

Correlates of Self-Reported Nocturia Among Community-Dwelling Older Adults

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Background. Nocturia is a common and bothersome problem with multifactorial etiology. This study examines clinical factors that are associated with nocturia among community-dwelling older adults.

Methods. A questionnaire-based survey was conducted among a convenience sample of community-dwelling older adults. Nocturia was defined as waking up to urinate two or more times per night for 3 or more days per week. Associations between nocturia status and sleep disturbance, daytime sleepiness, disease burden, and history of falls were determined.

Results. Questionnaires were mailed out to 433 participants, and returned questionnaires from 247 individuals (58%) individuals were adequate for analysis. There were 144 women (57%) and 103 men (42%), with mean \pm standard deviation age of 75.1 ± 6.9 and 76.6 ± 5.6 years for women and men, respectively. A total of 137 participants (55%) endorsed nocturia, and 57 participants (23%) endorsed nocturia and difficulty going back to sleep. Participants who endorsed nocturia and difficulty going back to sleep were more likely to report poor sleep quality, daytime sleepiness, increased disease burden, one or more falls, and symptoms related to primary sleep disorders.

Conclusions. The clinical characteristics of study participants with nocturia and difficulty going back to sleep were different from those with nocturia and no difficulty going back to sleep, suggesting that these two conditions may have different etiological factors and clinical consequences. These findings would have important implications in both clinical and research-related activities aimed at the management of nocturia in older adults.

Key Words: Nocturia—Sleep quality—Daytime sleepiness.

UNDER normal sleep-wake schedules, the volume of urine output is low during the sleep period and higher during the wake period (1,2). This pattern of urine output minimizes sleep disruption that is caused by the need to void. Nocturia, defined as waking up from sleep to void (3), is a common complaint among older adults, and the prevalence rate is reported to increase with age (4,5). Factors that contribute to the pathogenesis of nocturia include bladder- and kidney-related problems (decreased bladder capacity, nocturnal polyuria) as well as disorders that do not primarily involve the urinary system (6–8). Nocturia has been described as one of the most bothersome lower urinary tract symptoms, but all individuals with nocturia do not report being significantly bothered by this symptom. For example, in a study among men aged 40–79 years with lower urinary tract symptoms, only 30% of those with two or more episodes of nocturia reported being bothered by this symptom (9). In another study, in which women aged 19–95 years attending a urogynecologic clinic participated, 41% reported significant bother caused by nocturia (10).

Previous studies have described significant association between nocturia and common geriatric problems such as sleep disturbance, falls, and decreased quality of life (11–14). Furthermore, nocturia was reported to be more bothersome in study participants who endorsed nocturia and sleep complaints, as compared with those who reported nocturia but no sleep-related complaints (12,13). These

findings indicate that sleep-related complaints associated with nocturia may be important in determining the negative impact of nocturia. The current study was undertaken to examine if clinical characteristics of older adults with nocturia and a sleep-related complaint (difficulty going back to sleep) were different from those with nocturia and no difficulty going back to sleep. It is hypothesized that individuals who endorsed nocturia and difficulty going back to sleep would report, in addition to poor sleep quality, increased disease burden and history of falls.

METHODS

Data were derived from a questionnaire-based survey that was conducted as part of a study that examined the relationship between sleep-disordered breathing (SDB), 24-hour blood pressure pattern, and nocturnal polyuria. The purpose of the survey was to identify older adults with increased risk for SDB. Names and addresses of individuals who were 65 years or older and independent in all activities and instrumental activities of daily living were obtained from the Emory Center for Health in Aging program (ECHA) database. The ECHA keeps a registry of community-dwelling older adults who have expressed interest to participate in clinical research activities. Questionnaires were mailed out to these individuals with a stamped return envelope in June 2005. The study was

approved by the Institutional Review Board of Emory University.

