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Overactive Bladder Symptoms Negatively Affect Sleep Quality of Patients With Depression

Mikolaj Przydacz[1], Tomasz Golabek[1], Przemyslaw Dudek[1], Michal Skalski[2], Jerzy Sobanski[3], Katarzyna Klasa[3], Katarzyna Gronostaj[1], Dominika Dudek[4], Piotr Chlosta[1]

[1]Department of Urology, Jagiellonian University Medical College, Krakow, Poland
[2]Department of Adult Psychiatry, University Hospital, Krakow, Poland
[3]Department of Psychotherapy, Jagiellonian University Medical College, Krakow, Poland
[4]Department of Affective Disorders, Jagiellonian University Medical College, Krakow, Poland

Purpose: An established link exists between overactive bladder (OAB) syndrome and impaired sleep. However, earlier research on this subject only focused on the general population, and certain patient subgroups have not been examined adequately. Depressed patients constitute a unique population because of a possible bidirectional relationship between OAB and depression. Thus, we investigated the association between OAB symptoms and sleep quality in patients with depression.
Methods: In this prospective, cross-sectional study, we analyzed data on depression, sleep quality, and OAB symptoms from depressed patients treated at our department of adult psychiatry. Data were collected with the Hamilton Rating Scale for Depression, the Holland Sleep Disorders Questionnaire, the Athens Insomnia Scale, and the OAB Module of the International Consultation on Incontinence Questionnaire.
Results: In total, 102 patients treated for depression were enrolled. Thirteen patients (12.7%) met the diagnostic threshold of OAB with the International Consultation on Incontinence Questionnaire OAB Module. Patients with depression and concomitant OAB had significantly higher scores on the Holland Sleep Disorders Questionnaire than patients classified as non-OAB ($P<0.01$). OAB patients also had a higher risk of insomnia relative to non-OAB individuals ($P<0.05$). In addition, the relationship between OAB symptoms and sleep quality in patients with depression was independent from age and sex.
Conclusions: In our cohort composed exclusively of individuals treated for depression, OAB symptoms were present in a significant proportion of patients, and OAB negatively affected sleep quality. Therefore, we recommend that OAB symptoms should be assessed collectively in patients with depression.

Keywords: Urinary bladder, Overactive; Sleep; Depression

- **Research Ethics:** This study was approved by the research ethics committee of Jagiellonian University, Medical College (KBET/266/B/2013). This study was carried out in agreement with applicable laws and regulations, good clinical practice, and ethic al principles, as described in the Declaration of Helsinki of 1975, and revised in 2008. All included patients agreed to participate in the study, and informed consent was obtained from all individual participants included in the study.
- **Conflict of Interest:** No potential conflict of interest relevant to this article was reported.

INTRODUCTION

Overactive bladder (OAB) is a bladder-centric syndrome that consists of urinary urgency with or without urge urinary incontinence, often accompanied by frequency and nocturia [1]. The prevalence of OAB ranges from 7% to 27% in men and 9% to

Corresponding author: Mikolaj Przydacz https://orcid.org/0000-0002-7381-7420
Department of Urology, Jagiellonian University Medical College, ul. Grzegorzecka 18, 31-531 Krakow, Poland
Email: mikolaj.przydacz@yahoo.com
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43% in women; its prevalence tends to increase with age [2]. OAB-induced impairment of quality of life has been well documented, and OAB weakens physical, emotional, social, and mental functioning [3]. OAB may lead to isolation, embarrassment, reduced contact with family and friends, loss of confidence or motivation, sexual dysfunction, and hopelessness. As a result, OAB may advance some symptoms of depression.

Sleep is a major component of mental and physical health [4]. Sleep problems were found to be associated with poor social interaction, diminished work productivity and work quality, and lower overall quality of life. Numerous studies have linked lower urinary tract symptoms to sleep disturbance [5-7]. Both storage and voiding lower urinary tract symptoms were found to be independent predictors of sleep dysfunction. However, research has been limited regarding the possible correlation between OAB and sleep disorders [8,9], although the relationship between nocturia, an OAB symptom, and sleep problems has been examined extensively [10,11]. The relationship between OAB and sleep complaints, therefore, is not well understood and warrants additional investigation [12]. Importantly, thus far, investigators have examined only the general population (i.e., mentally healthy persons without diagnoses of depression or other psychiatric disorders). The association between OAB and sleep quality has not been assessed in detail for most specific patient subpopulations, although clinicians could better serve some of their patients if they were armed with information about the possible association between urinary tract symptoms, including OAB, and sleep quality [13].

