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Prevalence and Correlates of Nocturia in Community-Dwelling Older Adults

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Abstract

Objectives—To determine the prevalence and correlates of nocturia in community-dwelling older adults.

Design—Planned secondary analysis of cross-sectional data from the University of Alabama at Birmingham Study of Aging population-based survey.

Setting—Participants' homes.

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Participants—One thousand older adults (aged 65 to 106 years) recruited from Medicare beneficiary lists between 1999 and 2001. The sample was selected to include 25% African American women, 25% African American men, 25% white women, and 25% white men.

Measurements—In-person interviews included socio-demographic information, medical history, Mini-Mental State Examination, and measurement of body mass index (BMI). Nocturia was defined in the main analyses as getting up 2 or more times per night to void.

Results—Nocturia was more common among men than women (63.2% vs. 53.8%, OR=1.48, 95% CI=1.15–1.91, $P=.003$) and more common among African Americans than whites (66.3% vs. 50.9%, OR=1.89, CI=1.46–2.45, $P<.0001$). In multiple backward elimination regression analysis in men, nocturia was significantly associated with African American race (OR=1.54) and BMI (OR=1.22 per 5 kg/m²). Higher MMSE was protective (OR=0.96). In women, nocturia was associated with older age (OR=1.21 per 5 years), African American race (OR=1.64), history of any urine leakage (OR=2.17), swelling in feet and legs (OR=1.67), and hypertension (OR=1.62). Higher education was protective (OR=0.92).

Conclusion—Nocturia in community-dwelling older adults is a common symptom associated with male gender, African-American race, and some medical conditions. Given the significant morbidity associated with nocturia, any evaluation of lower urinary tract symptoms should include assessment for the presence of nocturia.

Keywords

nocturia; urination; epidemiology; prevalence; risk factors

INTRODUCTION

Nocturia, defined as waking from sleep at night to void,¹ is a common symptom in both men and women. In epidemiologic studies, its prevalence ranges from 18.1% to 57.1% and increases with age.^{2–8} Older adults are not only more likely to experience nocturia, but they are more likely to have multiple episodes per night.⁹

Nocturia has a negative impact on sleep,^{2,10} leading to daytime fatigue, increased frequency of napping,¹¹ missed work and possibly depression.^{2,3,12} Among older adults, it has been associated with increased risk of falls¹³ and coronary heart disease mortality.¹⁴ Among men, it has been shown to be one of the most bothersome symptoms associated with benign prostatic hyperplasia (BPH).¹⁵ Although the literature is inconsistent, previous research has reported a number of correlates of nocturia, including sleep apnea, cardiac disease, hypertension, diabetes, depression, diuretic use, urinary incontinence, increased body mass index (BMI), and race.^{3,4,7,8,12,16–21} In one community-based study, nocturia rates were highest among African-Americans in comparison to Hispanic and white participants, but a paucity of data exist about racial and ethnic differences.^{3,22, 23}

Nocturia is an under-reported, under-studied, and infrequently recognized problem in older adults.²⁴ The present study reports a planned secondary analysis of data from a population-based study of older adults, stratified by gender, race (white versus African American) and rural versus urban dwelling. The purpose of this analysis was to estimate the prevalence of nocturia in community-dwelling older adults and to identify correlates of the presence of nocturia in this population.

METHODS

This paper reports a secondary analysis of data from the UAB (University of Alabama at Birmingham) Study of Aging, a longitudinal study of risk factors for mobility in older adults.

Participants and Recruitment

From November 1999 to February 2001, 1,000 participants were enrolled from the Medicare beneficiary lists of five counties in west central Alabama. The lists were stratified by gender, race, and county (urban versus rural). The five counties have a significant proportion of African American residents (20% to 65%), and were chosen for their proximity to the study centers. The sample was specifically selected to include 25% African American women, 25% African American men, 25% white women, and 25% white men.

