



# The impact of nutrition and lifestyle on chronic urinary bladder conditions: a literature review

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**Background and Objective:** Chronic bladder conditions present bothersome symptoms that can negatively impact the patient's quality of life. Easily applicable modifications in lifestyle and dietary habits can support pharmacological therapy when treating chronic bladder dysfunction. This literature review presents a comprehensive summary on the impact of dietary and lifestyle changes in the treatment of chronic bladder conditions. The aim of this study is to provide a complete resource for patients as well as a framework for future research studies.

**Methods:** A PubMed search was performed to identify eligible studies according to certain criteria that provide evidence on relationship between nutritional intake and lifestyle modifications and its effects on chronic bladder conditions. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart was used to record the screening process.

**Key Content and Findings:** Studies revealed that certain factors increase severity and risk of developing chronic bladder dysfunction, such as obesity, smoking, alcohol intake, and ingestion of certain foods and beverages like citrus fruits and caffeine. Acquiring certain lifestyle modifications and maintaining a diet consisting of recommended comestibles proved to alleviate bladder symptoms. Dietary management also aids in bladder pain relief.

**Conclusions:** Patient education on the ideal lifestyle and dietary model tailored to their bladder condition is an integral part of symptom management. Nutrient deficiencies, inappropriate lifestyle, and comorbid conditions should be managed in parallel to other medical and pharmaceutical interventions.

**Keywords:** Nutrition; chronic bladder conditions; lifestyle

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## Introduction

### Background

You might have heard of the saying “you are what you eat”. This is reflected by the acknowledgment of the effect of nutrition on human health since ancient times.

However, it was not until the 19th and 20th centuries that dietary management and supplements were integrated into the treatment of medical conditions. During the 1970s, numerous research studies tried to refine the management of urinary conditions by including diet in the therapy (1). More recently, there has been an increased attention

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towards the impact of tailored nutritional intake and lifestyle modifications in the enhancement of symptoms of chronic bladder conditions, including interstitial cystitis (IC), overactive bladder (OAB), chronic painful bladder syndrome (PBS) (stand alone or as part of a chronic pelvic pain syndrome), and post-traumatic bladder irritation (i.e., after bladder tumor resection and/or radio-/chemotherapy). Patients living with those chronic bladder conditions develop coping strategies to hide their bothersome symptoms such as urinary incontinence (UI) and nocturia. These symptoms subsequently negatively impact their quality of life in several aspects including their physical, social, and psychological (anxiety, negative self-image, and isolation) wellbeing (2,3).

The equation for a healthy lifestyle is simple: avoiding harmful products, committing to regular physical activity, and consuming a personalized diet based on your body's needs. Any missing component of the formulation will not equate to the desired answer. Thus, following this holistic approach, along with the appropriate medical treatment, can significantly change the patient's lifestyle, and in turn positively affect their wellbeing.

The way dietary products act on the urinary tract anatomy and physiology explains the relationship between them. Briefly, nutrients or its metabolites excreted in the urine can either act on urinary bladder urothelium directly, can modulate urinary properties (i.e., pH), or can reach the bladder muscle through the blood stream where they act at tissue level as anti-inflammatory or immune-boosting products. They may also act as neuromodulators of the sympathetic and parasympathetic bladder innervation. In certain chronic conditions such as IC, the glycosaminoglycan layer of the urothelial barrier is dysregulated as a result of abnormal protein expression, disruption of proteoglycans, tight junctions, cell adhesion proteins and bacterial defense molecules (4,5). This allows typically harmless dietary metabolites to migrate across the urothelium and act as noxious stimuli leading to symptoms such as sharp pelvic pain and dysuria (6). Similarly, dietary metabolites acting as stimuli in one organ can produce parallel physiological effects in neighboring organs through a mechanism known as organ "crosstalk" via integrated sensory pathways. One important example is the possible interaction between irritable bowel syndrome and OAB. Not only are these visceral organs anatomically close but they also share similar physiological roles, such as storing and excreting wastes from body, as well as their common innervation from spinal afferent pathways through

convergence of pelvic afferents (7,8). Experimental evidence from an animal study involving single-unit bladder afferent nerve recordings has shown that colonic irritation directly sensitizes the mechanical and chemical receptive properties of bladder sensory C-fibers, with mastocytosis largely contributing to the long-term pelvic organ sensitization (9). Nutrition plays a major role in bowel function, and—given the above relationship—this may also be true for the bladder whereby colonic inflammation may result in severe bladder dysfunction (7).

