Patterns of sleep disorders in women

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Background Across the lifespan, several biological and hormonal differences affect symptoms and consequences of sleep and circadian rhythm sleep-wake disorders in women. Published data on women with restless leg syndrome are few.

Objective To find out the pattern of sleep disorders in premenopausal or postmenopausal women.

Patients and methods This cross-sectional study included 60 women with a history of sleep disturbance fulfilled by the Epworth sleepiness scale. Medical history, anthropometric measures, and full night-attended polysomnography were done.

Results Regarding STOP-Bang questionnaire, there was a statistically significantly higher proportion of women with hypertension, BMI more than 35 kg/m^2, and neck size more than 17.5 cm in the postmenopausal group compared with the premenopausal group ($P<0.05$). The presence of restless leg syndrome was reported in 87.9% of the postmenopausal compared with 81% in the premenopausal group. Regarding the presence and type of insomnia, there was no significant difference. More than 30% of women had initiation insomnia and the vast majority of them had difficulty in maintaining sleeping. The proportion of women with insufficient length of sleep was significantly higher among postmenopausal women. The premenopausal group had a statistically significant lower proportion of N1 (9.2%) and N2 (3%) compared with N1 (18.2%) and N2 (6.1%) in the postmenopausal group ($P<0.001$). The average sleep efficiency, daytime sleep latency, and apnea–hypopnea index were comparable between both groups.

Conclusion Postmenopausal women had statistically significant higher STOB-Bang score and insufficient length of sleep, which may reflect a significant change in sleep architecture and patterns after menopause, which could be explained by the hormonal changes that occur after menopause.

Egypt J Bronchol 2019 13:767–773

Egyptian Journal of Bronchology 2019 13:767–773

Keywords: disorders, sleep, women

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Received: 2 May 2019 **Accepted:** 21 June 2019
Published: xx xx 2020

Introduction

In women across their lifespan, several biological and hormonal differences affect symptoms and consequences of sleep and circadian rhythm sleep-wake disorders [1,2]. In transitioning menopause and postmenopausal women, the prevalence rates of self-report sleep difficulties are ranged from 40 to 56%, compared with 31% in premenopausal women in their late-reproductive stage [3]. Obstructive sleep apnea (OSA) is a common disorder characterized by repetitive upper-airway collapse during sleep. The diagnosis is made by nocturnal polysomnography. Women are two to three times less likely than men to have classic OSA symptoms [4].

Women have a higher incidence of poor sleep, which leads to depression and insomnia; this will cause many health problems such as cardiovascular diseases, neurocognitive dysfunction, and poor quality of life owing to depression and anxiety. Hormones have an important effect in sleep pattern in women which change with hormonal change. Women are also more likely to complain of headache, insomnia, irritability, loud snoring, and cessation of respiration during sleep. Mortality is high in women with OSA, especially in patients with cardiovascular disease, which decrease by suitable management such as use of continuous positive airway pressure. Social factors, race, and sex affect sleep duration. Women with OSA are present with atypical symptoms however, classical symptoms usually seen in men [5].

Restless leg syndrome, a movement disorder, is characterized by an urge to move the legs, typically during rest, which is relieved by activity. Symptoms are often accompanied by sensations of 'creeping', 'pulling', 'itching', or 'tingling', and the diagnosis requires the presence of sensory symptoms. Published data on women with restless leg syndrome are few, and more research focusing on the symptoms and treatment options for women is needed to tailor both diagnostic and treatment strategies [6].

Aberration of the adrenocortical rhythm owing to sleep restriction may increase the risk of depression among women [7].

Women are more likely to report sleep disturbances and are 41% more likely than men to experience insomnia. The late-luteal phase of the menstrual cycle, menopause, and third trimester of pregnancy are associated with insomnia, with ~50% of a premenopausal woman reporting significant symptoms [8].

The aim of this study was to find out the pattern of sleep disorders in women either premenopausal or postmenopausal.

Patients and methods

The cross-sectional analytic study was carried out from June 2016 to December 2017 at the sleep disordered breathing unit in a tertiary hospital. This study included 60 women, either premenopausal (regular menstrual periods and not on hormonal therapy) or postmenopausal (no menstrual period in the past 12 months and age above 40 years old) [9], and we used nonprobability consecutive sampling technique to collect the data from eligible women; the women were recruited consecutively from the sleep disorder unit. Participants in the targeted institutions were informed about the study objectives, methodology, risk, and benefit. Patients who agreed to fill in the questionnaire implied that they agreed to participate in the study. This study was approved by the Faculty of Medicine Ethics Committee.

