Nutrient Intake of Crohn's Patients: Is There Consistency between Crohn's Disease Activity Index, Subjective Global Assessment and Body Mass Index?

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Abstract

Background: We aimed to determine the nutrient intake of Crohn's patients and to expose its relationship with Crohn's Activity Index (CDAI), Subjective Global Assessment (SGA) and Body Mass Index (BMI).
Methods: This randomized controlled trial was conducted on patients enrolled in the Gastroenterology Polyclinic of a University Medical Faculty Hospital, Kayseri, Turkey in 2017. Two groups were included in this study: Crohn's Group (n = 100) and Control (n = 89). Crohn's Disease Activity Index was used to detect disease activity. Malnutrition risk was determined by the SGA and daily energy and nutrient intakes were calculated.
Results: There was a significant relationship between SGA and both CDAI and BMI (*P<0.001*, *P=0.008*, respectively). Daily energy, carbohydrate, monosaccharide, starch, sucrose, fructose, poly-unsaturated fatty acids, omega-3 fatty acids, fiber, vitamin E and C, thiamine, niacin, pyridoxine, Mg, P, Fe, Cu, Zn intakes were significantly lower in Crohn's Group than in Control Group. While more than 50% of the patients did not consume enough, B6, C, thiamine, niacin, folic acid, Mg, Ca and fiber, intakes of vitamin E, riboflavin, Fe, P, and Zn were adequate. Energy and nutrient (vitamin E, thiamine, vitamin B6, mono and poly unsaturated fatty acids, saturated fatty acids, Mg, Ca, P, Zn, n-3 fatty acids and starch) intakes were negatively correlated with CDAI, but there was no relationship between these intakes and SGA.
Conclusion: There was a relationship between CDAI, SGD and BMI used to determine nutritional status in patients with Crohn's.

Keywords: Body mass index; Nutrient intake; Crohn's; Crohn's disease activity index

Introduction

Crohn's disease (CD) is a recurrent, transmural inflammatory disease of the gastrointestinal mucosa. CD may involve any or all parts of the entire GI tract from mouth to the anus (1). The rate of protein energy malnutrition among patients ranges from 20%-85% (2). Various factors such as re-duced oral food intake, malabsorption, enteric nutrient loss, increased energy requirements due to systemic inflammation and iatrogenic factors (drug and surgery related) contribute to malnutrition in Inflammatory Bowel Disease (IBD) patients (3). The European Society for Clinical Nu-

trition and Metabolism (ESPEN) guideline recommended that patients with IBD should be screened for malnutrition at the time of diagnosis and regularly after diagnosis, as they are at risk. Prognosis, complication rates, mortality and quality of life worsen in malnourished IBD patients who were not properly treated (4).

In the acute phase of the disease, fat tissue-related weight loss, decreased nutrient intake, increased losses, negative nitrogen balance, potassium, calcium, magnesium, phosphorus and fat-soluble vitamins deficiency and steatorrhea are observed. In remission, micronutrient deficiency can be seen as well as calcium, vitamin D and Vitamin B12 deficiencies which are caused by drug treatment (5). In recent years, nutritional support is accepted as a primary treatment. Nutritional support approaches prevent from malnutrition or to improve malnutrition, and to help to put the patient in remission (6).