In this review, we will highlight the evidence-based relationship between certain comestibles and lifestyle factors on chronic bladder conditions. The aim of this content is to allow the reader to make an informed decision by the end of the paper on how they would like to adjust their way of living, particularly to the best version of themselves.

### *Rationale and knowledge gap*

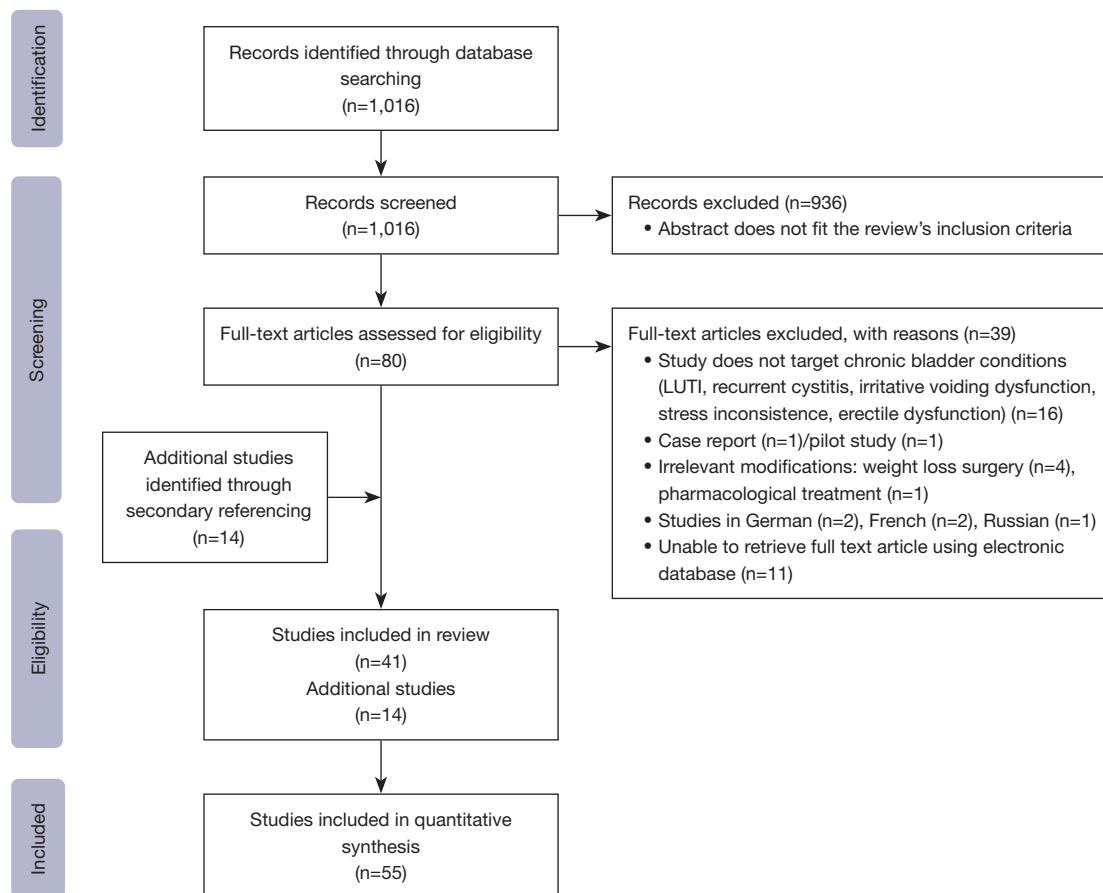
It is known that consuming harmful products such as cigarettes or ingesting fast food can harm our health. However, there are a few papers that integrate evidence-based information on the combined effect of lifestyle and diet on common bladder conditions like OAB and IC. This comprehensive review allows the patient to understand the mechanism behind this relationship and choose to apply it to their daily life.