Study Questionnaires

The questionnaires included Pittsburgh Sleep Quality Index (PSQI) (15), Epworth Sleepiness Scale (ESS) (16), Geriatric Depression Scale (GDS) (17), and restless legs syndrome (RLS) (18) questionnaire. In addition, questionnaires that focused on demographic characteristics and clinical characteristics such as snoring, sleep-wake patterns, nocturia frequency, falls, cardiovascular and cerebrovascular morbidity, and medication use were included in the survey. Frequency of nocturia was determined based on a response to the question, "During the past one month, how many days per week did you wake up 2 or more times for urination?" The responses included "never," "less than once per week," "one to two times per week," "three to four times per week," "five to seven times per week," and "do not know." For the purpose of this study, nocturia was defined as waking up two or more times per night for 3 or more days per week. In addition, participants who endorsed nocturia were divided into two groups based on whether they report difficulty going back to sleep.

The PSQI is a 19-item questionnaire that measures sleep quality and sleep disturbances for the past 1 month. The 19-items in the questionnaire are organized into seven components, with each component generating a score that ranges from 0 to 3. The sum of these component scores yields the PSQI score that ranges from 0 to 21, with higher scores indicating worse sleep. A score of greater than 5 has been found to have a high sensitivity and specificity to distinguish between good and poor sleepers (15). History of falls (defined as any event in which an individual comes to rest on the ground unintentionally) was obtained using a questionnaire. To determine medication use, participants were asked to write down all prescription and nonprescription drugs that they were taking. These drugs were categorized into prescription and nonprescription medications by the principal investigator, based on information obtained from Physician Desk Reference (19). Study participants with self-reported history of congestive heart failure, coronary artery bypass graft, angioplasty, heart attack, pace maker placement, or stroke were considered to have cardiovascular/cerebrovascular disease (CVCVD), and those with self-reported history of hypertension, diabetes mellitus, or hypercholesterolemia were considered to have cardiovascular risk factors (CVRF).

Statistical Analysis

Data entry and analysis was performed using SPSS statistical software (SPSS for Windows® version 15). The primary outcome variables included the presence or absence of (a) nocturia and (b) nocturia and difficulty going back to sleep. Chi-square test for categorical variables,

and Mann-Whitney test and Kruskal-Wallis test for continuous variables were used to compare clinical characteristics in study participants with and without nocturia, and with and without nocturia and difficulty going back to sleep. Logistic regression analysis was performed to determine if there is independent association between nocturia and difficulty going back to sleep (dependent variable), and demographic variables (age, gender) and clinical variables that showed significant relationship with the outcome variable on bivariate analysis. Additional logistic regression analysis was done with history of falls as the dependent variable, to determine if nocturia independently predicted the occurrence of falls. Log transformation ($y = [\log_{10} + .001]$) was performed on continuous variables that were found to have nonnormal distribution. Statistical significance was considered to be achieved at two-tailed p value of less than .05.

RESULTS

A total of 433 questionnaires were mailed out to potential study participants, and 262 subjects (60%) returned the questionnaires. Of these returned questionnaires, 247 participants (57%) responded to the nocturia-related question and were included in the analysis. One hundred thirty-seven participants (55%) endorsed having nocturia. Table 1 shows selected characteristics of study participants with and without nocturia. Hundred twenty-three of the 137 participants who reported nocturia responded to the question that asked if they have difficulty going back to sleep, and 57 participants (46%) reported difficulty going back to sleep.

To determine the characteristics of participants who reported nocturia and difficulty going back to sleep, study participants were divided into three groups as follows: "no nocturia," "nocturia and no difficulty going back to sleep," and "nocturia and difficulty going back to sleep." Table 2 shows selected characteristics of study participants among these groups. As expected, those with nocturia and difficulty going back to sleep were more likely to endorse poor sleep quality, increased disease burden, one or more falls in the past 6 months, and complaints suggestive of primary sleep disorders, when compared with study participants with no nocturia or nocturia and no difficulty going back to sleep. Only four participants were taking loop diuretics (Furosemide) (all taken in the morning), and two participants were on dopaminergic drugs. There was no statistically significant difference between nocturia status and use of sedative/hypnotic medications, selective serotonin reuptake inhibitors, bladder muscle relaxants, or alpha-blockers.

