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TANAFFOS

Investigating Sleep Disorders among Patients Suffering from Pulmonary Arterial Hypertension

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Background: Pulmonary arterial hypertension (PAH) is a progressive and fatal disease. Studies have shown a link between sleep disorders and pulmonary hypertension; however, sleep disorders generally remain undiagnosed. This study aimed to investigate the types of sleep disorders and their prevalence among patients with pulmonary hypertension.

Materials and Methods: A total of 68 patients with a definitive diagnosis of pulmonary hypertension were examined for the existence of sleep disorders. The STOP-BANG, ISI, ESS, RLS, and parasomnia questionnaires were used to evaluate sleep disorders, including obstructive sleep apnea, insomnia, excessive sleepiness, and movement disorders, such as restless leg syndrome and parasomnia, respectively. The data were analyzed using SPSS software.

Results: The average age of the patients was 48.0 ± 14.2 years while 64.7% were women. The most prevalent (45.6%) sleep disorder among the patients was probable obstructive sleep apnea (STOP-BANG positive). Among STOP-BANG positive and negative groups, the ratios of men were 48.4% and 24.3%, respectively (P=0.046). In addition, there was a significant difference between STOP-BANG positive and negative groups regarding the variables of gender, age, having high systemic blood pressure, insomnia index, and daytime sleepiness (P values= 0.020, 0.046, 0.011, 0.023, and 0.011, respectively). The prevalence of parasomnia (P= 0.039) and daytime sleepiness (P=0.072) was significantly higher in people suffering from insomnia. The body mass index was significantly higher in people with idiopathic pulmonary hypertension than in those with thromboembolic pulmonary hypertension (P= 0.001). There was a significant association between age and the functional class of the patients (P= 0.003).

Conclusion: The prevalence of sleep disorders, especially obstructive sleep apnea, is relatively high in patients with PAH, and its presence seems to worsen the prognosis of PAH necessitating identifying at-risk people and properly treating them to improve their quality of life.

Keywords: Pulmonary hypertension; Obstructive apnea; Insomnia; Restless leg syndrome; Parasomnia

INTRODUCTION

Pulmonary arterial hypertension (PAH) is a debilitating and progressive disease that can be associated with right-sided heart failure and death. It is characterized by an increase in the average pulmonary arterial pressure of more than 20 mmHg, which encompasses various hemodynamic types according to its new definition as shown in Table 1 (1).

Table 1. The Hemodynamic Definitions of Pulmonary Hypertension

Definition	Characteristics	Clinical Groups
Precapillary Pulmonary hypertension	MPAP>20 mmHg PAWP<15 mmHg PVR>3 WU	1,3,4,5
Isolated post capillary pulmonary hypertension	MPAP>20 mmHg PAWP>15 mmHg PVR<3 WU	2,5
Combined precapillary and post capillary pulmonary hypertension	MPAP>20 mmHg PAWP>15 mmHg PVR>3 WU	2,5

mPAP: mean pulmonary arterial pressure, PAWP: pulmonary arterial wedge pressure, PVR: pulmonary vascular Resistance, WU: Wood Unit, group1: PAH group2: PH due to left heart disease, group 3: PH due to lung disease, 4: PH due to pulmonary artery obstruction, 5: PH with unclear or multifunction mechanism.

These patients are expected to have some degree of right-sided heart failure and related symptoms, affecting the quality and quantity of sleep and predisposing them to various types of sleep disorders. The most common types of sleep disorders can be listed as insomnia sleep breathing disorders (SBD), and movement disorders, especially restless legs syndrome. Regarding the link between the lungs, chest, and upper respiratory tracts, ventilation-perfusion mismatch in pulmonary hypertension, and congestion in all lower organs, people with pulmonary hypertension are predisposed to breathing disorders during sleep. On the other hand, pulmonary hypertension can lead to symptoms such as nausea, fatigue, dyspnea at night, and interrupted sleep, which can overlap with the symptoms of sleep disorders. Also, sleep breathing disorders themselves can predispose to PAH. Accordingly, timely diagnosis and treatment of sleep disorders in patients with pulmonary hypertension can not only improve their quality of sleep but also prevent disease progression in the case that they are the primary etiology of the condition or associated with the primary cause, reducing the need for PAH medications and the number of hospitalizations. In this study, we investigated the types and prevalence of sleep disorders among patients with pulmonary hypertension using the Restless Leg Severity Scale (RLS) questionnaire.

