

Association Between Ultra-Processed Food Consumption and Ulcerative Colitis Severity: The Result of a Cross-Sectional Study

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Abstract

Background: The consumption of ultra-processed food (UPF) has an effect on the gut barrier and gut microbiome. Considering that there are limited studies on the association of UPFs and inflammatory bowel disease (IBD) with the small number of ulcerative colitis (UC) patients, this cross-sectional study was conducted to evaluate the relationship between UPFs and UC severity.

Methods: One hundred fifty-eight patients with UC participated in this study. The disease severity was assessed by the Mayo score. Dietary intake was recorded by a 168-item Food Frequency Questionnaire. UPF consumption was calculated based on the NOVA classification. In addition, the relationship between UC activity and UPF consumption was analyzed by the logistic regression adjusting for dietary factors, demographic values, and lifestyle factors.

Results: There were no significant differences between participants across different tertiles of UPFs, except for age ($P=0.03$) and gender ($P=0.04$). The mean consumption of UPF components was significantly greater in the high tertile of the UPF score, except for packaged bread, cream, mayonnaise, curd, margarine, and soft drinks. In the crude (odds ratio [OR]: 1.21, 95% CI: 0.56, 2.60) and adjusted (OR: 1.10, 95% CI: 0.47, 2.56) models, disease severity was not associated with consuming UPFs.

Conclusion: In this study, no significant association was found between UPF consumption and UC activity in patients with UC. However, considering the limitations of this study, especially regarding design and sample size, there is a need to conduct more prospective studies or clinical trials to assess the correlation between UPFs and UC activity.

Keywords: Ulcerative colitis, Inflammatory bowel disease, Disease course, Food processing

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Introduction

Ulcerative colitis (UC) is one of the subtypes of inflammatory bowel diseases (IBDs) that is characterized by relapsing intestinal inflammation.¹ In patients with UC, the goal of all treatments is preventing flares and maintaining remission. Considering the high burden of flares in patients with UC, many researchers are investigating factors that affect remission in these patients. In this regard, various investigations focused on the effect of dietary factors on disease course in patients with IBDs.²⁻¹⁰ Some dietary factors, such as a diet with a high inflammatory index, were shown to be related to higher disease severity.¹¹ On the other hand, plant-based dietary patterns have been related to lower disease activity in these patients. Another dietary-related feature that may

affect the disease course in UC patients is the consumption of ultra-processed foods (UPFs). Due to their ingredients, such as artificial flavors, sugars, stabilizers, emulsifiers, and preservatives, UPFs may affect the gut barrier and gut microbiome, which may alter the disease course in patients with IBD.^{12,13} With these assumptions, some cohort studies assessed the association between UPF consumption and the risk of IBD and provided contradictory results. One cohort study demonstrated a positive association between UPF consumption and the risk of UC development¹⁴; however, others reported no significant association between these two variables.¹⁵⁻¹⁸ The result of the systematic review showed a positive association between UPF consumption and Crohn's disease risk but not UC risk.¹⁹ Nevertheless, there is a



limited body of research on the role of processed food in the context of the UC course. Two studies analyzed the association between ultra-processed and processed food consumption and the indicators of disease course, such as the need for IBD-related operations,¹⁵ inflammation, and time to hospitalization,²⁰ in IBD patients and reported the adverse effects of these foods on the disease course of IBD. Moreover, a cross-sectional study on IBD patients also revealed a positive association between UPF consumption and active disease.²¹

The diet is important in the UC course, and UPFs can affect the gut barrier and gut microbiome. Considering that limited studies have been conducted on the association of UPFs and IBD with the small number of UC patients, the current cross-sectional study was designed to evaluate the relationship between UPFs and UC severity.

Methods

One hundred fifty-eight patients with UC participated in this cross-sectional study. The participants were recruited from July 2022 to March 2023 by convenience sampling. The center for patient recruitment was the IBD Clinic of Imam Reza Hospital, which is the main center of IBD management in East Azerbaijan, Iran.

Before participation, informed consent was obtained, and the protocol of the study was approved by the Ethics Committee of Tabriz University of Medical Sciences.

