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Food Sensitivities in a Diverse Nationwide Cohort of Veterans with Interstitial Cystitis/Bladder Pain Syndrome

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Abstract

Purpose: Prior studies suggest that certain foods exacerbate interstitial cystitis/bladder pain syndrome symptoms. However, these studies were limited in size and demographics. We assessed the presence of diet sensitivities among patients with interstitial cystitis/bladder pain syndrome and compared them with patients with other pelvic pain conditions and healthy controls.

Materials and Methods: We identified Veterans Affairs patients nationwide by querying ICD-9/10 codes for IC/BPS. Patients were assigned to IC/BCP, other pelvic pain (OPP), or healthy control (HC) cohorts after chart review. We mailed all patients the Shorter-Moldwin Food Sensitivity Questionnaire (SMQ) to evaluate the self-perceived effects of specific foods/beverages on urinary symptoms and/or bladder pain.

Results: In the IC/BPS cohort, 70% had ≥1 food sensitivity vs. 37% of the OPP cohort and 32% of HC ($p<0.001$). The average number of sensitivities were similar between OPP and HC cohorts, which were significantly less than in IC/BPS patients. IC/BPS patients were more sensitive to acidic, spicy foods, and certain beverages vs. other cohorts (all $p<0.001$). Within the IC/BPS cohort, Black patients had significantly higher alcoholic and non-caffeinated beverages sensitivity than whites. Black patients did report significantly worsened urinary urgency than whites ($p<0.05$).

Conclusions: In a diverse population of veterans, IC/BPS patients had significantly more food sensitivities than those without IC/BPS. This suggests that food sensitives could be suggestive of

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IC/BPS, which could make the SMQ a helpful diagnostic tool and aid in distinguishing IC/BPS from conditions often confused with IC/BPS.

Keywords

Food sensitivities; interstitial cystitis/ bladder pain syndrome

Introduction:

The Society of Urodynamics, Female Pelvic Medicine, and Urogenital Reconstruction (SUFU), define interstitial cystitis/bladder pain syndrome (IC/BPS) as “an unpleasant sensation (pain, pressure, discomfort) perceived to be related to the urinary bladder, associated with lower urinary tract symptoms of more than six weeks duration, in the absence of infection or other identifiable causes” .[1–3] The burden of IC/BPS on the American public is immense, yet prevalence varies widely in the literature. The prevalence of IC/BPS among women ranges from 0.045% based on administrative claims data to 6.5% in population-based studies, whereas in men the prevalence is lower, from 0.008% in administrative claims data to 4.2% in population-based telephone studies.[4–7] Since there are no specific diagnostic criteria for IC/BPS, the condition is often underdiagnosed or misdiagnosed due to the overlap of symptoms with other pelvic conditions such as chronic prostatitis/urogenital chronic pelvic pain syndrome (UCPPS), urinary tract infections, endometriosis, and vulvodynia.[8]

The American Urological Association (AUA) recommends beginning with non-invasive approaches for managing symptoms. Among these approaches are patient education, stress reduction, and behavioral modifications which can include dietary changes.[9] However, there is limited evidence to support which dietary approaches may be most beneficial, especially in a diverse population.

Prior studies suggest that certain foods can exacerbate bladder urgency, frequency, and bladder pain in those with chronic pelvic pain conditions. One study analyzed responses from 104 women from a single medical center who had been diagnosed with IC/BPS, and 90% reported symptom exacerbation related to specific comestibles.[10] Likewise, a study by Herati et al. surveyed 95 men with chronic prostatitis, and 47% reported symptom exacerbation relating to certain foods and beverages.[11] Similarly, both cohorts reported sensitivities to coffee, tea, alcohol, citrus fruit and juices, hot peppers/chilis, and other spicy foods. While these studies were limited by cohort size, gender, and race, Shorter et al. produced a validated questionnaire to incorporate into future research addressing dietary sensitivity in IC/BPS.[10,12] Herein we utilized the validated Shorter Moldwin Food Sensitivity Questionnaire (SMQ) to determine diet sensitivities in a heterogeneous population of veterans diagnosed with IC/BPS across the United States and examine if differences existed by race, sex, and symptoms.

