



Risk Factors for Lower Urinary Tract Symptoms in a Population-based Sample of African-American Men

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Previous epidemiologic studies evaluating risk factors for lower urinary tract symptoms (LUTS) have focused on White populations. Between September 1996 and January 1998, in a population-based sample of African-American men aged 40–79 years in Flint, Michigan, the authors assessed the role of putative sociodemographic, lifestyle, and medical history risk factors in moderate to severe LUTS, including the subcategories of obstructive and irritative symptoms. After the exclusion of men with prostate cancer or prior prostate surgery and men who were taking alpha-blockers for urinary tract symptoms, 708 participants provided responses to a structured interviewer-administered questionnaire. After multivariable adjustment, current and former smokers were at increased risk of moderate to severe LUTS, including obstructive symptoms. Heavy alcohol consumption and a history of hypertension or diabetes were positively associated with LUTS, and high income (\geq \$30,000) was inversely associated with LUTS and with obstructive and irritative symptoms. A history of heart disease was positively associated with LUTS and with irritative symptoms. To the authors' knowledge, this was the first population-based study undertaken in African-American men to evaluate putative risk factors for moderate to severe LUTS, including subcategories of obstructive and irritative urinary symptoms. These results describe associations with specific lifestyle and medical history risk factors.

hyperplasia; men; risk factors; urinary tract

Abbreviations: BPH, benign prostatic hyperplasia; CI, confidence interval; LUTS, lower urinary tract symptoms; OR, odds ratio.

Obstructive or irritative lower urinary tract symptoms (LUTS) of increasing severity with increasing age are manifestations of benign prostatic hyperplasia (BPH) (1, 2). In the United States, an average of 380,000 transurethral resections of the prostate are performed annually (3) to alleviate symptoms due to BPH. Despite this significant public health burden, the etiology of BPH has not been fully elucidated. Having functional testes, the major source of circulating androgens, and advancing age are well-established risk factors for BPH (4, 5).

Studies of other potential risk factors have yielded conflicting results (6). One reason for this discrepancy has

been the lack of a universally accepted case definition (7). Most studies have focused on factors associated with surgical intervention, while other studies have used increased prostate volume or severity of LUTS as the outcome criterion (8, 9). Studies that have investigated the impact of LUTS on quality of life in elderly men may have been confounded by the increasing prevalence of comorbid diseases with age (10).

In general, previous studies evaluating risk factors for BPH have included only Caucasian populations. The Flint Men's Health Study is investigating the natural history of BPH and LUTS among African-American men. In a recent

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report based on a subgroup of 364 clinically evaluated participants in the Flint Men's Health Study, Wei et al. (11) reported that moderate to severe LUTS was experienced by 39.6 percent (95 percent confidence interval (CI): 34.6, 44.6) of African-American men aged 40–79 years. The authors also reported an overall prevalence of bothersome symptoms of 35.0 percent, increasing from 25.0 percent in men aged 40–49 years to 50.0 percent in men aged 70–79 years. The “bother score” was observed to be highly correlated ($r = 0.76$, $p = 0.0001$) with the interviewer-administered American Urological Association Symptom Index. The objective of the current study was to investigate potential demographic, lifestyle, and medical history risk factors for LUTS in a population-based sample of African-American men.

MATERIALS AND METHODS

Details on the study protocol were approved by the University of Michigan Institutional Review Board and have been given in previous publications (11–13). Probability sampling of households or group dwelling units that was undertaken in Flint, Michigan, and in select census tracts in Beecher Township identified 943 African-American men aged 40–79 years who were eligible for participation in the Flint Men's Health Study in-home interview. The interviews were conducted between September 1996 and January 1998. Because of the established relation between age and prostatic morbidity, the pool of eligible subjects aged 60–79 years was oversampled. The interview was designed to identify putative risk factors for prostate cancer and BPH. A total of 819 (87 percent) men consented to be interviewed and completed a structured questionnaire that elicited information on socio-demographic characteristics, tobacco and alcohol consumption, height and weight, physical activity, vasectomy, and past medical history, including heart disease, hypertension, diabetes mellitus, and sexually transmitted infectious diseases.