Recruitment for the UAB Study of Aging has been previously described in detail.²⁵ Potential participants were sent letters about the study, followed by a telephone call to arrange in-home interviews. The study protocol was approved by the University Institutional Review Board for Human Use. All participants signed informed consent forms prior to the beginning of the interview.

Interview Procedures

Interviews lasted approximately 2 hours. Using a structured questionnaire, trained interviewers asked participants about sociodemographic factors, medical history, and health behaviors. Sociodemographic factors included self-reported age, race, and education. Rural vs. urban residence was classified based on county designation.

To quantify nocturia, participants were asked, "How many times do you get up at night to urinate?" and asked to respond with a whole number. For the analyses of correlates of nocturia, a threshold of two or more times per night was used to define nocturia, because it is more clinically relevant than using a single episode.²⁶ Medical history included self-report of congestive heart failure, hypertension, diabetes, and COPD. Swelling in the feet and legs was defined as a positive response to a probe about swelling, which was asked if they answered "yes" to the question, "Has a physician ever told you that you had peripheral vascular disease or circulatory problems, that is, a problem with arteries, veins, or swelling?" Symptoms of incontinence were determined by a positive response to the question, "Have you ever leaked even a very small amount of urine?" Variables unique to men included benign prostatic hyperplasia and a history of prostate surgery. Variables unique to women included a history of hormone replacement therapy, hysterectomy, and bladder surgery.

To verify medical conditions, participants' personal physicians were contacted by mail to confirm medical diagnoses, and hospital discharge summaries were requested for participants hospitalized within three years of the interview. To identify diuretic use, participants were asked to show the interviewers all medications they were taking, both prescription and non-prescription. These were listed by the interviewer and categorized using the American Hospital Formulary Service Pharmacologic-Therapeutic Classification.²⁷

Participants were measured for height and weight. BMI was calculated from the measured height and weight (kg/m^2) for persons able to stand (91% of the sample). For participants unable to stand, height and weight were calculated from knee-height and arm circumference measurements obtained at the in-home interview ($n=89$). If the knee height was unavailable,

self-reported height and weight were used to calculate BMI ($n=37$). The Mini-Mental State Exam (MMSE) was used to assess cognitive status.²⁸

Statistical Analysis

For the analysis of correlates, nocturia was defined as a dichotomous variable, with participants who reported getting up 2 or more times per night to void coded as 1, and those getting up once a night to void or not at all coded as 0.

Logistic regression analyses were conducted for men and women separately to evaluate which factors were correlated with nocturia. Potential correlates included demographic variables (age, race, rural residence, education), MMSE score, BMI, history of incontinence, alcohol use, diuretics, and the medical history variables. We selected our independent variables with an interest in identifying factors that potentially contribute to nocturia or place a person at risk for nocturia.

Odds ratios for each correlate were calculated from univariate models that included no covariate adjustments and from multivariable models that adjusted for the effects of age, race, and rural versus urban status. Race and rural versus urban residence were included as demographic covariates in these models due to their prominence as stratifying factors in the sampling design. All variables for each gender were then entered into a comprehensive multivariable model, and backward elimination was used to remove variables one at a time based on the highest p -value until only statistically significant predictors remained ($P < .05$). SAS Proc Logistic (Version 9) was used for the statistical analyses.

RESULTS

The characteristics of the 1,000 participants are shown in Table 1. Mean age was 73.8 years. By design, the sample consisted of 25% African American women, 25% African American men, 25% white women, and 25% white men. The mean score on the Mini-Mental Status Exam was 25 (SD: 4.9), and 29.8% scored below 24.

The overall prevalence of nocturia (≥ 2 voids per night) was 58.5%, including 31.8% who reported getting up at least 3 times per night to void (Table 2). Nocturia was more common among men than among women (63.2% vs. 53.8%, OR = 1.48, 95% CI = 1.15 – 1.91, $P = .003$). Mean voids per night was 2.15 (SD: 1.64) for men and 1.93 (1.55) for women ($P = .03$). Nocturia was also more common among African Americans than whites (66.3% vs. 50.9%, OR = 1.89, 95% CI = 1.46 – 2.45, $P < .0001$). Subsequent analyses were conducted separately for women and men.