MATERIALS AND METHODS

This cross-sectional analytical study conducted on patients with PAH who were periodically visited at the Pulmonary Hypertension Clinic and the Institute for Tuberculosis and Pulmonary Diseases of Masih Daneshvari Hospital, affiliated with Shahid Beheshti University of Medical Sciences, in Tehran. Those patients fulfilling the inclusion criteria were enrolled in the study. A total of 68 patients were included in the study. For a definitive diagnosis of PAH, the patients underwent examinations for the basic hemodynamic status, lung functional tests, echocardiography, ventilation-perfusion scan, screening for pulmonary artery thromboembolism, and right and left heart catheterization by a cardiologist and a pulmonologist. In cases where pulmonary hypertension was not consistent with the clinical condition, patients who provided positive responses to the following questions: "Do you wake up several times during sleep?", "Do you feel sleepy during the day?", and "Do you snore?", underwent polysomnography so that sleep-breathing disorders could be ruled out as the primary cause of pulmonary hypertension.

Sleep breathing disorders and hypoventilation were diagnosed if, in polysomnography, AHI was≥15, oxygen saturation fell below 90% in above 25% of total sleep time, or hypercapnia was more than 45 mmHg. Patients with hypoventilation due to obesity, neuromuscular conditions, drug consumption, and other medical causes were further investigated and referred to a pulmonologist for further evaluation; these patients were excluded from the study.

Most of the patients were placed in either of the two groups: PAH 1(iPAH) or PAH 4 (i.e., chronic thromboembolic pulmonary hypertension (CTPH) or pre-capillary type in terms of hemodynamic classification (Table 1). After right heart catheterization and determining the hemodynamic status, the STOP-BANGs questionnaire, the ISI scale, and the questionnaire related to other sleep disorders (i.e., IRLS and parasomnia) were completed.

Data Analysis

In this research, the data were either quantitative (such as age, blood pressure, insomnia, STOP-BANG, pro-BNP

level, height, weight, and body mass index) or qualitative/nominal (such as marital status and occupation). The main independent variable in this study was PAH while insomnia, STOP-BANG, and restless leg syndrome were the main dependent variables. After collection and classification, the data were entered into SPSS version 24 software and analyzed. Tables and graphs were used to describe qualitative data. The relationship between qualitative variables was assessed using the Chi-square test, and parametric and non-parametric tests were used to determine relationships between quantitative variables. All quantitative data were reported as mean and standard deviation. The association between the main variables and the STOP-BANG score was investigated using Spearman correlation. The statistical significance level was designated as $P<0.05$.

Ethical Considerations

The ethics committee of Shahid Beheshti University of Medical Sciences approved this study (IR.SBMU.NRITLD.REC.1402.09).

RESULTS

Sixty-eight patients diagnosed with PAH were included in the study of whom, 35% were men and 65% were women. The mean age of the patients was 48.0±14.2 years.

Clinical Findings

Thirty-one patients (45.6%) were STOP-BANG positive, and 37 (54.4%) patients were STOP-BANG negative. Table 2 compares the studied variables based on the diagnosis. The BMI variable in the CTEPH group was significantly higher than other diagnostic groups (P=0.001); however, there was no significant difference in terms of other variables such as age, pro-BNP level, neck circumference, functional class, sleepiness, the severity of pulmonary hypertension, and the presence or absence of parasomnias.

Based on the peak prevalence of the disease, the patients were categorized into two main classes: IPAH, CTEPH, and other diseases. Table 3 compares the distribution of the studied variables between STOP-BANG positive and negative groups. Men constituted 48.4% and 24.3% of patients in the STOP-BANG positive and negative groups, respectively, showing a disparity in disease distribution according to gender (P=0.046). This finding indicated that men with PAH were more likely to become STOP-BANG positive than their female counterparts.

The proportion of people with HTN was significantly different between the STOP-BANG positive (51.7%) and negative (17.4%) groups (P=0.011). Also, individuals with positive STOP-BANG had a significantly higher mean age than those with negative STOP-BANG (52.4±15.3 versus 44.3±12.2, P=0.006).

The mean ESS was significantly higher in the STOP-Bang positive group than in the STOP-BANG negative group (7.4±5.4 versus 4.3±3.8, P=0.011). Also, mean ISI was significantly higher in those with positive STOP-BANG (13.6±7.5) than in patients with negative STOP-BANG (9.5±6.1, P=0.023).

In this study, patients with an ISI score of 0 to 7 were regarded to have no insomnia, while those with a score of 7 and above were considered to suffer from insomnia (2). Among the studied variables, the functional class was significantly associated with age (P=0.003).