Of the 819 men interviewed, 87 were ineligible for this analysis because of a prior diagnosis of prostate cancer ($n = 55$) or prior prostate surgery ($n = 32$), and 11 were ineligible because of a positive biopsy for cancer following an abnormal prostate-specific antigen test and/or digital rectal examination. Also excluded were 11 men who reported taking alpha-blocker medications that affect urinary symptoms and two men who were found subsequently to be age-ineligible. Thus, the final analytical sample consisted of 708 (86.4 percent) of the 819 men who participated in the in-home interview.

Participants were also evaluated according to the American Urological Association Symptom Index, which assesses the severity of seven BPH-related urinary symptoms. Each symptom is scored on a scale of 0–5, and individual symptom scores are summed, yielding a possible range of total scores from 0 to 35. Using standard cutpoints for symptom severity, men with total scores of 7 or less were classified as having mild symptoms, whereas scores in the range of 8–19 and 20–35 were indicative of moderate and severe symptoms, respectively. We further classified men according to the presence of moderate to severe obstructive symptoms (≥ 5 out of 20 points for the sensation of incom-

plete bladder emptying, stopping and starting several times during urination, a weak urinary stream, and pushing or straining to begin urination) and moderate to severe irritative symptoms (≥ 4 out of 15 points for having to urinate less than 2 hours after voiding, finding it difficult to postpone urination, and number of instances of getting up to urinate per night) (9).

Smoking history was classified in terms of former smoking (at least 100 cigarettes smoked in a lifetime), current smoking, and never smoking. For current smokers, the number of cigarettes smoked per day over the previous 12 months was categorized as 1–9, 10–19, and ≥ 20 . Drinking status was defined as never, former, or current drinking (at least one drink of beer, wine, or liquor per month for at least the past 6 months). For estimation of total alcohol intake in grams per day, servings of specified types of alcoholic beverages were multiplied by the number of grams per serving (liquor = 15.1 g/serving, beer = 13.2 g/serving, and wine = 10.8 g/serving) (9). For assessment of physical activity, participants were asked to estimate the average number of hours per day that they engaged in vigorous activities that required them to work up a sweat, as well as their weekly pattern of exercise. Vigorous physical activity status was classified as never or ever. Current body mass index (weight (kg)/height (m)²) was calculated on the basis of self-reported height and weight. Men were classified as having hypertension, heart disease, or diabetes if they responded affirmatively to the question “Has a doctor ever told you that you have high blood pressure or hypertension, heart disease, diabetes, or high blood sugar?”. Subjects were classified as having a history of sexually transmitted disease if they reported having had at least one of the following diseases in their lifetime: gonorrhea, syphilis, genital herpes, or genital warts.

Statistical analysis

Subjects were stratified into four 10-year age groups (40–49, 50–59, 60–69, and 70–79 years). The prevalences of mild and moderate to severe LUTS in total and of obstructive and irritative symptoms were determined for each age group. Sociodemographic, lifestyle, and medical history characteristics were examined across age categories, and the Mantel-Haenszel chi-square test was performed to assess trends across ordered categories. Crude odds ratios and corresponding 95 percent confidence intervals were calculated for examination of associations between putative risk factors and LUTS. Three sets of logistic regression models were used to identify explanatory variables that predicted the odds of having moderate to severe LUTS, obstructive symptoms, and irritative symptoms, respectively. Backward model-building procedures were used to produce the most parsimonious subset of explanatory factors associated with each LUTS endpoint. Factors that contributed significantly to the models ($p < 0.05$ by Wald test) were retained and likelihood ratio tests were conducted to assess differences between models. All analyses were performed using the statistical package SAS, version 8.2 (SAS Institute, Inc., Cary, North Carolina). To adjust for oversampling of the older age groups, we applied age-specific sampling weights

TABLE 1. Prevalence of lower urinary tract symptoms and of obstructive and irritative symptoms among African-American men in Flint, Michigan, by age, 1996–1998

	Age group (years)										p value*
	Total		40–49		50–59		60–69		70–79		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Total symptoms											0.0097
Mild	483	70.3	142	74.7	140	66.4	121	71.2	80	58.4	
Moderate	195	25.9	44	23.2	60	28.4	41	24.1	50	36.5	
Severe	30	3.8	4	2.1	11	5.2	8	4.7	7	5.1	
Obstructive symptoms											0.0098
Mild	558	80.7	162	85.3	161	76.3	138	81.2	97	70.8	
Moderate-severe†	150	19.3	28	14.7	50	23.7	32	18.8	40	29.2	
Irritative symptoms											0.0034
Mild	400	58.9	121	63.7	118	55.9	99	58.2	62	45.3	
Moderate-severe‡	308	41.1	69	36.3	93	44.1	71	41.8	75	54.7	

* Mantel-Haenszel chi-square test for trend.

