Prevalence of nocturia and associated factors in women attending two urogynecology outpatient clinics in the state of Rio de Janeiro: a cross-sectional study

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Abstract

Objective: To identify the prevalence and factors related to nocturia in women presenting lower urinary tract symptoms. *Methods*: Observational cross-sectional survey, individualized, hospital-based, involving women attended by the Unified Health System in urogynecology outpatient clinics in Niterói and Petrópolis, RJ, Brazil. Sociodemographic, clinical, and lifestyle data were collected. Two outcomes of nocturia were considered: one or more nocturnal voids and two or more nocturnal voids, the latter due to its greater impact on quality of life. Associations between the investigated variables and the outcomes were assessed by logistic regression models, and crude and adjusted odds ratios were obtained. *Results*: A total of 132 participants were included. The prevalence of nocturia was 71.2%, and of two or more voids, 56.8%. Lower education level OR 0,260 (0,106; 0,637), mixed urinary incontinence OR 2,533 (1,103; 5,817), and three or more comorbidities OR 3,105 (1,340; 7,196) were associated with a higher chance of nocturia. Lower education level OR 0,324 (0,148; 0,709), lower caffeine consumption OR 0,995 (0,990; 1,000), and overactive bladder syndrome OR 2,761 (1,189; 6,409) were associated with a higher chance of two or more voids. *Conclusions*: In the population attending specialized services, the prevalence of nocturia was similar to that of the general population and to that of similar services, but the prevalence of two or more voids was higher. Active screening for nocturia in women with comorbidities, especially three or more, and their adequate management, proved to be important in addressing the symptom.

Keywords: Nocturia. Lower Urinary Tract Symptoms. Women's Health.

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INTRODUCTION

Nocturia is defined by the International Continence Society (ICS) as the number of voids during the main sleep period. Each void should be followed by a period of sleep or the intention to sleep[1]. Studies on the impact of nocturia on quality of life (QoL), however, suggest that the symptom becomes significant from two voids onward[2].

According to a population-based study conducted in the United States of America, the prevalence of two or more episodes of nocturia in women reaches 46.6% in those aged 80 years or older, and the prevalence increases with age[3]. In a study conducted in the same country involving patients from urology services with a mean age of 57.3 years, the prevalence of nocturia in women was 41.5%, and of two or more episodes, 14.3% [4].

In a population-based study conducted among Colombian women, the prevalence of nocturia was 60.4%, and of two or more voids, 19.9% [5]. In the LUTS Brazil study, the prevalence of two or more voids in women aged 40 and older was 32.4%. This, the largest study on the prevalence of lower urinary tract symptoms (LUTS) ever conducted in the country, was a population-based study that did not include the population of the state of Rio de Janeiro[6]. The study by Cruz et al.[7] was a population-based study conducted in Niterói (RJ) and found, in women, a prevalence of nocturia of 68.4% and of two or more voids, 49%.

Regarding the morbidity and mortality associated with nocturia, the literature suggests an increased risk of nocturia in women with anxiety and depression and a higher risk of falls and fractures among those with nocturia[8,9]. The risk of death within the next five years in individuals over 60 years old with nocturia is higher compared to non-nocturia sufferers[10]. Additionally, there is an association between the number of episodes of nocturia and absenteeism from work, leading to impaired work capacity[11].

Historically, nocturia has been attributed, more specifically in women, to overactive bladder (OAB) syndrome. In recent years, there has been growing recognition that nocturia can be caused by a wide spectrum of factors. Additionally, concerning lower urinary tract dysfunctions, an increase in post-void residual volume can be mentioned, whether caused by infravesical obstruction or detrusor underactivity. Regarding other causes, they involve the mechanism of global polyuria or nocturnal polyuria and are associated with alterations in water and sodium homeostasis, such as diabetes mellitus (DM), chronic kidney disease (CKD), heart failure, chronic venous insufficiency (CVI), and obstructive sleep apnea (OSA)[12].

Daugherty et al.[3], in a population-based study, identified an association of body mass index (BMI) of 30 kg/m^2 or higher, urgency urinary incontinence (UUI), depression, systemic arterial hypertension (SAH), arthritis, and OSA with nocturia. Nevertheless, Yow et al.[13] demonstrated associations with DM, CKD, and OAB syndrome. According to Madhu et al[8]., there are associations with asthma, hysterectomy, menopause, uterine prolapse, urinary tract infection (UTI), irritable bowel syndrome, and cardiovascular disease.

In Brazil, Cruz et al.[7] identified an association between black skin color, increased risk of OSA, and the use of calcium channel blockers and nocturia, indicating that the symptom may be related to the effect of medications and reinforcing the complexity of its management in a context of multiple comorbidities and polypharmacy.

