



Association Between Socioeconomic Status (SES) and Lower Urinary Tract Symptom (LUTS) Severity Among Black and White Men

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BACKGROUND: A higher prevalence of moderate or severe lower urinary tract symptoms (LUTS) has been reported among African Americans, but the separate effects of race and socioeconomic status (SES) on LUTS severity are unclear.

OBJECTIVE: We investigated the roles of education, income, marital status, and source of health insurance on LUTS reporting among black and white U.S. men.

DESIGN: A prospective cohort within the Southern Community Cohort Study

MAIN MEASURES: The International Prostate Symptom Score (IPSS) was completed during follow-up by 2488 white men and 4188 black men. Multivariable linear and logistic regression methods were used to compare IPSS scores and LUTS severity by race and SES after adjusting for age, duration of follow-up, benign prostatic hyperplasia (BPH) treatment, source of recruitment, smoking status, BMI, mode of follow-up ascertainment, and prior diagnosis of hypertension, diabetes, or hypercholesterolemia.

KEY RESULTS: Overall IPSS scores and the prevalence of moderate/severe LUTS were not significantly associated with race. Instead, higher IPSS scores were significantly associated ($p < 0.05$) with a lower income, marital status, and source of insurance. Education was also marginally associated with IPSS scores ($p = 0.06$) among black men. Furthermore, moderate/severe LUTS onset was significantly associated with a household income less than \$15,000/year (OR=1.56 (1.23, 1.96)) and having private health insurance (OR=0.79 (0.67, 0.93)).

CONCLUSIONS: Social or behavioral factors related to SES affect LUTS reporting, and suggests a potential affect on BPH diagnosis.

KEY WORDS: benign prostatic hyperplasia; lower urinary tract symptoms; race; socio-economic status.

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the more common conditions among aging men, making BPH a leading source of healthcare expenditure in the United States^{1,2}. Unfortunately, the pathophysiology of BPH and the progression to lower urinary tract symptoms (LUTS) remains poorly understood, as not all men with BPH experience symptoms and symptoms are, at best, only moderately correlated with prostate volume³. Indeed, while the diagnosis of many common diseases associated with aging, such as cardiovascular disease or certain cancers, is usually based on a combination of objective laboratory tests and radiologic assessments in addition to more subjective patient reporting, the diagnosis of BPH relies almost entirely on patient reporting and complaints of incomplete emptying, urgency, discomfort, or hesitancy. As such, the diagnosis of BPH has a highly subjective component compared to other common age-related chronic conditions, and may be more susceptible to various forms of reporting bias possibly rooted in sociocultural differences in symptom perception or the willingness of patients to report and discuss urinary symptoms. Education, income, marital status, and source of health insurance are all components of socioeconomic status (SES) which may differ by race/ethnicity, and underlay a broader latent relationship between a person's status in society and the connections to overall health, healthcare access, or individual attitudes and behaviors toward health and well-being. However, the literature exploring the relative importance of race/ethnicity or SES indices on LUTS severity is inconclusive^{4–11}. Better understanding the contributions of race/ethnicity and SES on LUTS reporting could help target clinical evaluation strategies and enhance clinical judgment for BPH risk stratification. However, in order to draw conclu-

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sions concerning the separate effects of race/ethnicity and SES, one needs a racially diverse study population with adequately large differences in SES-related indices within each race/ethnicity. Previous studies have tended to evaluate predominantly white, middle-class study populations and were not ideally suited to address the combined effects of SES and race/ethnicity on LUTS progression. The goal of the current study was to use the Southern Community Cohort Study (SCCS), which collected data from a large, ethnically and economically diverse population to better understand the relationship between incident LUTS/BPH, income, education, marital status, health insurance and race/ethnicity.

