Impact of behaviour and lifestyle on bladder health

Bladder conditions, including UTI, UI, and bladder cancer, are highly prevalent and affect a wide range of populations. There are a variety of modifiable behavioral and lifestyle factors that influence bladder health. Some factors, such as smoking and obesity, increase the risk or severity of bladder conditions, whereas other factors, such as pelvic floor muscle exercise, are protective. Although clinical practice may be assumed to be the most appropriate ground for education on behavioral and lifestyle factors that influence bladder health, it is also crucial to extend these messages into the general population through public health interventions to reach those who have not yet developed bladder conditions and to maximize the prevention impact of these behaviors. Appropriate changes in these factors have the potential for an enormous impact on bladder health if implemented on a population-based level.

Introduction

It is widely accepted that individual behaviour patterns, particularly diet and exercise, affect health status through impact on multiple systems. These relationships have been convincingly demonstrated in various disease states, including cardiovascular disease (e.g. myocardial infarction, stroke) and metabolic conditions (e.g. diabetes) (1,2). However, less recognised is the relationship between behaviour and bladder health.

Similar to other disease states, some behavioural and lifestyle factors can precipitate or exacerbate bladder conditions, and as such represent bladder health risks, whereas other factors can contribute positively to bladder health by preventing or modifying existing bladder conditions (3,4). Currently, some of the evidence supporting which specific factors represent a bladder health risk or whether they are modifiable is limited. However, awareness and implementation at a societal level of behavioural modifications that are established to prevent or reverse bladder disease/dysfunction may lead to a substantial reduction in the human and economic burdens of impaired bladder health, as well as an improvement in overall health.

In this article, we review the current state of knowledge on behavioural and lifestyle factors

that influence bladder conditions, including the lower urinary tract symptoms (LUTS) of urinary incontinence (UI), urgency, frequency and nocturia, as well as urinary tract infection (UTI), bladder pain syndrome/interstitial cystitis (BPS/IC) and bladder cancer. Among the behavioural factors considered are cigarette smoking, dietary intake, body-mass index, fluid intake, voiding habits and techniques, bowel habits, physical activity and exercise, and pelvic floor muscle skills and exercise. In addition, we describe potential modifications of these behavioural and lifestyle factors that could reduce or ameliorate risk and optimise bladder health and also provide suggestions to incorporate behavioural modifications into public health programmes. Our goals are to increase awareness of the relationship between behaviour and bladder health, to stimulate changes in both public decision-making and individual habits, and to promote incorporation of behavioural modifications discussed here into public health programmes in an effort to improve both bladder health and overall health at a population-based level.

Behavioural and lifestyle factors that influence bladder health

Cigarette smoking

Cigarette smoking is directly correlated with the development of bladder cancer. Smokers have a threefold higher risk of bladder cancer, and the American Cancer Society reports that the incidence increases with advancing age (5). The duration of smoking appears to be particularly relevant (6,7). In a population-based study of smoking practices and risk of bladder cancer, smoking fewer cigarettes over a long period of time was found to be more harmful than smoking more cigarettes over a shorter period of time (7). Gender may also be associated with bladder cancer incidence, as it has been demonstrated that the risk of bladder cancer among smokers is significantly higher in women compared with men who smoked a comparable amount of cigarettes over the same length of time (8). The exact causal

> Bladder conditions are highly prevalent and affect a wide range of populations. Behavioral modifications can improve bladder health or prevent or reduce the deterioration of bladder health

pathway between smoking and bladder cancer risk has not yet been established; however, various chemicals in cigarettes, such as nicotine, have known carcinogenic properties, and smoking is associated with abnormal growth of bladder lining cells (9).

Smoking cessation has been shown to decrease the risk of bladder cancer (8,10). Thus, there is an ongoing need for educational initiatives to convey information explaining the need to quit smoking, as well as smoking cessation programmes to assist individuals, including those with or at increased risk for developing bladder cancer, to change their behaviour (11,12). Health professionals have a critical role in disseminating information to populations they interact with regarding the risk of bladder cancer associated with smoking and in encouraging smoking cessation (12).