Considering the high prevalence of nocturia, its negative impact on survival and QoL, and the lack of specific studies with the female population with LUTS in Brazil, the present study investigated the prevalence and factors associated with nocturia in a sample of this population.

METHODS

The present study is an observational cross-sectional survey, individualized, and hospital-based. The research is in accordance with Resolution number 466/2012 and Resolution number 510/2016. The study, titled "Nocturia: etiology and impact on quality of life in users of the Unified Health System" (SUS - Sistema Único de Saúde), was approved by

the Research Ethics Committee of the Faculdade de Medicina of the Universidade Federal Fluminense (opinion 5286801), with consent from the Research Ethics Committee of the Centro Universitário Arthur Sá Earp Neto (UNIFASE). All participants signed the Informed Consent Form.

The sample was convenience-based, consisting of women with LUTS attending the Urogynecology outpatient clinics of the Hospital Universitário Antônio Pedro (HUAP) and UNIFASE between 2021 and 2022. Women with preserved cognitive capacity were included, while those under 18 years of age, currently pregnant, with a history of pelvic radiotherapy, surgery for pelvic cancer, or neurological disease were excluded.

Anamnesis and physical examination were conducted as part of comprehensive gynecological evaluation, and the risk of OSA was estimated, given that it is a cause of nocturia and there is significant difficulty in access to polysomnography for patients attending both outpatient clinics.

The sociodemographic data analyzed included: data collection location – Niterói and Petrópolis (cities located in the state of Rio de Janeiro); age, dichotomized as under 60 years and 60 years or older; and education level, dichotomized as up to incomplete primary education and complete primary education or higher.

Regarding lifestyle variables, caffeine consumption was estimated by quantifying the consumption of coffee, mate, cocoa powder, soda, and chocolate, while tobacco consumption was estimated in packs/year[14]. Both were treated as continuous quantitative variables.

In the anamnesis, we sought to identify the presence of symptoms of pelvic floor dysfunctions. The main LUTS investigated was nocturia. Two possibilities were considered as outcomes of nocturia: one or more voids (nocturia 1), according to the definition of the ICS, and two or more voids (nocturia 2), due to a greater impact on QoL.

The other LUTS evaluated were: stress urinary incontinence (SUI), UUI, mixed urinary incontinence (MUI), OAB syndrome, hesitancy, slow stream, sensation of incomplete bladder emptying, and post-voiding incontinence. The other pelvic floor dysfunction symptoms evaluated were pelvic organ prolapse (POP), fecal incontinence, and constipation, defined by the Bristol stool scale and a frequency of less than three bowel movements per week[15]. The ICS[16] standardized nomenclature was used for defining LUTS and other pelvic floor dysfunctions.

In addition to pelvic floor dysfunctions, other comorbidities were investigated, namely: history of recurrent UTI, SAH, DM, heart failure, CKD, CVI, anxiety/depression, and other comorbidities. Anxiety and depression were addressed together, as they are often associated, and many participants were unable to provide precise diagnoses[17]. The risk of OSA was assessed using the validated Portuguese version of the STOP-BANG questionnaire, which, for the analyses, was dichotomized into low and intermediate/high risk categories[18]. Considering that the study was conducted in reference centers, which serve individuals with a high number of comorbidities, the variable was dichotomized into up to two comorbidities and three or more.

Among medications, the use of antidepressants, diuretics, calcium channel blockers, benzodiazepines, angiotensin II receptor blockers, beta-blockers, hypoglycemic agents, insulin, and angiotensin-converting enzyme inhibitors was investigated. Polypharmacy was considered as the concurrent use of five or more drugs[19].

During the physical examination, the body mass index (BMI) was calculated, with different cutoff points for participants under 60 years of age and those 60 years or older, and stratified into underweight/eutrophic, overweight, and obesity. The first two categories were grouped together due to the small number of participants underweight and because overweight and obesity are more relevant in evaluating nocturia[20]. POP was staged using the Pelvic Organ Prolapse Quantification (POP-Q) system. The anterior, posterior, and apical compartments of the POP-Q were stratified into up to stage II and from stage III onwards.

Frequency distribution tables were prepared for the sociodemographic, clinical, and lifestyle

characteristics of the participants, and joint distribution tables were created for the outcomes of nocturia according to each of these characteristics.

Univariate logistic regression models were adjusted to estimate the odds of presenting one or more voids (nocturia 1) and two or more voids (nocturia 2). The explanatory variables considered in the statistical modeling were the sociodemographic, clinical, and lifestyle characteristics of the patients. For all univariate logistic regression models, crude odds ratios were estimated, along with their respective 95% confidence intervals and *p*-values from the Wald test.