One or more falls in the past 6 months was reported by 61 participants. The falls occurred at home in 32 participants, outside the home in 20 participants, and both at home and outside of home in 9 participants. There was no statistically significant difference between nocturia and reported site of falls (home vs outside home). Detailed

Table 1. Selected Characteristics of Study Participants With and Without Nocturia ($N = 247$)

	No Nocturia ($N = 110$)	Nocturia ($N = 137$)	p Value
Age (y), mean (SD)	75.6 (6.0)	75.9 (6.7)	.838 ^a
Gender, n (%)			
Female	72 (50)	72 (50)	.041 ($\chi^2_{2b} = 4.2$)
Male	38 (37)	65 (63)	
Pittsburgh Sleep Quality Index score, mean (SD)	5.4 (3.4)	6.8 (4.0)	.044 ^a
Epworth Sleepiness Scale score, mean (SD)	6.6 (4.1)	7.6 (4.5)	.078 ^a
Geriatric Depression Scale score, $n = 244$ (%)			
≤ 5	99 (45)	121 (55)	.303 ^b
> 5	7 (33)	14 (67)	
CVCV ^c disease status, $n = 241$ (%)			
No CVRF ^d , no disease	39 (59)	27 (41)	.003 ($\chi^2_{2b} = 11.7$)
CVRF ^d , no disease	54 (44)	70 (56)	
CVCV ^c disease	14(28)	37 (73)	
Number of prescription medications (%)			
0	14 (48)	15(52)	.006 ($\chi^2_{2b} = 10.1$)
1–3	60 (55)	50 (45)	
≥ 4	36 (33)	72 (67)	
Falls, ^e $n = 242$ (%)			
No	93 (52)	87 (48)	<.001 ($\chi^2_{2b} = 12.5$)
Yes	16 (26)	46 (74)	

Notes: SD = standard deviation.

^aMann-Whitney U test.

^bChi-square test.

^cCardiovascular/cerebrovascular disease.

^dCardiovascular risk factors such as hypertension, diabetes mellitus, and hypercholesterolemia.

^eHistory of one or more falls in the past 6 months.

information about time of falls was not collected. Six participants sustained bone fracture as a result of the fall (type of bone not identified).

Snoring and frequent RLS symptoms (2 or more days per week) was reported by 51 individuals (21%) and 41 individuals 16%, respectively. Participants who endorsed these complaints were more likely to endorse nocturia and difficulty going back to sleep as shown in Table 2.

To determine factors that would independently predict nocturia with difficulty going back to sleep, a backward stepwise logistic regression analysis was performed, with demographic characteristics as well as clinical factors significantly associated with the dependent variable entered into the model. The results of this regression analysis indicated that cardiovascular/cerebrovascular morbidity and symptoms suggestive of primary sleep disorders such as SDB and RLS were independent predictors of nocturia and difficulty going back to sleep (Table 3).

Because there was a significant relationship between nocturia status and history of falls on bivariate analysis, a backward stepwise logistic regression analysis was performed to determine if nocturia with difficulty going back to sleep independently predicted history of falls (dependent variable). Independent variables in the model included age, gender, number of prescription medications (log transformed), CVCVD status, use of sedative hypnotics, poor sleep quality (PSQI score > 5), and daytime sleepiness (ESS score

≥ 10), in addition to nocturia with difficulty going back to sleep status (Table 4). The results showed that nocturia and difficulty going back to sleep as well as use of sedative hypnotics were independent predictors of one or more falls.