Patients with depression represent a uniquely important population because of a possible bidirectional relationship between OAB and depression [14,15]. This bidirectional relationship should encourage the multidisciplinary management of patients with depression coordinated by psychiatrists and urologists. However, until now, the medical community has not investigated the impact of OAB on sleep quality in patients with depression. Even though current recommendations underscore the need for sleep assessment of OAB patients, it is still unknown whether OAB is correlated with sleep quality in patients treated for depression. This data vacuum may lead to a hypothesis that the coexistence of OAB and sleep dysfunction in depressed patients might be more complex, underreported, and undertreated. These absent data are necessary to provide a more comprehensive understanding of the clinical workup and integrated care that depressed patients need. Moreover, the sleep quality of patients with depression may be independently decreased by depression itself. Thus, the aim of this study was to investigate connections between OAB and sleep quality in patients with depression. We hypothesized that patients with depression who reported OAB symptoms experienced greater sleep impairment than patients with depression who did not have OAB symptoms.

MATERIALS AND METHODS

Between 2014 and 2015, adult patients treated in our outpatient and inpatient department of adult psychiatry were prospectively recruited for this study. We assessed the severity of their depression, sleep disturbances, and OAB symptoms. All the included patients met both the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) and International Classification of Diseases, 10th Revision (ICD-10) criteria for depression, and psychiatrists established the diagnoses of all patients. The following demographic data were considered a priori: age, sex, education, employment status, relationship, recent hospitalizations due to depression, familial history of depression, and depression medications.

Instruments

The Hamilton Rating Scale for Depression (HRSD), also known as the Hamilton Depression Rating Scale, was used to classify depression severity. The HRSD was designed to be administered by clinicians after a structured or unstructured patient interview to determine their symptoms [16]. The HRSD has been used in many key studies of depression and treatment, and consists of 17 questions with a total score between 0 and 54. For this study, patients were classified as being in remission - no depression (0–7), having mild depression (8–16), having moderate depression (17–23), or having severe depression ($\geq$24). Psychiatrists completed the HRSD questionnaire.

We used the Holland Sleep Disorders Questionnaire (HSDQ) to assess sleep quality. The HSDQ is a clinically validated instrument composed of International Classification of Sleep Disorders clusters of sleep complaints/symptom descriptions; the HSDQ enables a clinician to determine whether the respondent meets the diagnostic criterion/criteria for 1 or more sleep disorders [17]. The HSDQ has 32 questions and a total score between 32 and 160. In this research, we focused on the continuous variable of general sleep disorder from the HSDQ. Patients self-administered the questionnaire.

We evaluated insomnia using the Athens Insomnia Scale

(AIS). The AIS is a self-assessment psychometric instrument designed for quantifying sleep difficulty based on the ICD-10 criteria [18]. Sleep difficulty is measured using 8 factors, among which the first 5 factors are related to nocturnal sleep and the final 3 aspects are related to daytime dysfunction. The first 5 factors pertain to sleep induction, awakening during the night, final awakening, total sleep duration, and sleep quality. The last 3 refer to well-being, functioning capacity, and daytime sleepiness. The factors are rated on a 0–3 scale and a total score between 0 and 24. A cutoff score of ≥6 on the AIS is equated to a diagnosis of insomnia [19].

The International Consultation on Incontinence Questionnaire Overactive Bladder Module (ICIQ-OAB) is a brief yet comprehensive instrument for evaluating OAB. It is a measure that assesses the impact of urinary frequency, urgency, urge incontinence, and nocturia [20]. The ICIQ-OAB consists of 8 questions with a total score between 0 and 54. An ICIQ-OAB score greater than or equal to 28 has been considered diagnostic for OAB in multiple studies [21]. We also used this threshold in our study, and we divided our patients into 2 groups: OAB (ICIQ-OAB score greater than or equal to 28) and non-OAB (ICIQ-OAB score less than 28). The instrument was self-administered by patients.