† Defined as ≥ 5 out of 20 points for the sensation of incomplete bladder emptying, stopping and starting several times during urination, a weak urinary stream, and pushing or straining to begin urination.

‡ Defined as ≥ 4 out of 15 points for having to urinate less than 2 hours after voiding, finding it difficult to postpone urination, and number of times of getting up to urinate per night.

to obtain overall sample proportions and when fitting multi-variable logistic regression models. Statistical significance was set at an alpha level of 0.05.

RESULTS

Overall, 29.7 percent (95 percent CI: 26.3, 33.1) of men reported having moderate to severe LUTS, with the prevalence increasing with age ($p = 0.0097$). The proportions of men with moderate to severe obstructive and irritative symptoms increased with age, with a greater proportion experiencing irritative symptoms (41.1 percent) than obstructive symptoms (19.3 percent) (table 1).

The majority of men were married or living with a partner (58.2 percent), had a high school education or its equivalent (70.2 percent), and reported an annual income of less than \$50,000 (65.9 percent) (table 2). Overall, 44.0 percent were current smokers and 52.4 percent currently consumed alcohol, but the prevalence of smoking and drinking decreased with age. Nearly one third of the study population was classified as being obese (body mass index ≥ 30) (14). Thirty-two percent reported that they never engaged in vigorous physical activity, with the proportion increasing above 40 percent in men aged 50 years or older. Few men reported having had a vasectomy (5.3 percent), but more than half (54.3 percent) reported a history of sexually transmitted infectious diseases. Overall, 54.1 percent of men reported a history of hypertension, with the proportion exceeding 60 percent among men over age 50 years. Only 9.4 percent and 16.4 percent of men reported having heart disease and diabetes, respectively, with the prevalence of diabetes ranging between 25 percent and 30 percent in men over age 60 years.

Men aged 70–79 years experienced more than a twofold increase in the odds of moderate to severe LUTS (odds ratio (OR) = 2.11, 95 percent CI: 1.32, 3.38) and the odds of obstructive symptoms (OR = 2.39, 95 percent CI: 1.38, 4.11) and irritative symptoms (OR = 2.12, 95 percent CI: 1.36, 3.32) in comparison with men aged 40–49 years (table 3). Smaller increases in the odds of LUTS were also observed for men in their fifties and sixties. Odds ratios for measures of socioeconomic status, namely education and income, suggested an inverse relation between the prevalence of moderate to severe LUTS and socioeconomic status. Men who had completed high school had slightly reduced odds of having moderate to severe irritative symptoms (OR = 0.71, 95 percent CI: 0.52, 0.97) when compared with men with less than a high school education. Men with incomes of \$30,000 or more, in comparison with men with lower incomes, experienced reduced risks of moderate to severe LUTS (OR = 0.60, 95 percent CI: 0.43, 0.84) and obstructive (OR = 0.56, 95 percent CI: 0.38, 0.83) and irritative (OR = 0.58, 95 percent CI: 0.43, 0.79) symptoms. Marital status was not associated with urinary symptoms.

Both current and former smokers were at increased odds of having moderate to severe LUTS in comparison with never smokers, although the increase in odds with current smoking was not significant for those who were currently smoking ≥ 20 cigarettes/day (OR = 1.65, 95 percent CI: 0.96, 2.84). Current smoking of ≥ 20 cigarettes/day was also marginally associated with obstructive and irritative symptoms. Former smokers were at increased risk of experiencing obstructive symptoms (OR = 1.83, 95 percent CI: 1.09, 3.06).

