.085	−0.098
EAT	**0.554****	0.117	**0.409****	**0.364****	**0.442****	**0.402****	**0.389****	−0.103	−0.088	−0.099	−0.125	−0.106	−0.088
Fat Anxiety	0.051	−0.159	−0.175	−0.174	−0.147	−0.169	−0.173	−0.100	−0.085	−0.063	−0.140	−0.089	−0.124
Dieting	0.117	−0.201	**0.338****	**0.347****	**0.359****	**0.324****	**0.299****	−0.025	−0.017	−0.004	−0.050	0.011	−0.095
Social Pressure	1	**0.258***	**0.468****	**0.430****	**0.485****	**0.409****	**0.483****	−0.107	−0.098	−0.076	−0.122	−0.111	−0.110
Deal with Weakness	**0.258***	1	0.117	0.87	0.108	0.117	0.126	−0.041	−0.038	−0.098	−0.022	−0.025	−0.012
Quality of Life	**0.468****	0.117	1	**0.974****	**0.979****	**0.982****	**0.982****	-	-	-	-	-	-
Emotion	**0.430****	0.087	**0.974****	1	**0.938****	**0.954****	**0.944****	-	-	-	-	-	-
Social	**0.485****	0.108	**0.979****	**0.938****	1	**0.946****	**0.948****	-	-	-	-	-	-
Anxiety	**0.409****	0.117	**0.982****	**0.954****	**0.946****	1	**0.952****	-	-	-	-	-	-
Gastrointestinal	**0.483****	0.126	**0.982****	**0.944****	**0.948****	**0.952****	1	-	-	-	-	-	-
Zarit	−0.107	−0.041	-	-	-	-	-	1	**0.994****	**0.921****	**0.961****	**0.948****	**0.887****
Psyc. Stress	−0.098	−0.038	-	-	-	-	-	**0.994****	1	**0.913****	**0.946****	**0.934****	**0.870****
Irritability	−0.076	−0.098	-	-	-	-	-	**0.921****	**0.913****	1	**0.843****	**0.826****	**0.770****
Det.	−0.122	−0.022	-	-	-	-	-	**0.961****	**0.946****	**0.843****	1	**0.904****	**0.854****
Economic Burden	−0.111	−0.025	-	-	-	-	-	**0.948****	**0.934****	**0.826****	**0.904****	1	**0.762****
Dep.	−0.110	−0.012	-	-	-	-	-	**0.887****	**0.870****	**0.770****	**0.854****	**0.762****	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). Sig.: (2-tailed), Pearson Correlation performed. Duration of Eating: Duration of Eating with Patient, Det.: Deterioration in Social Relation, Zarit: Zarit Total Score, Psyc. Stress: Psychological Stress, Dep.: Dependency.

Table 4. Regression Analyses of Variables

Regression						
İndependent Variable	**Dependent Variable**	***β***	***R²***	**SD**	**Lower Bound 95% CL**	**Upper Bound 95% CL**
Disease Duration	Cleanliness	0.074	0.204	0.082	0.042	0.367
	Orto-15	−0.326	0.06	0.146	−0.616	−0.035
	EAT-40	1.045	0.147	0.285	0.478	1.613
	Social pressure	0.279	0.294	0.049	0.181	0.376
	Quality of life	0.584	0.013	0.947	-1.355	2.524
Diagnosis Age	Cleanliness	0.054	0.036	0.017	0.002	0.071
	EAT-40	0.302	0.281	0.055	0.193	0.411
	Dieting	0.073	0.239	0.015	0.044	0.102
	Social pressure	0.039	0.134	0.011	0.017	0.062
	Quality of life	−0.228	0.011	0.408	−1.065	0.608
BMI	Fat anxiety	0.215	0.183	0.051	0.112	0.317
	Dieting	0.145	0.067	0.061	0.023	0.267
	Social pressure	0.125	0.097	0.043	−0.211	−0.039
	Deal with weakness	−0.129	0.128	0.038	−0.204	−0.053
Duration of Eating with Patient	Zarit total score	4.843	0.628	0.538	3.762	5.925
	Psychological stress	1.867	0.587	0.226	1.413	2.321
	Irritability	0.775	0.662	0.080	0.614	0.935
	Deterioration	0.630	0.510	0.089	0.451	0.810
	Economic burden	1.054	0.609	0.122	0.809	1.299
	Dependency	0.517	0.384	0.095	0.327	0.707

Both the patient and meal companion groups exhibited higher levels of orthorexia compared to the control group. This may be attributed to the need for a gluten-free diet as a result of CeD disease, leading to more meticulous eating behavior in both patients and their meal companions. Although there are limited studies on orthorexia in CeD patients, a recent study suggests that the evidence on the relationship between CeD and orthorexia is insufficient.[10] In line with previous research, we found that eating disorders were more prevalent in patients with CeD.[29] A study investigating altered eating behavior in adults with CeD suggested that the disease itself, rather than gastrointestinal symptoms or psychological factors, may contribute to the pathological eating behaviors of CeD patients . Additionally, some studies have suggested a link between orthorexic behavior and obsessive-compulsive disorder.[30] It is important to note that these evaluations are based on objective research and should be presented as such. In line with previous research, we found that eating disorder risk was more prevalent in patients with CeD.