Because of the advantages and disadvantages of the various methods used to evaluate the nutritional status of Crohn's patients, it is difficult to assess and a standardized method for evaluation has not yet been determined. Nutritional status of 75 patients were investigated in remission (Crohn's Activity Index (CDAI) < 150) (7). Malnutrition rates changed according to the methods: upper central arm muscle area (26.7%), arm circumference (29.3%), Subjective Global Assessment (SGA) (18.7%), body mass index (6.7%), skinfold thickness (37.3%) and hand dynamometer (73.3%). The patients were risk even in remission, body mass index (BMI) should not be used as reference and that handgrip strength was more suitable to determine high prevalence of malnutrition (7). Body composition was compared, nutrient intake and basal metabolic rate of 54 Crohn's patients and 25 healthy individuals (8). It was detected that 37 patients were well-nourished, 12 were mildly malnourished and 4 patients were severely malnourished according to the SGA in this study. Nutritional status was compared (SGA, BMI and trace element intake), body composition (BIA, anthropometry), handgrip strength and quality of life of 94 patients in remission and 61 controls (9). The majority of patients (74%) were well nourished according to the SGA and BMI (9). In another study, the researchers investigated the relationship between CDAI and seven days food consumption of 74 Crohns' patients and compared the results with Canadian Dietary Reference Intakes. Energy, protein intakes of the patients were sufficient, folic acid, vitamin E, vitamin C and calcium intakes were low and total carbohydrate, fat and saturated fat intakes were high. Because folic acid, vitamin C and E and calcium intake levels were so low, dietary counselling was recommended (10). Serghini et al (11) compared energy, carbohydrate, fat and protein intake of active and inactive Crohn's patients, they found that percentages of carbohydrate, fat and protein intake were similar; energy intake was significantly lower in active than in inactive patients. In addition, they found that energy intake negatively correlated with CDAI and BMI (11). Energy, carbohydrate, mono unsaturated fatty acids, fiber, calcium, vitamin C, D, E and K intake, BMI and physical activity level were significantly lower in Crohn's patients than in controls (12). All of these results showed that malnutrition in CD is often related to micronutrient deficiency due to insufficient intake of certain foods.

Despite the use of different methods to determine malnutrition and nutritional status in CD results in recent studies have been contradictory (8-12). Upon examination of the literature no studies on this subject were found in our country. Thus, we aimed to determine nutrient intake of Crohn's patients and to expose its relationship with CDAI, SGA and BMI.

Materials and Methods

Design

This observational randomized controlled trial was conducted on patients enrolled in the Gastroenterology Polyclinic of a University Medical Faculty Hospital between Jan 2017 and Jun 2017.

Subjects

The sample number was determined according to the literature and power analysis was found as 0.99 (13). Two groups were enrolled in this study:

Crohn's Group (n = 100) and Control Group matched in terms of age, sex and BMI (n = 89). All controls were determined to be health following a medical history questionnaire, physical examination and biochemical tests.

The participants were informed about the study and they signed the informed consent form. Approval was received from the Local University Ethics Committee (Dated 04 Jan, 2017, number 2017/13).

Socio demographic characteristics of the participants were obtained by recorded face to face. CDAI was determined by physician and SGA was determined by the researchers. Daily energy and nutrient intake sufficiency were determined according to the Turkey-Specific Nutrition Guide, 2015 (14).

Individuals who had taken multivitamin-mineral supplements in the previous 6 months, had communication problems, < 18 and > 65 yr old or were treated with alternative treatments other than drug were excluded from the study.

Anthropometric Measurements

Weight was measured using a calibrated digital scale which is sensitive to 100 grams (Oncomed SC 102, USA), height was measured with an inflexible tape according to Frankfort Plane. BMI (kg/m2) was calculated with using obtained values. Participants whose less than <18.5 were classified underweight, whose BMI 18.5-24.9 kg/m² were classified normal weight, whose BMI 25.0-29.9 kg/m² were classified as mildly obese, whose BMI $\geq$ 30 kg/m² were classified as obese (15).

SGA

SGA was used for assessing malnutrition. Analysis of the data and the results are scored as A, B and C. If the patient is well-nourished scored is A, mildly malnutrition is scored B and severely malnutrition scored is C (16).

CDAI

CDAI is a sensitive and numeric evaluation used in clinical trials. In this evaluation, parameters such as general condition of the patients, defecation number, abdominal pain, anemia, weight loss, abdominal cyst and the presence of complications are scored. If the result is 150 or lower it is asymptomatic remission and if it is 150-200 it is mildly to moderately active CD. Patients with a score 220-450 have severely active CD, 450 and higher have severely active to fulminant disease (17).