Former alcohol drinkers, when compared with never drinkers, had an approximately twofold increase in the odds of moderate to severe LUTS (OR = 2.09, 95 percent CI: 1.24, 3.51), while current heavy drinkers (>72 g/day) had a nearly

TABLE 2. Demographic, lifestyle, and medical history characteristics of African-American men in Flint, Michigan, by age, 1996–1998

Characteristic	Age group (years)										p value*
	Total		40–49		50–59		60–69		70–79		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Marital status											0.2297*
Married/living with partner	407	58.2	117	61.6	119	56.4	90	53.3	81	59.1	
Divorced/separated/widowed	235	30.6	39	20.5	80	37.9	65	38.5	51	37.2	
Never married	65	11.2	34	17.9	12	5.7	14	8.3	5	3.7	
Completed high school	445	70.2	155	81.6	158	74.9	87	51.5	45	32.9	<0.0001
Annual income											<0.0001
<\$15,000	200	27.3	49	26.5	46	22.9	50	30.9	55	41.7	
\$15,000–\$29,999	167	20.9	27	14.6	40	19.9	48	29.6	52	39.4	
\$30,000–\$49,999	121	17.7	29	15.7	33	16.4	42	25.9	17	12.9	
≥\$50,000	192	34.1	80	43.2	82	40.8	22	13.6	8	6.1	
Smoking status											0.0015
Never smoker	157	22.7	43	22.6	51	24.2	37	21.8	26	19.0	
Former smoker	270	33.3	45	23.7	69	32.7	80	47.1	76	55.5	
Current smoker	281	44.0	102	53.7	91	43.1	53	31.2	35	25.6	
Current smoking (cigarettes/day)											0.0408
1–9	67	22.9	24	23.5	20	22.0	10	18.9	13	37.1	
10–19	98	33.1	30	29.4	32	35.2	21	39.6	15	42.9	
≥20	116	43.9	48	47.1	39	42.9	22	41.5	7	20.0	
Former smoking (cigarettes/day)											0.7748
1–9	63	23.7	11	24.4	17	25.0	16	20.8	19	25.0	
10–19	72	26.6	12	26.7	13	19.1	27	35.1	20	26.3	
≥20	131	49.7	22	48.9	38	55.9	34	44.2	37	48.7	
Alcohol drinking status											0.0003
Never drinker	112	15.9	32	16.8	33	15.7	23	13.5	24	17.7	
Former drinker	251	31.7	45	23.7	69	32.9	69	40.6	68	50.0	
Current drinker	343	52.4	113	59.5	108	51.4	78	45.9	44	32.4	
Current alcohol intake (g/day)											0.0010
1–28.3	119	32.0	24	21.2	46	42.6	33	42.3	16	36.4	
28.4–72.0	130	37.6	44	38.9	37	34.3	30	38.5	19	43.2	
≥72	94	30.3	45	39.8	25	23.2	15	19.2	9	20.5	
Former alcohol intake (g/day)											0.0002
1–28.3	95	33.5	11	24.4	22	31.9	27	39.1	35	51.5	
28.4–72.0	61	23.3	7	15.6	21	30.4	16	23.2	17	25.0	
≥72	95	43.2	27	60.0	26	37.7	26	37.7	16	23.5	
Body mass index†											0.0627
<25	215	29.3	52	27.5	63	30.0	50	29.4	50	36.5	
25–29.9	284	40.3	77	40.7	81	38.6	72	42.4	54	39.4	
≥30	207	30.4	60	31.8	66	31.4	48	28.2	33	24.1	
Engaging in vigorous physical activity	445	68.1	162	84.4	123	58.3	94	55.3	66	48.2	<0.0001
Vasectomy	34	5.3	12	6.3	12	5.7	5	3.0	5	3.7	0.1340
History of STDs‡	390	54.3	94	59.5	118	56.2	104	61.5	74	54.4	0.1772
History of hypertension	407	54.1	83	43.7	129	61.1	104	61.2	91	66.4	<0.0001
History of heart disease	77	9.4	11	5.8	23	10.9	21	12.4	22	16.1	0.0031
History of diabetes mellitus	139	16.4	16	8.4	39	18.5	43	25.3	41	29.9	<0.0001

* Chi-square test for association; otherwise, Mantel-Haenszel chi-square test for trend.

† Weight (kg)/height (m)².

‡ STDs, sexually transmitted diseases.

threefold increase (OR = 2.96, 95 percent CI: 1.61, 5.44). The odds of moderate to severe obstructive symptoms (OR =

2.10, 95 percent CI: 1.07, 4.13) and irritative symptoms (OR = 2.04, 95 percent CI: 1.16, 3.57) were increased

TABLE 3. Crude odds ratios for moderate to severe lower urinary tract symptoms and obstructive and irritative symptoms among African-American men in Flint, Michigan, 1996–1998