The univariate analyses and the multivariable analyses adjusting for the effects of age, race, and rural status identified several significant correlates of nocturia in men (Table 3) and in women (Table 4). In the final multivariable model from the backward elimination analyses for the men, nocturia was associated with African American race and higher BMI (Table 5). Higher MMSE score was protective. In the final multivariable model for the women, the following factors were significantly associated with nocturia: older age, African American race, history of urinary incontinence, swelling in the feet and legs, and hypertension (Table 5). Higher education level was protective.

DISCUSSION

The results of this study demonstrate a high prevalence of nocturia in a community-based sample of older adults. At 58.5%, the overall prevalence of nocturia in this sample was higher than has been reported in other studies. Much of this difference can be attributed to

the age of the respondents. All participants in the UAB Study of Aging were over 65 years of age, with slightly more than half over the age of 75 years, and there was no upper limit on age. Several studies,^{3–6} including the present study, have demonstrated a relationship between nocturia and age. For example, in a population-based study of men in Finland, Tikkinen and colleagues found that men 70–79 years of age had 155 times greater odds of having nocturia compared to men under the age of 30.⁵ In the Boston Area Community Health (BACH) study, responses from 5,506 adults aged 30–79 indicated an overall prevalence of 28.4% for nocturia;³ but with the sample restricted to only those aged 60–79, the prevalence of nocturia was 41.2%.

Another factor contributing to the high prevalence of nocturia in this study may have been the racial make-up of the study sample, which over-represented African Americans by design. Adjusted to match the percentage of African Americans in the state (26.3%), the prevalence of nocturia in community-dwelling older adults would be 55%.

In the current study, a greater proportion of men (63.2%) than women (53.8%) reported having two or more episodes of nocturia. While authors utilizing population-based studies have alternately concluded that nocturia was more common in women,^{3,6} more common in men,² or equally common,¹⁰ most of the differences in the findings have likely resulted from the age of the sample. In general, samples considering all adults or only younger adults have shown a higher prevalence of nocturia in women,⁶ whereas samples of older adults or those with consideration of prevalence by age strata have shown older men to more often have nocturia.⁵ This is understandable from a pathophysiologic perspective, as benign prostatic hyperplasia is a contributing factor in men, and rises dramatically in prevalence with age, but is not a relevant factor for nocturia in women. Interestingly, in men, having a diagnosis of BPH was not associated with nocturia when adjusting for other variables. This gender difference in nocturia prevalence was the basis for the decision to analyze the correlates of nocturia separately for men and women in the present study.

One of the most interesting and provocative findings of this study is the higher prevalence of nocturia among African Americans, both among men and women. This finding corroborates an earlier report from the BACH study, which included 1,770 African American respondents and 1,859 white individuals.^{3,23} Similar to the present study, in multivariable analysis, African Americans had a nearly 90% greater odds of reporting nocturia compared to whites even after controlling for sociodemographic factors. Most population-based studies examining nocturia have had inadequate minority representation for analysis of racial differences.⁵

One possible explanation for the observed racial differences in nocturia is that African American respondents had a higher prevalence of conditions that could possibly cause nocturia (diabetes mellitus, hypertension, obesity, and cardiovascular disease). Although we controlled for the presence or absence of these conditions in the multivariable analysis, it is possible that this dichotomous approach might not adequately capture whether a given condition is of sufficient severity to contribute to nocturia.

A second possibility is that differences are due to factors not measured in this study. Since there were no frequency-volume charts or sleep diary data, there might have been undetected differences in nocturnal polyuria or in sleep apnea. For example, older African-Americans have been reported to have twice the rates of sleep apnea when compared to Caucasians.²⁹ Another possibility is that a portion of African American respondents had sickle-cell trait, since between 8% and 12% of African Americans have this genotype. While most individuals show no overt disease, sickle trait can result in renal concentration deficits,

which through nocturnal polyuria could result in nocturia. Most likely, the racial differences between African Americans and whites are a combination of multiple factors.