Food Consumption

Twenty-four-h food consumption for three consecutive days including at least one weekend day was recorded by all participants. Volumes and portion sizes were estimated with 2-dimensional food models and with a portion size picture booklet including 120 photographs of food, each with 3–5 different portion sizes (18). BeBiS (Ebispro for Windows, Germany; Turkish Version/BeBiS 7) was used to determine energy and nutrient intake (19). Energy and nutrient intake levels were compared with the Turkey-Specific Nutrition Guide 2015 and sufficiency level was determined. Sixty-seven percent and lower of recommended intake was accepted as insufficient, 68%-133% intake of recommended was accepted sufficient, 133% and higher intake was over the recommended level (20).

Statistical Analysis

Statistical analysis of the data was performed by SPSS 16.0 (Chicago, IL, USA). Descriptive statistics were expressed as mean and standard deviation for normal distributed variables, median (minimum-maximum) used for variables with no normal distributed and percentage used for categorical variables. Normality evaluation of continuous variables was examined with Kolmogorov-Smirnov and Shapiro-Wilk tests. Differences between the groups were analyzed by Student's *t*-test, Mann Whitney-U test and Chi-Square test. The relationships between SGA, BMI, CDAI and food consumption was evaluated by Spearman Correlation Analysis. $P < 0.05$ was accepted as significant.

Results

There was no significant difference between the groups in terms of age, weight, height, BMI and BMI classification (Table 1). Educational and income levels were higher in Controls than in Crohn's Group ($P < 0.05$). While alcohol consumption was similar among the groups, cigarette use was significantly lower in Controls (32.5%) than in Crohn's Group (42%) ($P < 0.05$) (Table 2).

Table 1: Age and anthropometric measurements of the groups

Variable	Crohn's Group X ± S	Control Group X ± S	P
Age (yr)	40.71 ± 12.65	39.46 ± 11.99	0.488
Weight (kg)	72.14 ± 14.42	72.7 ± 14.24	0.763
Height (cm)	168.8 ± 9.82	168.02 ± 9.99	0.591
BMI (kg/m²)	25.37 ± 4.99	25.82 ± 4.88	0.537

Data were analyzed by Student's *t*–test. $P < 0.05$ is significant

Table 2: Socio-demographic characteristics of the groups

Variable	Crohn's Group (n = 100)	(%)	Control Group (n = 89)	(%)	P
Sex					
Male	58	58.0	47	52.8	0.476
Female	42	42.0	42	47.2	
Marital Status					
Married	76	76.0	64	71.9	
Single	19	19.0	22	24.7	0.951
Divorcee	5	5.0	3	3.4	
Educational Level					
Illiterate	5	5.0	1	1.1	
Finish primary school	33	33.0	21	23.6	
Middle school graduate	12	12.0	3	3.4	0.003
High school graduate	24	24.0	26	29.2	
University graduate	26	26.0	38	42.7	
Profession					
Housewife	29	29.0	27	30.3	
Retired	10	10.0	5	5.6	0.352
Officer	13	13.0	11	12.4	
Tradesmen	16	16.0	1	12.4	
Labour	14	14.0	7	7.9	
Student	8	8.0	11	12.4	
Office worker	5	5.0	17	19.1	
Unemployed	5	5.0	27	30.3	
The number of people in family					
< 5	76	76.0	63	70.8	0.269
≥ 5	24	24.0	26	29.2	
Income level TL*/month					
No income	3	3.0	6	6.7	
800-1200	8	8.0	1	1.1	0.001
1200-1800	35	35.0	12	13.5	
1800-2400	15	15.0	12	13.5	
2400-3000	20	20.0	24	27.0	
≥3000	19	19.0	34	38.2	
Cigarette use					
Don't smoke	58	58.0	61	68.5	0.032
1-10	20	20.0	11	12.3	
More than 11	22	22.0	17	19.2	
Alcohol consumption					
None	96	96.0	85	95.5	
1 drink per month	3	3.0	3	3.4	
1 drink per week	1	1.0	1	1.1	0.875

Data were analyzed by Chi-square test. $P < 0.05$ is significant. *TL (Turkish Lira)

According to the CDAI, 97% of the patients were in remission, and 3% had mildly to moderately active CD. According to the SGA, 85% of the patients were well-nourished, 14% were mildly malnutrition, and 1% was severely malnourished. There was significant relationship between SGA and both CDAI and BMI ($P < 0.001$, $P < 0.05$, respectively) (Table 3).