	Moderate to severe LUTS*				Moderate to severe obstructive symptoms				Moderate to severe irritative symptoms			
	No.	%	OR*	95% CI*	No.	%	OR	95% CI	No.	%	OR	95% CI
Age group (years)												
40–49	48	25.3	1.00		28	14.7	1.00		69	36.3	1.00	
50–59	71	33.7	1.50	0.97, 2.32	50	23.7	1.80	1.08, 3.00	93	44.1	1.38	0.93, 2.07
60–69	49	28.8	1.20	0.75, 1.91	32	18.8	1.34	0.77, 2.34	71	41.8	1.26	0.83, 1.92
70–79	57	41.6	2.11	1.32, 3.38	40	29.2	2.39	1.38, 4.11	75	54.7	2.12	1.36, 3.32
Marital status												
Married/living with partner	120	29.5	0.88	0.50, 1.54	85	20.9	1.17	0.60, 2.28	165	40.5	0.66	0.39, 1.12
Divorced/separated/widowed	84	35.7	1.17	0.65, 2.09	53	22.6	1.29	0.64, 2.58	109	46.4	0.84	0.48, 1.45
Never married	21	32.3	1.00		12	18.5	1.00		33	50.8	1.00	
Completed high school												
Yes	133	29.9	0.79	0.57, 1.09	85	19.1	0.72	0.50, 1.03	180	40.5	0.71	0.52, 0.97
No	92	35.1	1.00		65	24.8	1.00		128	48.9	1.00	
Annual income												
<\$30,000	133	36.2	1.00		91	24.8	1.00		180	49.1	1.00	
≥\$30,000	80	25.6	0.60	0.43, 0.84	49	15.7	0.56	0.38, 0.83	112	35.8	0.58	0.43, 0.79
Cigarette smoking status												
Never smoker	35	22.3	1.00		24	15.3	1.00		64	40.8	1.00	
Former smoker	94	34.8	1.86	1.19, 2.92	67	24.8	1.83	1.09, 3.06	118	43.7	1.13	0.76, 1.68
Current smoker of <20 cigarettes/day	59	35.5	1.92	1.17, 3.14	32	19.3	1.32	0.74, 2.37	68	41.0	1.01	0.65, 1.57
Current smoker of ≥20 cigarettes/day	37	32.2	1.65	0.96, 2.84	27	23.5	1.70	0.92, 3.14	58	50.4	1.48	0.91, 2.40
Alcohol consumption												
Never drinker	24	21.4	1.00		18	16.1	1.00		39	34.8	1.00	
Former drinker	91	36.3	2.09	1.24, 3.51	63	25.1	1.75	0.98, 3.12	121	48.2	1.74	1.10, 2.76
Current drinker of ≤72 g/day	67	26.9	1.35	0.79, 2.30	42	16.9	1.06	0.58, 1.94	97	39.0	1.19	0.75, 1.90
Current drinker of >72 g/day	42	44.7	2.96	1.61, 5.44	27	28.7	2.10	1.07, 4.13	49	52.1	2.04	1.16, 3.57
Body mass index†												
<25	65	30.2	1.00		45	20.9	1.00		88	40.9	1.00	
25–29.9	91	32.0	1.09	0.74, 1.60	59	20.8	0.99	0.64, 1.53	119	41.9	1.04	0.73, 1.49
≥30	68	32.9	1.13	0.75, 1.70	45	21.7	1.05	0.66, 1.67	100	48.3	1.35	0.92, 1.98
Engaging in vigorous physical activity												
No	102	38.5	1.00		72	27.2	1.00		133	50.2		
Yes	123	27.8	0.61	0.44, 0.85	78	17.6	0.57	0.40, 0.83	175	39.5	0.65	0.48, 0.88
Vasectomy												
Yes	10	29.4	0.90	0.42, 1.91	6	17.7	0.79	0.32, 1.96	16	47.1	1.17	0.59, 2.33
No	214	31.8	1.00		143	21.3	1.00		291	43.2	1.00	
History of STDs*												
Yes	139	35.6	1.50	1.08, 2.07	90	23.1	1.30	0.90, 1.88	175	44.9	1.13	0.84, 1.52
No	85	27.0	1.00		59	18.7	1.00		132	41.9	1.00	
History of hypertension												
Yes	150	36.9	1.76	1.26, 2.45	102	25.1	1.76	1.20, 2.58	208	51.1	2.10	1.54, 2.86
No	75	24.9	1.00		48	16.0	1.00				1.00	
History of heart disease												
Yes	40	52.0	2.61	1.61, 4.21	24	31.2	1.81	1.08, 3.05	50	64.9	2.68	1.63, 4.39
No	185	29.3	1.00		126	20.0	1.00		258	40.8	1.00	
History of diabetes mellitus												
Yes	62	44.6	2.01	1.37, 2.93	38	27.3	1.54	1.00, 2.35	81	58.3	2.10	1.44, 3.07
No	163	28.7	1.00		112	19.7	1.00		227	39.9	1.00	

* LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval; STDs, sexually transmitted diseases.