Inclusion criteria

The following were the inclusion criteria:

(1) Women above 18 years old.
(2) History of sleep disturbance fulfilled by the Epworth sleepiness scale (ESS) [10].

Exclusion criteria

The following were the exclusion criteria:

(1) Disturbed level of consciousness.
(2) Hemodynamic instability (shocked patients).
(3) Patients with OSA associated with other pulmonary diseases such as chronic obstructive pulmonary disease, asthma, interstitial lung disease, and bronchiectasis.
(4) Pregnant women.
(5) Anemic women.

All eligible women were subjected to the following:

(1) Medical history and physical examination: attention was given to history suggestive of obstructive sleep apnea syndrome (OSAS): night symptoms of OSAS (snoring, chocking and witnessed apnea, bad dreams and nocturnal) and daytime symptoms (morning headache, excessive daytime sleepiness; assessed using the ESS). Height, weight, BMI, waist circumference, and neck circumference were recorded. Signs of periodic leg movement (PLM) syndrome, neurological disorders, and insomnia were recorded.
(2) ESS [10].
(3) STOP questionnaires: high-risk of OSA: answering yes to two or more questions. Low risk of OSA: answering yes to less than two questions [11].
(4) Examining the oropharynx to determine Mallampati score (MMP) [12].
(5) Full night-attended polysomnography (Somnstar 4100; Sensor-Medics Co., Yorba Linda, California, USA). The polysomnography was scored manually based on the American Academy of sleep medicine [13].

Statistical analysis

An Excel spreadsheet was established for the entry of data. We used validation checks on numerical variables and option-based data entry method for categorical variables to reduce potential errors. The analyses were carried with statistical package for the social sciences software (SPSS, version 24; SSPS Inc., Chicago, Illinois, USA). Frequency tables including percentages were used for categorical variables and descriptive statistics (mean and SD) were used for numerical variables. Either Student *t*-test or Mann–Whitney tests were used to compare quantitative variables, whereas Pearson's χ^2-test was used to analyze categorical variables. A *P* value less than 0.05 is considered statistically significant.

Results

This study included 60 adult women with a history of sleep disturbance fulfilled by ESS. The mean age of the included women was 47.9±16.02 years, whereas the majority of them were married (85%). Only 6% of the patients were smokers. They were allocated into two groups: 33 (55%) postmenopausal and 27 (45%) premenopausal (Table 1).

Regarding STOP-Bang questionnaire, there was a statistically significantly higher proportion of women who had or are being treated for high blood pressure in the postmenopausal group (30%) than premenopausal group (3%; *P*=0.016). Similarly, 51% of the patients in postmenopausal group had BMI more than 35 kg/m^2

Table 1 Demographic data of the study group

Variables	Patients (*N*=60)
Age (years)	
Mean (SD)	47.9 (16.02)
Median (IQR)	49 (37.25–60)
Marital status	
Married	51 (85.0)
Not	9 (15.0)
Special habit	
No	54 (90)
Smoker	4 (10)
Weight	
Mean (SD)	83.75 (18.9)
Median (IQR)	85 (79.25–94.75)
Height	
Mean (SD)	155.15 (16.8)
Median (IQR)	157.5 (152–163.75)
BMI	
Mean (SD)	33.62 (8.8)
Median (IQR)	33.5 (28.97–37.37)
Waist circumference	
Mean (SD)	107.7 (29.04)
Median (IQR)	108.5 (98–116)
Neck circumference	
Mean (SD)	39.7 (9.6)
Median (IQR)	39 (37.25–42.75)
Mallampati score	
Mean score	1.83 (0.46)
Median (IQR)	1–4
Class I	
Class II	4 (6.7)
Class III	47 (78.3)
Class IV	9 (15)
Relation to menopause	
Pre	27 (44.6)
Post	33 (55.4)

Data expressed as *n* (%), mean (SD) and median (IQR).

Table 2 STOP-Bang questionnaire and Mallampati score of study groups

Variables	Premenopause (*N*=27) [*N* (%)]	Postmenopause (*N*=33) [*N* (%)]	*P* value
STOP-Bang Questionnaire			
Snoring			
Yes	27 (100)	33 (100)	0.99
No	0	0	
Tired			
Yes	27 (100)	33 (100)	0.99
No	0	0	
Observed			
Yes	27 (100)	33 (100)	0.99
No	0	0	
Pressure			
Yes	1 (3)	10 (30.3)	0.016*
No	26 (27)	23 (69.7)	
BMI>35 kg/m^2			
Yes	2 (6)	17 (51.5)	<0.001*
No	25 (94)	16 (48.5)	
Age older than 50			
Yes	0	28 (84.8)	<0.001*
No	27 (100)	5 (15.2)	
Neck size large>17.5 cm			
Yes	4	18 (54.5)	0.003*
No	23	15 (45.5)	
Mallampati score			
Class I	0	0	0.086
Class II	2 (7.4)	2 (6.1)	
Class III	24 (88.9)	23 (69.7)	
Class IV	1 (3.7)	8 (24.2)	