Regarding the modeling strategy, only variables with an association with the outcome of nocturia in univariate analysis with a *p*-value ≤ 0.20 were considered in the multivariate analysis. Only variables that had a statistical association with the outcome (*p*-value ≤ 0.05) were kept in the multivariate analysis. It should be noted that in the multivariate analysis, non-significant variables were excluded in decreasing order of their *p*-value until obtaining a model with all significant variables at the 5% level. Adjusted odds ratios were estimated for these variables, along with their respective 95% confidence intervals.

DATA AVAILABILITY

The entire dataset supporting the findings of this study is available upon request to the corresponding author, Ingrid Antunes da Silva.

RESULTS

A total of 132 participants were included in the study, as shown in Tables 1 and 2. Of these, 71.2% had one or more voids, and 56.8% had two or more voids. 52.3% of the participants were aged 60 years or older, 45.5% had not completed elementary education, and 66.7% had three or more comorbidities.

Table 1. Descriptive analysis of the sociodemographic characteristics and lifestyle habits of women attending two urogynecology outpatient clinics (N=132). Niterói (RJ) and Petrópolis (RJ), 2021-2022.

Characteristics	% of patients (N=132)	Nocturia 1 (number of voids)		Nocturia 2 (number of voids)	
	or Mean ± SD	None (n=38)	One or more (n=94)	Up to one (n=57)	Two or more (n=75)
Location					
Niterói	34.1	35.6	64.4	46.7	53.3
Petrópolis	65.9	25.3	74.7	41.4	58.6
Age (in years)					
< 60	47.7	33.3	66.7	49.2	50.8
≥60	52.3	24.6	75.4	37.7	62.3
Education					
Incomplete elementary education	45.5	16.7	83.3	31.7	68.3
Complete elementary education or higher	54.5	38.9	61.1	52.8	47.2
Caffeine (mg/day)	163.1 ± 77.8	173.0 ± 86.1	159.0 ± 74.3	178.0 ± 85.7	151.0 ± 69.6
Tobacco (packs/year)	4.4 ± 13.5	5.6 ± 19.1	3.8 ± 10.6	5.4 ± 17.3	3.6 ± 9.9

Table 2. Descriptive analysis of the clinical characteristics of women treated at two urogynecology outpatient clinics (N=132). Niterói (RJ) and Petrópolis (RJ), 2021-2022.

Characteristics	% of patients (N=132) or Mean ± SD	Nocturia 1 (number of voids)		Nocturia 2 (number of voids)	
		None (n=38)	One or more (n=94)	Up to one (n=57)	Two or more (n=75)
Nocturia 1					
No voids	28.8				
One or more	71.2				
Nocturia 2					
Up to one void	43.2				
Two or more voids	56.8				
Stress urinary incontinence					
Absent	82.6	26.6	73.4	40.4	59.6
Present	17.4	39.1	60.9	56.5	43.5
Urgency urinary incontinence					
Absent	87.1	30.4	69.6	44.3	55.7
Present	12.9	17.6	82.4	35.3	64.7
Mixed urinary incontinence					
Absent	43.9	37.9	62.1	55.2	44.8
Present	56.1	21.6	78.4	33.8	66.2
Overactive bladder syndrome					
Absent	26.5	42.9	57.1	62.9	37.1
Present	73.5	23.7	76.3	36.1	63.9
Hesitancy					
Absent	88.6	28.2	71.8	42.7	57.3
Present	11.4	33.3	66.7	46.7	53.3
Slow stream					
Absent	82.6	30.3	69.7	44.0	56.0
Present	17.4	21.7	78.3	39.1	60.9
Feeling of incomplete bladder emptying					
Absent	44.7	32.2	67.8	52.5	47.5
Present	55.3	26.0	74.0	35.6	64.4
Post-voiding incontinence					
Absent	68.2	28.9	71.1	45.6	54.4
Present	31.8	28.6	71.4	38.1	61.9
Pelvic organ prolapse (symptom)					
Absent	68.2	30.0	70.0	40.0	60.0
Present	31.8	26.2	73.8	50.0	50.0
Anterior vaginal wall prolapse					
Up to stage II	89.4	28.8	71.2	42.4	57.6
Stage III or IV	10.6	28.6	71.4	50.0	50.0
Posterior vaginal wall prolapse					
Up to stage II	97.7	29.5	70.5	43.4	56.6
Stage III or IV	2.3	0	100	33.3	66.7