In addition to its link to bladder cancer, smoking has also been associated with increased risk of BPS/IC and other LUTS, including UI, frequency, urgency, nocturia, incomplete emptying and hesitancy (13–25). In a cross-sectional study of women seeking gynaecological care, an association was found between bladder pain and current smoking; tobacco use was the only modifiable risk factor identified (22). In a case–control study of women with and without UI, it was demonstrated that previous and current cigarette smoking increased the odds of both stress UI and urgency UI (13). When modifiable lifestyle factors associated with UI were examined in a large, epidemiological study, heavy smoking (former or current) had one of the highest odds ratios (14).

A prospective cohort study comparing smokers and non-smokers determined that smokers had a stronger urethral sphincter, which may have a protective effect against stress UI. However, the authors concluded that violent coughing by smokers was likely to contribute to stress UI because of earlier development of anatomical and pressure transmission defects, leading to weakening of the sphincters (15). Whether the coughing is causally related to stress UI, exacerbates the condition, or contributes to earlier development has not yet been elucidated.

In a longitudinal study, smoking increased the 1-year incidence of overactive bladder in women, but did not significantly affect the risk of stress UI (25). In men, smoking has been associated with both overactive bladder and prostatic enlargement (17,18,23,24), although results have been inconsistent (20,26). In a longitudinal study of men aged 40–70 years, cigarette smoking was associated with incident benign prostatic enlargement (23) and it was suggested that avoidance of smoking might be of benefit. A population-based cross-sectional study of men in Austria also showed a positive correlation between the International Prostate Symptom Score (used to assess benign prostatic enlargement symptomatology) and the daily nicotine usage of current smokers (24). In this study, the association with nicotine was shown for storage symptoms, but not for voiding symptoms associated with benign prostatic enlargement.

Dietary intake

Although nutrition-based interventions or activities have historically been focused on disease states such as cardiovascular and metabolic conditions, ample evidence suggests that it may be beneficial to incorporate the impact of dietary intake on bladder health.

Caffeine

Foods and beverages containing caffeine have been reported to be risk factors for urgency, frequency and UI. Caffeine promotes urgency and frequency through diuresis, decreased threshold of sensation at filling phase, and increased flow rate and voided volume (27,28). The association of daily caffeine intake with UI is described in a prospective cohort study of 65,176 adult women (27). A significant association with weekly incontinence was reported for the group with the highest (> 450 mg/day) vs. the lowest (< 150 mg/day) caffeine intake (RR 1.19, 95% CI 1.06–1.34). Risk of UI associated with high caffeine intake was 25% (27).

Alcohol

Alcohol can promote urgency and frequency by interfering with the bladder signals regulating micturition. Alcohol also acts as a diuretic and causes dehydration (29). A study in men concluded that among other factors, alcohol consumption was an avoidable risk factor for the development of LUTS (30). Another study in men aged $\geq$ 20 years demonstrated that high alcohol consumption was a factor positively associated with an increased risk of moderate and severe LUTS (31). However, studies are inconsistent, with some showing an inverse relationship between alcohol consumption and the incidence of overactive bladder (26) and benign prostatic enlargement (23,32,33). A meta-analysis of 19 studies (120,091 men) demonstrated that alcohol reduced the risk of benign prostatic enlargement, but not LUTS (32). The causal pathways and exact mechanisms that are associated with this reduction in risk are still in an exploratory phase (32).

Bladder irritants

In addition to caffeine and alcohol, several foods and beverages have been identified as triggering or exacerbating urinary symptoms, particularly in patients with