Materials and Methods:

Cohort Selection.

Using the Veterans Affairs Informatics and Computing Infrastructure (VINCI), we identified VA patients nationwide by querying ICD-9/10 codes (595.1/N30.10) for IC/BPS. A randomly selected subset was generated for confirmation of their diagnosis via chart review and enrollment into a prospective observational study to expand knowledge of the prevalence, incidence, and characteristics of IC/BPS and to improve the methodology for diagnosis of IC/BPS and thus develop new insight into this condition. Chart review was performed by trained study personnel. To meet clinical criteria for IC/BPS, a patient must have one of the following:

1. Two visits with bladder pain ≥6 weeks apart in the absence of a positive urine culture.
2. One visit complaining of bladder pain and a second visit complaining of "likely" IC/BPS related symptoms (such as frequency/urgency) in the absence of a positive urine culture.
3. A history of bladder pain and/or IC/BPS with an additional visit complaining of bladder pain in the absence of a positive urine culture.[8]

Complicated diagnoses were reviewed by a urologist specializing in IC/BPS (JTA) for confirmation. After chart reviews were conducted and diagnoses were confirmed, patients were assigned to either the IC/BPS, other pelvic pain (OPP), or healthy control (HC) cohorts. The OPP cohort was identified by querying ICD-9 codes 601.1, 625.0, 625.1, 625.7, and 625.71, which are indicative of the non-bladder pelvic pain conditions, chronic prostatitis, dyspareunia, vaginismus, vulvodynia, and vulvar vestibulitis. HCs were randomly selected for enrollment from a list of patients who did not have an ICD-9 diagnosis of IC/BPS or other conditions which might be confused with IC/BPS at any point in their medical record. Since men with IC/BPS are thought to be underdiagnosed, we purposely oversample men in our cohort to have closer to a 50:50 ratio of men:women.[5,13]

Study Procedures.

Once written informed consent was obtained, and after diagnosis and demographic data were captured, the IRB-approved Shorter-Moldwin Food Sensitivity Questionnaire was mailed to all three cohorts to evaluate the self-perceived effects of specific foods/beverages on urinary frequency, urgency, and/or bladder pain. Additional questionnaires included in the mailings assessed other habits such as smoking and alcohol use, as well as the presence of comorbidities including migraine, fibromyalgia, irritable bowel, and diabetes. All comorbidities were queried using ICD codes from the medical record.

Food Sensitivity Questionnaire.

The Shorter-Moldwin Food Sensitivity Questionnaire (SMQ) is a self-administered, statistically validated survey instrument developed to determine whether certain foods and beverages worsen the symptoms of IC/BPS.[12] The questionnaire includes items about the incidence of food sensitivity, food-related urine frequency/urgency and bladder pain, the

frequency with which foods are consumed that worsen bladder symptoms, whether diets have been modified after learning that certain foods worsen symptoms, and the effect of various food items on symptoms. For this last item, the questionnaire presents a list of 47 food items, 35 of which have been previously identified to worsen IC symptoms and 12 of which have been identified as least bothersome to IC patients.[12] For each item, participants were asked to rate how the food affects their bladder symptoms on a Likert scale of (1) I don't know, (2) Worsens symptoms, (3) No effect, and (4) Improves symptoms.

Statistical Analysis.

Categorical data were summarized with frequencies and percentages, and continuous data were summarized with the mean (SD), median, and interquartile range (quartile1, quartile3). To examine differences between groups, chi-square tests were used for categorical data and Kruskal-Wallis tests were used for continuous data. For ease of analysis and to account for low numbers in some categories, we compared food sensitivities between food categories as opposed to each specific food item. All tests used a predetermined significance value of $p<0.05$. For all analyses SAS 9.4 (SAS Institute, Cary, NC) was used.