### *Objective: "key question"*

"What is the medical evidence behind lifestyle and dietary modifications on chronic bladder conditions and how exactly will it impact the symptoms of chronic bladder conditions" is the key question that the reader will conclude while exploring this review. The objective is to collect and review the available evidence in the literature on the topic and present it in a comprehensive review to help raise an understanding of the mechanisms and awareness of the ameliorating role of nutritional science in patients with chronic bladder conditions. We present this article in accordance with the Narrative Review reporting checklist (available at <https://lcm.amegroups.com/article/view/10.21037/lcm-21-39/rc>).

### **Methods**

A literature review was conducted in April 2020 and updated in November 2023 following the Preferred Reporting Items



**Figure 1** PRISMA flow diagram illustrating the data selection process. Detailed reasons for exclusion of papers are stated. LUTI, lower urinary tract infection; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (10) (Figure 1).

When searching PubMed, a combination of Medical Subject Headings (MeSH) search terms was used and they included all of the above-mentioned bladder conditions, as well as “bladder”, “lower urinary tract symptoms”, “nocturia”, “frequency”, “urgency”, “dysuria”, “chronic pelvic pain”, “irritable bowel syndrome”, “bladder pain” in combination with “nutrition”, “nutrients”, “diet”, “lifestyle”, and “herbal medicine”. Studies that cover the nutritional approach of irritable bowel were evaluated to assess a relation with bladder conditions of mutual symptoms.

Study and data selection process: after an initial selection of studies based on the title and abstract, nominated studies were further scrutinized for full text screening. Irrelevant studies that did not fit the eligibility criteria were excluded. Studies that were selected for full article screening were

evaluated. Applicable full text articles were included in the qualitative synthesis. Reference lists from each retrieved full text article were evaluated through secondary referencing, and applicable studies were added to the qualitative synthesis. The data was collected by one reviewer under the supervision of co-reviewers.

Eligibility criteria: all studies published in English or translated to English in a listed peer reviewed scientific paper or international reputed journal were included. Published web communications by a reputed health organization or patient organization were also included. Case reports and studies that did not meet these criteria were excluded.

There was no statistical analysis conducted in this study. Qualitative and quantitative information collected from included studies were summarized and organized in specially designed tables. Only English studies were included in

**Table 1** The search strategy summary

Items	Specification
Date of search	10th of April 2020 (updated in November 2023)
Databases and other sources searched	PubMed, Google Scholar
Search terms used	“Interstitial cystitis”, “overactive bladder”, “painful bladder syndrome”, “bladder”, “lower urinary tract symptoms”, “nocturia”, “frequency”, “urgency”, “dysuria”, “chronic pelvic pain”, “irritable bowel syndrome”, “bladder pain” in combination with “nutrition”, “nutrients”, “diet”, “lifestyle”, and “herbal medicine”
Timeframe	January 1984–November 2023
Inclusion and exclusion criteria	All studies published in English or translated to English in a listed peer-reviewed scientific paper or international reputed journal were included. Published web communications by a reputed health organization or patient organization were also included. Case reports and studies that did not meet these criteria were excluded
Selection process	Data was collected by a single author under the supervision of the co-authors. No consensus was required

this study which introduced language bias. There are no ethical considerations in this paper. The search strategy is summarized in *Table 1*.

## Results

Initially, 1,016 articles were identified. Following screening by title and abstract, 80 studies were identified for full text evaluation. Finally, 39 articles were included in this review, in addition to 14 studies retrieved from secondary referencing of these selected studies. Updated search in 2023 included two more systematic reviews with similar evidence identified in this review. The PRISMA flow diagram (*Figure 1*) was used to record and summarize the results of the data selection process. There is no discrepancy between abstract and main journal outcome.

## Discussion

### OAB

OAB is a symptom complex of urgency, with or without urgency incontinence, usually with increased daytime frequency and nocturia (11). It is a prevalent condition which affects approximately 11–16% of men and 13–17% of women aged  $\geq 18$  years (12,13). There are a variety of modifiable behavioral and lifestyle factors, both, protective or damaging that can affect bladder health and educating the people at risk is important for the prevention of development of OAB (14–16). Apart from pharmacotherapy, treatment of OAB includes behavioral interventions and lifestyle changes, which are collectively considered first-line

treatments for OAB symptoms, as well as diet modifications and herbal medications.