The inclusion criterion was the age range of 20–60 years, and the diagnosis was made at least 6 months prior to the contribution. On the other hand, participants having other digestion issues, cancers, autoimmune illnesses, or other conditions that necessitate following special diets were not entered into the study.

The sample size was calculated by Power Analysis and Sample Size software according to several assumptions, including an alpha error of 5%, a beta error of 20%, and the association between dietary intake and UC relapse rate reported in a previous study.²²

For the acquisition of demographic information, the interview was conducted by a trained nutritionist to gather information on age, gender, and a history of cigarette smoking. In addition, the nutritionist measured height (in meters) and weight (in kg), and then the body mass index (BMI) was calculated by dividing the weight (kg) by the square of height (meters).

Moreover, the same nutritionist completed the dietary intake of participants by a 168-item food frequency questionnaire (FFQ).²³ Then, the energy, micronutrient, and macronutrient intake were obtained by Nutritionist IV software (N Squared Computing, California, USA).

The NOVA food classification was applied to calculate the UPF score. NOVA is used to classify foods into four food groups, namely, unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and UPFs, based on the processing methods utilized during their manufacture. The consumption of each component of UPF was calculated based on the data obtained by FFQ,

and total UPF consumption was calculated as the sum of all these food items. Then, the consumption of UPF was converted to energy percentage from UPFs, and this value was considered a primary indicator for UPF intake.

The information regarding the disease, such as diagnosis time, the UC extensions, and drug treatment, was recorded by an expert gastroenterologist. In addition, the Mayo score was used to assess disease severity based on several criteria, including rectum hemorrhage (scored 0–3), defecation rate (scored 0–3), physician's global assessment (scored 0–3), and endoscopy report (scored 0–3). The sum of these components was considered the total Mayo score. In this study, a score of less than six was an indicator of inactive or mild disease severity, and a score of equal or more than six was an indicator of a moderate or severe UC stage.

Statistical Analysis

For reporting the characteristics of participants, the continuous variables were reported as means and standard deviations (SD), and the nominal and categorical data were presented as frequencies and percentages. The participants were divided into three groups according to the tertiles of the UPF score. The comparison of participants' characteristics across tertiles of the UPF score was conducted by the one-way analysis of variance and chi-square where appropriate. The association of tertiles of UPFs (as the independent variable) and disease activity (a binominal dependent factor) was determined by the logistic regression in crude and two adjusted models. In the adjusted models, variables entered into the model were demographic features (e.g., age, gender, and smoking), nutritional features (e.g., dietary intake of energy, BMI, nutritional supplement use, and following a special diet), and disease-related information (e.g., treatments and disease duration), which were considered covariates.

Results

The participants' mean age was 42.52 ± 12.61 years, and the mean disease duration was 7.96 ± 5.85 months. The demographic information of participants across tertiles of UPF score is provided in [Table 1](#). Based on the results, there were no significant differences between participants across different tertiles of the UPF score except for age ($P=0.03$), which was significantly higher in patients in the first tertile, and gender ($P=0.04$).

[Table 2](#) presents the mean daily (g/d) consumption of UPF components across different tertiles of UPF. The mean consumption of UPF components was significantly greater in the high tertile of the UPF score, except for packaged bread ($P=0.46$), cream ($P=0.24$), mayonnaise ($P=0.06$), curd ($P=0.09$), margarine ($P=0.37$), and soft drinks ($P=0.27$).

[Table 3](#) reports the odds of active disease across the UPF tertile. In the crude model, disease severity was not associated with consuming UPFs (odds ratio [OR]: 1.21,

Table 1. Characteristics of Participants Stratified by Ultra-processed Food Tertiles

