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Authors

Thurmon, Kerri L
Breyer, Benjamin N
Erickson, Bradley A

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Association of Bowel Habits with Lower Urinary Tract Symptoms in Men: Findings from the 2005–2006 and 2007–2008 National Health and Nutrition Examination Survey

Kerri L. Thurmon, Benjamin N. Breyer and Bradley A. Erickson*

From the Department of Urology, University of Iowa, Iowa City, Iowa (KLT, BAE), and University of California-San Francisco, San Francisco, California (BNB)

Purpose: We examine the association between self-reported lower urinary tract symptoms and bowel habits in men in a large, cross-sectional, population based cohort study.

Materials and Methods: The study included 3,077 men participating in the 2005–2006 or 2007–2008 cycles of the NHANES (National Health and Nutrition Examination Survey) who were 40 years old or older and without a history of prostate cancer. Men were considered to have lower urinary tract symptoms if they reported nocturia, urinary hesitancy and/or incomplete bladder emptying. Bowel habits were characterized by frequency of bowel movements per week and stool consistency based on the Bristol Stool Form Scale. Weighted associations between bowel habits and lower urinary tract symptoms were determined using univariate and multivariate techniques, adjusting for age, race, body mass index, diabetes, alcohol intake, activity level and smoking.

Results: The prevalence of lower urinary tract symptoms was 37%, with 4% reporting all 3 symptoms. Reporting 3 or fewer bowel movements per week was associated with nocturia (OR 1.67, 95% CI 1.21–2.30), incomplete bladder emptying (OR 2.14, 95% CI 1.06–4.31) and urinary hesitancy (OR 2.06, 95% CI 1.06–4.02). Reporting more than 10 bowel movements per week was associated with nocturia only (OR 1.42, 95% CI 1.01–1.55). Hard (OR 1.76, 95% CI 1.31–2.37) and loose (OR 1.25, 95% CI 1.01–1.55) stool consistency increased the odds of reporting nocturia.

Conclusions: Lower urinary tract symptoms in the adult male were independently associated with low stool frequency, hard stool type and loose stool type. These data suggest causality or a common pathophysiology of lower urinary tract symptoms and abnormalities of bowel habits.

Key Words: lower urinary tract symptoms, prostatic hyperplasia, constipation, defecation

Abbreviations and Acronyms

BM = bowel movement

BMI = body mass index

LUTS = lower urinary tract symptoms

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* Correspondence: Department of Urology, University of Iowa, 200 Hawkins Dr., 3 RCP, Iowa City, Iowa 52242-1089 (telephone: 319-356-7221; FAX: 319-356-3900; e-mail: brad-erickson@uiowa.edu).

LOWER urinary tract symptoms are common among men, with an estimated prevalence between 19% and 48% in those older than age 40 years in the United States and Europe.^{1,2} These symptoms not only cause morbidity in the form of decreased quality of life,^{1,3} but also lead to increased

health care expenditures with an estimated \$4 billion spent on LUTS annually in the United States.⁴ As the population ages, these prevalence and cost estimates will likely increase. Understanding the pathophysiology of these symptoms to identify potentially modifiable risk factors will be increasingly important.

LUTS in men have historically been attributed to obstruction from prostatic hyperplasia and treatments have focused on the prostate. However, contemporary research suggests that the mechanism of LUTS is multifactorial, likely involving a complex interplay of vascular, neurological, muscular and receptor abnormalities of the bladder, prostate and pelvic floor.⁵ In addition, lifestyle factors such as diet, alcohol intake, exercise and smoking have also been implicated as risk factors for the development of LUTS independent of prostate size.⁶

The association of LUTS with gastrointestinal disturbances is well documented in the pediatric population, but less so in adults. The bladder and rectum share a common embryologic origin and motor nerve supply, and are anatomical neighbors.^{7,8} Research in the elderly population has shown that LUTS improve after the relief of constipation.⁹ In this study we examine the association of LUTS with abnormalities in bowel habits among men age 40 years or older using a large database representative of the United States population. We hypothesize that men with LUTS have concomitant abnormalities in bowel habits.