### Effect of lifestyle on OAB

#### *Behavioural modifications*

Behavioral modifications altering habits that may alleviate bladder symptoms and promote bladder health such as smoking cessation as well as diet, fluid intake, bowel, and weight management, and training techniques that involve teaching skills that promote symptom control in bladder dysfunction (17). This includes counseling the patient that the bladder should be emptied every 3 to 4 hours, and that it is not necessary to void with every sensation of bladder fullness, considering the pathophysiology of OAB which involves oversensitivity of the detrusor muscle to bladder signals. Patients are advised to keep bladder diaries (18). Training techniques include simple urgency control and suppression techniques, bladder training, and multicomponent behavioral training. Simple urgency control and suppression techniques can be applied by performing general relaxation techniques and slow deep breathing that decreases the intensity or urgency and relaxes the bladder. Distracting techniques like sudoku puzzles and self-motivational phrases like “I can” are also effective (17,19). Similarly, bladder training aims to restore normal bladder function by combining a progressive voiding schedule and teaching techniques to suppress urgency. It is suitable for motivated patients has been showed to resolve urinary urge-incontinence by 12% to 73% (20). In multicomponent behavioral training, which is composed of techniques known as pelvic floor muscle (PFM) contractions also called Kegels, the patient is taught to locate their

striated skeletal PFM around the urethra and contract them in order to relax the detrusor muscle, aiming to suppress urgency, control incontinence and restore normal voiding interval (14). A combination of correctly taught bladder training, PFM exercises, fluid restriction, and electrical stimulation showed a significant reduction in frequency and residual volume in patients with idiopathic detrusor instability while increasing voiding interval, flow rate, and maximum capacity (21). Finally, poor lifestyle factors that are linked to diabetes and obesity, such as lack of exercise can contribute to onset of OAB (22,23). The evidence is conclusive that lifestyle modifications like habit changes and certain training techniques like PFM exercises can improve OAB symptoms.

#### ***Weight and obesity***

Obesity is a modifiable risk factor for UI which can be a symptom of OAB. Recent studies discuss the benefits of nonsurgical weight loss on reducing symptoms of OAB, particularly urinary urge-incontinence. Obesity increases the risk of onset of OAB in women (23). In a study carried out on 338 obese women, a 6-month weight loss program (diet, exercise, and behavioral modification) was initiated. The average weight loss in the intervention group was 8.0%. After 6 months, the intervention group showed a mean decrease of 47.4% in the total number of incontinence episodes per week as compared to the control group with 28.1%. There was a 42.4% decline in the frequency of urge incontinence episodes compared to 26.0% in the control group. However, these differences were not statistically significant (24). In a similar study, it was concluded that 5% to 10% of weight loss was sufficient to significantly improve UI. Thus, weight loss should be considered as the initial treatment for incontinence in overweight women (25). Moreover, because diabetic neuropathy, a complication of diabetes, may lead to OAB, obese prediabetic women are encouraged to lose weight to reduce the risk of development of type 2 diabetes. The lower prevalence of UI resulting from lifestyle modifications, particularly weight loss, provides a powerful motivator for prediabetic women to reduce their weight (26).

#### ***Smoking and alcohol consumption***

Smoking has been associated with symptoms of OAB, with an increased chance of incontinence in previous and current female smokers (27,28). Another study showed that smoking increased the 1-year incidence of OAB in women (23). Similarly, smoking in men has been linked with OAB and prostatic enlargement (28). However, smoking showed no association with the onset of OAB in men, but an increased

risk in females by factor 1.44 (23,29). Notably, studies on cats show nicotine induced detrusor overactivity (30).

In a study to investigate the onset of OAB in male patients, beer consumption showed a significant protective role for the onset of OAB at all levels of intake compared to people who never drank beer (29). In contrast, another study reported that alcohol increases the risk of lower urinary tract symptoms (LUTS) (31) thus studies are inconsistent.