METHODS

SCCS Overall Design

A detailed description of the Southern Community Cohort Study (SCCS) has been published previously¹². Briefly, the SCCS is a large-scale prospective cohort study designed to help resolve questions regarding the etiology of lung, breast, colorectal, prostate, and other cancers, as well as to elucidate causes of the disparities in cancer incidence and mortality across racial and urban/rural groups. To be eligible, participants must have been between 40 and 79 years of age; English-speaking; and not under treatment for cancer within the past year (with the exception of non-melanoma skin cancer). All SCCS protocols have been approved by IRBs at Vanderbilt University Medical Center and Meharry Medical College, and all participants provided written informed consent. SCCS recruitment strategies included in-person recruitment from 71 community health centers (CHCs) and a mass-mailing campaign throughout the southeastern United States. CHCs provide medical and preventive care mainly to medically-underserved and lower-income urban and rural areas, while the mass-mailing campaign was developed to include more middle income participants from the southeastern U.S.

Framework

We approached racial differences in LUTS reporting using a conceptual framework developed by Burgess and colleagues to investigate race and self-reported cancer screening behaviors¹⁴. This framework views the relationship between race and self-reported behaviors as being mediated by cognitive pathways (e.g., literacy, knowledge) as well as motivational factors to respond accurately, with each pathway grounded in basic demographic information (e.g., education, income, marital status) and individual health characteristics and histories, and with additional cultural and experiential inputs, to culminate in the formulation of a response to question. Our analyses focus on the mutable demographic characteristics involved in formulating a response, including income, marital status, insurance source, and education as indices of SES that mediate differences in LUTS reporting

between black and white men within this broader conceptual framework.

Baseline Measures

Participants who enrolled at CHCs were interviewed by a trained interviewer using a computer-assisted interview protocol. Baseline data collection included: demographics, including self-defined race, income, and occupation. Additional questions included alcohol and tobacco uses, dietary intake, disease histories, medications, and a wide range of other potential cancer risk factors. This structured interview was converted to a structured self-administered questionnaire to assess the same potential cancer risk factors among participants of the mass-mailing campaign. Subjects were specifically queried as to whether they had a history of BPH or prostate cancer, or if they had ever been told by their healthcare provider that they had an enlarged prostate. Men responding in the affirmative to any of these items were excluded to focus the current analysis on incident LUTS.

Follow-up Measures

An average of approximately five years after their enrollment (range 1.4 to 7.6 years), participants were contacted to complete a 4-page follow-up survey (available at www.southerncommunitystudy.org) by telephone interview or mailed questionnaire. Questions assessed changes in tobacco use, medication use, and asked participants if they had been diagnosed with cancer, diabetes, heart disease, and other conditions since baseline. Men were asked if they had been diagnosed with BPH or received treatment for BPH since baseline. They also completed the International Prostate Symptom Score (IPSS) to ascertain the presence and severity of LUTS. The IPSS is a validated and reliable questionnaire that is considered the gold standard for assessment of LUTS in men¹³. Responses to the seven IPSS items on a Likert scale are summed, and increasing IPSS scores are used to categorize patient symptoms as having mild (0 to 7), moderate⁸⁻¹⁹, or severe (20 to 35) LUTS. For this analysis, participants who reported an IPSS score of 8 or higher on the follow-up survey were considered to have incident LUTS. In addition, participants who had IPSS scores of less than 8 but reported the initiation of medical BPH treatment or surgical intervention for BPH during the follow-up period (n=155) were also considered to have incident moderate/severe LUTS.

Statistical Analysis

From the 9,271 male subjects who completed the baseline and follow-up survey we excluded participants reporting at baseline a prior prostate cancer (n=276) or BPH (n=1020) diagnosis. Further exclusion included incident prostate cancer on the follow-up questionnaire (n=167) or who were identified as having been diagnosed with prostate cancer since baseline through linkage with relevant cancer registries (n=18). We also excluded participants with incomplete IPSS responses (n=768), or reporting race/ethnicity other than black or white (n=

346), leaving 6,676 participants (2,488 white and 4,188 black men).