Table 1 Bladder- and prostate-friendly foods

Food type	Eat	Try it	Avoid
Beverages	Chamomile tea, Evian, pear juice, pure blueberry juice, milk, peppermint tea, almond milk, rice milk, Lactaid, non-dairy creamer, non-alcoholic eggnog	Alfalfa tea, bottled water, herbal coffees, low-acid decaf coffee, roasted carob tea or coffee, low-acid juices, gin, rice milk, decaf root beer w/ice (not diet), rum, tap water, vodka, some sports drinks	Alcohol, carbonated water, flavoured water, chocolate milk, citrus juices, cranberry juice, herb tea blends, green teas, most fruit juices, regular coffee, sodas, soy milk, tea, energy drinks, powdered drinks
Grain products	Buckwheat, cornbread, white bread, oat bread, pita, potato bread, couscous, matzo, millet, oatmeal, pasta, rice, quinoa, rice, spelt, most cereals	Amaranth, grits, rye bread, sourdough bread, some graham crackers without problem ingredients, whole wheat bread, instant hot cereals	Breads or cereals with preservatives, soy flour, prepared pasta or rice dishes
Fats and nuts	Peanuts, butter, canola oil, coconut w/o preservatives, coconut oil, corn oil, margarine, olive oil, peanut oil, safflower oil, sesame oil, shortening, soy oil, homemade salad dressings	Almonds, almond butter, cashews, tahini, sunflower seeds, butter-flavoured shortening	Filberts, hazelnuts, macadamia nuts, mayonnaise, most prepared salad dressings, peanuts, pecans, pistachio nuts, English and black walnuts
Soups	Homemade soups with non-problem meats (see below) and vegetables	Canned, low sodium, organic soups without problem ingredients	Bouillon cubes, bouillon powder, most packaged and canned soups
Meat, fish and poultry	Beef, chicken, eggs, fish, lamb, liver (beef or chicken), pork, shellfish, fresh crabmeat, shrimp, turkey, veal, whey protein powder	Anchovies, bacon, Canadian bacon, caviar, corned beef, liverwurst, prosciutto, some sausages without problem ingredients, ham, soy-free veggie burgers	Bologna, hot dogs, most sausage, pepperoni, salami, smoked fish, canned crabmeat, soy products
Cheeses and other dairy	Cream cheese, cottage cheese, feta, mozzarella, ricotta, string cheeses, American cheese, whipped cream, ice cream, milk, Lactaid, rice milk	Buttermilk, canned parmesan cheese, Monterey jack, Cool Whip, some sherbets, some frozen yogurt, Rice Dream	Aged cheeses, blue cheese, brie, brick parmesan, camembert, cheddar, edam, emmentaler, gruyere, hard jack, roquefort, sorbet, soy milk, soy cheese, Sour cream, stilton, swiss, Cheez Wiz, yogurt
Vegetables and dried beans	Broccoli, brussels sprouts, cabbage, carrots, cauliflower, chives, collard greens, corn, cucumber, kale, lentils, lettuce, mustard greens, mushrooms, most dried beans, okra, parsley, peas, potatoes, pumpkin, radishes, snow peas, split peas, summer squash, turnips, winter squash, yams, zucchini	Avocado, beets, chicory, cooked bulb, onions, cooked leeks, dandelion greens, eggplant, low-acid tomatoes, purslane, raw green onions, rhubarb, rutabagas, swiss chard, spinach, turnip greens, watercress	Chilli peppers, black beans, fava beans, lima beans, pickles, raw bulb onions, sauerkraut, soy beans, (edamame), tomato, tomato sauces, tomato juice, tofu
Fruits	Dates without preservatives, coconut without preservatives, pears, apples, homemade applesauce, watermelon	Bananas, brown raisins, cherimoya, citrus peels, crenshaw melon, dried currants, Gala apples, honeydew, mango, maraschino cherries, rhubarb	Apricots, all citrus fruit, cantaloupe, cherries, dried fruit peaches, most plums, most dried figs, golden raisins, grapes, guava, kiwi fruit, most berries, passion fruit, papaya, persimmon, pineapple, starfruit
Snacks	Almonds, carrots, celery, plain corn chips, plain potato chips, soda crackers, oatmeal bars, peanuts, popcorn, pretzels	Glazed doughnuts, graham crackers, fruit and nut bars with OK ingredients, licorice, pizza with OK ingredients	Seasoned potato chips, processed baked goods, dessert cakes – fast food restaurants