Results:

Patient Characteristics.

We collected demographic information and clinical characteristics of all 425 patients who completed the SMQ, of which 266 (63%) were from the IC/BPS cohort, 68 (16%) were from the OPP cohort, and 91 (21%) were HC (Table 1). Patients were predominantly White (81%), and roughly half (56%) were male. No significant differences in demographic features emerged between cohorts ($p>0.05$). Higher rates of fibromyalgia were observed for the IC/BPS cohort (24%) compared to OPP (18%) and healthy control (9%) cohorts ($p=0.008$). Likewise, higher rates of irritable bowel syndrome (IBS) were observed for the IC/BPS (22%) compared to OPP (15%) and HC (9%) cohorts ($p=0.015$). A similar proportion of patients in the IC/BPS (72%) and OPP (74%) cohorts reported back pain, which was more frequent than that reported among healthy controls (58%) ($p=0.037$). Rates of alcohol abuse, diabetes, migraines, PTSD, and history of depression did not significantly differ between cohorts ($p>0.05$).

Differences in Food Sensitivities Between Cohorts.

Compared to 60% of the IC/BPS cohort, 24% of the OPP and 21% of healthy control cohorts reported that certain foods and beverages worsen their urine frequency, urgency, and bladder pain (e.g., eat foods that will increase symptoms and modified diet) ($p<0.001$) (Table 2). Patients diagnosed with IC/BPS had a significantly higher total number of food sensitivities (7.2; SD = 8.1) compared to patients with OPP diagnoses (1.9; SD = 3.3) and HC (2.1; SD = 4.2) ($p<0.001$). Consistent with prior research, the frequencies with which "non-bothersome (water and milk)" foods were reported to worsen symptoms in the IC/BPS cohort were relatively low whereas sensitivities to historically "bothersome" foods were much more frequent ($p<0.001$) (Table 3). Compared to OPP patients and healthy controls, IC/BPS patients had more sensitivity to foods classified as acidic, spicy foods, alcoholic beverages, other beverages, and other food/additives (Table 2). No significant differences

(p>0.05) emerged between cohorts for sensitivities to meats, artificial sweeteners, or digestive aids/supplements (Table 2).

Demographic Factors and Food Sensitivities among Patients Diagnosed with IC.

Among the IC/BPS cohort, Black patients (n=49) were significantly more likely to report a food-related worsening of urine urgency compared to White patients (n=210) (57% vs. 35%, p=0.009) (Table 4). A higher rate of Black (vs. White) patients also reported being sensitive to alcoholic beverages (51% vs. 36%; p=0.048) as well as non-caffeinated beverages (49% vs. 32%; p=0.024). No other differences in food sensitivity outcomes emerged between Black and White patients. No significant differences were found between female (n = 107) and male (n = 159) patients within the IC/BPS cohort (p>0.05) (data not shown).

IC/BPS and Other Food-Sensitive Comorbidities.

When restricted to the IC/BPS cohort, no significant difference in number of food sensitivities emerged between patients with (n = 63, M = 8.37, SD = 8.93) and without fibromyalgia (N = 203, M = 6.88, SD = 7.75) (p=0.202). There were no significant differences in the number of bladder-specific food sensitivities reported in patients with IBS (n = 76, M = 6.62; SD = 7.62) compared to those without IBS (n = 349, M = 5.00; SD = 7.14) across all cohorts. Again, when restricted to the IC/BPS cohort, the number of bladder-related food sensitivities was similar between those with IBS (n = 58, M = 7.93, SD = 7.99) and without IBS (n = 208, M = 7.04, SD = 8.08) (p=0.460).