Descriptive characteristics were compared across race using analysis of variance. Multivariable linear regression was used to compare average IPSS scores among black compared with white men while controlling for age, length of follow-up, BPH treatment, source of recruitment, mode of follow-up ascertainment, smoking status, BMI, and a prior diagnosis of hypertension, diabetes, or high cholesterol levels. Additional models also controlled for SES effects by adding income, education, marital status and source of health insurance, and partial F-tests were used to develop p-values to evaluate the importance of each factor within race groups. Multivariable logistic regression was used to calculate odds ratios (OR) and 95% confidence intervals (95% CI) summarizing the association between moderate/severe LUTS, race/ethnicity, and factors associated with healthcare access and SES. Interactions between race and factors related to SES or healthcare access were investigated using a cross-product term between race and the factor in a model that contained all main-effect terms. P-values less than 0.05 were considered significant, and all analyses were conducted using Statistical Analysis System (SAS, version 9.2) software.

RESULTS

The participants ranged in age at cohort entry from 40 to 79 years (Table 1). White men were more likely than black men to be married (67% vs. 39%), to have any health insurance (77% vs. 59%), an income above \$25,000 (58% vs. 23%), to have private health insurance (42% vs. 22%), and prior diagnoses of hypercholesterolemia (45% vs. 28%). Tobacco use was more common among black men (51% vs. 26%).

Table 2 presents adjusted IPSS scores for white and black men stratified by education, income, marital status, and source of health insurance. Higher IPSS scores were associated with a lower household income and a lower education level. However, the association between education and IPSS scores became weaker and was only marginally significant ($p=0.06$) among black men after controlling for income, marital status, and insurance source. Marital status remained significant only among black men after controlling for other SES indices. IPSS scores significantly varied with sources of insurance, with the lowest IPSS scores among black men with private health insurance or white men with military insurance. Lack of a significant interaction between race and indices of SES suggested observed heterogeneity between race groups was not large.

IPSS scores were approximately 0.3 points higher among white men compared to black men ($P=0.11$, adjusted for age, time between baseline and follow-up, recruitment source, and model of follow-up ascertainment). Similarly, race/ethnicity was not significantly associated with the prevalence of moderate/severe LUTS ($(OR=0.98 (0.87, 1.11))$ (Table 3). Further control for SES ($OR=0.91 (0.80, 1.03)$) and comorbidity ($OR=0.89 (0.79, 1.02)$) did not substantially change this result.

Additional analyses in Table 3 characterize the components of SES relevant to LUTS reporting. Moderate to severe LUTS remained significantly associated with a lower income after controlling for other SES indices and comorbidities (income <

Table 1. Study Population Description at Baseline

	White		Black		P values
	n	%	n	%	
Age (years)					$p<0.0001$
40-49	754	30%	2109	50%	
50-59	970	39%	1512	36%	
60-69	658	26%	481	11%	
70-79	106	4%	86	2%	
Education					$p<0.0001$
<9 years	137	6%	296	7%	
9-11 years	213	9%	844	20%	
High school or equivalent	719	29%	1714	41%	
Some or junior college	493	20%	832	20%	
College graduate	922	37%	499	12%	
Unknown	4	0%	3	0%	
Total household income					$p<0.0001$
<\$15,000 per year	667	27%	2192	52%	
\$15,000 - \$24,999	320	13%	946	23%	
\$25,000 - \$49,999	478	19%	600	14%	
\$50,000+	978	39%	391	9%	
Unknown	45	2%	59	1%	
Marital Status					$p<0.0001$
Currently married	1679	67%	1638	39%	
Separated/divorced	423	17%	1186	28%	
Widowed	49	2%	133	3%	
Single	234	9%	1202	29%	
Unknown	103	4%	29	1%	
Health insurance					$p<0.0001$
Medicare	570	23%	754	18%	
Medicaid	118	5%	484	12%	
Military	143	6%	208	5%	
Private	1052	42%	934	22%	
Other	23	1%	70	2%	
None	560	23%	1711	41%	
Unknown	22	1%	27	1%	
Body mass index (kg/m ²)					$p<0.0001$
<18.5	18	1%	52	1%	
18.5-24.99	604	24%	1264	30%	
25-29.99	1004	40%	1464	35%	
30-34.99	548	22%	830	20%	
35+	301	12%	552	13%	
Unknown	13	1%	26	1%	
Current smoker	638	26%	2129	51%	$p<0.0001$
Ever Diagnosed					
Hypertension	1152	46%	2210	53%	$p<0.0001$
Diabetes	410	16%	774	18%	$p=0.03$
High cholesterol	1117	45%	1152	28%	$p<0.0001$
Enrolled at a CHC	1111	45%	3604	86%	$p<0.0001$
Telephone Follow-up	157	6%	1051	25%	$p<0.0001$
BPH and LUTS at Follow-up					
BPH treatment recently	163	7%	270	6%	$p=0.87$
LUTS Severity (IPSS)					$p<0.0001$
Mild	1585	64%	2359	56%	
Moderate	582	23%	1170	28%	
Severe	321	13%	659	16%	