### **Effects of nutritional intake on OAB**

#### ***Comestibles***

A balanced diet is the key to a healthy body. More particularly for your bladder health, consuming large quantities of potato showed an increased risk of onset of OAB ( $P < 0.05$ ) (29). Similarly, in women, consumption of carbonated drinks increased the risk of OAB while vegetables, bread, and chicken (preferably twice or more a week) reduced the risk (23).

Moving on to the crowd's favourite: caffeine. There is a strong evidence that caffeine ingestion at a dose of 4.5 mg/kg produced diuretic effects with an increased flow rate and voided volume, increasing urgency and frequency symptoms in OAB (32). Patient education about this concept resulted in significant reduction in caffeine intake ( $P < 0.0001$ ) in patients with LUTS and, in turn, significantly reduced frequency ( $P = 0.037$ ) and urgency ( $P = 0.002$ ) (33).

Additionally, a study carried out on Korean women showed a significantly higher carbohydrate content in women with UI compared to a control group ( $P = 0.041$ ) (34). Poor evidence revealed that high dietary levels of protein ( $P = 0.03$ ) and potassium ( $P = 0.05$ ) decreased the risk of onset of OAB, as did an increased intake of niacin ( $P = 0.13$ ) and vitamin B6 ( $P = 0.08$ ) (35). In a study on Malaysian elderly, increased dietary monosaturated fat and plasma triglyceride levels decreased the risk of UI (36).

Even though 60% of our body is made up of water, consuming fluids at a moderate rate is recommended to reduce unwanted side effects. Drinking an average of  $>3,700$  mL/day of fluids leads to a higher voiding frequency and risk of UI compared to an intake of  $<2,400$  mL/day. Research shows that nocturia in the context of OAB can be managed by the ingestion of fruits and vegetables while avoiding caffeine and high-salt diet (37). Likewise, vegetable intake in patients with type 2 diabetes mellitus (T2DM) showed reduced nocturia ( $\geq 2$  voids/night) in men as well as reduced severe nocturia ( $\geq 3$  voids/night) in females (38).

Finally, dietary phytoestrogens, typically found in

**Table 2** OAB comestible sensitivities

Foods/beverages that exacerbate symptoms of OAB	Foods/beverages that alleviate symptoms of OAB
Carbonated drinks (sparkling water, energy drink)	Fruits (banana, apple, coconut, watermelon)
Caffeinated beverages (coffee, tea)	Vegetables (broccoli, celery, asparagus, kale)
Chocolate	Fiber rich foods (lentils, beans, oats, almonds)
Citrus fruit	Protein (fish, chicken, eggs)
Spicy food	
Honey	
Raw onion	
Tomato and tomato products (e.g., ketchup)	
Artificial sweetener (saccharin, aspartame)	
Salty food (chips, salted nuts)	
Cranberry	

OAB, overactive bladder.

soybeans, tofu, and linseed, in low and high intake levels, showed no association in the development or prevention of urge incontinence in midlife women transitioning to menopause (39). Pre-treatment with epigallocatechin-3-gallate, a major catechin found in green tea, cranberry, and nuts, can prevent OAB induced by metabolic syndrome/ovarian hormone deficiency by reducing inflammation, improving storage function, and in turn decreasing bladder overactivity (40). The effects of comestibles on OAB are summarized in *Table 2*.

#### ***Vitamins and minerals***

Vitamins and minerals in the body have a very integral role in several metabolic functions such as converting food into energy and repairing cellular damage. Recent studies have been focusing on vitamin D and how it affects the normal bladder physiology. In one study carried out by the National Health and Nutrition Examination Survey, involving 1,881 women participants, symptomatic patients with UI measured lower mean vitamin D levels in their body. In addition, vitamin D deficiency in geriatric patients shows association with OAB and increased severity of UI, particularly urgency incontinence as a result of its effects on smooth and straited smooth muscle function (41). High intake of vitamin D decreases risk of onset of OAB ( $P=0.008$ ) (35,42). Furthermore, higher levels of Vitamin D ( $>30$  ng/mL) have been proven to show protective function in younger and older women with or without UI (43). This finding is further supported by a randomized control trial that was carried out on postmenopausal women with