† Weight (kg)/height (m)².

TABLE 4. Adjusted odds ratios for moderate to severe lower urinary tract symptoms and obstructive and irritative symptoms among African-American men in Flint, Michigan (final multivariable model), 1996–1998

	Moderate to severe LUTS*		Moderate to severe obstructive symptoms		Moderate to severe irritative symptoms	
	OR*	95% CI*	OR	95% CI	OR	95% CI
Age group (years)						
40–49	1.00		1.00		1.00	
50–59	1.44	1.12, 1.85	1.84	1.15, 2.95	1.44	0.97, 2.16
60–69	0.99	0.73, 1.34	1.11	0.78, 1.59	0.97	0.74, 1.27
70–79	1.61	1.05, 2.47	1.76	1.32, 2.36	1.44	0.97, 2.16
Annual income \geq \$30,000	0.75	0.60, 0.94	0.65	0.50, 0.84	0.63	0.52, 0.77
Cigarette smoking status					NA*,†	
Never smoker	1.00		1.00		1.00	
Former smoker	1.76	1.29, 2.39	1.87	1.31, 2.66		
Current smoker of <20 cigarettes/day	2.07	1.50, 2.85	1.32	0.90, 1.94		
Current smoker of \geq 20 cigarettes/day	1.51	1.06, 2.15	1.73	1.16, 2.56		
Alcohol consumption						
Never drinker	1.00		1.00		1.00	
Former drinker	1.21	0.95, 1.55	1.24	0.94, 1.64	1.19	0.95, 1.48
Current drinker of \leq 72 g/day	0.87	0.68, 1.12	0.74	0.56, 0.98	1.20	0.96, 1.50
Current drinker of >72 g/day	2.35	1.67, 3.29	1.65	1.13, 2.41	1.92	1.40, 2.62
History of hypertension	1.29	1.04, 1.61	1.33	1.04, 1.72	1.60	1.31, 1.95
History of heart disease	1.96	1.41, 2.74	NA†		2.04	1.46, 2.85
History of diabetes mellitus	1.95	1.49, 2.57	1.50	1.11, 2.04	1.74	1.34, 2.27

* LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval; NA, not applicable.

† Variable was not associated and thus was not included in the final model for this outcome.

twofold among current heavy drinkers as compared with never drinkers.

There was no consistent pattern of association between increasing body mass index and LUTS, but engaging in vigorous physical activity was inversely associated with the odds of moderate to severe LUTS (OR = 0.61, 95 percent CI: 0.44, 0.85) and the odds of obstructive (OR = 0.57, 95 percent CI: 0.40, 0.83) and irritative (OR = 0.65, 95 percent CI: 0.48, 0.88) symptoms. The odds of moderate to severe LUTS, including obstructive and irritative symptoms, were elevated among men with a history of hypertension, heart disease, or diabetes. History of sexually transmitted diseases was associated with moderate to severe LUTS, but having had a vasectomy was not associated with urinary symptom severity.

After adjustment for lifestyle risk factors and medical conditions, the associations between increasing age and severity of urinary tract symptoms persisted (table 4). Similarly, the inverse relations between severity of LUTS, including irritative and obstructive symptoms, and socioeconomic status were evident, after controlling for age, smoking, drinking, and medical history.

In the multivariable adjusted regression model, the associations of current heavy drinking with total LUTS and obstructive and irritative urinary symptoms persisted and were independent of the associations with smoking history. In contrast, the inverse associations between regular vigorous physical activity and severity of LUTS, including

obstructive and irritative symptoms, disappeared after adjustment for other lifestyle and medical history risk factors (data not shown). The associations of history of hypertension or diabetes with LUTS and obstructive and irritative symptoms persisted, though they tended to be of lesser magnitude after multivariable adjustment. Heart disease was associated with a history of LUTS and irritative symptoms after multivariable adjustment for age and smoking and drinking history.