\$15,000: $OR=1.56 (1.23, 1.96)$. Private health insurance was associated with a lower risk ($OR=0.79 (0.67, 0.93)$), while marital status and education were no longer significantly associated with progression to moderate/severe LUTS.

DISCUSSION

Patient reporting of LUTS severity could be affected to socio-cultural factors affecting reporting, comorbidity status, or risk

Table 2. IPSS Scores by Education, Income, Marital Status, and Source Of Health Insurance, Among White And Black Men

		White*	Black*	P (int)§	White**	Black**	P (int)§
		Mean (95% CI)	Mean (95% CI)		Mean (95% CI)	Mean (95% CI)	
Education	<9 years	10.9 (9.4-12.3)	12.5 (11.4-13.6)		10.0 (8.3-11.7)	11.8 (10.5-13.1)	
	9-11 years	11.7 (10.3-13.0)	11.4 (10.5-12.2)		11.1 (9.6-12.7)	10.9 (9.9-11.9)	
	High school	10.7 (9.6-11.8)	10.8 (10.0-11.6)		10.6 (9.3-11.9)	10.5 (9.6-11.5)	
	Any college	11.0 (9.9-12.2)	10.5 (9.7-11.4)		11.1 (9.7-12.4)	10.4 (9.4-11.4)	
	College graduate	10.2 (9.0-11.3)	10.1 (9.1-11.0)	0.10	10.6 (9.2-12.0)	10.2 (9.1-11.3)	0.06
Household income	PSS	0.05	0.001		0.42	0.06	
	<\$15,000 per year	12.0 (10.8-13.1)	11.7 (10.9-12.5)		11.7 (10.4-13.0)	11.4 (10.5-12.3)	
	\$15,000 - \$24,999	10.9 (9.6-11.8)	10.9 (10.1-11.8)		10.7 (9.3-12.2)	11.0 (10.0-12.0)	
	\$25,000 - \$49,999	10.2 (9.1-11.4)	9.5 (8.6-10.4)		10.5 (9.1-11.9)	9.8 (8.8-10.9)	
	\$50,000+	9.4 (8.2-10.5)	10.1 (9.1-11.2)	0.12	9.8 (8.4-11.3)	10.8 (9.6-12.1)	0.09
Marital Status	PSS	<0.001	<0.001		0.02	0.001	
	Married	10.6 (9.5-11.6)	10.4 (9.6-11.2)		10.3 (9.2-11.5)	10.8 (10.0-11.8)	
	Separated/divorced	11.6 (10.4-12.8)	11.2 (10.4-12.0)		10.9 (9.6-12.2)	11.4 (10.4-12.3)	
	Widowed	11.6 (9.4-13.7)	9.5 (8.0-10.9)		11.1 (8.9-13.4)	9.6 (8.1-11.1)	
	Single	11.5 (10.1-12.8)	11.3 (10.4-12.1)	0.56	10.4 (8.9-11.8)	11.3 (10.3-12.2)	0.52
Health insurance	PSS	0.03	0.003		0.46	0.04	
	Medicare	11.6 (10.5-12.7)	11.1 (10.2-12.0)		11.7 (10.4-13.0)	10.6 (9.6-11.6)	
	Medicaid	11.7 (10.1-13.2)	12.0 (11.0-12.9)		11.2 (9.5-13.0)	11.4 (10.3-12.4)	
	Military	9.6 (8.1-11.1)	10.7 (9.5-11.9)		10.0 (8.3-11.6)	10.6 (9.3-11.9)	
	Private	9.6 (8.5-10.7)	9.7 (8.9-10.6)		10.2 (8.9-11.5)	9.9 (8.9-10.8)	
	Other	9.8 (7.0-12.7)	11.5 (9.5-13.4)		10.1 (7.1-13.1)	11.4 (9.5-13.4)	
	None	11.3 (10.1-12.4)	11.2 (10.4-12.0)	0.65	11.0 (9.7-12.3)	10.7 (9.8-11.7)	0.61
	PSS	<0.001	<0.001		0.04	0.04	