METHODS

NHANES 2005–2006 and 2007–2008

The NHANES program is a cross-sectional health survey conducted by the National Center for Health Statistics, a division of the Centers for Disease Control and Prevention. It provides estimates of the health status of the United States population by selecting a nationally representative sample of the civilian, noninstitutionalized population using a complex, stratified, multistage, probability cluster design. The National Center for Health Statistics ethics review board approved the protocol and all participants provided written informed consent.

Study Population

NHANES participants are interviewed in their homes and undergo physical examination in a mobile examination center. Trained interviewers ask about LUTS and bowel habits as part of a private interview with all men older than 40 years. In the present analysis we included all men who were 40 years old or older at participation (3,168) and excluded those who reported having a history of prostate cancer (91), leaving 3,077 men for analysis.

Lower Urinary Tract Symptoms

The 3 voiding questions asked of all men age 40 years or older were 1) how many times per night do you usually get up to urinate? (nocturia, defined as waking at least twice per night to urinate¹⁰), 2) after urinating, does your bladder feel empty? (incomplete emptying) and 3) do you usually have trouble starting to urinate? (hesitancy).

Bowel Symptoms

Bowel habits were evaluated using the question, “How often do you usually have bowel movements?” (stool frequency), and the Bristol Stool Form Scale, which asks

participants to identify their typical stool type using a visual card (stool consistency). Stool frequency per week was categorized into low (3 or fewer BMs), intermediate (4 to 10 BMs) and high (more than 10 BMs) based on the distribution of the sample. Stool consistency was categorized into hard stools (types 1 and 2), normal stools (types 3 and 4) and loose stools (types 5, 6 and 7).¹¹

Demographics

Age was analyzed as a continuous variable. BMI (kg/m^2) was dichotomized into normal/overweight (less than $30.0 \text{ kg}/\text{m}^2$) or obese ($30.0 \text{ kg}/\text{m}^2$ or greater). Smoking was categorized into current smokers (including those who quit less than 1 year ago), former smokers and nonsmokers (never smoked). The consumption of alcoholic beverages during the last month was assessed using a food frequency questionnaire, and men were dichotomized into those with none to minimal alcohol use (less than 1 drink daily) and those who average at least 1 drink daily. Race/ethnicity was categorized as nonHispanic white, nonHispanic black, Hispanic (including Mexican-American) and other. Men were considered to have diabetes if they currently used insulin or oral diabetes medications, or if their doctor told them that they were diabetic. Physical activity was ascertained by interview, and was classified by rate of energy expenditure in the last month, dichotomized into moderate/vigorous or minimal.

Statistical Analysis

The NHANES 2005–2006 and 2007–2008 data for participants age 40 years or older were combined to provide more robust sample sizes. All analyses were calculated using SAS® v9.2. We used sample weights that took into account the specific probabilities of selection for the individual domains that were oversampled, nonresponse, and differences between the demographic characteristics of the sample and the total United States population.

The outcome of interest was the presence of LUTS. The Mantel-Haenszel chi-square test was used to assess the association between LUTS, and demographic and medical characteristics. Logistic regression modeling was used to calculate the OR and 95% CI of LUTS for each stool frequency and caliber category. Models calculated ORs for 3, 2 and 1 symptom vs 0 symptoms. All models were adjusted for age, BMI, smoking, alcohol intake, race, diabetes and activity using categorization as previously described. Statistical significance was defined as $p < 0.05$.

RESULTS

Of the 3,077 men in the analysis 37% reported at least 1 lower urinary tract symptom. Of these men 75.9% reported 1 symptom, 20.1% reported 2 symptoms and 4% reported 3 symptoms. The comparison of unweighted demographic information among those without LUTS and those with 1, 2 or 3 LUTS are presented in [table 1](#). LUTS were more common in older men, in current or former smokers, those who drank no to minimal alcohol, diabetics and the minimally active. [Table 2](#) shows the frequency of LUTS by participant self-reported bowel movements per week and the Bristol Stool Form. Men with LUTS were more