*Significant.

compared with 6% in premenopausal group ($P<0.001$). However, there was a statistically significantly higher proportion of women with a neck size larger than 17.5 cm in the postmenopausal group compared with premenopausal group ($P=0.003$). Regarding the MMP, no statistical significance was noticed between both the groups (Table 2). However, the study group had high MMP (1.83±0.46).

Tables 3 and 4 show the clinical features of the study groups. Regarding day symptoms, 84% of the postmenopausal patients had high blood pressure compared with only 48% in the premenopausal group ($P=0.005$). Moreover, the proportion of obese women in the postmenopausal group was significantly higher than premenopausal group ($P<0.001$). In addition, 87.9% of postmenopausal women had a known restless leg syndrome compared with 81% in the premenopausal group ($P=0.71$). There were no statistically significant differences between the two groups in signs of neurological disorders ($P>0.05$). The proportion of patients with extreme daytime sleepiness was 96% in the premenopausal group and 81% in the postmenopausal group. Regarding the presence and type of insomnia, 36% of the postmenopausal women had difficulty in initiating sleeping compared with 33% in the premenopausal group ($P=0.807$). However, the vast majority of the patients in both groups had difficulty maintaining sleeping. The proportion of patients with insufficient length of sleep was significantly higher among postmenopausal females (30 vs. 3%) ($P=0.016$).

The polysomnographic findings are shown in Table 5. In terms of sleep stages, the premenopausal group had a statistically significant lower proportion of N1 (9.2%) and N2 (3%) compared with N1 (18.2%) and N2 (6.1%) in the postmenopausal group ($P<0.001$). However, the average sleep efficiency and daytime

Table 3 Clinical assessment including day and night symptoms of the study groups

Variables	Premenopause (*N*=27) [*N* (%)]	Postmenopause (*N*=33) [*N* (%)]	*P* value
Day symptoms			
Sleepiness or fatigue during the day			
Yes	26 (96.3)	30 (90.9)	0.62
No	1 (3.7)	3 (9.1)	
High blood pressure			
Yes	13 (48.1)	28 (84.8)	0.005*
No	14 (51.9)	4 (15.2)	
Morning headache			
Yes	26 (97)	33 (100)	0.45
No	1 (3)	0	
Gastroesophageal reflux			
Yes	22 (81.5)	29 (87.9)	0.49
No	5 (18.5)	4 (12.1)	
Large neck size>17.5 cm			
Yes	8 (29.6)	18 (54.5)	0.069
No	19 (70.1)	15 (45.5)	
Obesity			
Yes	4 (14.8)	24 (72.7)	<0.001*
No	23 (85.2)	9 (37.3)	
Night symptoms			
Loud snoring			
Yes	26 (96.3)	33 (100)	0.45
No	1 (3.7)	0	
Waking up with a choking or gasping sensation			
Yes	27 (100)	32 (97)	0.99
No	0	1 (3)	
Nocturia			
Yes	27 (100)	33 (100)	NA
No	0	0	

NA, not available. *Significant.

Table 4 Signs of periodic leg movement syndrome, neurological disorders and insomnia of the study groups

Variables	Premenopause (*N*=27) [*N* (%)]	Postmenopause (*N*=33) [*N* (%)]	*P* value
Signs of PLMS			
Known restless leg syndrome			
Yes	22 (81.5)	29 (87.9)	0.71
No	5 (18.5)	4 (18.2)	
Sleepiness or fatigue during the day			
Yes	23 (85.2)	31 (93.9)	0.26
No	4 (14.8)	2 (6.1)	
An aching or snoring of the leg during walking			
Yes	0	1 (3)	0.99
No	27 (100)	32 (97)	
Jerking of the leg during sleep			
Yes	2 (7.4)	2 (6.1)	0.99
No	25 (92.6)	31 (93.9)	
Signs of neurological disorders			
Extreme daytime sleepiness			
Yes	26 (96.3)	27 (81.8)	0.49
No	1 (3.7)	6 (18.2)	
Hallucinations			
Yes	0	2 (6.1)	0.47
No	27 (100)	31 (93.9)	
Cataplexy			
Yes	0	0	NA
No	27 (100)	33 (100)	
Sleep paralysis			
Yes	1 (3.7)	0	0.45
No	26 (96.3)	33 (100)	
Signs of insomnia			
Difficulty in initiating sleeping			
Yes	9 (33.3)	12 (36.6)	0.807
No	18 (66.7)	21 (73.4)	
Difficulty in maintain sleeping			
Yes	19 (70.1)	19 (57.6)	0.306
No	8 (29.9)	14 (42.4)	
Insufficient length of sleep			
Yes	1 (3)	10 (30.3)	0.016*
No	26 (97)	23 (69.7)	