* IPSS scores adjusted for baseline age, time between baseline and follow-up, on-going BPH treatment, recruitment source (GP vs CHC), BMI, current smoking status, mode of follow-up ascertainment, and a prior diagnosis of hypertension, diabetes, and high cholesterol

** IPSS scores also adjusted for other listed factors (i.e., baseline education, income, marital status, and insurance source)

§ p for interaction between race/ethnicity and each factor

§§ p for differences within each race/ethnicity group

factors related to LUTS etiology. Furthermore, the relative importance of these factors may differ across race/ethnicity groups. Results from the SCCS, a large diverse community-based sample of men, indicate that there is little difference in LUTS severity or the incidence of moderate/severe LUTS between black and white men. In contrast, lower income was significantly associated with higher IPSS scores and the risk of developing moderate/severe LUTS. IPSS scores were also significantly associated with the type of insurance coverage, while IPSS scores among black men were also associated with marital status and marginally with education. These patterns suggest that social and economic factors require further consideration the detection of moderate/severe LUTS.

Previous research of SES and LUTS measurement has generally reported results similar to ours, although findings with respect to racial differences in LUTS have been mixed. Johnson and colleagues administered the IPSS to 407 urology patients identified from a public hospital or a university hospital in Atlanta, Georgia. IPSS question comprehension was assessed by comparing written IPSS responses to those during a later clinical interview^{4,5}. Patient comprehension of IPSS questions was significantly lower among those with a lower literacy level, less education, and among patients seeking healthcare at a publically-funded hospital. For variation by race, analysis of data from the Third National Health and Nutrition Examination Survey (NHANES III) found race/ethnicity differences in LUTS were substantially reduced after adjusting for education and marital status⁶. In addition, black and white men had similar BPH or LUTS prevalence in analyses from the Health Professionals Follow-up Study¹⁵ and the Boston Area Community Health (BACH) survey¹⁶. On the other hand, Kristal and colleagues reported that black men

in the Prostate Cancer Prevention Trial had a significant 41% increased risk of BPH progression compared to white men despite comparable monitoring protocols across all study participants⁷. Furthermore, combined analyses of the Flint Men's Health Study and Olmsted County Study of Urinary Symptoms found greater LUTS severity among black men despite controlling for income, education, and marital status⁸. These findings, although inconsistent, had raised the possibility that there are race/ethnicity differences in the pathobiology of BPH and LUTS progression consistent with higher age-adjusted prostate size and higher prostate-specific antigen (PSA) levels reported among African-American men⁹⁻¹¹. Our results suggest that racial differences in LUTS presentation may be predominantly socioeconomic in nature.