to be continued

Continuation of Table 2

Characteristics	% of patients (N=132) or Mean ± SD	Nocturia 1 (number of voids)		Nocturia 2 (number of voids)	
		None (n=38)	One or more (n=94)	Up to one (n=57)	Two or more (n=75)
Apical prolapse					
Up to stage II	97.7	29.5	70.5	43.4	56.6
Stage III or IV	2.3	0	100	33.3	66.7
Fecal incontinence					
Absent	93.2	30.9	69.1	45.5	54.5
Present	6.8	0	100	11.1	88.9
Constipation (Bristol stool scale)					
Absent	80.3	32.1	67.9	46.2	53.8
Present	19.7	15.4	84.6	30.8	69.2
Constipation (frequency)					
Absent	78.8	27.9	72.1	44.2	55.8
Present	21.2	32.1	67.9	39.3	60.7
Recurrent UTI					
Absent	87.1	31.3	68.7	45.2	54.8
Present	12.9	11.8	88.2	29.4	70.6
Systemic arterial hypertension					
Absent	40.9	31.5	68.5	48.1	51.9
Present	59.1	26.9	73.1	39.7	60.3
Diabetes mellitus					
Absent	69.7	32.6	67.4	47.8	52.2
Present	30.3	20.0	80.0	32.5	67.5
Heart failure					
Absent	98.5	29.2	70.8	43.1	56.9
Present	1.5	0	100	50.0	50.0
Chronic kidney disease					
Absent	97.7	29.5	70.5	44.2	55.8
Present	2.3	0	100	0	100
Chronic venous insufficiency					
Absent	67.4	28.1	71.9	42.7	57.3
Present	32.6	30.2	69.8	44.2	55.8
Depression/Anxiety					
Absent	86.4	27.2	72.8	43.0	57.0
Present	13.6	38.9	61.1	44.4	55.6
Body mass index					
Underweight or Eutrophic	21.2	28.6	71.4	42.9	57.1
Overweight	56.8	30.7	69.3	40.0	60.0
Obesity	22.0	24.1	75.9	51.7	48.3
OSA risk					
Low	40.9	35.2	64.8	50.0	50.0
Moderate or high	59.1	24.4	75.6	38.5	61.5

to be continued

Continuation of Table 2

Characteristics	% of patients (N=132) or Mean ± SD	Nocturia 1 (number of voids)		Nocturia 2 (number of voids)	
		None (n=38)	One or more (n=94)	Up to one (n=57)	Two or more (n=75)
Number of comorbidities					
Up to 2 comorbidities	33.3	43.2	56.8	54.5	45.5
3 or more	66.7	21.6	78.4	37.5	62.5
Antidepressant					
Absent	80.3	29.2	70.8	46.2	53.8
Present	19.7	26.9	73.1	30.8	69.2
Diuretic					
Absent	70.5	30.1	69.9	44.1	55.9
Present	29.5	25.6	74.4	41.0	59.0
Calcium channel blocker					
Absent	82.6	28.4	71.6	44.0	56.0
Present	17.4	30.4	69.6	39.1	60.9
Benzodiazepine					
Absent	89.4	28.8	71.2	44.1	55.9
Present	10.6	28.6	71.4	35.7	64.3
ARBs					
Absent	55.3	31.5	68.5	43.8	56.2
Present	44.7	25.4	74.6	42.4	57.6
Beta-blocker					
Absent	83.3	29.1	70.9	43.6	56.4
Present	16.7	27.3	72.7	40.9	59.1
Hypoglycemic agent					
Absent	70.5	32.3	67.7	47.3	52.7
Present	29.5	20.5	79.5	33.3	66.7
Insulin					
Absent	94.7	30.4	69.6	44.8	55.2
Present	5.3	0	100	14.3	85.7
ACEI					
Absent	94.7	30.4	69.6	45.6	54.4
Present	5.3	0	100	0	100
Polypharmacy					
Less than 4 medications	68.2	28.9	71.1	46.7	53.3
5 or more	31.8	28.6	71.4	35.7	64.3

UTI: Urinary tract infection. OSA: Obstructive sleep apnea. ARBs: Angiotensin II receptor blocker. ACEI: Angiotensin-converting enzyme inhibitor.

For the outcome of nocturia defined as one or more voids, the multivariate analysis included education level, constipation assessed by the Bristol stool scale, recurrent UTI, DM, number of comorbidities, use of hypoglycemic agents, risk of OSA, MUI and OAB syndrome. At a significance level of 5%, the following variables remained associated with the likelihood of the patient having one or more voids: education level, number of comorbidities, and MUI.