LUTS. They were treated with high dose of vitamin D (20,000 IU of vitamin D twice a week) in comparison to the control group treated with standard vitamin D dose. After 1 year of treatment, there was a statistically significant reduction in improvement of LUTS, including reducing the severity of urine incontinence, in comparison to the control group ( $P<0.05$ ) (44). In a cohort study, seasonal variation of vitamin D levels was demonstrated. During the winter season, patients presented with lower vitamin D levels and consequently, aggravated LUTS and increased severity of OAB symptoms as well as a greater impact on the quality of life. However, prostate volume, maximum urinary flow rate ( $Q_{max}$ ) and post-void residual (PVR) urine volume were not affected (45).

One possible theory is the anti-inflammatory action of vitamin D supplements. This was demonstrated by lowering erythrocyte sedimentation rate (ESR) levels in people treated with vitamin D, thus, possibly, reducing effects of chronic inflammation in the bladder (45).

Vitamin D receptor agonist known as elocalcitrol showed an inhibition in the RhoA/Rho kinase signaling pathway and upregulation in the  $Ca^{2+}$  entry through L-type channels which modulates bladder contractility (46). Vitamin D and its analogs were shown to cause calcium desensitization thereby relaxing smooth muscles (42).

On the other hand, water-soluble vitamin C can also produce changes in the bladder. Baseline dietary intake of vitamin C from fruits and vegetables was associated with lower chance of progression of daytime storage symptoms

in men and urgency symptoms in women.

Inversely, excessive vitamin C supplements has shown worsening in daytime urinary storage problems in women (47). This is due to the increased level of vitamin C byproduct, ascorbate, in the urine resulting in increased acidity of urine composition leading to OAB symptoms (48).

#### **Herbal treatments**

Herbal medicine has shown an increased demand as a treatment for OAB. The World Health Organization states that approximately 80% of the world's population currently uses herbal medicine for some aspect of primary health care, with a higher percent of women than men (49,50). In a 12-week study carried out on 117 women, the effectiveness of Granu Fink Femina on OAB was investigated. It is a German-based herbal medication containing high concentration of plant phytosterols including seed oil from uromedic pumpkin, rhus aromatica bark extract, and humulus lupulus cone extract. The combination of those products acts on the beta3-adrenoceptor agonists in the detrusor muscle to strengthen and calm the bladder with minimal side effects. Results showed statistically significant decrease in urinary frequency as well as decrease in frequency of leakage and used pads from the 1st week of initiation of treatment. In addition, the quality of life of the patient showed improvement from the 1st week of treatment and continued to progress until the 12th week, and it also showed excellent tolerability by the patients (51). A recommended dose of 500 mg was shown to benefit patients with mild to moderate LUTS. The evidence confirms that recommended herbal medications can improve bladder frequency and storage symptoms.

#### **IC/PBS**

IC or PBS is a common cause of chronic pelvic pain, with suggestive symptoms found in 2.7–6.5% of women in the USA (52). Symptoms include frequency, urgency, dysuria and lower abdominal, bladder, vaginal, urethral, or perineal pain, in the absence of bacterial cystitis. It is a difficult condition to treat, however, certain management plan including dietary and behavioral changes can help improve symptoms (53,54). Medications and surgery can be considered should these conservative measures fail (45).

#### **Effect of nutritional intake on IC/PBS**

##### **Comestibles**

Consuming bladder friendly food and beverages can limit bladder inflammation and irritation. In a questionnaire