NA, not available; PLMS, periodic leg movement syndrome. *Significant.

sleep latency were comparable between both the groups ($P>0.05$). Regarding respiratory events, the average apnea–hypopnea index (AHI) in the premenopausal group was 35.73±15.2 compared with 38.94±11.8 in the premenopausal group, with no statistically significant difference ($P=0.18$). Additionally, there were no statistically significant differences between the two groups in different types of apnea, oxygen saturation, maximum heart rate, and arousal index ($P>0.05$). Premenopausal women had a statistically significant higher cardiac index than postmenopausal women ($P=0.05$). Otherwise, there were no statistically significant differences between the studied groups in PLM variables.

Discussion

Women generally show longer sleep duration and perhaps have a higher sleep need than men [1], yet women may sacrifice sleep because they often are the primary caregiver for their families. Furthermore, across the lifespan, several biological and hormonal differences affect symptoms and consequences of sleep and circadian rhythm sleep-wake disorders in women [2].

This study was conducted to evaluate sleep disorders in women, either premenopausal or postmenopausal. The current study included 60 adult women with a history of sleep disturbance fulfilled by ESS; they were allocated in two groups: 33 (55%) postmenopausal and 27 (45%) premenopausal. This study demonstrated that the mean age of the included women was 47.9±16.02 years; this is in line with a previous study [14,15]. This may be explained by old age is a significant risk factor of sleep disorder.

Table 5 Findings of polysomnography of the study groups

Variables	Premenopause (*N*=27)	Postmenopause (*N*=33)	*P* value
Sleep stage duration [mean (SD)]			
Sleep efficiency (%)	93.1 (6.7)	94.08 (7.4)	0.19
DSL (min)	59.93 (65.3)	82.44 (66.9)	0.14
Sleep architecture [*N* (%)]			
REM	21 (63.7)	25 (75.8)	<0.001*
N1	3 (9.2)	6 (18.2)	
N2	1 (3)	2 (6.1)	
N3	2 (6.1)	0	
Respiratory event [mean (SD)]			
AHI (index)	35.73 (15.2)	38.94 (11.8)	0.13
Apnea	33.76 (22.4)	30.87 (15.1)	0.88
Obstructive	28.07 (16.6)	30.24 (14.9)	0.51
Central	1 (3.2)	0.57 (1.3)	0.44
Hypopnea	76.48 (28.5)	87.93 (31.2)	0.18
Oxygen saturation and maximum heart rate [mean (SD)]			
O_2 saturation	52.89 (44.1)	50.17 (43.3)	0.19
Maximum heart rate	78.32 (57.2)	67.98 (56.4)	0.15
Arousal variables [mean (SD)]			
Arousal (index)	26.08 (19.5)	23.38 (18.6)	0.68
Arousal in REM	37.52 (19.9)	34.78 (22.7)	0.26
Arousal in non-REM	30.06 (15.4)	33.72 (17.7)	0.50
PLM [mean (SD)]			
PLM (index)	18.2 (18.5)	19.23 (15.8)	0.55
Isolated LM	12.01 (8.2)	11.49 (15.7)	0.59
PLM with APOUWAL (index)	0.83 (1.04)	1.62 (2.6)	0.19
Cardiac index	62.97 (182.9)	37.32 (57.5)	0.05*

Data expressed as *n* (%). DSL, daytime sleep latency; PLM, periodic leg movement. *Significant.

This study revealed that most of the included women were obese (average BMI=33.62±8.8 kg/m^2), and this was comparable with another study in which BMI mean was 31.3±7.7 [15].

Sleep disturbances either caused by SDB, sleep-related movement, or insomnia have a link with obesity [16]. This may indicate that the detection and treatment of sleep disturbances in obesity are important. Regarding MMP, the study group had high MMP (1.83±0.46), although no significant difference was noticed between the two groups.

This goes in line with the study of Nuckton *et al.* [17], where the mean score was 2.5±0.8. Moreover, they reported that the MMP was an independent predictor of OSA, including its presence and severity. In addition, this was consistent with an observational study that was performed in high-risk Indian pregnant women to diagnose various sleep disorders, and the mean Mallampati grade of the patients was 2.2 ±0.8 [18].