Discussion:

Our primary finding is that patients with IC/BPS, regardless of race or gender, report significantly more food sensitives than those with OPP conditions or HCs. This falls in line with previous findings from Shorter et al, which reported 90% of patients with IC/BPS reported exacerbation of bladder symptoms following consumption of specific foods and beverages.[10] Though food sensitivities were prevalent in our VA cohort, with 60% of IC/BPS patients reporting symptom exacerbation and 70% reporting at least one food sensitivity, it was less than that reported by Shorter, et al. We believe this difference is likely due to our cohort's greater diversity in sex, race, and geography. This finding leads us to consider whether food sensitivities are indicative of IC/BPS, as there was a significant difference in food sensitivities between IC/BPS vs OPP and HC patients, with IC/BPS patients reporting more sensitivities overall. OPP and HC had similar results between cohorts. Sensitivities are so prevalent among IC/BPS patients that we could consider including diet sensitivity in the clinical evaluation of patients suspected of having IC/BPS.

There are several theories that may explain the role of diet on IC/BPS symptoms. The first theory suggests epithelial dysfunction and loss of the glycosaminoglycan layer—a layer that could potentially protect one's bladder urothelium against dietary triggers.[14] Parsons et al. examined the effects of cations in urine and found that urine with higher levels of cations can damage the bladder's mucus and initiate an epithelial leak.[15] Furthermore, a review by Klumpp outlined another plausible theory—pelvic crosstalk.[16] According to this theory, comestibles that evoke a response in the colon or surrounding organs could exacerbate

the bladder-centric symptoms felt by IC/BPS patients. While more research needs to be done to determine direct mechanisms, these theories can help guide the design of future studies. Importantly, current literature continues to suggest that IC/BPS patients are more food sensitive than those without IC/BPS.

Our heterogeneous cohort shows no statistical differences in the overall presence of or total number of food sensitivities between Black and White patients, despite a trend towards Black patients being more food sensitive overall. While we did see a significant difference in reports of food-induced urinary urgency among Black patients, we consider the lack of statistical power to detect racial differences a limitation of our dataset. Though we were able to accrue a higher representation of male participants (53%) compared to past studies, there were no significant differences in food sensitivities between men and women with IC/BPS. There was no association between food sensitivities and other comorbidities (IBS, diabetes, and Fibromyalgia). While IC/BPS patients have a higher incidence of IBS, diabetes, and fibromyalgia, the IC/BPS patients also diagnosed with these comorbidities did not have any more food sensitivities than IC/BPS patients without additional comorbidities. Since IBS is another food-sensitive condition, and would coincide with organ cross talk theory, we suspected that IC/BPS patients also diagnosed with IBS would have more bladder-centric sensitivities than those without IBS, but this was not found in our study. Larger numbers of patients with IBS and IC/BPS are needed to determine if there is an additive effect of both conditions on dietary sensitivity.

Currently, IC/BPS is diagnosed based on the presence of bladder-centric pain, often with urinary urgency/frequency, in the absence of other diseases that may cause similar symptoms, such as urinary tract infections, bladder cancer, prostatitis (in men) or endometriosis (in women).[1,9] Tests such as urinalysis, urine culture, and cystoscopy are important to conduct in order to rule out these similar conditions.[1,9] However, based on our findings of such high prevalence of dietary sensitivity among both men and women with IC/BPS, an evaluation of dietary sensitivity may be a helpful diagnostic tool in predicting IC/BPS. For example, patients suspected of having IC/BPS could be administered the SMQ as part of their urological evaluation. The most common sensitivities we identified in patients with IC/BPS were citrus, spicy foods, alcoholic beverages, caffeinated coffee/tea, regular/diet sodas, and Equal, MSG, vinegar, horseradish, and tomato products. We believe the inclusion of the SMQ for patients suspected of having IC/BPS could help prioritize which foods to eliminate/re-incorporate and serve as an overall less invasive tool for managing comestibles that may trigger IC/BPS symptoms.