DISCUSSION

To our knowledge, this is the first study undertaken in a population-based sample of African-American men to have assessed the potential role of demographic, lifestyle, and medical history risk factors in the development of LUTS. Current and former smokers exhibited increased odds of moderate to severe LUTS. Alcohol drinking in general was associated with LUTS; in particular, heavy alcohol consumption (>72 g/day) was associated with moderate to severe obstructive and irritative symptoms. Increased socioeconomic status was associated independently with decreased odds of LUTS, while several medical conditions, including a history of hypertension, heart disease, or diabetes, were independently associated with increased risk of LUTS morbidity.

The observed effect of cigarette smoking on risk of surgical intervention for BPH, clinically detectable BPH, or severity of LUTS is conflicting, with some studies showing an inverse association with current smoking (15–18) and others showing no effect (8, 19–28). In the Olmsted County Study, Roberts et al. (29) reported a biphasic association between cigarette smoking and LUTS. For current smokers of less than 1.5 packs per day, the odds ratio was 0.87 (95 percent CI: 0.56, 1.36), whereas current heavy smokers (≥ 1.5 packs/day) were more likely to have severe symptoms (OR = 1.32, 95 percent CI: 0.84, 2.07). Our data suggested that both current smokers and former smokers were more likely than never smokers to experience severe symptoms. This observation was consistent with the findings of Koskimaki et al. (30), who reported increased odds of LUTS in both current smokers (OR = 1.39, 95 percent CI: 1.02, 1.93) and former smokers (OR = 1.34, 95 percent CI: 1.03, 1.75) in a population-based study of Finnish males. Among participants in the Health Professionals Follow-up Study, Platz et al. (9) reported a positive association with BPH in those men who smoked 35 or more cigarettes per day as compared with nonsmokers (OR = 1.45, 95 percent CI: 1.07, 1.97).

Nicotine increases sympathetic nervous system activity (31, 32), and by this mechanism it may exacerbate irritative urinary symptoms (9). In a large cross-sectional study of Austrian men, Haidinger et al. (20) demonstrated that irritative symptoms correlated positively with the number of cigarettes smoked per day. However, Platz et al. (9) noted that obstructive symptoms were more strongly associated than irritative symptoms with current smoking. We did not observe any association between smoking and irritative symptoms, but we noted significant associations with obstructive symptoms in former smokers and current heavy smokers.

Alteration in levels of serum androgenic and estrogenic steroid hormones among smokers has been hypothesized as a potential mechanism in the induction and maintenance of BPH (33–35). Cigarette smoking has been correlated with elevations in mean serum levels of testosterone and androstenedione (36, 37), and Platz et al. (9) hypothesized that elevations in intraprostatic androgens, mainly dihydrotestosterone, resulting from a history of sustained smoking, may be associated with prostate enlargement. However, prostate volume was poorly correlated with LUTS severity in the Flint Men's Health Study (11).

Most studies examining the role of alcohol consumption in risk of surgically treated BPH, clinically diagnosed BPH, or severity of LUTS have shown an inverse association (8, 9, 22, 24, 25) or no association (15, 16, 18, 21, 27, 28) with alcohol consumption. Among participants in the Flint Men's Health Study, positive associations of heavy current alcohol consumption with LUTS and with obstructive and irritative symptoms were observed. Porta et al. (38) also observed a positive association between alcohol consumption and BPH. Haidinger et al. (20) observed higher total symptom scores and irritative scores in men who regularly consumed alcohol as compared with nondrinkers, but only among men aged 40–49 years. In contrast, Platz et al. (9) observed reduced odds of both obstructive symptoms and irritative symptoms

with alcohol consumption. Acute and chronic consumption of alcohol may result in higher serum estrogen levels and reduced androgen levels (39). In several epidemiologic studies, the altered ratio of estrogens to androgens was predictive of increased prostate volume (8, 40, 41).

There are limited data regarding physical activity and BPH, with all studies (8, 18, 42) but one (43) suggesting an inverse association with physical activity. In the Physicians' Health Study (8), men who exercised at least once per week, when compared with more sedentary men, had a lower risk of surgical treatment for BPH. In the Massachusetts Male Aging Study (18), men who were more physically active had a lower risk of clinical BPH than sedentary men. In the Health Professionals Follow-up Study (42), an inverse association was observed between physical activity and surgery for BPH, symptomatic LUTS, and both obstructive and irritative symptoms. In contrast, Lacey et al. (43) found no association between physical activity and BPH in a population-based case-control study in Shanghai, China.