Statistics

Means, standard deviations, medians, minimum and maximum values (range), and 95% confidence intervals were used to present descriptive results for continuous data, and counts and percentages were used for discrete data. The Shapiro-Wilk test was used to analyze distribution and the Leven (Brown-Forsythe) test was used to investigate the hypothesis of equal variance. To evaluate differences between 2 groups (unrelated variable model), we used the Student t-test (or the Welch test in the absence of variance homogeneity) or the Mann-Whitney U-test (if the Student t-test could not be applied or for variables measured on an ordinal scale). Regression analysis was used to investigate the effect of OAB on sleep quality in patients with depression regardless of age and sex. To establish links between variables, and to assess the strength and direction of those relationships, correlation analysis was conducted by calculating Pearson and/or Spearman correlation coefficients. Statistical significance was considered to be present if the P-value was <0.05. Data analysis was conducted with Statistica ver. 12.0 (StatSoft Inc., 2014, Tulsa, OK, USA).

RESULTS

Demographic and Clinical Characteristics

Initially, 106 subjects were enrolled; 4 patients failed to complete the questionnaires, leaving 102 patients to be analyzed. The mean age of our cohort was 46.1 years (range, 20–67 years). There were more women than men. Most of the 102 patients were employed, had attained higher education, and were in stable relationships based on patients' perceptions (Table 1).

The mean number of hospitalizations related to depression was 2.4 (range, 0–20). The mean time between diagnosis of depression and inclusion in the study was 10.7 years. We analyzed the familial history of depression in 31 individuals. Most patients were being treated with selective serotonin reuptake inhibitors and serotonin norepinephrine reuptake inhibitors (Table 1). Only 6 patients were taking medications to aid with sleep (zolpidem or zopiclone); their demographic and clinical characteristics were not statistically significantly different from those of other patients. Some individuals had concomitant anxiety (n=19), personality (n=4), obsessive-compulsive (n=3), and eating (n=3) disorders. All these patients met specific ICD-10 criteria for their specific concomitant disorders.

Instrument Scores

The mean score of the HRSD questionnaire in our study was 15.9 (range, 1–32), and most of our patients experienced mild depression (n=37), followed by moderate depression (n=29), severe depression (n=20), and remission (n=16). The mean HSDQ score of our cohort was 77.4 (range, 32–146). The mean score of the AIS was 11.3 (range, 0–24), and 82 out of 102 patients had a score of ≥6 points (i.e., diagnostic for insomnia).
The mean score of the ICIQ-OAB instrument was 10.8 (range, 0–55); 13 patients (12.7%) met the threshold of 28 points that was diagnostic for OAB. Although OAB symptoms tended to be more prevalent in women than in men, there were no statistically significant differences between OAB and non-OAB patients in terms of age, sex, and depression severity. Table 2 presents detailed a comparison of the characteristics of the 2 study groups.

Correlations

We found statistically significant correlations between depression severity and sleep quality in the studied patients (Table 3). Patients with moderate or severe depression had higher HSDQ scores than those who were in remission or had mild depres-

Table 1. Demographic characteristics and drugs used by the included patients

Specification	No. (%)
No. of included patients (%)	102 (100)
Sex	
Male	42 (41.2)
Female	60 (58.8)
Education	
Primary	3 (2.9)
Secondary (including students)	45 (44.1)
Higher	54 (52.9)
Employment status	
Employed	55 (53.9)
Unemployed	13 (12.7)
Pensioners	30 (29.4)
Students	4 (3.09)
Relationship	
Stable relationship/marriage	73 (71.6)
Unstable relationship/marriage	12 (11.8)
Single	17 (16.7)
Pharmacotherapy	
Antidepressants	
SNRIs	47 (46.1)
SSRIs	46 (45.1)
TCAs	23 (22.5)
NaSSAs	21 (20.6)
SARIs	21 (20.6)
Lithium	14 (13.7)
Other antidepressants	10 (9.8)
Antiepileptics	
Valproate	23 (22.5)
Lamotrigine	16 (15.7)
Carbamazepine	10 (9.8)
Neuroleptics, first generation	
Phenothiazines	35 (34.3)
Thioxanthenes	13 (12.7)
Butyrophenones	6 (5.9)
Neuroleptics, second generation	
Quetiapine	24 (23.5)
Sulpiride	16 (15.7)
Olanzapine	14 (13.7)
Aripiprazole	8 (7.8)
Other neuroleptics	6 (5.9)
Anxiolytics	
Benzodiazepines	33 (32.4)
Hydroxyzine	10 (9.8)
Buspirone	3 (2.9)