Regarding the gynecological history of the included women in this study, almost 55% of women were postmenopausal. This was inconsistent with Pien *et al.* [19] who reported that later menopausal stage and time in menopause were both associated with higher AHI. AHI suggests an exposure-response relationship between further progression through menopause and sleep-disordered breathing severity.

Regarding the STOP-Bang questionnaire, the presence of hypertension was statistically significantly higher in the postmenopausal group (84.8%) than premenopausal group (48.1%; *P*=0.016). Similarly, 51% of the patients in the postmenopausal group had BMI more than 35 kg/m^2 compared with 6% in the premenopausal group (*P*<0.001). However, there was a statistically significantly higher proportion of patients with a neck size larger than 17.5 cm in the postmenopausal group compared with the premenopausal group (*P*=0.003). This agreed with the findings of Marik and Desai [20] who assessed the effect modification by interacting menopausal status and time in menopause with several different covariates: age, years in postmenopause, use of menopausal hormone therapy, BMI, waist circumference, and neck circumference.

This study reveals no statistically significant differences between both groups in any of the signs of neurological disorders. This result goes in line with Xu *et al.* [21] who reported that insomnia duration and presence of psychiatric disorders were comparable in both groups.

Regarding the presence and type of insomnia, 36.6% of the postmenopausal women had difficulty in initiating sleeping compared with 33.3% in the premenopausal group (*P*=0.807). However, the vast majority of the patients in both groups had difficulty maintain sleeping. The proportion of women with insufficient length of sleep was significantly higher among postmenopausal women (30 vs. 3%; *P*=0.016). Moreover, Lampio *et al.* [22] reported that postmenopausal women had maintenance insomnia more than premenopausal women, but not initiation insomnia. This could be explained by the more prevalent hot flashes and night sweats in postmenopausal females.

Lack of estrogen leads to vasomotor hot flashes that results in maintenance of insomnia. Progesterone is considered as a respiratory stimulant and so preserves the tone of the genioglossus muscles. Owing to deficiency of this hormone in postmenopausal

women, the chances for women to have sleep apnea increase [23]. In postmenopausal women, risk of insomnia may be owing to low progesterone and estrogen levels [24].

In terms of sleep stage duration, this study demonstrated that the premenopausal group had a statistically significant lower proportion of N1 (9.2%) and N2 (3%) compared with N1 (18.2%) and N2 (6.1%) in the postmenopausal group ($P<0.001$). This is in contrast to Xu *et al.* [21], who reported that no significant differences were found on variables such as the percentage of stages N1, N2, N3, and REM.

However, in this study, the average sleep efficiency and daytime sleep latency were comparable between both groups ($P>0.05$), and the proportion of women with extreme daytime sleepiness was 96.3% in premenopausal group and 81.8% in postmenopausal group. This was confirmed by the study by Xu *et al.* [21] on 74 women, which showed that in menopausal women, total wake time was longer and sleep efficiency was lower than the non-menopausal women. In menopausal groups, no significant difference was noticed on sleep parameters.

Regarding respiratory events, the average AHI in the premenopausal group was 35.73±15.2 compared with 38.94±11.8 in the premenopausal group, with no statistically significant difference ($P=0.18$). Additionally, no statistically significant differences were observed between the two groups in AHI, different types of apnea, oxygen saturation, maximum heart rate, and arousal index.

However, Campbell *et al.* [25] reported that late-premenopausal and postmenopausal women had more high-frequency beta EEG activity, which indicates cortical hyperarousal during sleep than premenopausal and early-premenopausal women.

Premenopausal females had a statistically significant higher cardiac index than postmenopausal females. Otherwise, PLM variables were similar. In women transitioning to menopause, duration and severity of sleep difficulties vary from poor nights of sleep with transient affection on quality of life to more severe and chronic sleep difficulties, greater affection on quality-of-life sleep [26].

Limitations

The sample size was relatively small, which may affect the generalizability of the findings. In addition, there was no follow-up for the patients for long-term patient-centered outcomes. Moreover, the female hormonal profile was not performed. Moreover, iron profile was not performed.

Conclusion

Postmenopausal women had statistically significant higher STOB-Bang score and insufficient length of sleep, which may reflect a significant change in sleep architecture and patterns after menopause.

Recommendations

This study shows that postmenopausal women experience some changes in their sleep pattern; thus, hormonal assays should be included in the algorithm of the investigation and management of sleep disorders.

Acknowledgements

The authors thank all the technicians in the sleep unit for their help.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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