Other variables significantly and independently associated with nocturia in women included history of any urinary leakage, swelling in the feet and legs, hypertension, and less education. The association between nocturia and urinary incontinence has been reported in a prior study of older women,⁸ and may be explained by these symptoms having a common causal mechanism in overactive bladder or a weak pelvic floor. This is consistent with the observation that treatments for urgency and incontinence in women with urge predominant urinary leakage have also been effective for nocturia as well.³⁰

Pathophysiologically, swelling in the feet and legs could be related to nocturia in several ways. First, for some individuals, lower extremity edema may be part of congestive heart failure, which itself has been shown in other samples to be associated with nocturia (and with nocturnal enuresis).³¹ Alternatively, lower extremity edema tends to mobilize with the recumbent position at night, resulting in a nocturnal polyuria which increases nocturia. The association of nocturia with less education is unclear and may be due to differences in reporting related to health literacy. Perhaps, individuals with less education may have less knowledge of medical conditions, a different understanding of how the body works, and possibly different language usage for reporting medical conditions.

For men, only two additional significant and independent correlates were identified: higher BMI and lower Mini Mental State score. The association of nocturia with lower Mini-Mental State Examination scores is difficult to explain, but it may be related to issues of reporting as we suggested for the association of nocturia with lower education in women. MMSE scores are lower in persons with lower education levels.

The relationship of nocturia with BMI has been reported for both men and women in several prior studies.^{3,6,7,17,18,20,32,33} Some investigators have reported that the association was strong in women but weaker or absent in men.^{6,17} Others report the opposite,⁶ consistent with the present study, in which BMI was an independent risk factor only in men, and not in women. These different results are likely due to differences in study populations (6,000 Finns with a younger average age versus 1,000 older African-Americans and whites). The absence of age as a risk factor for men in the UAB Study of Aging may be a consequence of the older age distribution of the respondents. Clearly, age has been shown to be a very strong risk factor for nocturia when considering a sample of adult men of all ages.⁵

Our study has several strengths. It is among the first studies to model correlates of nocturia separately for men and women from the same study population.^{20,34} Also, the sample was population-based, with respondents identified using sampling from Medicare beneficiary lists. Further, participants were interviewed in their own homes, where actual weight and height measurements could be taken. Balanced sampling of men and women and over sampling of African Americans allowed for sound gender and racial comparisons. Finally, questions about lower urinary tract symptoms were included and *a priori* analyses planned in the original design of the UAB Study of Aging.

The primary limitation of the study, as in most studies of correlates of nocturia, is that presence of nocturia was based on self-report. In this study, presence of nocturia was based on the answer to the question, "How many times do you get up at night to urinate?" This definition is similar to the definition of the International Continence Society,¹ "waking from sleep at night to void," but without the concept of "waking," which could be different in some patients.

In conclusion, nocturia in community-dwelling older adults is a common condition associated with gender, race, and medical conditions, and gender-specific models yield different patterns of correlates of nocturia in men and women. Given the significant morbidity associated with nocturia, any evaluation of lower urinary tract symptoms should include assessment for the presence of nocturia in this patient population.