Variables	UPF Tertiles			P value
	Tertile 1 (n=52)	Tertile 2 (n=53)	Tertile 3 (n=53)	
Demographic information				
Age (years) mean ± SD	48.27 ± 11.73	40.64 ± 13.28	40.72 ± 12.16	0.03*
Gender (male), n (%)	33 (63.5)	30 (56.6)	21 (39.6)	0.04**
Current smoker, n (%)	7 (13.5)	9 (17)	6 (11.3)	0.71**
Disease-related information				
Disease duration (month) mean ± SD	8.31 ± 6.88	8.27 ± 5.32	7.30 ± 5.29	0.60*
Treatments				
Mesalazine, n (%)	52 (100)	53 (100)	53 (100)	-
Azathioprine, n (%)	32 (61.5)	36 (67.9)	40 (37)	0.33**
Prednisolone, n (%)	17 (32.7)	18 (34.0)	24 (45.3)	0.36**
Disease extension, n (%)				
Ulcerative proctitis	4 (7.7)	10 (18.9)	2 (12.5)	
Left-sided colitis	31 (35.6)	27 (31)	29 (33.3)	0.19**
Proctosigmoiditis	14 (26.9)	12 (22.6)	19 (35.8)	
Pancolitis	3 (5.8)	4 (7.5)	3 (5.7)	
BMI (kg/m ²), mean ± SD	25.65 ± 3.98	26.36 ± 4.95	25.40 ± 4.09	0.50*
Nutritional supplements use, n (%)	42 (80.8)	48 (90.6)	48 (90.6)	0.25**
Following diet, n (%)	19 (36.5)	19 (35.8)	18 (34)	0.97**

Note. SD: Standard deviation; BMI: Body mass index; UPF: Ultra-processed food. *P-value of one-way ANOVA; **P-value of Chi-square.

Table 2. Dietary Intakes of UPF Diet Components Among Participants Across Tertiles of the UPF Score

Variables	UPF Tertiles			P Value*
	Tertile 1 (n=52)	Tertile 2 (n=53)	Tertile 3 (n=53)	
Packaged breads	5.05 ± 16.56	10.29 ± 31.36	8.00 ± 12.89	0.46
Hamburger (g/d)	0.32 ± 0.72	1.29 ± 2.35	2.41 ± 5.47	0.009
Sausage (g/d)	0.55 ± 1.21	2.63 ± 4.75	3.28 ± 5.72	0.004
Cream cheese (g/d)	1.90 ± 2.56	7.74 ± 8.99	17.59 ± 13.54	<0.001
Yogurt drink (g/d)	43.69 ± 45.58	44.51 ± 49.99	87.07 ± 78.51	<0.001
Cream (g/d)	0.90 ± 2.31	0.98 ± 2.40	1.67 ± 2.95	0.24
Ice cream (g/d)	2.64 ± 3.20	6.13 ± 8.98	5.85 ± 5.62	0.009
Margarine (g/d)	0.00 ± 0.00	0.001 ± 0.007	0.00 ± 0.00	0.37
Curd (g/d)	0.53 ± 0.85	0.98 ± 1.68	1.09 ± 1.49	0.09
Ketchup, mayonnaise, or mustard sauce (g/d)	0.71 ± 1.06	0.91 ± 1.09	1.31 ± 1.69	0.06
Soft drinks (g/d)	13.31 ± 26.09	18.14 ± 26.93	22.36 ± 31.97	0.27
Commercial fruit juices (g/d)	3.27 ± 8.93	6.22 ± 16.18	18.80 ± 44.51	0.01
Pastries (g/d)	9.33 ± 6.08	16.19 ± 9.20	24.02 ± 17.63	<0.001
Snacks (g/d)	1.82 ± 2.03	5.27 ± 4.91	9.49 ± 10.58	<0.001

Note. ANOVA: Analysis of variance; UPF: Ultra-processed food. *P value of one-way ANOVA.

95% confidence interval [CI]: 0.56, 2.60). This association remained non-significant after adjusting for various demographic, disease-related, and nutritional factors (OR: 1.10, 95% CI: 0.47, 2.56).