In the multivariate analysis, patients with incomplete elementary education had approximately four times higher odds of presenting one or more voids (nocturia 1) compared to patients with at least completed elementary education (OR: 1/0.260 = 3.8; *p*-value = 0.003).

Patients with three or more comorbidities had approximately three times higher odds of presenting one or more voids compared to patients with up to two comorbidities (OR: 3.105; *p*-value = 0.008).

Patients with MUI had a 2.5 times higher chance of experiencing nocturia 1 (one or more voids) compared to those without MUI (OR: 2.533; *p*-value = 0.028) (Table 3).

For the outcome of nocturia defined as two or more voids, the multivariate analysis included age, education level, sensation of incomplete bladder emptying, fecal incontinence, constipation assessed by the Bristol scale, DM, number of comorbidities, use of antidepressants, oral hypoglycemic agents, and insulin, risk of OSA, SUI, MUI, OAB syndrome and caffeine consumption. In the selected multivariate logistic model, it can be observed that education level, OAB syndrome, and caffeine consumption remained associated with this outcome of nocturia.

Patients with incomplete elementary education had approximately three times higher odds of presenting two or more voids (nocturia 2) compared to patients with at least completed elementary education (OR: 1/0.324 = 3.1; *p*-value = 0.005).

Patients with OAB syndrome had approximately 2.8 times higher odds of presenting two or more voids compared to those without OAB syndrome (OR: 2.761; *p*-value = 0.018).

Regarding caffeine consumption, it is observed that for each 1 mg/day increase in caffeine consumption, there is a 0.5% reduction in the odds of the patient presenting two or more voids (OR: 0.995; *p*-value = 0.041) (Table 4).

Table 3. Association between sociodemographic and clinical characteristics and the likelihood of experiencing one or more nocturia episodes (nocturia 1) in women attending two urogynecology outpatient clinics (N=132). Niterói (RJ) and Petrópolis (RJ), 2021-2022.

Characteristics	Univariate logistic models			Multivariate logistic model			Selected logistic model		
	OR	95% CI	*p-value	OR	95% CI	*p-value	OR	95% CI	*p-value
Location: Petrópolis vs Niterói	1.630	0.748;3.551	0.219						
Age: ≥60 years vs <60	1.529	0.717;3.263	0.272						
Education: Complete elementary education or higher vs. Incomplete elementary education	0.314	0.137;0.719	0.006	0.275	0.107;0.706	0.007	0.260	0.106;0.637	0.003
Hesitancy: Present vs Absent	0.786	0.250;2.473	0.680						
Slow stream: Present vs Absent	1.563	0.535;4.565	0.414						
Feeling of incomplete bladder emptying: Present vs Absent	1.350	0.634;2.875	0.437						
Post-voiding incontinence: Present vs Absent	1.016	0.452;2.283	0.970						
Pelvic organ prolapse (symptom): Present vs Absent	1.208	0.531;2.749	0.653						
AVP: Stage III or IV vs. Up to stage II	1.012	0.297;3.448	0.985						
Constipation (Bristol): Present vs Absent	2.597	0.830;8.127	0.101	1.552	0.444;5.424	0.491			
Constipation (frequency): Present vs Absent	0.816	0.331;2.011	0.659						
Recurrent UTI: Present vs Absent	3.418	0.742;15.738	0.115	3.266	0.648;16.456	0.151			
SAH: Present vs Absent	1.247	0.582;2.671	0.570						
DM: Present vs Absent	1.935	0.796;4.708	0.145	1.220	0.086;17.327	0.883			
CVI: Present vs Absent	0.901	0.406;2.003	0.799						
Depression/Anxiety: Present vs Absent	0.587	0.209;1.650	0.312						
Number of comorbidities: 3 or more vs. Up to 2	2.760	1.261;6.041	0.011	2.808	1.043;7.562	0.041	3.105	1.340;7.196	0.008
Antidepressant: Present vs Absent	1.122	0.429;2.937	0.815						
Diuretic: Present vs Absent	1.249	0.537;2.906	0.605						
Calcium channel blocker: Present vs Absent	0.908	0.341;2.422	0.848						
Benzodiazepine: Present vs Absent	1.012	0.297;3.448	0.985						
ARB: Present vs Absent	1.349	0.627;2.904	0.444						