Table 1 Continued

Food type	Eat	Try it	Avoid
Desserts and sweets	Brown sugar, carob, carrot muffins or cake, creme brulee, custards, divinity, homemade pound cake, homemade white/yellow cakes, homemade vanilla frosting, homemade caramel frosting, honey, licorice, maple syrup, pear pastries, sugar, sugar cookies, tapioca, vanilla ice cream, vanilla pudding	Banana bread, blueberry pastries, caramel candies, peppermint ice cream, plain pastries with almonds, plain cheesecakes, some frozen yogurt, some hard candies without acids, some popsicles, Splenda® (sucralose), stevia, white chocolate	Acesulfame K, aspartame, catsup, milk chocolate, dark chocolate, coffee ice cream, desserts with problem nuts, mustard, pastries with problem fruits, pecan pie, sorbets, store-bought fruitcakes, mincemeat pie, Nutrasweet®, saccharine
Seasonings and additives	Allspice, almond extract, anise, basil, caraway seed, coriander, dill, fennel, garlic, mace, marjoram, oregano, poppy seed, rosemary, sage, salt, thyme, tarragon, vanilla extract	Black pepper, celery seed, cilantro, cinnamon, cumin (small amount), dried parsley, dried chervil, ginger, lemon extract, malt powder, nutmeg, onion powder, orange extract, turmeric	Ascorbic acid, autolyzed yeast, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), benzoates, caffeine, cayenne, cloves, chilli powder, citric acid, hot curry powder, hydrolyzed protein, meat tenderizers, miso, oleoresin paprika, paprika, red pepper, soy sauce, tamari, vinegar, Worcestershire sauce, MSG (monosodium, glutamate), metabisulphites, sulphites
Fibre supplements	Acacia fibre, Benefiber, plain Metamucil	Colace, Metamucil cinnamon wafers	Metamucil orange, Metamucil berry burst, sugar-free psyllium fibre, senna

Adapted from IC/PBS Ad Hoc Committee on Diet. 2009 IC/PBS Food List: Bladder & Prostate Friendly Foods; and Understanding Diet and IC. Available at: http://www.ic-network.com/handbook/diet.html. Accessed 12 January 2012.

the symptoms of BPS/IC (urinary urgency and/or frequency, pressure and pain; Table 1) (34–36). A study in women aged ≥ 40 years demonstrated that carbonated beverages increased the 1-year incidence of overactive bladder and stress UI (25). There are a number of ingredients that might account for this effect (37). For example, diet sodas contain four well-known bladder irritants: acidic carbonation, citric and other acids, caffeine and artificial sweeteners (29).

Certain foods may stimulate and sensitise nerves in the bladder, which can exacerbate the already heightened nerve sensitivity present in individuals with BPS/IC. Other foods are high in histamine, an irritating substance that can provoke mast cells, which are increased and activated in certain patients with BPS/IC (29,38). A study investigating the possible association between dietary factors and the onset of stress UI in women aged ≥ 40 years demonstrated that total fat, saturated fatty acids and monounsaturated fatty acids were associated with an increased risk of stress UI (39). Another study reported that a diet low in fat and red meat and high in protein and vegetables may reduce risk of symptomatic benign prostatic enlargement (33).

Guidance is available for the elimination or modification in foods, beverages, food ingredients and

nutrients that have been identified as risk factors for bladder conditions, but there may be considerable variability between individuals (34). A Painful Bladder Syndrome/Interstitial Cystitis Ad Hoc Committee on Diet published a list of 'bladder- and prostate-friendly foods' with the intention of helping patients modify their diets to improve bladder health. Eating and drinking 'bladder-friendly' foods and beverages and/or limiting the consumption of foods or beverages known to irritate the bladder to moderate levels can help prevent bladder irritation (37).

Cancer risk factors
Certain foods/nutrients and beverages, including alcohol, may increase the risk of bladder cancer, whereas other foods may decrease the risk (40–43). A population-based study investigating the effect of dietary micronutrients on the risk of bladder cancer demonstrated that calcium intake was associated with higher risk (41). Additional analysis of this population revealed a possible association between bladder cancer and a high intake of cheese, while noting a protective effect for olive oil (42).