Table 1. Baseline demographics of male study participants

	No. Men (unweighted)	Weighted Prevalence (%)*				p Trend†
		No LUTS (1,675)	1 Symptom (1,064)	2 Symptoms (282)	3 Symptoms (56)	
Overall	3,077	63	28.4	7.3	1.3	
Age:						<0.0001
40–49	667	71.4	23.7	4	0.9	
50–59	713	63.8	27.6	6.7	1.8	
60–69	742	48	39.4	10.3	2.3	
70–79	558	41	42.8	13.6	2.5	
80–89	307	29.3	51.8	16.9	2	
BMI (kg/m ²):						0.37
Less than 30	1,976	54.1	34.9	9.5	1.6	
30 or Greater	1,011	53.1	35.2	9.2	2.5	
Smoking habits:						0.0002
Current	656	55.3	31.3	11.1	2.3	
Former	1,170	47.4	39.7	10.6	2.4	
Nonsmoker	1,161	59.4	32.4	7.2	1.1	
Alcohol intake:						<0.0001
None to minimal	1,068	47.3	38.2	12.6	1.9	
Daily	1,919	57.4	33.2	7.6	1.9	
Race/ethnicity:						0.57
NonHispanic white	1,652	56.2	31.5	10.5	1.8	
Hispanic	608	47.3	41	9.2	2.5	
NonHispanic black	638	53	38.2	6.9	1.9	
Diabetes:						<0.0001
Diabetic	497	40.6	44.7	12.3	2.4	
Nondiabetic	2,490	56.4	33.1	8.8	1.8	
Activity:						<0.0001
Moderate-vigorous	671	59	32.1	7.3	1.6	
Minimal	1,004	47.4	38.8	11.2	2.6	

* Prevalence percentages were calculated using NHANES sample weights.

† Mantel-Haenszel chi-square test.

likely to report 3 or fewer BMs per week ($p < 0.0001$) and hard or loose stools ($p < 0.0001$). Multivariate models of stool frequency and consistency by LUTS are shown in table 3.

Stool Frequency

Men reporting 3 or fewer BMs per week had a significantly higher odds of reporting 1, 2 and 3 symp-

toms in the fully adjusted models compared to men with normal stool frequency, although only men reporting 3 symptoms had a statistically significant association (OR 7.59, 95% CI 1.63–35.3, table 3). Men reporting more than 10 BMs per week had a higher odds of reporting 1 symptom (OR 1.30, 95% CI 1.08–1.56).

Stool Consistency

Subjects reporting hard stools had a significantly higher odds of reporting 1, 2 and 3 symptoms vs

Table 2. Stool frequency and consistency by LUTS

	No. Men	No LUTS	1 Symptom	2 Symptoms	3 Symptoms
Unweighted sample size	2,963	1,598	1,037	274	54
Weighted prevalence (%)					
stool frequency					
(BMs/wk):*					
3 or Less	116	43.2	36.6	13.1	7.1
4–10	1,687	64.7	26.5	7.7	1.1
Greater than 10	1,160	62.3	30.4	6.3	1
Unweighted sample size	2,928	1,585	1,022	268	53
Weighted prevalence (%)					
stool consistency					
(Bristol Stool Form):*					
Types 1 + 2	137	48.6	39.2	8.7	3.5
Types 3 + 4	2,369	64.8	27	7.3	0.9
Types 5, 6 + 7	422	58.9	31.9	6.4	2.8

All values p trend <0.0001, Mantel-Haenszel chi-square test.

* All percentages calculated using NHANES sample weights.

Table 3. Odds ratios and 95% CIs of LUTS by stool frequency and consistency

	All 3 LUTS	Any 2 Symptoms	Any 1 Symptom
Stool frequency			
(BMs/wk):			
3 or Less	7.59 (1.63–35.3)	1.77 (0.79–3.95)	1.57 (0.77–3.20)
4–10	1.00 (ref)	1.00 (ref)	1.00
Greater than 10	0.85 (0.47–1.54)	1.01 (0.69–1.49)	1.30 (1.08–1.56)
Stool consistency			
(Bristol Stool Form):			
Types 1 + 2	3.48 (1.00–12.13)	1.77 (0.79–3.95)	1.88 (1.12–3.15)
Types 3 + 4	1.00 (ref)	1.00 (ref)	1.00
Types 5, 6 + 7	3.78 (1.41–10.18)	0.83 (0.52–1.32)	1.29 (0.92–1.79)

All results were calculated using sampling weights.