Table 3: Relationship between Subjective Global Assessment (SGA) and both Crohn's Activity Index (CDAI) and body mass index (BMI)

Variable			SGA					
		A		B		C		P
		n	%	n	%	n	%	
CDAI	Asymptomatic remission	84	86.6	13	13.4	0	0	< 0.001
	Mildly to moderately active Crohn's disease	1	33.3	1	33.3	1	33.3	
BMI	< 18.5	3	42.8	3	42.8	1	14.4	0.008
	18.5-25	32	80	8	20	0	0	
	25-30	35	92.1	3	7.9	0	0	
	30-35	15	100	0	0	0	0	

Data were analyzed by Chi-square test. $P<0.05$ is significant

Daily energy, carbohydrate, monosaccharide, starch, sucrose, fructose, poly-unsaturated fatty acids, omega-3 fatty acids, fiber, vitamin E and C, thiamine, niacin, pyridoxine, Mg, P, Fe, Cu, Zn intakes were significantly lower in Crohn's Group than in Controls ($P < 0.05$). There were not any differences between the groups in terms of protein, saturated and mono unsaturated fatty acids, cholesterol, vitamin A, D, K, B12, riboflavin, folic acid, Ca and caffeine consumption (Table 4).

Table 4: Daily energy and nutrient intakes of the groups

Energy and nutrient	Crohn's Group Median (Min-max)	Control Group Median (Min-max)	P
Energy (kkal)	1403.30 (455.43-3516.70)	1670.50 (715.95-3445.15)	0.002
Protein (g)	*56.27 ± 22.11	59.22 (20.50-162.20)	0.079
Fat (g)	61.25 (13.80-148.67)	66.47 (27.70-157.70)	0.020
Carbohydrate (g)	152.00 (12.30-476.60)	190.61 (80.60-440.50)	0.002
Fiber (g)	14.20 (2.50-42.20)	18.4 (6.5-50.6)	< 0.001
Mono unsaturated fatty acids (g)	20.20 (5.26-51.40)	*23.85 ± 8.59	0.05
Poly unsaturated fatty acids (g)	13.95 (2.30-43.59)	16.72 (5.80-45.30)	0.001
Saturated fatty acids (g)	20.55 (4.91-70.60)	23.89 (7.70-53.90)	0.198
Cholesterol (mg)	235.65 (33.23-834.90)	*258.39 ±127.48	0.541
Omega-3 fatty acids (mg)	1.11 (0.28-3.23)	1.48 (0.50-9.72)	< 0.001
Sucrose (g)	15.67 (0.17-234.91)	26.80 (2.16-413.06)	< 0.001
Fructose (g)	6.12 (0.28-42.59)	10.01 (1.08-60.94)	0.001
Lactose (g)	4.45 (0.00-23.44)	4.93 (0.01-40.51)	0.092
Vitamin A (mcg)**	651.20 (69.48-6412.70)	743.97 (234.3-5883.2)	0.082
Vitamin D (mcg)	1.10 (0.00-20.20)	1.10 (0.10-11.90)	0.677
Vitamin E (mcg)	11.66 (2.30-42.20)	13.70 (4.10-40.27)	0.012
Vitamin K (mcg)	*255.6 ± 128.7	*286.2 ± 120.9	0.094
Thiamine (mg)	0.58 (0.20-1.90)	0.68 (0.24-1.93)	0.002
Riboflavin (mg)	1.00 (0.30-5.60)	*1.11 ± 0.37	0.183
Niacin (mg)	7.40 (2.13-30.40)	*9.52 ± 4.02	0.026
Pyridoxine (mg)	0.83 (0.36-2.80)	1.00 (0.40-2.50)	0.004
Folic acid (mcg)***	95.35 (11.30-417.80)	101.63 (38.60-393.20)	0.437
Vitamin B12 (mcg)	2.99 (0.40-91.30)	3.50 (0.17-24.70)	0.220
Vitamin C (mg)	54.05 (4.00-199.80)	*80.55 ± 47.71	0.004
Magnesium (mg)	164.9 (70.20-432.21)	198.42 (69.60-602.40)	< 0.001
Calcium (mg)	494.80 (160.53-1358.90)	532.50 (197.80-1216.80)	0.056
Phosphorus (mg)	813.51 (288.13-2094.60)	605.63 (462.30-1936.55)	0.015
Iron (mg)	8.25 (3.00-21.90)	9.57 (3.80-23.70)	< 0.001
Copper (mg)	1.19 (0.46-5.50)	1.44 (0.52-3.60)	< 0.001
Zinc (mg)	7.65 (2.39-18.80)	8.56 (3.23-23.90)	0.011
Caffeine (mg)	32.00 (0.00-1122.70)	36.00 (0.00-168.30)	0.991