Discussion

Considering the effect of UPF on the gut barrier and gut microbiota, it was hypothesized that the consumption of these foods may be associated with disease activity in UC patients. Nonetheless, the results indicated no significant

association between UPF consumption and disease activity in patients with UC. Previously, the relationship between UPF consumption and the risk of UC development was evaluated in cohort studies, leading to contradictory results. In a cohort multinational study, Narula et al showed that UPF consumption was a significant risk factor for IBD development.¹⁴ However, in line with our findings, the results of some other cohort studies demonstrated no significant association between UPF consumption and the risk of UC development.¹⁵⁻¹⁸ Regarding the association

Table 3. The Association Between Disease Severity and UPF Score Tertile in Patients With Ulcerative Colitis

Models	UPF Tertiles				
	Tertile 1 (n=52)	Tertile 2 (n=53)		Tertile 3 (n=53)	
		OR (95% CI)	P Value	OR (95% CI)	P Value
Crude model	1	0.65 (0.30, 1.42)	0.28	1.21 (0.56, 2.60)	0.62
Model 1*	1	0.62 (0.27, 1.40)	0.25	1.14 (0.50, 2.60)	0.75
Model 2**	1	0.64 (0.27, 1.49)	0.30	1.10 (0.47, 2.56)	0.81

Note. BIM: Body mass index; UPF: Ultra-processed food; OR: Odds ratio; CI: Confidence interval.

Dependent variable: Disease severity; Independent variable: Tertiles of UPF score.

Disease severity was categorized into remission and mild active (mayo score ≤ 5), and moderately and severe active disease (mayo score ≥ 6).

*Adjusted for age, gender, smoking, treatments, and disease duration.

**Adjusted for model 2 plus dietary energy, carbohydrate, protein, fat intake, BMI, following special diet, and nutritional supplement use.

of UPF consumption and disease course in IBD patients, Chen et al found that UPF consumption was significantly associated with the need for IBD-related operations in UC overtime.¹⁵ Furthermore, in another cohort study of IBD patients, a meaningful relationship was reported between the consumption of sugar-sweetened beverages [as one of the important foods in UPF diets] and disease activity biomarkers and inflammation, and a decreased time to hospitalization.²⁰ Moreover, a cross-sectional study on IBD patients reported a positive association between UPF consumption and active disease.²¹ The differences in the results of various studies may be partly related to the demographic characteristics of participants. The participants in the present study were younger compared to previous cohorts. The effect of UPF consumption on disease severity may be influenced by participants' age groups. Further, the accumulative UPF consumption in one's lifetime should be taken into consideration. In addition to age, the mean consumption of alcoholic drinks in the previous cohorts was considered in the analysis. However, the consumption of alcoholic drinks is illegal in Iran. Thus, most patients did not report the true consumption of these drinks. For this reason, we could not adjust our results to the consumption of these drinks. In addition, some of these studies were conducted on IBD patients and analyzed the data of UC and Crohn's disease (CD) patients together. However, only UC patients were included in our study. Considering the differences in risk factors that exacerbate the disease symptoms between UC and CD, this factor partly could be the source of differences in the results of various studies. More importantly, the differences in the study's design could be another source of controversial findings.

The present study suffers from some important limitations. First, it had a cross-sectional study design, limiting the inferring causality of relationships. Moreover, the generalizability of the findings was limited due to the small sample size and recruiting of patients from one center in northwest Iran. Furthermore, the information regarding UPF consumption was gathered by FFQ. Although this questionnaire is one of the widely used questionnaires in epidemiological studies, its restrictions may affect the results. Additionally, as mentioned before, due to the illegal nature of consuming alcoholic drinks in

Iran, most patients underreport the consumption of these drinks. Hence, we could not adjust the results for this important confounder. In addition to alcoholic drinks, we could not adjust the regression analysis for some other covariates.²⁴⁻²⁷

Conclusion

Overall, the results of the present study indicated no significant correlation between UPF consumption and disease activity in patients with UC. Thus, there is no need to add more restrictions on UC patients' diets regarding UPF. However, considering the limitation of this study, especially regarding design and sample size, there is a need to conduct more multicenter studies with larger sample sizes and prospective or clinical trial designs to assess the association of UPFs and disease activity in patients with UC. Moreover, future studies could compare the effect of UPF consumption on disease severity in UC and CD patients.

Ethics statement

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethics code: IR.TBZMED.REC.1401.694).

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None.

Conflict of interests declaration

The authors declare that they have no conflict of interests.

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Data availability statement

Data will be available upon request from corresponding author

Author contributions

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Consent for publication

Not Applicable.

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