While our study has many strengths, including our nationwide recruitment of a racially diverse cohort, there are limitations to this study. One limitation is the reporting of symptoms in healthy controls. Bias may be present given that the questionnaire is intended for patients experiencing bladder pain symptoms, which healthy controls are presumably not experiencing. In other words, the power of suggestion may elicit symptoms. Another limitation of this questionnaire is that it captures participant responses on a Likert scale as opposed to a sliding scale of symptom severity, which could potentially be considered for future research. Also, as discussed earlier, we lacked statistical power to show potential race-related differences in food sensitivity. For the comorbidities sub-analyses, we were also

underpowered to detect differences. It is possible that with larger sample sizes, some of the effects observed here may have been statistically significant.

Conclusion:

Patients with IC/BPS have significantly more food sensitivities than OPP and HC, specifically to citrus, spicy foods, alcoholic beverages, other beverages (e.g., caffeinated/decaffeinated coffee, tea, soda) and vinegar, MSG, horseradish, and tomato products. Due to the consistency of our results with prior studies of very different populations, we suggest that a food sensitivity assessment be considered as part of the clinical evaluation of patients suspected of having IC/BPS. Further research should include continued efforts studying larger, diverse cohorts to further explore racial differences in dietary sensitivities as well as more systematic and detailed examinations of specific food sensitivities.

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Abbreviations:

AUA	American Urological Association
HC	healthy control
IC/BPS	interstitial cystitis/bladder pain syndrome
MSG	monosodium glutamate
OPP	other pelvic pain
SMQ	Shorter-Moldwin Food Sensitivity Questionnaire
SUFU	Society of Urodynamics, Female Pelvic Medicine, and Urogenital Reconstruction
VA	Veterans Affairs
VINCI	Veterans Affairs Informatics and Computing Infrastructure

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Table 1:

Patient Characteristics Stratified by Cohort

	IC/BPS Cohort (N=266)	Other Pelvic Pain Cohort (N=68)	Healthy Control (N=91)	p value
Gender				0.096[1]
Female	107 (40%)	34 (50%)	47 (52%)	
Male	159 (60%)	34 (50%)	44 (48%)	
Race				0.200[1]
White	210 (79%)	49 (72%)	70 (77%)	
Black	49 (18%)	13 (19%)	18 (20%)	
Other	7 (3%)	6 (9%)	3 (3%)	
Ethnicity				0.366[1]
Missing	12	1	3	
Hispanic	15 (6%)	4 (6%)	9 (10%)	
Non-Hispanic	239 (94%)	63 (94%)	79 (90%)	
Age at Study Start				0.646[2]
Mean (SD)	51.3 (13.0)	53.0 (14.4)	52.6 (14.4)	
Median	51.8	53.9	53.5	
Interquartile range	42.1, 62.0	42.5, 63.0	40.3, 63.6	
Body Mass Index (kg/m^2)				0.287[2]
Mean (SD)	29.2 (5.9)	28.4 (5.4)	30.1 (5.8)	
Median	28.8	28.8	29.4	
Interquartile range	24.9, 32.6	23.9, 32.0	26.0, 35.0	
Smoking Status				0.024[1]
Current Smoker	40 (15%)	11 (16%)	18 (20%)	
Former Smoker	91 (34%)	23 (34%)	25 (27%)	
Never Smoker	118 (44%)	28 (41%)	31 (34%)	
Unknown	17 (6%)	6 (9%)	17 (19%)	
Presence of:				
Alcohol Abuse	28 (11%)	4 (6%)	9 (10%)	0.510[1]
Back Pain	191 (72%)	50 (74%)	53 (58%)	0.037[1]
Diabetes	60 (23%)	16 (24%)	11 (12%)	0.081[1]
Fibromyalgia	63 (24%)	12 (18%)	8 (9%)	0.008[1]
IBS	58 (22%)	10 (15%)	8 (9%)	0.015[1]
Migraines	20 (8%)	2 (3%)	3 (3%)	0.178[1]
PTSD	98 (37%)	23 (34%)	30 (33%)	0.761[1]
History of Depression	102 (38%)	30 (44%)	31 (34%)	0.435[1]