Data were analyzed by Student's *t*-test and Mann Whitney-U test. *They were shown as mean and standard deviation. **RAE retinol activity equivalent ***Free folic acid equivalent. Min-max = minimum-maximum

Compared with Turkey Specific Nutrition Guide, carbohydrate intake was inadequate in 44% of the patients and protein intake was inadequate in 1%. While more than 50% of the patients did not consume enough vitamin D, B6, C, thiamine, niacin, folic acid, Mg, Ca and fiber, intakes of vitamin E, riboflavin, Fe, P, and Zn were adequate. While there was no relationship between energy and nutrient intakes of the patients and SGA, energy, protein, fat, vitamin E, thiamine, vitamin B6, mono and poly unsaturated fatty acids, saturated fatty acids, Mg, Ca, P, Zn, n-3 fatty acids and starch intakes of patients were negatively correlated with CDAI ($P < 0.05$) (Table 5).

Table 5: Correlation of SGA, CDAI and nutrients

Energy and nutrient	SGA		CDAI	
	r	P	r	P
Energy (kkal)	-0.014	0.887	-0.255	0.010
Protein (g)	0.012	0.903	-0.241	0.016
Fat (g)	0.058	0.569	-0.289	0.003
Carbohydrate (g)	-0.096	0.340	-0.166	0.100
Fiber (g)	-0.045	0.654	-0.184	0.067
Mono unsaturated fatty acids (g)	0.100	0.321	-0.289	0.003
Poly unsaturated fatty acids (g)	0.025	0.805	-0.249	0.013
Saturated fatty acids (g)	0.013	0.901	-0.281	0.005
Cholesterol (mg)	0.104	0.303	-0.168	0.096
Omega-3 fatty acids (mg)	0.073	0.467	-0.285	0.004
Starch (g)	-0.134	0.185	-0.245	0.014
Vitamin A (mcg)**	0.081	0.422	-0.074	0.464
Vitamin D (mcg)	0.044	0.667	-0.133	0.187
Vitamin E (mcg)	0.004	0.969	-0.225	0.024
Vitamin K (mcg)	0.031	0.761	-0.094	0.350
Thiamine (mg)	-0.009	0.926	-0.226	0.024
Riboflavin (mg)	0.109	0.282	-0.085	0.398
Niacin (mg)	-0.008	0.934	-0.108	0.286
Pyridoxine (mg)	0.020	0.840	-0.198	0.048
Folic acid (mcg)***	0.018	0.860	-0.133	0.187
Vitamin B12 (mcg)	0.100	0.321	0.025	0.802
Vitamin C (mg)	-0.039	0.700	-0.066	0.514
Magnesium (mg)	0.029	0.778	-0.206	0.040
Calcium (mg)	0.136	0.178	-0.233	0.020
Phosphorus (mg)	0.097	0.335	-0.247	0.013
Iron (mg)	-0.028	0.785	-0.172	0.088
Copper (mg)	-0.037	0.718	-0.098	0.334
Zinc (mg)	0.048	0.637	-0.209	0.037
Caffeine (mg)	-0.171	0.089	-0.054	0.593

**RAE retinol activity equivalent ***Free folic acid equivalent

Discussion

Protein energy malnutrition and micronutrient deficiency due to disease activity and insufficient food intake is often seen in Crohn's patients (21). CDAI is a sensitive and numeric evaluation used in clinical trials (17). BMI is generally used to determine nutritional status. SGA is an evaluation method used to detect the presence of malnutrition and malnutrition risk in these patients (7). However, there are still contradictions regarding the use of these methods in some studies.