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References

1. van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology in nocturia: Report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodynam*. 2002; 21:179–183.
2. Bing MH, Moller LA, Jennum P, et al. Prevalence and bother of nocturia, and causes of sleep interruption in a Danish population of men and women aged 60–80 years. *BJU Int*. 2006; 98:599–604. [PubMed: 16827903]
3. FitzGerald MP, Litman HJ, Link CL, et al. The Association of Nocturia With Cardiac Disease, Diabetes, Body Mass Index, Age and Diuretic Use: Results From the BACH Survey. *J Urol*. 2007; 177:1385–1389. [PubMed: 17382738]
4. Johnson TM 2nd, Sattin RW, Parmelee P, et al. Evaluating potentially modifiable risk factors for prevalent and incident nocturia in older adults. *J Am Geriatr Soc*. 2005; 53:1011–1016. [PubMed: 15935026]
5. Tikkinen KA, Tammela TL, Huhtala H, et al. Is nocturia equally common among men and women? A population based study in Finland. *J Urol*. 2006; 175:596–600. [PubMed: 16407003]
6. Choo MS, Ku JH, Park CH, et al. Prevalence of nocturia in a Korean population aged 40 to 89 years. Prevalence of nocturia in a Korean population aged 40 to 89 years. *Neurourol Urodynam*. 2008; 27:60–64.
7. Hsieh CH, Chen HY, Hsu CS, et al. Risk factors for nocturia in Taiwanese women aged 20–59 years. *Taiwan J Obstet Gynecol*. 2007; 46:166–170. [PubMed: 17638626]
8. Hsieh CH, Kuo TC, Hsu CS, et al. Nocturia among women aged 60 or older in Taiwan. *Aust N Z J Obstet Gynaecol*. 2008; 48:312–316. [PubMed: 18532964]
9. Malmsten UG, Milsom I, Molander U, et al. Urinary incontinence and lower urinary tract symptoms: An epidemiological study of men aged 45 to 99 years. *J Urol*. 1997; 158:1733–1737. [PubMed: 9334589]
10. Coyne KS, Zhou Z, Bhattacharyya SK, et al. The prevalence of nocturia and its effect on health-related quality of life and sleep in a community sample in the USA. *BJU Int*. 2003; 92:948–954. [PubMed: 14632853]
11. Foley DJ, Vitiello MV, Bliwise DL, et al. Frequent napping is associated with excessive daytime sleepiness, depression, pain, and nocturia in older adults: Findings from the National Sleep Foundation '2003 Sleep in America' Poll. *Am J of Geriatr Psych*. 2007; 15:344–350.
12. Kupelian V, Rosen RC, Link CL, et al. Association of urological symptoms and chronic illness in men and women: contributions of symptom severity and duration--results from the BACH Survey. *J Urol*. 2009; 181:694–700. [PubMed: 19091335]
13. Stewart RB, Moore MT, May FE, et al. Nocturia: a risk factor for falls in the elderly. *J Am Geriatr Soc*. 1992; 40:1217–1220. [PubMed: 1447437]
14. Bursztyrn M, Jacob J, Stessman J. Usefulness of nocturia as a mortality risk factor for coronary heart disease among persons born in 1920 or 1921. *Am J Cardiol*. 2006; 98:1311–1315. [PubMed: 17134620]