designed to explore the relationship between food/beverages and bladder symptoms, 90.2% of participants reported exacerbation in IC/PBS with certain nutrients (55). Recent studies state that acidic food like citric fruits worsen IC symptoms (56) while alkaline food like sodium bicarbonate and acid neutralizing food like calcium glycerophosphate improve symptoms (57). Moreover, high potassium levels (sweet potato, milk) may be linked to exacerbation of bladder pain (58), however only studies with small sample size were carried out and further surveys do not show alteration in IC symptoms with potassium intake. Thus, results are inconclusive. Histamine containing food (like eggplant) can exacerbate IC by increasing mast cells and inflammation (1). Similar to OAB, caffeine can aggravate IC symptoms in the same mechanism (59). In an animal study, protein deficiency showed an increased risk in the development cyclophosphamide (CP) induced hemorrhagic cystitis (HC) in rats, stressing on the importance of nutritional assessment and supplementation prior to CP treatment (60). Likewise, patients with complication of pelvic radiotherapy, known as hemorrhagic radiation cystitis (HRC), presented with higher grades of hematuria associated with lower serum nutrients like albumin, prealbumin, zinc, selenium, and essential fatty acids. It is known that a good nutritional status is required for wound healing, which enhances the efficacy of hyperbaric oxygen therapy (HBOT). Thus, pre-treating HRC patients with dietary supplements prior to HBOT would maximize healing of bladder mucosa (61). The effects of comestibles are summarized in *Table 3*.

##### **Vitamins**

CP, an antineoplastic drug, induces HC. In rats, treatment with antioxidant vitamin C and histidine showed improvement of HC by reducing free radical induced damage (62). Vitamin C inhibited histopathological changes of CP like inflammatory infiltration and hemorrhage in mucosa propria (63), while histidine reduced congestion, hemorrhage, edema, and leukocyte infiltration (64). HRC is normally worse in patients with lower serum levels of vitamins C, D, and B12 (61).

#### **Effects of lifestyle on IC/PBS**

##### **Smoking and alcohol**

In a study on women participants, an association was found between bladder pain and smoking, where tobacco was labeled as a modifiable risk factor (65). In a similar manner, alcohol irritates wounds in IC bladder, exacerbating the symptoms. The O'Leary-Sant Interstitial Cystitis Symptom

**Table 3** IC/PBS comestible sensitivities

Foods/beverages that are most bothersome to patients with IC/PBS	Foods/beverages that are least bothersome to patients with IC/PBS
Cranberry juice, carbonated water, green tea	Apples, pears, blueberries
Coffee (caffeinated and decaffeinated)	Mushroom, carrot, corn
Alcohol (beer, red and white wine, champagne)	Milk, water, chamomile, peppermint
Acidic fruit (lemon, pineapple, kiwi)	Corn and oat bread, rice
Salad dressing, vinegar	Eggs, beef, fish, lamb
Chili pepper, onion, pickles, tomato (and products)	Oil, butter, nuts
Hotdog, smoked fish	Ricotta cheese, cottage cheese, ice cream
Chips and fast food	Popcorn, pretzels
Spicy food/Mexican, Thai, and Indian food	Custard, vanilla flavour pudding, and milkshake
Artificial sweetener, chocolate, candy	Homemade soup

IC, interstitial cystitis; PBS, painful bladder syndrome.

and Problem Indices Questionnaire (ICN) survey reported that only 21% of IC patients can tolerate drinking wine without getting IC flares, with tequila being the most irritating.

#### ***Behavioral modifications and physiotherapy***

Pelvic floor manual therapy for women with IC caused mild to moderate improved in 70% of patients, by decreasing the exaggerated PFM tone thus alleviating urgency and frequency (66). Stress management, relaxation strategies, and sleep hygiene also improve symptoms of IC (67).

## **Conclusions**

This review explored the effects of dietary and lifestyle factors on bladder health, particularly on symptoms of chronic bladder conditions, and focused on modifications of these factors that lead to improved management of symptoms and enhanced bladder health. The key modifications include behavioral and lifestyle changes, which are considered first-line treatment. Finally, and with medical/nutritionist supervision, elimination of harmful diet to the urinary bladder can be implemented in patients to determine dietary irritants without limiting their nutritional intake.

## **Limitations of the review**

Despite the maximal efforts in providing a comprehensive review that displays evidence published over the past few years, there are limitations that arise. Firstly, consideration

of nutritional variations in different regions as well as diverse patient factors (age, gender, comorbidities, etc.) were not discussed in this review as it was beyond the scope of the search. Secondly, even though papers were collected from a wide range of publication dates (from the early 2000s to 2020), including more recent papers would have added further value to our review. Finally, following the exclusion criteria of omitting papers published in non-English language limited the evidence that could have been impactful from other international authors. We aim to explore those differences in the future and compile a broader and more up to date review.

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