DISCUSSION

The clinical characteristics of study participants with nocturia and difficulty going back to sleep was different from that of participants with nocturia and no difficulty going back to sleep. This suggests that these nocturia-related complaints may indicate conditions with different etiological factors and clinical consequences. Recognizing these differences in individuals who complain of nocturia may facilitate the management of nocturia-related disorders.

Increased nocturia frequency per night has been reported to be associated with poor sleep and decreased quality of life (11–13,20), suggesting that the number of nocturia episodes may be one of the important factors in determining the negative impact of nocturia. However, in this study, participants with nocturia and difficulty going back to sleep were more likely to report poor sleep quality, daytime sleepiness, increased depression score, and increased disease burden. This finding underscores the importance of this sleep-related symptom as a significant contributor to the negative impact of nocturia. It is interesting to note that there was no significant difference

Table 2. Characteristics of Study Participants by Nocturia and Difficulty Going Back to Sleep Status ($N = 236$)

	Nocturia and No Difficulty Sleep ^a ($N = 66$) ^b	Nocturia and Difficulty Sleep ^a ($N = 57$) ^b	p Value	Statistics	
Age (y), mean (SD)	75.6 (6.0)	76.6 (6.5)	74.6 (7.1)	NS	K-W ^c test
Gender, n (%)					
Female	72 (53)	29 (22)	34 (25)	$p = .019$	$\chi^{2d} = 7.9$
Male	38 (39)	37 (38)	23 (23)		
Pittsburgh Sleep Quality Index, mean (SD)	5.4 (3.4)	4.5 (2.5)	9.5 (3.9)	$p < .001$, ^e A vs C < .001, B vs C < .001	K-W ^c test
Epworth Sleepiness Scale, mean (SD)	6.6 (4.1)	6.40 (3.9)	9.0 (4.9)	$p = .004$, ^e A vs C = .003, B vs C = .004	K-W ^c test
Geriatric Depression Score, $n = 230$)					
≤ 5	99 (48)	61 (29)	47 (23)	$p = .025$	$\chi^{2d} = 7.4$
> 5	7 (35)	3 (15)	10 (50)		
CVCV disease status, ^e $n = 228$ (%)					
No risk factors, no disease	39 (62)	16 (25)	8 (13)	$p = .003$	$\chi^{2d} = 15.8$
Risk factors, no disease	54 (47)	31 (27)	29 (26)		
CVCV disease	14 (28)	17 (33)	20 (39)		
Number of prescription medications (%)					
0	14 (54)	9 (35)	3 (11)	$p = .005$	$\chi^{2d} = 15.0$
1–3	60 (58)	24 (23)	19 (19)		
≥ 4	36 (34)	33 (32)	35 (34)		
Falls, $n = 230$ (%) ^f					
No	92 (54)	45 (26)	34 (20)	$p = .002$	$\chi^{2d} = 12.5$
Yes	17 (30)	16 (29)	23 (41)		
Snoring, $n = 215$ (%)					
No	69 (50)	46 (33)	24 (17)	$p = .002$	$\chi^{2d} = 17.1$
Yes	18 (36)	9 (18)	23 (46)		
Do not know	12 (52)	6 (26)	5 (22)		
Restless legs symptoms, $n = 234$ (%)					
No	98 (51)	55 (28)	41 (21)	$p = .019$	$\chi^{2d} = 7.9$
Yes	12 (31)	11 (28)	16 (41)		

Notes: NS = not significant; A = no nocturia; B = nocturia and no difficulty sleep; C = nocturia and difficulty sleep.

^aNocturia and no difficulty or nocturia and difficulty going back to sleep.

^b126 of the 140 participants with nocturia responded to difficulty going back to sleep question.

^cKruskal-Wallis test.

^dChi-square test.

^eCardiovascular and cerebrovascular disease status determined by the presence of history of cardiovascular risk factors (hypertension, diabetes mellitus, hypercholesterolemia) or history of cardiovascular disease or stroke.