Abbreviations: IBS: Irritable Bowell Syndrome; PTSD: Post Traumatic Stress Disorder

[1]Chi-Square

[2]Kruskal Wallis

Table 2:

Food Sensitivity Outcomes Stratified by Cohort

	IC/BPS Cohort (N=266)	Other Pelvic Pain Cohort (N=68)	Healthy Control (N=91)	p value
Reported that certain foods and/or beverages worsen bladder symptoms				<0.001[1]
No	41 (15%)	27 (40%)	37 (41%)	
Yes	160 (60%)	16 (24%)	19 (21%)	
Unknown/Missing	65 (24%)	25 (37%)	35 (38%)	
If foods do worsen bladder symptoms, they:				
Make Urine Frequency…				<0.001[1]
Worse	122 (46%)	12 (18%)	15 (16%)	
No change	32 (12%)	4 (6%)	2 (2%)	
Not applicable/Missing	112 (42%)	52 (76%)	74 (81%)	
Make Urine Urgency…				<0.001[1]
Worse	107 (40%)	9 (13%)	9 (10%)	
No change	47 (18%)	7 (10%)	5 (5%)	
Not applicable	112 (42%)	52 (76%)	77 (85%)	
Make Bladder Pain…				<0.001[1]
Worse	120 (45%)	3 (4%)	3 (3%)	
No change	33 (12%)	7 (10%)	8 (9%)	
Not applicable	113 (42%)	58 (85%)	80 (88%)	
Eats foods, beverages, or supplements that they know will increase symptoms				<0.001[1]
Daily	27 (10%)	4 (6%)	8 (9%)	
Weekly	42 (16%)	4 (6%)	5 (5%)	
Monthly	25 (9%)	0 (0%)	2 (2%)	
Less than once a month	53 (20%)	5 (7%)	3 (3%)	
Never	39 (15%)	21 (31%)	24 (26%)	
Unknown/missing	80 (30%)	34 (50%)	49 (54%)	
Has modified diet because of media reports about foods worsening bladder symptoms				<0.001[1]
Yes	146 (55%)	9 (13%)	11 (12%)	
Has at least one food sensitivity				<0.001[1]
Yes	185 (70%)	25 (37%)	29 (32%)	
Number of sensitivities				<0.001[2]
Mean (SD)	7.2 (8.1)	1.9 (3.3)	2.1 (4.2)	
Median	5.0	0.0	0.0	
Interquartile range	0.0, 12.0	0.0, 3.0	0.0, 2.0	
Sensitive to (food groups):				
Acidic food (fruits and juices)	110 (41%)	7 (10%)	8 (9%)	<0.001[1]
Spicy food or ethnic food	94 (35%)	6 (9%)	6 (7%)	<0.001[1]

	IC/BPS Cohort (N=266)	Other Pelvic Pain Cohort (N=68)	Healthy Control (N=91)	p value
Alcoholic beverages	103 (39%)	12 (18%)	18 (20%)	<0.001[1]
Beef, tuna, or chicken	15 (6%)	0 (0%)	2 (2%)	0.065[1]
Caffeinated beverages	143 (54%)	19 (28%)	25 (27%)	<0.001[1]
Non-caffeinated beverages	94 (35%)	11 (16%)	19 (21%)	0.001[1]
Artificial sweeteners	22 (8%)	1 (1%)	3 (3%)	0.051[1]
Digestive aids/supplements	7 (3%)	0 (0%)	2 (2%)	0.404[1]

[1]Chi-Square

[2]Kruskal Wallis

Table 3:

Specific Food Sensitivity Outcomes by Cohort

		IC/BPS Cohort (N=266)	Other Pelvic Pain Cohort (N=68)	Healthy Control (N=91)	p value
Foods previously identified as least bothersome ("non-bothersome") to IC/BPS patients (n=13)	**Sensitive to at least one food**				0.017[1]
	No	196 (73.7%)	61 (89.7%)	72 (79.1%)	
	Yes	70 (26.3%)	7 (10.3%)	19 (20.9%)	
	Number of foods sensitive to				0.014[2]
	Mean (SD)	0.4 (1.1)	0.1 (0.3)	0.3 (0.7)	
	Median	0.0	0.0	0.0	
	Interquartile range	0.0, 1.0	0.0, 0.0	0.0, 0.0	
	Food item worsens symptoms				
	Pears	8 (3%)	0 (0%)	0 (0%)	
	Beef	11 (4%)	0 (0%)	1 (1%)	
	Tuna	6 (2%)	0 (0%)	1 (1%)	
	Chicken	5 (2%)	0 (0%)	0 (0%)	
	Milk	20 (8%)	2 (3%)	5 (5%)	
	Water	32 (12%)	5 (7%)	14 (15%)	
	Prelief	3 (1%)	0 (0%)	1 (1%)	
	Tums	4 (2%)	0 (0%)	1 (1%)	
	Metamucil/FiberCon	5 (2%)	0 (0%)	1 (1%)	
	Senekot	2 (1%)	0 (0%)	1 (1%)	
	Aloe Vera	3 (1%)	0 (0%)	0 (0%)	
	Rice	5 (2%)	0 (0%)	2 (2%)	
	White Potatoes	5 (2%)	0 (0%)	1 (1%)	
Foods previously identified as bothersome to IC/BPS patients (n=34)	**Sensitive to at least one food**				<0.001[1]
	No	86 (32.3%)	45 (66.2%)	62 (68.1%)	
	Yes	180 (67.7%)	23 (33.8%)	29 (31.9%)	
	Number of foods sensitive to				<0.001[2]
	Mean (SD)	6.5 (7.3)	1.8 (3.1)	1.8 (3.5)	
	Median	5.0	0.0	0.0	
	Interquartile range	0.0, 10.0	0.0, 2.5	0.0, 2.0	
	Food item worsens symptoms				
	Grapefruit	63 (23%)	1 (1%)	0 (0%)	
	Lemons	65 (24%)	2 (2%)	2 (2%)	
	Oranges	54 (20%)	0 (0%)	0 (0%)	
	Pineapples	44 (17%)	1 (1%)	0 (0%)	
	Cranberry Juice	52 (20%)	2 (2%)	5 (5%)	
	Grapefruit Juice	59 (22%)	4 (6%)	2 (2%)	

		IC/BPS Cohort (N=266)	Other Pelvic Pain Cohort (N=68)	Healthy Control (N=91)	p value
	Orange Juice	74 (27%)	3 (4%)	4 (4%)	
	Pineapple Juice	42 (15%)	2 (2%)	2 (2%)	
	Chili	67 (25%)	1 (1%)	3 (3%)	
	Burritos	47 (18%)	1 (1%)	3 (3%)	
	Hot Peppers	80 (30%)	5 (7%)	5 (5%)	
	Mexican Food	69 (25%)	1 (1%)	4 (4%)	
	Indian Food	35 (13%)	1 (1%)	3 (3%)	
	Thai Food	34 (12%)	3 (4%)	4 (4%)	
	Beer	71 (26%)	10 (15%)	17 (18%)	
	Red Wine	57 (21%)	7 (10%)	3 (3%)	
	White Wine	48 (18%)	6 (8%)	3 (3%)	
	Champagne	41 (15%)	6 (8%)	5 (5%)	
	Liquor and Mixed Drinks	76 (29%)	7 (10%)	7 (7%)	
	Caffeinated Coffee	110 (41%)	16 (24%)	19 (21%)	
	Decaffeinated Coffee	34 (12%)	5 (7%)	7 (7%)	
	Caffeinated Tea	90 (34%)	11 (16%)	13 (14%)	
	Decaffeinated Tea	28 (11%)	5 (7%)	6 (7%)	
	Cola Soda	104 (39%)	8 (12%)	18 (19%)	
	Non-Cola Soda	50 (18%)	3 (4%)	7 (7%)	
	Diet Soda	52 (20%)	5 (7%)	11 (12%)	
	Nutrasweet	18 (7%)	1 (1%)	2 (2%)	
	Sweet & Low	19 (7%)	1 (1%)	2 (2%)	
	Equal	21 (8%)	0 (0%)	2 (2%)	
	Saccharin	20 (8%)	0 (0%)	2 (2%)	
	MSG	36 (14%)	1 (1%)	1 (1%)	
	Vinegar	39 (15%)	1 (1%)	2 (2%)	
	Horseradish	42 (15%)	2 (2%)	1 (1%)	
	Tomato/tomato sauce	74 (28%)	3 (4%)	0 (0%)	