15. DuBeau CE, Yalla SV, Resnick NM. Implications of the most bothersome prostatism symptom for clinical care and outcomes research. *J Am Geriatr Soc.* 1995; 43:985–992. [PubMed: 7544816]
16. Zhao ZH, Sullivan C, Liu ZH, et al. Prevalence and clinical characteristics of sleep apnea in Chinese patients with heart failure. *Int J Cardiol.* 2007; 118:122–123. [PubMed: 16919341]
17. Tikkinen KA, Auvinen A, Huhtala H, et al. Nocturia and obesity: A population-based study in Finland. *Am J Epidemiol.* 2006; 163:1003. [PubMed: 16597705]
18. Asplund R. Obesity in elderly people with nocturia: Cause or consequence? *Can J Urol.* 2007; 14:3424–428. [PubMed: 17324321]
19. Häkkinen JT, Shiri R, Koskimäki J, et al. Depressive symptoms increase the incidence of nocturia: Tampere Aging Male Urologic Study (TAMUS). *J Urol.* 2008; 179:1897–1901. [PubMed: 18353384]
20. Tikkinen KA, Auvinen A, Johnson TM 2nd, et al. A systematic evaluation of factors associated with nocturia—the population-based FINNO study. *Am J Epidemiol.* 2009; 170:361–368. [PubMed: 19515794]
21. Rampart A, Norgaard J-P, Andersson K-E. Nocturia and associated morbidity in a community-dwelling elderly population. *BJU Int.* 2003; 92:726–730. [PubMed: 14616455]
22. Gopal M, Sammel MD, Pien G, et al. Investigating the associations between nocturia and sleep disorders in perimenopausal women. *J Urol.* 2008; 180:2063–2067. [PubMed: 18804245]
23. Kupelian V, Link CL, Hall SA, et al. Are race/ethnic disparities in the prevalence of nocturia due to socioeconomic status?. Results from the Boston Area Community Health (BACH) survey. *J Urol.* 2009; 181:1756–1763. [PubMed: 19233415]
24. Chen FY, Dai YT, Liu CK, et al. Perception of nocturia and medical consulting behavior among community-dwelling women. *Int Urogyn J.* 2007; 18:431–436.
25. Allman RM, Sawyer P, Roseman JM, et al. The UAB Study of Aging: Background and insights into life-space mobility among older Americans in rural and urban settings. *Aging Health.* 2006; 2:417–428.
26. Tikkinen KA, Johnson TM 2nd, Teuvo LJ, et al. Nocturia frequency, bother, and quality of life: How often is too often? a population-based study in Finland. *Eur Urol.* 2009 Epub ahead of print.
27. American Society of Health-System Pharmacists. AHFS Drug Information for 1999. Bethesda: AHFS; 1999.
28. Folstein MF, Folstein SE, McHugh PR. “Mini-mental state” A practical method for grading the cognitive state of patients for the clinician. *J Psych Res.* 1975; 12:189–198.
29. Redline S, Tishler PV, Hans MG, et al. Racial differences in sleep-disordered breathing in African-Americans and Caucasians. *Am J Respir Crit Care Med.* 1997; 155:186–192. [erratum appears in *Am J Respir Crit Care Med* 1997;155:1820]. [PubMed: 9001310]
30. Johnson TM 2nd, Burgio KL, Redden DT, et al. Effects of behavioral and drug therapy on nocturia in older incontinent women. *J Am Geriatr Soc.* 2005; 53:846. [PubMed: 15877562]
31. Asplund R. Nocturia, nocturnal polyuria, and sleep quality in the elderly. *J Psychosom Res.* 2004; 56:517–525. [PubMed: 15172208]
32. Laven BA, Orsini N, Andersson SO, et al. Birth weight, abdominal obesity and the risk of lower urinary tract symptoms in a population based study of Swedish men. *J Urol.* 2008; 179:1891–1895. [PubMed: 18353377]
33. Shiri R, Hakama M, Häkkinen J, et al. The effects of lifestyle factors on the incidence of nocturia. *J Urol.* 2008; 180:2059–2062. [PubMed: 18804241]
34. Bing MH, Moller LA, Jennum P, et al. Pathophysiological aspects of nocturia in a Danish population of men and women age 60 to 80 years. *J Urol.* 2007; 178:552–557. [PubMed: 17570415]

Table 1

Characteristics of Participants

Variable	Groups	African- American Men				African- American Women				White Men				White Women			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age	65-74 years	511	49.4	124	46.6	116	54.8	137	53.7	134							
	75-84 years	376	38.6	97	38.6	96	36.4	91	36.8	92							
	85+ years	113	12.0	30	14.9	37	8.8	22	9.6	24							
Education	≤ 6th grade	204	40.2	101	30.1	75	7.6	19	3.6	9							
	7th-11th	228	32.7	82	36.1	90	22.4	56	26.4	66							
	High School	235	12.0	30	22.1	55	31.2	78	28.8	72							
Living Status	Beyond High School	267	15.1	38	11.6	29	38.8	97	41.2	103							
	Lives Alone	319	29.9	75	38.2	95	16.0	40	43.6	109							
	Lives with others	681	70.1	176	61.8	154	84.0	210	56.4	141							
	Urban	486	49.4	124	48.6	121	48.0	120	48.4	121							