Vitamin D
There is now a body of literature supporting the protective role of vitamin D in maintaining continence

in women and men. Three large epidemiologic studies have provided evidence linking UI risk with insufficient vitamin D levels (44–46). One study investigated the association between nutrient composition of the diet and the onset of overactive bladder and UI in community-dwelling women $\geq$ 40 years of age (44). After a year, higher vitamin D intake was significantly associated with a decreased risk of the onset of overactive bladder and UI in women. Another study characterised the prevalence of vitamin D deficiency in non-pregnant women with pelvic floor disorders in the National Health and Nutrition Examination Survey (NHANES) (45). Multivariable analysis revealed that the likelihood of UI was significantly reduced by 45% when vitamin D levels were normal. In the third study, NHANES data showed that men with deficient vitamin D levels had a significantly higher rate of moderate/severe UI and a greater likelihood of having $\geq$ 1 LUTS, including nocturia, incomplete emptying, hesitancy and UI (46). Because vitamin D receptors exist in many tissues and organ systems, it is possible that vitamin D may help prevent UI and other bladder symptoms by increasing pelvic floor muscle strength, improving urethral sphincter function, inhibiting detrusor muscle overactivity and/or decreasing prostatic hypertrophy.

Cranberry products

Diet can also play a role in the development of UTIs, particularly in women for whom UTIs are the most common infection. Cranberries, cranberry juice and cranberry supplements have been shown to have a protective or preventative effect against UTI, particularly recurrent UTIs in women (47,48). A-type proanthocyanidins, which are a component of cranberries, inhibit bacterial adherence to the uroepithelium in a dose-dependent manner (49,50). Despite this, there is conflicting evidence and not all studies have been supportive.

In a study comparing the antibiotic trimethoprim-sulfamethoxazole (TMP-SMX) with cranberry supplements in 221 premenopausal women with recurrent UTIs, participants in the TMP-SMX group had fewer symptomatic UTIs over 12 months than those in the cranberry supplement group; however, antibiotic resistance increased in the TMP-SMX group and not in the cranberry group (51). Another study evaluated the effect of drinking 8 ounces of cranberry juice twice daily on the risk of recurring UTI among 319 college women with an acute UTI; those drinking cranberry juice did not have a decreased 6-month incidence of a second UTI compared with placebo (52). Even with conflicting evidence, incorporating the recommendation of cranberry intake as

a protective measure in community-based interventions, such as sexual health interventions or healthy ageing interventions, may help reduce the risk for UTIs among highly susceptible populations.

Drug abuse

Severe LUTS, including urgency, UI, frequency and nocturia, as well as cystitis, haematuria, reduced bladder capacity, hydronephrosis and renal impairment have been associated with ketamine abuse (53). The mechanism(s) producing these effects on the bladder is unknown. Symptoms appear to improve after cessation of ketamine in cases where irreversible damage to the renal tract has not occurred (53).

Body-mass index

Related to dietary intake is the ability to maintain a healthy weight. Obesity is an established risk factor for UI, as demonstrated in several population-based studies (14,54). In addition, several weight loss intervention studies have demonstrated that weight loss is associated with reductions in UI (55–57). The most definitive randomised clinical trial showed that overweight and obese women who participated in a 6-month behavioural weight loss intervention (resulting in an 8% weight loss) reduced UI episodes by 47% (compared with 28% in the control group) and reduced urgency UI episodes by 42% (compared with 26% in control) (57). Elevated body-mass index also appears to be associated with increased incidence of nocturia and increased risk for UTI (58–60). In men, obesity is associated with benign prostatic enlargement and increased risk of LUTS (61,62). Given the benefits of weight loss for urinary symptoms, it might be prudent to integrate this information into weight loss programmes to provide an added incentive for overweight men and women to engage in the long-term behaviour changes needed to lose weight.

Fluid intake volume

Fluid intake volume is also an important factor affecting bladder function, as consuming a healthy amount of fluid can help prevent UI and other bladder conditions (16,63–66). Limiting fluid intake is sometimes used as a self-directed 'preventative' strategy by those experiencing urgency, frequency, nocturia or UI (3,63,64,67). However, this practice can increase urine concentration, leading to irritation of the bladder mucosa, thereby increasing the incidence of LUTS and UTI (68,69).