Overall, 61 Crohn's patients in remission were well nourished according to SGA and BMI (9). Energy intake of 23 Crohn's patients was negatively correlated by CDAI and BMI (11). BMI was less sensitive for prediction of body cell mass and skeletal muscle mass loss and that handgrip were more effective for prediction of nutritional status and muscle strength (13). In our study, there was a consistency between SGA, CDAI and BMI in Crohn's patients and thought that these methods may be useful to determine nutritional deficiencies (Table 4).

Although there were not any differences in energy requirements, insufficient food intake is seen during both of active periods and remission of patients with IBD. Energy, carbohydrate, mono unsaturated fat, fiber, calcium, vitamin C, D, E, K intake, physical activity and BMI are significantly lower in 78 Crohn's patients than in controls (12). Folic acid, vitamin E, C, retinol, tocopherol, ascorbic acid, thiamine, riboflavin, niacin and folic acid and calcium intake was low in Crohn's patients in both of active periods and remission (10). Dietary counselling should be provided to these patients (10). Vitamin C, pyridoxine, folic acid, cholecalciferol, tocopherol, calcium and zinc intakes were lower in 54 Crohn's patients in remission than in controls (8). In this study, similarly the previous studies (8, 10), the intakes of energy and many nutrients were inadequate. It was thought that deficiency of carbohydrate consumption (44% deficient) may be affected from insufficient energy, thiamine, and niacin sources (respectively, 85%, 73% deficient) intake of the patients. The high insufficiency rates of consumption of vitamin C, folic acid fiber in patients (57%, 99%, 67%, respectively) may be due to limiting their consumption of vegetables and fruits in order to both for economic reasons and reducing the gastrointestinal problems (Not shown in table).

Lactose intolerance is the main determinant of low calcium intake. Inadequate calcium intake is seen in one third of patients with IBD and it is a reversible risk factor for osteoporosis. In Italy, in woman with CD intake calcium under the Recommended Dietary Allowance (RDA) when calcium intakes of patients with IBD were calculated from food consumption records (22). Although it was not statistically significant, we found that daily calcium intake was lower in Crohn's Group than in Controls. Moreover, it was detected that 78% of patients consume insufficient calcium according to the Turkey-Specific Nutrition Guide. Crohn's patients consume high protein depending on high meat consumption because of nutritional habits in Brazil (23). In addition, they specified that low calcium intake of the patients may be related with belief that the clinical symptoms will deteriorate due to the content of lactose in the milk (23). Similarly, while, protein intake of 90% of the patients was adequate, low calcium intake might be due to inadequate milk consumption in our study.

Geerling et al demonstrated micronutrient deficiencies in patients with long-standing CD in remission period, especially in male patients (24). In other study conducted with CD patients in remission, macronutrient needs are generally covered by food intake, but micronutrient deficiencies are frequent (8). In our study, 97% of the patients are in remission and some nutritional deficiencies were shown compared to the control group. Similar to previous mentioned studies we found that energy, protein, fat, vitamin E, thiamine, vitamin B6, mono and poly unsaturated fatty acids, saturated fatty acids, Mg, Ca, P, Zn, n-3 fatty acids and starch intakes of patients were negatively correlated with CDAI ($P < 0.05$) (Table 5).

Limitations of the Study

The data were collected in winter and the participants may not have accurately reflected food consumption, thus reported nutrient intakes might have been affected.

Conclusion

There was a relationship between CDAI, SGD and BMI used to determine nutritional status in patients with Crohn's in remission. Although the patients were well-nourished according to SGA, it was thought that they may have malnutrition risk due to energy and many nutrient deficiencies.

Moreover, further studies are required to determination of appropriate methods used to decide nutritional status of Crohn's patients.

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Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Conflict of interest

The authors declare that there is no conflict of interest.

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