We previously reported that black SCCS participants were less likely to be diagnosed with BPH, but also more likely to have a surgical intervention for BPH¹⁷. This suggested a delayed BPH diagnosis among black men, permitting the disease to advance to a state requiring surgical intervention. However, we were unable to evaluate the possibility that racial differences in LUTS severity were responsible for differences in BPH diagnoses and treatment. Here, we find that black men report similar levels of moderate/severe LUTS as white men, suggesting that our prior observation of a lower BPH diagnosis prevalence among black men is unlikely to derive from lower LUTS severity. Prior analyses also have suggested that racial/ethnic differences in LUTS or BPH derive from inherited genetic differences in androgen metabolism, androgen activity, or other biological differences¹⁸⁻²¹. We found that racial differences in the SCCS could be attributed to SES, and may suggest previously reported racial differences in BPH diagnoses and treatment patterns are more likely to be a function of healthcare access and utilization.

Table 3. Multivariable Logistic Regression Modeling Results for Progression to Moderate/Severe LUTS

		OR ^a	95% CI	OR ^b	95% CI	OR ^c	95% CI
Race	White	1.0	Ref	1.0	Ref	1.0	Ref
	AA	0.98	0.87, 1.11 P=0.75	0.91	0.80, 1.03 P=0.14	0.89	0.79, 1.02 P=0.084
Education	College or more	1.0	Ref	1.0	Ref	1.0	Ref
	Some college	1.26	1.07, 1.49	1.09	0.91, 1.31	1.05	0.87, 1.26
	High school	1.28	1.10, 1.49	1.07	0.90, 1.27	1.03	0.86, 1.23
	9-11 yrs	1.59	1.33, 1.91	1.23	1.00, 1.52	1.17	0.95, 1.45
	< 9 yrs	1.48	1.17, 1.88 P<0.0001	1.07	0.82, 1.39 P=0.32	1.02	0.78, 1.33 P=0.51
Marriage	Married	1.0	Ref	1.0	Ref	1.0	Ref
	Separated/divorced	1.28	1.12, 1.45	1.11	0.97, 1.27	1.13	0.98, 1.30
	Widowed	0.79	0.57, 1.08	0.70	0.51, 0.97	0.74	0.53, 1.02
	Single	1.25	1.09, 1.44 P<0.0001	1.03	0.89, 1.20 P=0.045	1.07	0.92, 1.24 P=0.054
Annual Income	\$50,000 or more	1.0	Ref	1.0	Ref	1.0	Ref
	\$25,000 - \$49,999	1.15	0.96, 1.38	1.06	0.87, 1.30	1.05	0.85, 1.29
	\$15,000-\$24,999	1.64	1.36, 1.97	1.40	1.13, 1.75	1.36	1.09, 1.71
	less than \$15,000	1.99	1.67, 2.37 P<0.0001	1.59	1.27, 2.00 P<0.0001	1.56	1.23, 1.96 P=0.0001
Health Insurance	None	1.0	Ref	1.0	Ref	1.0	Ref
	Medicare	1.16	0.99, 1.35	1.17	1.00, 1.37	1.09	0.93, 1.28
	Medicaid	1.23	1.02, 1.47	1.17	0.97, 1.41	1.10	0.91, 1.33
	Military	0.88	0.69, 1.12	1.02	0.80, 1.32	1.01	0.78, 1.31
	Private	0.66	0.57, 0.76	0.80	0.68, 0.94	0.79	0.67, 0.93
	Other	0.97	0.63, 1.49 P<0.0001	1.04	0.67, 1.61 P=0.0008	1.05	0.67, 1.64 P=0.009

IPSS score of 8 or more, or initiation of BPH treatment after baseline

a. adjusted for age, time between baseline and follow-up, recruitment source (GP vs CHC), and mode of follow-up ascertainment

b. adjusted for age, time between baseline and follow-up, recruitment source (GP vs CHC), mode of follow-up ascertainment, race, education, marital status, income, and insurance source

c. adjusted for age, education, marital status, income, insurance source, time between baseline and follow-up, recruitment source (GP vs CHC), BMI, current smoking status, mode of follow-up ascertainment, and a prior diagnosis of hypertension, diabetes, and high cholesterol