Conversely, excessive fluid intake may exacerbate urinary symptoms. Fluid intake averaging > 3700 ml/day has been associated with a higher voiding frequency and incidence of UI compared with an intake of approximately 2400 ml/day (70). A

study of 30 healthy men aged 21–32 years demonstrated that participants in the excessive fluid intake group not only had significantly increased urine volume and frequency but also had significantly higher bladder pressure compared with those in the normal fluid intake group (71). Excessive evening fluid intake in particular may predispose individuals to nocturia, especially older adults and other individuals who experience nocturnal polyuria as a result of sleep apnoea, heart failure or other medical conditions affecting urine production (16,66).

Overall, promoting healthy fluid intake (approximately 25–30 ml/kg/day) may dilute the urine, balance the pH of urine, reduce bladder irritation and help prevent UTIs (16,63,65,66). In addition, healthy fluid intake (especially water) may reduce risk of bladder cancer (65,72).

Voiding habits and technique

Voiding frequency
Voiding frequency can be driven by many factors, including bladder sensation, convenience, opportunity, health beliefs and fear of UI episodes. Excessive frequency of voiding is often adopted as a strategy to avoid urgency and UI episodes (73). However, it is thought that frequent voiding, over time, leads to reduced functional bladder capacity and bladder dysfunction (74). Conversely, infrequent voiding may irritate the bladder mucosa, increasing the incidence of LUTS and UTI (68,69). It is also possible that infrequent voiding may overdistend the bladder, leading to reduced the awareness of bladder sensation, and contribute to UTI (75).

Postcoital voiding
Sexual intercourse has been positively correlated with UTIs. Proper hygiene, particularly postcoital hygiene for women, including emptying the bladder following sexual intercourse, has been recommended for the prevention of UTIs (76). Public health sexual education programmes should incorporate these concepts to inform individuals of the importance of bladder health to highlight that the occurrence of UTI in this context can be circumvented.

Voiding technique
Without an understanding of normal bladder function, people may develop the habit of voiding by valsalva (bearing down) or fail to relax the pelvic floor. Some women in particular report hovering over public toilet seats to avoid contact with unclean surfaces, which makes it difficult to relax and empty the bladder (77,78). Improper voiding techniques can lead to dysfunctional voiding and incomplete emptying, which may increase voiding frequency and risk of UTI (79).

Healthy toileting behaviours include a relaxed position for urination, relaxation of the pelvic floor and allowing adequate time for the bladder to empty (77,78,80–84). Public education, including messages for children and young adults, to disseminate a clear understanding of how the bladder fills and empties, normal voiding habits and problems associated with poor habits has potential to promote bladder health on a population level.

Bowel habits and constipation
Bowel health is known to affect bladder function, especially in older adults. Specifically, faecal impaction and constipation are associated with LUTS, including OAB symptoms of urgency, urgency UI, frequency and nocturia, as well as incomplete emptying (85,86). Furthermore, treatment of constipation has been shown to improve LUTS in children and adults (87–89).

Physical activity and exercise
The duration and level of competition have been correlated with LUTS across several sports, with high impact sports more frequently associated with UI than low impact sports (90). High impact sports appear to be associated with functional and anatomical changes in pelvic floor muscles. For female athletes who endure high impact, frequent intense training in landing/jumping sports (e.g. gymnastics, basketball), increased size and altered function of pelvic floor muscles have been demonstrated compared with athletes who participated in non-landing/ jumping sports (e.g. swimming, walking) (91).

On the other hand, long-term, moderate physical activity has been shown to be inversely related to UI (92), and lower activity levels have been associated with 2–3 times greater likelihood of incident LUTS in women (20). Furthermore, most studies in men indicate that physical activity decreases the risk of benign prostatic enlargement, suggesting that physical activity may be beneficial in men with LUTS (61). Thus, public health programmes addressing inactivity levels or promoting exercise programmes could incorporate the potential benefit of physical activity to bladder health as an added incentive.