Table 2

Frequency of Nighttime Urination in Older Men and Women

Number of Voids	Men (N=495) [*]		Women (N = 489) [†]		Total	
	N	%	N	%	N	%
0	60	12.1	78	16.0	138	14.0
1	122	24.7	148	30.3	270	27.4
2	146	29.5	117	23.9	263	26.7
3	98	19.8	73	14.9	171	17.4
4	35	7.1	49	10.0	84	8.5
≥ 5	34	6.9	24	4.9	58	5.9

^{*} 6 cases missing

[†] 10 cases missing

Table 3

Correlates of Nocturia in Men

Variable	OR	P-value	adj OR [*]	P-value
Age	1.02	.319	1.01	.498
Race	1.89	<.001	1.89	<.001
Rural status	1.27	.208	1.28	.190
Education (years)	0.92	.004	0.96	.230
MMSE [†]	0.95	.007	0.97	.247
Body mass index (kg/m ²)	1.04	.036	1.04	.077
History of urine leakage	1.28	.205	1.37	.119
Swelling in feet and legs	1.65	.062	1.68	.060
Congestive heart failure	1.47	.148	1.38	.241
Hypertension	1.34	.135	1.22	.333
Diabetes	1.51	.067	1.50	.078
COPD [‡]	1.51	.103	1.59	.070
Alcohol (drinks per week)	1.02	.500	1.03	.209
Diuretics	1.25	.269	1.13	.567
Variables unique to men				
Benign prostatic hypertrophy	1.40	.155	1.56	.067
Prostate surgery	1.09	.741	1.08	.763

* Adjusted odds ratio after controlling for age, race, and rural status. Adjustment made for other two demographic factors in the first three rows.

[†] Mini-Mental State Exam

[‡] Chronic Obstructive Pulmonary Disease

Table 4

Correlates of Nocturia in Women

Variable	OR	P-value	adj OR [*]	P-value
Age	1.04	.002	1.04	.005
Race	1.90	<.001	1.84	.001
Rural status	1.50	.026	1.49	.033
Education (years)	0.88	<.001	0.93	.025
MMSE [†]	0.94	.003	0.99	.712
Body mass index (kg/m ²)	1.03	.067	1.03	.115
History of urine leakage	1.81	.001	2.41	<.001
Swelling in feet and legs	2.15	.001	2.06	.003
Congestive heart failure	1.66	.101	1.33	.371
Hypertension	2.00	.001	1.79	.010
Diabetes	1.46	.073	1.36	.160
COPD [‡]	1.03	.915	1.34	.372
Alcohol (drinks per week)	0.95	.205	0.99	.853
Diuretics	1.59	.014	1.34	.138
Variables unique to women				
Hormone therapy	0.54	.005	0.81	.379
Hysterectomy	1.11	.577	1.32	.149
Bladder surgery	0.72	.425	0.90	.807

* Adjusted odds ratio after controlling for age, race, and rural status. Adjustment made for other two demographic factors in the first three rows.

[†] Mini-Mental State Exam

[‡] Chronic Obstructive Pulmonary Disease

Table 5**Multivariable Correlates of Nocturia in Men and Women**

Variable	OR	95% CI
MEN		
African American race	1.54	1.02 – 2.33
Higher body mass index (per 5 kg/m ²)	1.22	1.01 – 1.47
MMSE score [*]	0.96	0.92 – 1.00 [†]
WOMEN		
History of urinary incontinence	2.17	1.46 – 3.23
Swelling in feet and legs	1.67	1.02 – 2.75
African American race	1.64	1.06 – 2.53
Hypertension	1.62	1.03 – 2.56
Older Age (per 5 years)	1.21	1.05 – 1.39
Education (per year)	0.92	0.86 – 0.99

^{*} Mini-Mental State Exam

[†] Rounded from .9999