SNRIs, serotonin norepinephrine reuptake inhibitors; SSRIs, selective serotonin reuptake inhibitors; TCAs, tricyclic antidepressants; NaSSAs, noradrenergic and specific serotonergic antidepressants; SARIs, serotonin antagonist and reuptake inhibitors.
Other antidepressants: tianeptine, norepinephrine and dopamine reuptake inhibitors, norepinephrine reuptake inhibitors, reversible monoamine oxidase inhibitor, agomelatine. Other neuroleptics: risperidone, clozapine, amisulpride.

sion (P=0.0004). Similarly, patients with moderate or severe depression had significantly higher overall AIS scores than those who were in remission or had mild depression (P=0.0015). In addition, patients with moderate or severe depression had higher risks of insomnia (i.e., at least 6 points on the AIS) than patients in remission or with mild depression (P=0.0027).

We also found statistically significant correlations between OAB symptoms and sleep quality (Table 4). Depressed patients with at least 28 points on the ICIQ-OAB had higher HSDQ scores than those classified as non-OAB (P=0.003). OAB symptoms were also correlated with insomnia. OAB patients had a higher risk of insomnia (i.e., higher AIS scores) than non-OAB individuals (P=0.0192). In addition, 12 of 13 patients (92.3%) with OAB met the diagnostic threshold of insomnia as defined by the AIS (i.e., an AIS score ≥6), whereas 67 out of 89 (75.3%) non-OAB patients met the criteria (P=0.034).

Post hoc tests to investigate specific items of the ICIQ-OAB showed that nocturia (questions #3 and #4 of the ICIQ-OAB) had the strongest effect on sleep quality and insomnia of the included patients. Having at least 3 episodes per night of nocturia was associated with significantly higher HSDQ scores and AIS scores. The correlations between sleep quality/insomnia and ICIQ-OAB questionnaire questions are presented in detail in Table 5. Notably, question #1 (number of daily micturitions) had no or minimal effect on the quality of sleep or insomnia (weak correlation or no correlation). We did not find statistically significant associations between sleep quality, OAB symptoms, and the psychiatric medications that were used by our cohort.

(*Continued to the next page*)

Table 2. Comparative characteristic of patients without OAB symptoms (ICIQ-OAB score < 28, nNon-OAB group) and patients with OAB symptoms (ICIQ-OAB score ≥ 28, OAB group) in terms of sex, age, and severity of depression

Variable	Non-OAB group	OAB group	P-value
Sex, n (%)			0.0570‡
Women	49 (55.1)	10 (76.9)	
Men	40 (44.9)	3 (23.1)	
Age (yr)			0.3553†
Mean ± SD	45.9 ± 11.1	47.8 ± 13.4	
Median (range)	47.0 (20.0–67.0)	52.5 (24.0–61.0)	
95% CI	(43.6–48.2)	(39.3–56.4)	
Age group (yr), n (%)			0.6920‡
20–30	10 (11.1)	2 (16.7)	
31–40	16 (17.8)	1 (8.3)	
41–50	27 (30.0)	2 (16.7)	
51–60	32 (35.6)	6 (50.0)	
> 60	5 (5.6)	1 (8.3)	
HRSD			0.5749†
Mean ± SD	18.0 ± 10.4	15.8 ± 9.3	
Median (range)	18.0 (0.0–52.0)	16.0 (2.0–31.0)	
95% CI	(15.8–20.2)	(9.8–21.7)	
HRSD (category), n (%)			0.9105‡
Remission/no depression	15 (16.7)	3 (25.0)	
Mild depression	25 (27.8)	3 (25.0)	
Moderate depression	27 (30.0)	3 (25.0)	
Severe depression	23 (25.6)	3 (25.0)	

OAB, overactive bladder; ICIQ-OAB, International Consultation on Incontinence Questionnaire Overactive Bladder Module; SD, standard deviation; CI, confidence interval; HRSD, Hamilton Rating Scale for Depression.
†Mann-Whitney U-test. ‡Chi-square test.