Pelvic floor muscle skills and exercise
Healthy pelvic floor muscle function is an important factor for the maintenance of overall bladder health. Keeping muscles strong maintains tone, supports pelvic organs and promotes active use of pelvic floor muscles to control the bladder outlet.

Pelvic floor muscle training is a well-established treatment for stress UI in women, as well as men

(93,94). Behavioural training, which combines pelvic floor muscle training with urge suppression strategies, has proven effective for reducing urgency, frequency, nocturia and urgency UI in women and in men (3,74). Given the efficacy of these behavioural approaches to treating bladder symptoms, their low side effect profile and safety, they have also been examined as preventive interventions in high-risk populations, including child-bearing women, older women and men undergoing radical prostatectomy (95,96).

A systematic review comparing antenatal and postnatal care including pelvic floor muscle training with standard care demonstrated that pelvic floor muscle training may prevent UI in late pregnancy and postpartum and may effectively reduce persistent UI thereafter (97). Thus, public health initiatives aimed at improving the overall health of pregnant women should include education on executing pelvic floor muscle exercises to prevent or reverse compromised pelvic floor muscle function.

Although age is an established risk factor for UI, there is a single randomised clinical trial demonstrating the value of pelvic floor muscle training in a behaviour modification programme for reducing 12-month incidence of UI and 24-h, daytime and nocturnal voiding frequency in continent older women (98).

Because UI is often predictable after radical prostatectomy, behavioural interventions have also been implemented in the early postoperative period to help reduce symptom duration and severity (99,100). Another approach is to teach pelvic floor muscle control preoperatively, so that patients can practise their muscle skills before surgery and be more prepared to exercise and use their pelvic floor muscles immediately after catheter removal (96). There are now several randomised controlled clinical trials of peri-operative pelvic floor muscle training programmes that have shown reduced duration and severity of UI after prostatectomy (96,99,100).

Given the preventive value of safe behavioural intervention within at-risk populations, and our relative inability to predict who will develop bladder conditions, it is reasonable to consider the potential value of these interventions for preventing bladder symptoms on a broader population scale. Educating women and men about pelvic floor muscle exercises may enable them to consciously maintain better muscle tone and support for pelvic organs including the bladder and urethra. Pelvic floor muscle exercise, which has been used to prevent UI during pregnancy and following delivery, may be employed to prevent or deter pelvic floor weakening associated with ageing or weight gain. Better pelvic floor muscle relaxation may help people to void more naturally and effectively, and prevent problems with dysfunctional voiding. Educating individuals about how to contract their pelvic floor muscles to brace during coughing, sneezing and heavy lifting may help preserve the pelvic floor and prevent some of the anatomical changes that lead to stress UI and pelvic organ prolapse (101). Similarly, learning how to respond to urgency by staying still and using urge suppression strategies, rather than rushing to the bathroom, may enable people to control their voiding patterns, rather than lose control of urgency and voiding frequency.

Conclusions

This review has focused on behavioural and lifestyle factors that affect bladder health, explored associated risk for bladder conditions, and discussed modifications of these factors that contribute to maintenance or improvement of bladder health. Many of the behavioural modifications discussed can be employed to improve bladder health or to prevent or reduce the deterioration of bladder health. There are several key behavioural and lifestyle modifications that may be beneficial to incorporate into new or existing interventions to further improve the health of a population.

• 'Understand your bladder.' The more general knowledge you acquire and assimilate into your lifestyle, the more likely you are to prevent bladder health problems.
• Do not smoke.
• Consume a healthy amount of fluid (25–30 ml/kg/day, the amount needed to empty the bladder every 3–4 h).
• Eliminate or consume known bladder irritants in moderation.
• Adopt healthy toileting behaviours.
• Practice pelvic floor muscle exercises and preemptive pelvic floor contraction.
• Practice postcoital hygiene (women).
• Avoid constipation and obesity.

Although clinical practice may be assumed to be the most appropriate ground for this education, there is a need to disseminate the 'bladder basics' more broadly and educate at-risk populations, as well as the general public. It is crucial to extend these messages into the general population using broader public health interventions to reach those who have not yet developed bladder conditions and to maximise the prevention impact of these behaviour changes.

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