[1] Fishers Exact

[2] Kruskal Wallis

Table 4:

Food Sensitivity Outcomes for Patients with IC/BPS Stratified by Race

	Black (N=49)	White (N=210)	p value
Reported that certain foods and/or beverages worsen bladder symptoms			0.263[1]
No	4 (8%)	37 (18%)	
Yes	32 (65%)	122 (58%)	
Unknown/Missing	13 (27%)	51 (24%)	
If foods do worsen bladder symptoms, they:			
Make Urine Frequency…			0.272[1]
Worse	27 (55%)	89 (42%)	
No change	5 (10%)	27 (13%)	
Not applicable	17 (35%)	94 (45%)	
Make Urine Urgency…			0.009[1]
Worse	28 (57%)	73 (35%)	
No change	4 (8%)	43 (20%)	
Not applicable	17 (35%)	94 (45%)	
Make Bladder Pain…			0.307[1]
Worse	20 (41%)	96 (46%)	
No change	9 (18%)	22 (10%)	
Not applicable	20 (41%)	92 (44%)	
Eats foods, beverages, or supplements that they know will increase symptoms			0.822[1]
Daily	4 (8%)	21 (10%)	
Weekly	9 (18%)	32 (15%)	
Monthly	3 (6%)	20 (10%)	
Less than once a month	11 (22%)	42 (20%)	
Never	5 (10%)	33 (16%)	
Unknown/missing	17 (35%)	62 (30%)	
Has modified diet because of media reports about foods worsening bladder symptoms			0.259[1]
Yes	32 (65%)	110 (52%)	
Unknown/missing	1 (2%)	5 (2%)	
Has at least one food sensitivity			0.310[1]
Yes	37 (76%)	143 (68%)	
Number of sensitivities			0.402[2]
Mean (SD)	7.8 (8.0)	7.0 (8.0)	
Median	6.0	5.0	
Interquartile range	1.0, 12.0	0.0, 12.0	
Sensitive to			
Acidic food (fruits and juices)	20 (41%)	86 (41%)	0.986[1]
Spicy food or ethnic food	15 (31%)	75 (36%)	0.499[1]
Alcoholic beverages	25 (51%)	75 (36%)	0.048[1]

	Black (N=49)	White (N=210)	p value
Beef, tuna, or chicken	3 (6%)	12 (6%)	0.912[1]
Caffeinated beverages	29 (59%)	110 (52%)	0.390[1]
Non-caffeinated beverages	24 (49%)	67 (32%)	0.024[1]
Artificial sweeteners	6 (12%)	15 (7%)	0.239[1]
Digestive aids/supplements	2 (4%)	5 (2%)	0.509[1]

[1]Chi-Square

[2]Kruskal Wallis

Note: 7 patients were excluded from this analysis who had an unknown race