Our study found that individuals with CeD and their meal companions had higher MOCI scores than healthy controls, particularly in relation to the cleanliness subscale. It is important to note that these findings are objective and not influenced by personal opinions or biases. This may be due to the expectation that food should be both healthy and clean when following a gluten-free diet. In a study of adolescents with CeD, researchers observed a significant prevalence of disordered eating behaviors. The study also identified a potential association between these behaviors and the presence of obsessive-compulsive symptoms and disgust proneness. These findings suggest that CeD may contribute to the development of maladaptive eating behaviors in affected adolescents, potentially influenced by psychological factors such as obsessive-compulsive symptoms and disgust proneness.[31]

The results show that the patient group scored higher on the EAT-40 than the meal companions and controls, particularly on the social pressure and dieting subscales. This suggests that the CeD patient group may be at a higher risk of developing eating disorders. A study was conducted with patients diagnosed with CeD who were given the EAT-26 questionnaire. The results showed that individuals with CeD who had pathological EAT-26 scores were mainly characterized by dieting, body image concerns, and food preoccupation. In contrast, items reflecting oral control and eating-purging behavior were less prevalent. These findings suggest that individuals with CeD do not develop a specific eating pathology associated with their condition, but rather a "generalized" form of disordered eating behavior.[32]

A study found a significant correlation between maladaptive eating behaviors and CeD. It suggested that CeD may contribute to the development of these behaviors in affected adults. The study also highlighted the high prevalence of social anxiety among individuals with CeD and a potential link between this condition and social anxiety symptoms. Furthermore, it was noted that maladaptive eating habits and social anxiety can adversely affect the QoL of adults with CeD. The need for targeted interventions to address these issues was emphasized. It was suggested that CeD may contribute to the development of maladaptive eating behaviors and social anxiety in affected adults, ultimately impacting their overall well-being and QoL[33] In another study using a QoL questionnaire and the Celiac Dietary Adherence Test (CDAT), 53% of individuals who were observed to have maladaptive eating behaviors toward maintaining a gluten-free diet and who were similar to known risk factors for eating and eating disorders also had reduced QOL.[29]

Our study found that disease duration and age at diagnosis may have an increasing effect on EAT-40 scores, particularly the social pressure subscale. Longer disease duration may lead to more challenges related to dietary compliance and difficulty finding food in social situations. Additionally, we observed a positive correlation between BMI and fat anxiety, as well as dealing with weakness. As BMI increases, concerns about body fat and coping with physical weakness also increase. Regarding the meal companion, it was observed that the duration of meals with the patient with CeD increased the caregiver's burden for each subscale. This may be related to the fact that the process of adapting to a GFD also significantly affects the patient's family members. A study evaluating adherence to the GFD found that adhering to the diet was associated with better physical functioning and lower symptoms of anxiety and depression.[34] Another study examined the impact of the GFD on the QoL of patients with CeD and found that the stress of having to follow a gluten-free diet particularly affected young people and those whose disease had lasted less than four years.[35]

Upon examination of the factors associated with the severity of orthorexia in CeD patients and their meal companions, it was observed that the duration of the disease, the OCD scores, and the level of the eating disorder were particularly related. This may be attributed to the closely related nature of orthorexia with OCD and eating disorders. Although there are few studies on this topic, Tremelling et al[36] found that the risk of orthorexia may not only lie in healthy eating or obsessive food control, but also in increased preoccupation with body weight and shape, based on their examination of a group of dietitians. Additionally, several studies have shown that orthorexia is more prevalent in young people than in older people.[37]

Strengths and Limitations

Our study is the first to look at orthorexic behavior in celiac patients and their relatives. This is one of the strengths of our study. However, our study also has several limitations. One of these limitations is the effectiveness of the ORTO-15 scale in screening for orthorexia.[38] In future studies, this area can be screened with different and perhaps new scales. Another limitation is that the sample size is small. Thirdly, although the patient, meal companion, and control groups were matched in terms of age, they were not matched in terms of variables such as sex, education, and employment status. This is because the patient group is predominantly female, and the meal companion group consists of their husbands. One more limitation of the study was that the matched relatives of each patient were not included, resulting in separate samples for the patient and meal companion groups. As a result, dependent group analyses could not be performed.

CONCLUSION

This study examines the relationship between CeD, dietary restrictions, and psychological implications, specifically regarding ON. The results indicate that CeD patients and their meal companions have a higher tendency towards ON compared to healthy controls, highlighting the potential psychological impact of disease management. The amplified orthorexic behavior underscores the psychological strain of adhering to strict diets. This is shown by elevated eating attitude scores in domains of diet and social pressure, elucidating the multifaceted challenges faced by individuals with CeD within societal contexts. Additionally, there are nuanced connections between orthorexic behaviors, OCD symptoms, and diminished QoL. Disease duration and age at diagnosis are disease-related factors that correlate with specific orthorexic traits in CeD

patients. This suggests that these factors influence the psychological patterns of patients. The study also found associations between BMI, fat anxiety, eating duration, and meal companion burden, highlighting the complex psychological and social implications of managing CeD.

Availability of Data and Materials: The data that support the findings of this study are available on request from the corresponding author, Muhammed Emin Boylu. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

Ethics Committee Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval for this study was obtained from the Bezmialem Vakıf University Non-Interventional Research Ethics Committee (Approval no: E-54022451-050.01.04-3204, Date: January 19, 2021).

Informed Consent: Informed consent was not obtained from all individual participants included in the study. The data of the study participants were retrospectively scanned and used. In order to use these data, permission from the Scientific Committee was obtained from the Bezmialem Vakıf University.

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