The role of SES in BPH diagnosis is poorly understood, but may operate through cognitive factors or question comprehension¹⁴. Klag and colleagues observed that there was an association between black race and higher blood pressure only among men with a lower education level, suggesting black men may be sensitive to the effects of education on health outcomes²⁵. Our analysis found the association between education and IPSS scores was largely removed with control for income, marital status, and insurance coverage, although we did note a residual trend with education level among black men, and it remains possible that education or an unknown correlate of education plays an additional role in LUTS reporting among black men. Education is distinct from income as an index of SES in that, for most men, education levels are attained during youth and remain relatively stable with aging. In contrast, income changes over time, and may change unexpectedly. Men with a higher level of education may be better informed, have a greater sense of control, or may have a greater cognitive ability to respond to questions. Lower education levels have been associated with a greater number of symptoms^{6,22}, which perhaps suggests that questionnaire comprehension, patient literacy, or numeracy affects LUTS reporting. MacDiarmid and colleagues reported that a minimum of a 6th grade reading level is required for the IPSS²³. However, words such as 'urinate', 'urgency', and 'nocturia' are not used in common conversation, and older patients with lower reading skills, inadequate health literacy, or a more limited vocabulary may not fully comprehend the intent of the questions despite attaining a level of education believed to be sufficient for comprehension. The IPSS further requires patients to make a numerical estimate of symptom frequency, suggesting poor health numeracy and math-related

skills may also affect symptom reporting. Indeed, Masters and colleagues found poor numeracy skills predicted IPSS scores even after adjusting for education²⁴. Thus, the roles of health literacy or numeracy in at-risk population require evaluation, and practitioners should consider patient question comprehension.

In contrast to education, a lower income was associated with higher IPSS scores and an increased risk of moderate/severe LUTS among both white and black men. Income continued to be associated with moderate/severe LUTS despite adjusting for race and other SES indices, possibly reflecting additional resources and options for accommodating the inconveniences associated with LUTS available to higher income men. Similarly, higher income men may have fewer environmental or behavioral risk factors for LUTS progression, although we also controlled for many of these. Beyond income, indices of healthcare access such as private (blacks) or military (whites) health insurance coverage were associated with IPSS scores and moderate/severe LUTS. We have previously reported that married black men were more likely to be report a prior BPH diagnosis compared to unmarried black men, presumably through greater symptom awareness and also in recognition of the importance of women in the healthcare of men²⁶. A protective association for moderate/severe LUTS onset among widowed men may illustrate the role of symptom awareness and concern in diagnosing progressive BPH.

Strengths of this analysis include the investigation of a large sample of black and white men with a wide range of overlapping SES indices and sources of healthcare (especially the lower ranges of the SES distribution), while controlling for

BMI and multiple comorbidities. Past analyses were not able to make direct comparisons between black and white populations because of discriminating SES indices between race groups. Furthermore, we excluded men previously diagnosed with BPH, and controlled for men reporting treatment for BPH during the follow-up period. Reverse causality (i.e., more severe LUTS leading to limited employment and thus a lower income or change in insurance or marital status) is possible but unlikely as our LUTS outcome was ascertained on average five years after collecting baseline income information, and to the best of our ability the study was limited to men who were BPH-free at baseline.

Limitations include the possibility that self-reported symptom scores are affected by sociobehavioral or motivational factors that could not be addressed. It is possible that incident LUTS is over-estimated during the study period if some men had moderate LUTS at study entry but were never diagnosed or treated for BPH. However, these men clearly had LUTS at follow-up and our results are highly consistent with prior work in this area. It is also possible that differential measurement error with respect to race/ethnicity may impose the appearance of a racial difference in IPSS scores across educational status, and this would best be addressed through direct ascertainment of questionnaire comprehension. Generalization of our results will require replication.

In conclusion, results from the SCCS found that race was not associated with IPSS scores. Instead, socioeconomic and demographic factors were associated with IPSS scores and the onset of moderate/severe LUTS.

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