^fHistory of one or more falls in the past 6 months.

in ESS score between those with and without nocturia (Table 1), implying that difficulty going back to sleep may be a crucial symptom that determines the severity of sleep disruption and associated daytime sleepiness in this group of study participants.

Self-reported nocturia and difficulty going back to sleep in this study may also be indicative of sleep maintenance insomnia, a condition reported to be common, and associated with increased comorbidity among older adults (21,22). This entails that that sleep maintenance insomnia should be considered in the differential diagnosis of nocturia and difficulty going back to sleep among older adults.

The significant association between nocturia and difficulty going back to sleep and symptoms of primary sleep disorders such as snoring and RLS may indicate the contribution of primary sleep disorders such as SDB and RLS to this self-reported complaint. SDB, a common disorder

among older adults (23), is characterized by periods of apnea and hypopnea that may result in arousals and awakenings, and has been reported to be associated with nocturia in the elderly adult (8,23,24). RLS is also a common disorder among older adults that is closely associated with periodic leg movement disorders and has been described to cause both difficulty in initiating and maintaining sleep (25). Although significant relationship between nocturia and periodic leg movement disorder has been described (8), to the author's knowledge, this is the first study to report independent association between nocturia and RLS symptoms. These findings suggest that some of the complaints reported as nocturia events may be preceded by wake episodes caused by events unrelated to the urinary symptom such as apnea or RLS. A previous study has reported that individuals tend to report the reason for their waking up from sleep as nocturia, even when the wake episode was

Table 3. Results of Stepwise Logistic Regression Analysis With Nocturia and Difficulty Going Back to Sleep as the Dependent Variable—Final Model^{ab}

	β Coefficient	<i>p</i> Value	Odds Ratio	Confidence Interval
Age	-.058	.053	.943	.889–1.001
CVCV disease status ^c				
No CVRF ^d , no disease				
Risk factors, no disease	1.111	.036	3.036	1.074–8.579
CVCV disease	1.859	.001	4.425	2.069–19.920
Snoring				
No				
Yes	1.306	.001	3.692	1.678–8.123
Do not know	-.275	.667	.759	.217–2.656
Frequent RLS symptoms	1.120	.009	3.064	1.316–7.317

Notes: Nagelkerke $R^2 = 0.235$; Hosmer and Lemeshow test = 0.899; RLS = restless legs syndrome.

^aDependent variable: no nocturia or nocturia and no difficulty going back to sleep = 0. Nocturia and difficulty going back to sleep = 1.

^bIndependent variables: age, gender, number of medications (log transformed), cardiovascular/cerebrovascular disease status, snoring, restless legs syndrome symptoms.

^cCardiovascular and cerebrovascular disease (history of coronary artery disease and stroke).

^dCardiovascular risk factors, include history of cardiovascular risk factors (hypertension, diabetes mellitus, hypercholesterolemia).

caused by other factors such as primary sleep disorders, if these individuals end up going to the bathroom for urination after waking up (8).

The finding of independent association between history of falls and nocturia status confirms the only previous report in the area (14). One major limitation of the current study is that information on the time of occurrence of these falls was not collected. Although falls related to nocturia are alleged to occur during a trip to the bathroom, the absence of a relationship between nocturia status and the site of falls (home vs outside home) reported in this study does not support this hypothesis. It is possible that other factors such as daytime sleepiness may increase the risk of falls in these individuals. Given the potential consequences of falls in older adults, further studies may be needed to examine this relationship in more detail.

Independent association between use of sedative hypnotics and increased risk of falls has been reported previously (26), and the finding in the current study is in agreement with this and similar previous reports. More recently, “insomnia” rather than hypnotic use was reported to

be significantly associated with falls (27). However, the results of the current study did not show statistically significant relationship between falls and sleep quality (determined by PSQI).

Specific medications such as diuretics taken in the evening hours can increase urine production during the night and nocturia episodes. But in this study, there were only eight participants who were on loop diuretics, and the diuretics were all taken in the morning. This makes the possibility that diuretics may have caused nocturia in this study unlikely.