Adjusted for age, race, smoking history, BMI, alcohol intake, diabetes and activity level.

those reporting normal consistency with 3 (OR 3.78, 95% CI 1.41–10.18) and 1 (OR 1.88, 95% CI 1.12–3.15) symptom being statistically significant. Men reporting loose stools had a higher odds of reporting all 3 LUTS (OR 3.78, 95% CI 1.41–10.18, [table 3](#)).

[Table 4](#) presents the odds of each specific lower urinary tract symptom by stool frequency and consistency after adjusting for all covariates. Reporting 3 or fewer BMs per week was associated with nocturia (OR 1.67, 95% CI 1.21–2.30), incomplete bladder emptying (OR 2.14, 95% CI 1.06–4.31) and urinary hesitancy (OR 2.06, 95% CI 1.06–4.02). Reporting more than 10 BMs per week was associated with nocturia only (OR 1.42, 95% CI 1.01–1.55). Hard (OR 1.76, 95% CI 1.31–2.37) and loose (OR 1.25, 95% CI 1.01–1.55) stools increased the odds of reporting nocturia.

DISCUSSION

In this cross-sectional study representative of United States men 40 years old or older, irregular bowel habits were associated with a greater risk of LUTS. The odds of reporting LUTS were significantly greater in men reporting 3 or fewer BMs weekly and in those who reported hard or loose stools after adjusting for known LUTS risk factors.

In children there is well supported evidence of an association between bowel habits and voiding dysfunction. Constipation is reported in 30% to 88% of children with bladder dysfunction,¹² and children with constipation have higher rates of concomitant fecal and urinary incontinence than those without.¹³ It is theorized that either rectal distention places direct pressure on the posterior bladder wall, leading to detrusor overactivity and urinary retention,¹⁴ or that prolonged anal sphincter contraction in the presence of a large stool bolus leads to inappropriate pelvic floor muscle contraction and secondary detrusor-sphincter dyssynergia.¹⁵ Aggressive bowel treat-

ment programs have been shown to decrease urinary symptoms significantly in children.^{12,16}

In the elderly population the treatment of constipation has been shown to improve LUTS. A prospective study showed that the medical treatment of constipation in men and women older than age 65 years resulted in decreased self-reported urgency, frequency and dysuria symptoms.⁹ Residual urine decreased by an average of 50 cc ($p < 0.001$) and there was a significant decrease in the number of patients with bacteriuria after the treatment of constipation. A similar study randomized nursing home residents with constipation and urinary and fecal incontinence to a daily program of prompted timed voiding, exercise, and increased food and fluid intake.¹⁷ The authors showed significant improvement in urinary incontinence and frequency of bowel movements compared to controls. The relationship between bladder and bowel dysfunction in the elderly population is sufficiently established and in 2005 the International Consultation on Incontinence formally recommended the treatment of constipation to manage incontinence.¹⁸

In younger adults studies describing the association are rare. An epidemiological survey of men and women 40 years old or older from the United States demonstrated a relationship among overactive bladder, chronic constipation and fecal incontinence.¹⁹ Men and women with overactive bladder were significantly more likely to report chronic constipation (22% vs 6% of men and 36% vs 7% of women; $p < 0.0001$) and fecal incontinence (29% vs 6% of men and 32% vs 7% of women, $p < 0.0001$). In another study of 820 women with LUTS compared to controls, constipation and defecatory straining were more common in those with LUTS than in controls.²⁰ Demographic data from these large trials show that a parallel between LUTS and lower gastrointestinal symptoms exists.

In the present study we demonstrated that adult males with bowel dysfunction were significantly more likely to report LUTS than those with normal bowel function. To our knowledge, this represents one of the largest studies to date to describe such an association in the adult male population, and shows that mechanisms well described in the pediatric population may exist to a degree in healthy adults as well. However, this relationship remains poorly understood. Whether bowel dysfunction leads to LUTS (or vice versa) or these problems simply coexist is unknown.