to be continued

Continuation of Table 3

Characteristics	Univariate logistic models			Multivariate logistic model			Selected logistic model		
	OR	95% CI	*p-value	OR	95% CI	*p-value	OR	95% CI	*p-value
Beta-blocker: Present vs Absent	1.094	0.393;3.048	0.864						
Hypoglycemic agent: Present vs Absent	1.845	0.757;4.496	0.178	0.860	0.060;12.254	0.911			
Polypharmacy: 5 or more vs. Up to 4 medications	1.016	0.452;2.283	0.970						
BMI			0.805						
BMI: Overweight vs. Low weight/Normal weigh	0.904	0.348;2.351	0.837						
BMI: Obesity vs. Low weight/Normal weight	1.257	0.386;4.097	0.704						
OSA (Obstructive sleep apnea) risk: Moderate/high vs Low	1.686	0.788;3.608	0.179	0.946	0.375;2.386	0.906			
SUI: Present vs Absent	0.564	0.220;1.442	0.232						
UUI: Present vs Absent	2.042	0.552;7.557	0.285						
MUI: Present vs Absent	2.215	1.029;4.768	0.042	1.906	0.612;5.932	0.266	2.533	1.103;5.817	0.028
OAB: Present vs Absent	2.413	1.066;5.461	0.035	1.534	0.444;5.305	0.499			
Caffeine (mg/day)	0.998	0.993;1.003	0.338						
Tobacco (packs/year)	0.991	0.966;1.017	0.493						

CI: confidence interval; *p-value from the Wald test. AVP: anterior vaginal wall prolapse. UTI: urinary tract infection. SAH: systemic arterial hypertension. DM: diabetes mellitus. CVI: chronic venous insufficiency. ARB: angiotensin II receptor blocker. BMI: body mass index. LP: low weight. SUI: stress urinary incontinence. UUI: urgency urinary incontinence. MUI: mixed urinary incontinence. OAB: overactive bladder syndrome. Variables such as posterior vaginal wall prolapse, apical prolapse, fecal incontinence, heart failure, chronic kidney disease, and use of insulin and angiotensin-converting enzyme inhibitor were not included in the modeling since they presented one or more categories with null frequency among participants with one or more nocturia episodes (see Tables 1 and 2).

Table 4. Association between sociodemographic, lifestyle, and clinical characteristics and the likelihood of experiencing two or more nocturia episodes (nocturia 2) in women attending two urogynecology outpatient clinics (N=132). Niterói (RJ) and Petrópolis (RJ), 2021-2022.

Characteristics	Univariate logistic models			Multivariate logistic model			Selected logistic model		
	OR	95% CI	*p-value	OR	95% CI	*p-value	OR	95% CI	*p-value
Location: Petrópolis vs Niterói	1.240	0.601;2.558	0.561						
Age: ≥60 years vs <60	1.602	0.801;3.206	0.183	1.367	0.517;3.614	0.528			
Education: Complete elementary education or higher vs. Incomplete elementary education	0.415	0.203;0.847	0.016	0.288	0.114;0.727	0.008	0.324	0.148;0.709	0.005
Hesitancy: Present vs Absent	0.853	0.290;2.508	0.772						
Slow stream: Present vs Absent	1.224	0.488;3.068	0.666						
Feeling of incomplete bladder emptying: Present vs Absent	2.001	0.993;4.032	0.052	2.130	0.919;4.936	0.078			
Post-voiding incontinence: Present vs Absent	1.360	0.643;2.874	0.421						
POP (symptom): Present vs Absent	0.667	0.319;1.394	0.281						
AVP: Stage III or IV vs. Up to stage II	0.735	0.242;2.230	0.587						
PPP: Stage III or IV vs. Up to stage II	1.534	0.136;17.350	0.729						
Apical prolapse: Stage III or IV vs. Up to stage II	1.534	0.136;17.350	0.729						
Fecal incontinence: Present vs Absent	6.687	0.812;55.091	0.077	6.405	0.535;76.750	0.143			
Constipation (Bristol): Present vs Absent	1.934	0.774;4.835	0.158	1.304	0.438;3.877	0.633			
Constipation (frequency): Present vs Absent	1.226	0.523;2.872	0.639						
Recurrent UTI: Present vs Absent	1.981	0.655;5.987	0.226						
SAH: Present vs Absent	1.408	0.699;2.836	0.338						
DM: Present vs Absent	1.904	0.875;4.144	0.105	1.322	0.111;15.767	0.825			
Heart failure: Present vs Absent	0.757	0.046;12.363	0.845						
CVI: Present vs Absent	0.941	0.452;1.961	0.871						
Depression/Anxiety: Present vs Absent	0.942	0.346;2.564	0.907						
Number of comorbidities: 3 or more vs. Up to 2	2.000	0.960;4.166	0.064	1.549	0.546;4.400	0.411			
Antidepressant: Present vs Absent	1.934	0.774;4.835	0.158	1.923	0.614;6.019	0.262			
Diuretic: Present vs Absent	1.133	0.531;2.419	0.746						