Table 3. Comparative characteristics of patients with no depression or mild depression (HRSD score 0–16, group A) and patients with moderate or severe depression (HRSD score ≥ 17, group B) in terms of sleep quality (based on the HSDQ) and insomnia (based on the AIS)

Variable	Group A	Group B	P-value
HSDQ			0.0004†
Mean ± SD	69.2 ± 28.5	84.2 ± 19.2	
Median (range)	68.5 (32.0–146.0)	82.0 (39.0–134.0)	
95% CI	(60.7–77.6)	(79.1–89.4)	
AIS score, n (%)			0.0027‡
0-5	15 (32.6)	5 (8.9)	
≥ 6	31 (67.4)	51 (91.1)	
AIS overall score			0.0015†
Mean ± SD	9.3 ± 6.2	13.0 ± 4.8	
Median (range)	8.0 (0.0–24.0)	13.5 (3.0–24.0)	
95% CI	(7.4–11.1)	(11.7–14.3)	

HRSD, Hamilton Rating Scale for Depression; HSDQ, Holland Sleep Disorders Questionnaire; AIS, Athens Insomnia Scale; SD, standard deviation; CI, confidence interval.
†Mann-Whitney U-test. ‡Chi-square test.

Table 4. Comparative characteristic of patients without OAB symptoms (ICIQ-OAB score <28, non-OAB group) and patients with OAB symptoms (ICIQ-OAB score ≥28, OAB group) in terms of HSDQ and AIS scores

Variable	Non-OAB group	OAB group	P-value
HSDQ			0.0003†
Mean±SD	75.0±23.6	102.1±19.9	
Median (range)	76.0 (32.0–146.0)	102.0 (74.0–139.0)	
95% CI	(70.0–80.0)	(89.4–114.8)	
AIS			
Mean±SD	11.1±5.7	14.8±4.9	0.0192†
Median (range)	11.0 (0.0–24.0)	16.5 (4.0–20.0)	
95% CI	(9.8;12.3)	(11.6;17.9)	

OAB, overactive bladder; ICIQ-OAB, International Consultation on Incontinence Questionnaire Overactive Bladder Module; SD, standard deviation; CI, confidence interval; HSDQ, Holland Sleep Disorders Questionnaire; AIS, Athens Insomnia Scale.
†Mann-Whitney U-test.

Table 5. Correlations between sleep quality/insomnia and ICIQ-OAB questionnaire questions

Question number and content	Sleep quality (HSDQ)		Insomnia (AIS)	
	R	P-value	R	P-value
Q1. How often do you pass urine during the day? (0) 1 to 6 times; (1) 7 to 8 times; (2) 9 to 10 times; (3) 11 to 12 times; (4) 13 or more times	0.17	0.0970	0.25	0.0126
Q2. How much does this bother you? Likert-like scale between 0 (not at all) and 10 (a great deal)	0.43	0.0001	0.32	0.0009
Q3. During the night, how many times do you have to get up to urinate, on average? (0) none; (1) one; (2) two; (3) three; (4) four or more	0.57	0.0001	0.38	0.0001
Q4. How much does this bother you? Likert-like scale between 0 (not at all) and 10 (a great deal)	0.62	0.0001	0.39	0.0001
Q5. Do you have to rush to the toilet to urinate? (0) never; (1) occasionally; (2) sometimes; (3) most of the time; (4) all of the time	0.50	0.0001	0.33	0.0006
Q6. How much does this bother you? Likert-like scale between 0 (not at all) and 10 (a great deal)	0.51	0.0001	0.34	0.0005
Q7. Does urine leak before you can get to the toilet? (0) never; (1) occasionally; (2) sometimes; (3) most of the time; (4) all of the time	0.38	0.0001	0.23	0.0180
Q8. How much does this bother you? Likert-like scale between 0 (not at all) and 10 (a great deal)	0.43	0.0001	0.27	0.0052

ICIQ-OAB, International Consultation on Incontinence Questionnaire Overactive Bladder Module; HSDQ, Holland Sleep Disorders Questionnaire; AIS, Athens Insomnia Scale; R, correlation coefficient.

Regression Analysis

As presented in Table 6, we used regression analysis to investigate the effect of depression severity and OAB on sleep quality in depressed patients regardless of age and sex. We showed that depression severity affected sleep quality. Patients with no depression or mild depression (HRSD, 0–16) had better sleep quality than patients with moderate or severe depression (HRSD≥17). Further, the severity of OAB symptoms assessed with the ICIQ-OAB was associated with decreased sleep quality; an ICIQ-OAB score of 0–27 predicted better sleep quality, whereas an ICIQ-OAB score of ≥28 (i.e., diagnostic of OAB) predicted worse sleep quality.