One unexpected finding in this study is the negative relationship between nocturia and difficulty going back to sleep and age seen in the logistic regression model (Table 3; beta coefficient = -.058). One explanation for this could be that those with nocturia and difficulty going back to sleep may have a shorter survival as compared with those with no nocturia or nocturia and no difficulty going back to sleep. Another reason could be difference in the pattern of reporting symptoms among the different age groups.

Table 4. Results of Stepwise Logistic Regression Analysis With History of One or More Falls as the Dependent Variable—Final Model^{ab}

	B Coefficient	<i>p</i> Value	Odds Ratio	Confidence Interval
Age	.095	.004	1.104	1.032–1.181
Nocturia status				
No nocturia = 0				
Nocturia with no difficulty ^c = 1	1.157	.035	2.947	1.077–8.810
Nocturia with difficulty ^d = 2	1.527	.007	4.322	1.505–12.416
Use of sedative hypnotics	1.481	.025	4.397	1.203–16.703

Notes: Nagelkerke $R^2 = 0.192$; Hosmer and Lemeshow test = 0.367.

^aDependent variable: history of one or more falls in the past 6 months.

^bIndependent variables: age, gender, number of medications (log transformed), cardiovascular/cerebrovascular disease status, Pittsburgh Sleep Quality Index score >5, Epworth Sleepiness Scale ≥ 10 , use of sedative hypnotics, and nocturia status.

^cNocturia with no difficulty going back to sleep.

^dNocturia with difficulty going back to sleep.

There are several limitations to this study. This is a cross-sectional study involving a convenience sample of older adults. For this reason, it is not possible to infer causality in the relationship between nocturia and these clinical factors. In addition, this is a nonrandom sample of community-dwelling older adults and the results of this study may not be generalizable to all community-dwelling older adults.

Nocturia episodes are determined based on self-report rather than urine frequency-volume chart. Although it may be argued that this does not reliably predict the true nocturia frequency, previous studies have reported a strong correlation between self-reported nocturia frequency and objectively measured nocturia episodes in both females and males (28,29). The absence of objective measure of sleep or sleep disorders to corroborate the information obtained by self-report is another limitation in this study. Similarly, medical history in this study was obtained by self-report and may have limited accuracy. However, previous studies have reported good agreement (κ 0.73–0.80) between medical information obtained by self-report using questionnaires and medical record data for cardiovascular diseases and risk factors (30).

Information about weight and height of study participants was not collected, and consequently, the relationship between nocturia and body mass index was not evaluated. A previous study has reported a significant relationship between obesity and increased nocturia frequency (31).

Last but not least, information pertaining to bladder-related problems such as decreased bladder capacity or bladder outlet obstruction, and 24-hour urine output pattern was not collected. As a result, it was not possible to determine the role of disorders related to the urinary system in this study. Given age-associated changes in bladder function (eg, decreased bladder capacity) (32), contribution of bladder-related factors to nocturia-related symptoms is highly likely. Similar to other common disorders encountered in geriatric practice (33), it is probable that nocturia-related symptoms in older adults would be expected to have multifactorial etiology, involving both bladder-related and nonbladder-related factors.

In conclusion, the results of this study have shown significant association between self-reported nocturia and difficulty going back to sleep, and common geriatric problems such as poor sleep quality, daytime sleepiness, increased disease burden, symptoms related to primary sleep disorders, and history of falls. Furthermore, when compared with those with no nocturia, study participants with only self-reported nocturia (no difficulty going back to sleep) did not show a statistically significant relationship with history of falls, symptoms related to primary sleep disorders, poor sleep quality, and daytime sleepiness, suggesting that these two nocturia-related complaints (nocturia with and without difficulty going back to sleep) may have

different etiological factors and impact on quality of life. Recognition of these findings would have important implications for interventions aimed at the management of nocturia.

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