to be continued

Continuation of Table 4

Characteristics	Univariate logistic models			Multivariate logistic model			Selected logistic model		
	OR	95% CI	*p-value	OR	95% CI	*p-value	OR	95% CI	*p-value
Calcium channel blocker: Present vs Absent	1.224	0.488;3.068	0.666						
Benzodiazepine: Present vs Absent	1.418	0.448;4.488	0.552						
ARB: Present vs Absent	1.061	0.531;2.123	0.866						
Beta-blocker: Present vs Absent	1.118	0.441;2.833	0.814						
Hypoglycemic agent: Present vs Absent	1.796	0.823;3.919	0.141	0.981	0.082;11.763	0.988			
Insulin: Present vs Absent	4.870	0.570;41.612	0.148	1.210	0.106;13.850	0.878			
Polifarmácia: 5 or more vs. Less than 4	1.575	0.740;3.351	0.238						
BMI			0.559						
BMI: Overweight vs. Low weight/Normal weight	1.125	0.467;2.711	0.793						
BMI: Obesity vs. Low weight/Normal weight	0.700	0.246;1.989	0.503						
OSA risk: Moderate/high vs Low	1.600	0.793;3.228	0.189	0.641	0.256;1.607	0.343			
SUI: Present vs Absent	0.521	0.210;1.292	0.159	1.783	0.461;6.895	0.402			
UUI: Present vs Absent	1.461	0.506;4.219	0.484						
MUI: Present vs Absent	2.412	1.190;4.892	0.015	1.762	0.582;5.333	0.316			
OAB: Present vs Absent	2.998	1.345;6.679	0.007	2.715	0.695;10.609	0.151	2.761	1.189;6.409	0.018
Caffeine (mg/day)	0.995	0.991;1.000	0.051	0.994	0.988;0.999	0.025	0.995	0.990;1.000	0.041
Tobacco (packs/year)	0.990	0.965;1.017	0.465						

* Wald test p-value. POP: pelvic organ prolapse. AVP: anterior vaginal wall prolapse. PPP: posterior vaginal wall prolapse. UTI: urinary tract infection. SAH: systemic arterial hypertension. DM: diabetes mellitus. CVI: chronic venous insufficiency. ARB: angiotensin II receptor blocker. BMI: body mass index. LW: low weight. OSA: obstructive sleep apnea. SUI: stress urinary incontinence. UUI: urge urinary incontinence. MUI: mixed urinary incontinence. OAB: overactive bladder syndrome. Chronic kidney disease and use of angiotensin-converting enzyme inhibitor variables were not included in the modeling, as they presented some category with null frequency among participants with two or more urinations (see Tables 1 and 2).

DISCUSSION

The prevalence of nocturia defined as one or more voids (71.2%) was similar to that found in women in studies conducted in the general population in Salvador (BA) (71.2%) and in Niterói (RJ) (68.4%)[7,22]. Additionally, the prevalence of two or more voids (56.8%) was higher than that found in both studies and in the LUTS Brazil study (36.5%, 49%, and 32.4%, respectively)[6].

Such difference can be explained by the higher proportion of participants aged 60 years or older (52.3%) compared to other studies (20.8%, 43.3%, and 39.5%, respectively), as the prevalence of nocturia increases with age[3].

Additionally, unlike the mentioned population-based studies, participants attended in a university service usually have a higher number of comorbidities and are carriers of other LUTS, both factors associated with nocturia.

Nevertheless, Clemens et al.[4], evaluating American women in reference outpatient clinics, also observed lower prevalence rates of nocturia (49% for one void per night and 16.5% for at least two voids). This discrepancy may be partly related to different methods of assessing the number of nocturia episodes, which was self-reported by participants in the present study and assessed through a three-day voiding diary in the United States. Additionally, a higher level of education and income in that country may have contributed to a lower prevalence of nocturia.

Participants with education up to incomplete elementary level had a 74% higher chance of presenting one or more voids and a 68% higher chance of presenting two or more voids. Similarly, Cruz et al.[7] found nearly twice the chance of individuals with up to four years of education presenting two or more voids compared to those with five or more years of education. Daugherty et al.[3] also found an association between lower education level and nocturia. Education level can serve as a marker for income level, as household expenses may lead to dropout rates, or as a marker for access to basic services such as education and healthcare. Reduced access to the healthcare system may influence the diagnosis and management of comorbidities associated with nocturia.