DISCUSSION

Patients with lower urinary tract symptoms, including OAB, are thought to experience higher rates of sleep disturbance than the general population. Our study was the first to analyze the

Table 6. Regression analysis of the effect of depression severity and OAB symptoms assessed with the ICIQ-OAB on sleep quality in patients with depression regardless of age and sex

Parameter	P-value
Age (yr)	0.2633
20–30	0.7340
31–40	0.0808
41–50	0.4679
51–60	0.0514
>60	0.7670
Sex	
Women	0.4564
Men	0.4564
HRSD	0.0010
Remission/no depression (0–7)	0.0119
Mild depression (8–16)	0.2123
Moderate depression (17–23)	0.2780
Severe depression (≥24)	0.0193
HRSD (0–16)	0.0020
HRSD (≥17)	0.0020
ICIQ-OAB	0.0001
ICIQ-OAB (0–27)	0.0002
ICIQ-OAB (≥28)	0.0002

OAB, overactive bladder; ICIQ-OAB, International Consultation on Incontinence Questionnaire Overactive Bladder Module; HRSD, Hamilton Rating Scale for Depression.

impact of OAB symptoms on sleep quality in a unique patient population reliably diagnosed with, and treated for, depression. Almost 13% of patients with our depression in our cohort reached the diagnostic threshold of OAB using the validated ICIQ-OAB instrument. Thus, OAB symptoms may be present in a substantial percentage of patients with depression receiving routine psychiatric treatment. Further, sleep quality analyzed with 2 independent validated questionnaires (i.e., the HSDQ and AIS) was correlated with OAB. These disorders and symptoms tended to coexist and likely compounded the severity of each another. This coexistence property should prompt a re-evaluation of current recommendations on diagnosis of sleep problems for patients with depression [22,23]. Depressed patients, primarily those reporting sleep problems, should be screened carefully for OAB symptoms. Psychiatrists may have limited perception of lower urinary tract symptoms, including OAB, in their patient populations [24]; thus, complex management of this patient group, particularly by cooperation between psychiatrists and urologists, should be a priority among healthcare professionals.

A strength of this study was the use of validated scales to assess depression severity, sleep quality, and OAB symptoms. These instruments were unlikely to cause under- or overreporting of urological and psychiatric symptoms and sleep problems. The use of 4 different reliable questionnaires, including 2 independent instruments for sleep quality assessment, provided accurate results. Unlike our analysis, some prior investigations that reported correlations between OAB and sleep in the general population did not use validated questionnaires [25,26]. It is strongly recommended to collectively assess OAB symptoms with appropriate instruments [27].

Another strength of our study was its analysis of a homogeneous group of patients with depression, all of whom met the DSM-5 and ICD-10 criteria for depression. In all cases, psychiatrists confirmed the diagnoses. Further, all were treated for depression. The study results, therefore, clearly showed the relationship between sleep quality and OAB symptoms in this specific patient group.

In the literature, a link between sleep quality and OAB has been reported. Ge et al. [8], in their cross-sectional analysis of 51 OAB patients and 30 age-matched controls, showed that sleep disturbances were associated with more severe OAB symptoms and poorer psychosocial health. Savoie et al. [9], in a prospective study of 161 women, demonstrated that OAB patients had high rates of poor sleep quality and sleep disruption, even in the absence of nocturnal bladder symptoms. Similarly, several epidemiological studies have presented a link between OAB and depressive symptoms, and they have even suggested a bidirectional nature of this relationship. The largest epidemiological investigations of lower urinary tract symptoms and OAB (NOBLE, EPIC, and EpiLUTS) demonstrated this interconnection [15]. However, those studies all included participants from only the general population. Diagnoses of depression were neither established nor confirmed by psychiatrists. The results were based solely on single, sometimes nonstandard instruments to assess depression. The measures used in studies that focused on the general population were used only to screen for depression, and they were not diagnostic even if they were effective in assessing symptom load [28]. Therefore, all these earlier studies, in fact, analyzed correlations between sleep quality and OAB in the general population or, at best, in patients with depressive symptoms, but not necessarily depression. Until

now, it was questionable whether any relationship exists between OAB symptoms, sleep quality, and reliably diagnosed depression. Our study has established this relationship.

Nocturia needs special consideration. Studies of the general population showed that 2 episodes of nocturia is a threshold for bother [29]. One nightly void did not appear to be sufficiently disruptive to cause significant bother for most patients. However, this 2-episode threshold is not recommended for all patient populations [29]. In our study, at least 3 episodes of nocturia were necessary to significantly lower sleep quality in individuals with depression. We speculate that patients with depression have a greater tolerance for nocturia. We also found that nocturia may not be the only significant predictor of sleep disturbances because other OAB symptoms also contributed to impaired sleep patterns.