The mechanisms proposed for the pediatric population would support a causal relationship. In adults, several studies have evaluated the effect of rectal distention on bladder filling sensations determined during cystometric bladder filling. In a study of young, healthy women the sensation of rectal filling

Table 4. Odds ratios and 95% CIs of nocturia, incomplete emptying and hesitancy

	Nocturia	Incomplete Emptying	Hesitancy
Stool frequency (BMs/wk):			
3 or Less	1.67 (1.21–2.30)	2.14 (1.06–4.31)	2.06 (1.06–4.02)
4–10	1.00 (ref)	1.00	1.00
Greater than 10	1.42 (1.21–1.66)	0.94 (0.71–1.25)	0.82 (0.59–1.14)
Stool consistency (Bristol Stool Form):			
Types 1 + 2	1.76 (1.31–2.37)	0.76 (0.40–1.44)	1.26 (0.64–2.48)
Types 3 + 4	1.00 (ref)	1.00	1.00
Types 5, 6 + 7	1.25 (1.01–1.55)	0.97 (0.60–1.57)	0.90 (0.49–1.66)

All results were calculated using sampling weights.

Adjusted for age, race, smoking history, BMI, alcohol intake, diabetes and activity level.

was shown to be decreased when the bladder was full. Rectal distention also caused the sensation of bladder filling to occur at smaller volumes and significantly reduced maximum bladder capacity.²¹ These results were reproduced in women with LUTS, where rectal distention significantly reduced the filling volume at which participants reported first and strong desire to void compared to those with an undistended rectum.²² In addition, detrusor overactivity was demonstrated only in those patients with distended rectums. In a study of healthy men, rectal distention was associated with increased posterior urethral pressure, which may lead to obstructive voiding symptoms regardless of prostate size.²³ These findings show that the fullness of the rectum significantly influences the handling of sensory information from the lower urinary tract.

Another plausible explanation for the coexistence of LUTS and gastrointestinal symptoms is a shared etiology of the disorders. Urodynamic studies of patients with irritable bowel syndrome have shown that women with irritable bowel syndrome were significantly more likely to experience urinary frequency, urgency and detrusor instability than those without irritable bowel.²⁴ In a large analysis of patients with interstitial cystitis a higher incidence of inflammatory bowel conditions was noted compared to the general population.²⁵ This evidence suggests that the common linkage may be due to global smooth muscle or neural dysfunction. Furthermore, sacral nerve stimulation has been shown to be an effective treatment for urinary and functional anal-rectal disturbances.²⁶ Mechanisms of colon-bladder cross-talk have been studied in animal models, and inflammation or infection of either system has been shown to lead to sensitization of the other by proposed neural, endocrine and immunologic pathways.²⁷ Future research exploring the specific etiology and reasons for overlap is necessary.

The association of nocturia and bowel habits deserves special mention as we found strong associations with both extremes. Determining the exact mechanism of nocturia is complex as it has been

shown to result from multiple conditions, including those which lead to small nocturnal bladder capacity, excessive nighttime urine output and/or sleep disorders, in addition to the known bladder and prostate conditions.²⁸ We hypothesize that hard, infrequent stools may lead to nocturia by mechanisms previously described, mainly by their direct and indirect influence on the bladder and prostate. However, loose, frequent stools may lead to nocturia by alternative mechanisms, possibly by abnormalities in diet and fluid intake that affect both organ systems. Overall nocturia remains an under studied clinical entity, and this bimodal association with bowel habits is worth further study.

The limitations of this study are mainly due to the cross-sectional design and that diagnoses are based on self-reported symptoms of a rather limited scope. In addition, we did not control for the multiple medications these participants take that could potentiate LUTS, stool frequency or stool consistency such as diuretics, laxatives, anticholinergics or antidepressants because of the unknown effect that each medication has on these bowel and bladder functions and to what degree they interact. In fact, a separate study that focuses specifically on the role of medication in this association is indicated. Finally, our categorization of stool form and bowel frequencies was not based on strict clinical criteria for bowel disease.

CONCLUSIONS

In our study low stool frequency and hard or loose stool consistency were more common in men with LUTS. Men who reported 3 or fewer BMs per week and hard or loose stools were at increased risk for LUTS even after controlling for established confounders. Given this association, health care providers treating patients with LUTS should include assessments of patient bowel habits to look for potentially treatable gastrointestinal conditions. As the specific etiology and reasons for the association between bowel habits and LUTS are not definitively known, this area merits further investigation.

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