OAB syndrome was associated with a 2.8 times higher chance of experiencing two or more episodes of nocturia. OAB syndrome reduces nocturnal bladder capacity, which can be assessed through a voiding diary where information such as voiding times and volumes are recorded[23]. Additionally, the coexistence of OAB syndrome and other LUTS is common. Chan et al.[24] evaluated urodynamic studies conducted on 213 women with complaints of nocturia and identified, in 28% of cases, the simultaneous presence of detrusor overactivity, which may be present in OAB syndrome, and detrusor underactivity, a condition that can reduce bladder capacity due to elevated post-void residual.

The presence of MUI, characterized by the concomitance of UUI and SUI, was associated with a 2.5 times higher chance of experiencing one or more voids. UUI is one of the possible symptoms of OAB syndrome. OAB syndrome, in turn, has a complex pathophysiology and has been classified into different phenotypes, with the phenotype of interest being related to variation in urethral pressure during the bladder storage phase, which also presents with SUI[25]. Since no association was found between pure SUI and nocturia, the association between MUI and nocturia may be due to a high prevalence of this phenotype in the studied population.

The presence of three or more comorbidities was associated with a nearly three times higher chance of experiencing one or more episodes of nocturia. In 2019, 23.9% of Brazilians who responded to the National Health Survey reported having SAH, and 7.7% reported having DM, two of the most prevalent comorbidities[26]. The loss of physiological nocturnal blood pressure dipping is related to a higher risk of nocturia[27]. Furthermore, DM can lead to glucosuria and increased urinary output if poorly controlled, as well as lower urinary tract dysfunctions[28].

The consumption of caffeine showed a slight protective effect, with a reduction of 0.5% in the chance of presenting nocturia for each additional milligram consumed daily. In contrast to the findings of the present study, Le Berre et al.[29] conducted a scoping review on caffeine consumption and LUTS in adults and found a trend of benefit in reducing

caffeine consumption in LUTS overall. However, there is a scarcity of evidence regarding the specific effect of caffeine on nocturia, as well as the need to improve study designs to reduce the possibility of biases and standardize outcomes. Potential outcomes include the presence or worsening of mechanisms such as global polyuria and reduced bladder capacity based on data collected in voiding diaries.

Some limitations of the study should be acknowledged. Given the convenience sampling in specialty outpatient clinics, the prevalence of LUTS may be higher than in the general population. It was not possible to study the association of postmenopausal atrophy with nocturia, as a significant percentage of participants had a history of hysterectomy, making it difficult to determine the timing of menopause. The considered comorbidities were those reported by the patients, which may have introduced some imprecision in the prevalence of certain comorbidities. Additionally, it was not possible to classify participants as having compensated or decompensated diabetes, nor diagnose early-stage CKD, known to be associated with nocturia[30].

Nonetheless this study constitutes a still limited group of Brazilian studies on the prevalence of nocturia and gains special relevance due to the largest national study on LUTS until then, the LUTS Brazil project, not having collected data from the state of Rio de Janeiro. Additionally, it is one of the first in the country to address factors associated with nocturia. In this sense, it investigated a wide diversity of associations, including sociodemographic, clinical, and lifestyle factors. Such an approach contributes to understanding which factors are most associated with nocturia in the Brazilian population, providing a basis for the development of approach protocols for women with LUTS.

Nocturia has an increasing prevalence in women as age increases and is associated with a greater number of comorbidities, which is also more common in elderly individuals. Therefore, it is essential for all professionals serving the elderly population, especially those with lower levels of education, to actively seek the presence of nocturia.

The treatment of comorbidities and the investigation of LUTS and the risk of OSA, with appropriate referral of individuals to specialized centers, can contribute to reducing the number of episodes of nocturia.

CONCLUSIONS

The prevalence of nocturia was consistent with Brazilian studies conducted in the general population and with a North American study conducted in a population treated in specialized LUTS outpatient clinics, while the prevalence of two or more voids was higher. Factors associated with a greater chance of presenting nocturia included lower education level, lower daily caffeine intake, OAB syndrome, MUI, and the presence of three or more comorbidities.

Consequently, it is highly relevant for all healthcare professionals serving the elderly population to investigate the presence of nocturia, aiming to implement measures to minimize its impact on QoL and mortality. Moreover, the identification of sociodemographic, clinical, and lifestyle factors associated with nocturia, carried out in a pioneering manner in a sample of the Brazilian population, can provide insights for the development of protocols for addressing women with LUTS.

New studies involving elderly individuals from the general population and the performance of laboratory tests to identify clinical conditions or decompensation of diseases that may lead to nocturia are necessary, as well as research on the impact of this symptom on QoL.

AUTORSHIP

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- Carlos Augusto Faria - project conception, data collection, data interpretation, and article writing

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