The pathophysiology responsible for the negative effects of OAB on sleep quality is not well understood. First, nocturia, an OAB symptom, substantially deteriorates sleep quality. Nocturia-induced sleep fragmentation causes daytime drowsiness, poor concentration, and anxiety, which leads to impaired occupational functioning and physical and emotional health, ultimately degrading an individual's quality of life [30]. Second, obstructive sleep apnea, a disorder with repeated episodes of complete or partial obstruction of the upper airway during sleep, was also linked to OAB (mainly to nocturia and urgency) and poor sleep quality [31]. Obstructive sleep apnea may lead to increased secretion of atrial natriuretic peptide in response to airway obstruction, thereby causing nocturnal polyuria. Animal studies also showed that hypoxia induced by obstructive sleep apnea was associated with bladder oxidative stress, altered cell signaling, and structural damage, finally leading to increased urinary frequency and involuntary bladder contractions [32]. Notably, in our cohort, no patient was diagnosed with obstructive sleep apnea. Third, another hypothesis is that central sensitization with spinal hypersensitivity may lead to a variety of chronic pain disorders that share some pathophysiological pathways with OAB [33]. Finally, the increased presence of non-urologic symptoms in OAB patients suggests an underlying systemic etiology and pathogenetic mechanisms that may contribute to OAB. Differences have been observed between OAB and non-OAB patients across multiple organ systems, including neurological, cardiopulmonary, gastrointestinal, sexual, musculoskeletal, and gynecological systems [34]. About a third of OAB patients report widespread systemic symptoms, with a high symptom burden across multiple organ systems [34]. This multiorgan involvement suggests that correlation between OAB symptoms and sleep quality may be more complex than expected.

There are some potential weaknesses of our study. First, patients were not reliably diagnosed with OAB. An accurate diagnosis of OAB requires exclusion of urinary tract infection or other obvious pathologies. In addition, we did not collect data from voiding diaries. However, we assessed OAB symptoms using an instrument with an adequate threshold score that has been validated in other OAB studies. Second, we focused on the continuous variable of general sleep disorder from the HSDQ. We attempted to perform correlation analyses for each of the questionnaire clusters, which may have further differentiated various types of sleep disorders; however, using the HSDQ we were not able to identify consistent relationships between specific types of sleep disorders and OAB. Although our sample size was large enough for a powerful statistical analysis, the study may have lacked adequate power for specific and detailed analyses. Third, we were not able to longitudinally assess our patients. It is an open question whether OAB-specific treatments, including physiotherapy, patient education, and pharmacotherapy, would improve sleep quality in this specific patient group. In the general population, sleep quality improved after OAB therapies such as anticholinergics or sacral neuromodulation [35]. Nonetheless, we used data obtained from a prospectively maintained database. Finally, we acknowledge that the patients evaluated were a highly selected cohort, treated at a single, high-volume academic center; our findings could have been somewhat different if we had assessed a less highly selected cohort of patients treated for depression.

In conclusion, this study of a carefully constructed cohort has shown a link between OAB symptoms in patients with depression and sleep quality. OAB symptoms were present in a substantial percentage of our cohort of patients who had been diagnosed with, and were receiving treatment for, depression. We also found a strong correlation between OAB symptoms and sleep quality. Therefore, healthcare professionals who treat patients with depression should screen for both sleep problems and OAB symptoms. We suggest that our study will promote improved patient-centered care of individuals with depression.

AUTHOR ORCID

Mikolaj Przydacz 0000-0002-7381-7420
Jerzy Sobanski 0000-0001-6001-1068

Katarzyna Klasa 0000-0003-3885-5832
Katarzyna Gronostaj 0000-0002-4026-7178
Dominika Dudek 0000-0001-6120-0506
Piotr Chlosta 0000-0002-5919-4060

AUTHOR CONTRIBUTION STATEMENT

· Conceptualization: MP, TG, MS, JS, DD, PC
· Data curation: MP, PD, MS, JS, KK, KG, DD, PC
· Formal analysis: MP
· Methodology: MP
· Project administration: MP
· Writing-original draft: MP
· Writing-review & editing: MP, TG, PD, MS, JS, KK, KG, DD, PC

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