In the Flint Men's Health Study, although our initial analyses indicated significant inverse associations between LUTS severity and engaging in daily vigorous activity, the protective effects observed disappeared after adjustment for sociodemographic, lifestyle, and medical history risk factors. Although the cross-sectional nature of our study does not permit an assessment of risk based on antecedent or repeated measures of exposure, systematic review of the literature suggests that physical activity may be protective. Platz et al. (42) hypothesized that higher levels of physical activity inhibit or modulate sympathetic nervous system activity and thus mitigate the severity of LUTS.

Increases in body mass index are associated with higher levels of estrone and estradiol and lower levels of plasma testosterone (44). Some (20, 45–48) but not all (21, 26, 49) epidemiologic investigations found increased risks of BPH or LUTS with increasing body mass index or obesity. In the present report, body mass index was not a risk factor for LUTS, nor was it associated with the presence of obstructive or irritative symptoms, although in prior analyses we did observe that increasing levels of body mass index were significantly associated with larger prostate volumes (50, 51). Two other studies have also found that increasing levels of body mass index were associated with prostate enlargement but not with the severity of urinary symptoms (45, 47).

In the men with moderate to severe LUTS, we observed significant associations with a history of heart disease, hypertension, or diabetes. Concurrently with BPH, however, cardiovascular disease, hypertension, and diabetes mellitus are common conditions in elderly men (6). However, Hammarsten et al. (48, 52, 53) described components of a metabolic syndrome, namely hypertension, non-insulin-dependent diabetes mellitus, and hyperinsulinemia, as being risk factors for the development of BPH.

Evidence for sociodemographic differences in the odds of BPH or LUTS is conflicting. Glynn et al. (16) reported a reduction in risk of surgery with increasing socioeconomic status. In contrast, Araki et al. (28) and Signorello et al. (21) both found an increase risk of BPH among men with a higher educational background. Two studies have not demonstrated any relation between sociodemographic variables and LUTS

(49, 54). Similar to Glynn et al. (16), we found reduced odds of LUTS and obstructive and irritative symptoms among men with higher incomes, even after adjusting for lifestyle risk factors and medical history. Perhaps increased awareness of symptoms and economic resources may have led these men to seek amelioration with prior treatment.

Longitudinal studies of putative risk factors with repeated measures of LUTS severity are needed to elucidate the natural history of this highly prevalent condition. The potential for selection bias has been considered (12); however, the exclusion of men who reported prior prostatic surgery conceivably selected out men with more extreme exposure and LUTS characteristics. Therefore, our results may represent an underestimate of the prevalence in African-American men of moderate to severe LUTS. Another issue that must be taken into consideration concerns the validity of self-reported information. Medical history was not validated by an independent review of medical records, but in each instance of reported cardiovascular disease or diabetes, the disease was stated to have been diagnosed by a physician and the date of first diagnosis was specified. Although our study findings point to specific risk factors for LUTS, we did not assess other potentially important risk factors such as nutrient and food preference patterns, family history, and putative genetic biomarkers of susceptibility.

This community-based epidemiologic study of LUTS in African-American men aged 40–79 years explored potential sociodemographic, lifestyle, and medical history risk factors. Overall, 29.7 percent (95 percent CI: 26.3, 33.1) of African-American men experienced moderate to severe LUTS. The prevalence of moderate to severe symptoms increased from 25.3 percent in men aged 40–49 years to 41.6 percent in men aged 70–79 years. Heavy alcohol consumption and a history of hypertension or diabetes were positively associated and a higher income was inversely associated with LUTS, including obstructive and irritative symptoms. Current and former cigarette smoking were positively associated with obstructive symptoms, while a history of heart disease was positively associated with irritative symptoms. Longitudinal studies are needed to explicate fully the pattern of the independent relations of sociodemographic, lifestyle, medical history, and other putative epidemiologic risk factors with LUTS morbidity.

Although the severity of LUTS may be viewed as an inevitable consequence of aging, it would appear that cumulative exposures to cigarette smoke and current intense exposures to alcohol, or a lack of regular physical activity in conjunction with the exacerbating effects of chronic medical conditions, can have an impact on a man's quality of life. These observations may provide a rationale for effective medical or preventive interventions targeted toward adult African-American men.

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