Table 2. Comparison of the study variables based on the disease diagnosed

Items		Diagnosis			P-value
		IPAH	CTEPH	Other	
		43	14	11	
Gender	Male	16(37.2)	6(49.2)	2(18.2)	0.411
	Female	27(62.8)	8(57.1)	9(81.8)	
Age		45.5±13.6	52.5±14.2	52.6±15.3	0.154
BMI		25.1±3.5	27.8±6.1	21.1±2.9	0.001*
Neck		36.9±3.4	37.6±3.4	34.8±4.2	0.157
HTN		14(41.2)	3(30.0)	2 (25.0)	0.647
pro-BNP		574.1±573.7	420.7±415.2	475.50±459.7	0.780
Insomnia SI		10.5±6.6	12.7±6.5	14.4±9.3	0.397
Severity of disease		2.3±0.8	2.6±0.9	2.3±0.5	0.422
ESS		5.5±5.1	7.6±5.1	5.3±3.2	0.351
STOP- Bang (+)		19(613)	8(25.8)	4(12.9)	0.559
STOP- Bang (-)		24(64.9)	6(16.2)	7(18.9)	
Mallampati		3.0±1.0	3.2±1.3	2.0±1.7	0.412
6mwt (m)		343.8±111.1	386.8±92.7	314.8±104.7	0.464
Mean PAP		62.2±11.8	55.2±15.6	74.8±24.9	0.110
Sys PAP		86.7±26.8	85.9±28.9	87.5±48.9	0.994
Parasomnia (yes)		13(37.1)	2(20.0)	2(25.0)	0.619

*: Significant at 0.05 level

Table 3. Comparison of the study variables based on the STOP-BANG status

Items		STOP- Bang			P-value
		Stop Bang+	Stop Bang-	Total	
		n=31	n=37	n=68	
Gender	Male	15(48.4)	9(24.3)	24(35.3)	0.046*
	Female	16(51.6)	28(75.7)	44(64.7)	
IPAH		19(613)	24(64.9)	43(63.2)	
CTEPH		8(25.8)	6(16.2)	14(20.6)	0.559
Other		4(12.9)	7(18.9)	11(16.2)	
Age		52.4±15.3	44.3±12.2	48.0±14.2	0.020*
BMI		25.9±5.9	24.3±3.1	25.0±4.5	0.242
Neck		37.2±4.5	36.4±2.4	36.8±3.6	0.369
HTN(YES)		15(51.7)	4(17.4)	19(36.5)	0.011*
Pro BNP		533.8±592.9	533.6±501.1	533.7±349.3	0.355
Insomnia Severity Index		13.6±7.5	9.5±6.1	11.4±6.9	0.023*
Functional Class		2.5±0.7	2.2±0.8	2.4±0.7	0.156
ESS		7.4±5.4	4.3±3.8	5.8±4.8	0.011*
Mallampati		3.0±1.1	2.8±1.0	2.9±1.1	0.648
6Minute walking Test (meter)		318.4±115.0	373.8±94.2	349.0±106.3	0.111
Mean pap		57.2±11.4	66.5±17.2	62.9±15.7	0.109
Systolic Pulmonary Arterial Pressure		86.8±30.7	86.5±31.7	86.7±30.9	0.971
Parasomnia (yes)		9(34.6)	8(29.6)	17(32.1)	0.697

*: Significant at 0.05 level

Table 4. Comparison of the study variables based on insomnia

Items		ISI		P-value
		ISI+	ISI-	
		n=51	n=12	
Gender	Male	19(37.3)	3(25.0)	0.516
	Female	32(62.7)	9(75.0)	
Diagnosis (IPAH)		33(64.7)	10(83.3)	
Diagnosis (CTEPH)		11(21.6)	1(8.3)	0.377
Diagnosis (Other)		7(13.7)	1(8.3)	
Age		49.1±12.4	44.0±18.0	0.252
BMI		25.2±4.5	24.7±4.2	0.796
Neck		37.1±3.7	35.6±2.0	0.102
HTN		13(34.2)	4(40.0)	0.727
pro-BNP		603.6±609.0	219.1±90.7	0.360
Functional class		2.8±0.8	2.1±0. 8	0.298
ESS		6.5±5.2	3.0±2.7	0.072**
Mallampati		2.9±1.1	2.8±1.3	0.720
6mwt (m)		354.3±96.5	333.3±135.4	0.636
mean pap		62.7±16.7	64.0±15.0	0.851
sys pap		84.7±28.3	92.5±23.3	0.471
Parasomnia (yes)		16(31.3)	1(8.3)	0.039*

*:Significant at 0.05 level, **:Significant at 0.10 level

Based on the definition provided and the data obtained from the restless leg syndrome questionnaire, 17 (52%) patients were diagnosed with this syndrome (RLS positive). None of the demographic or clinical variables and other sleep disorders, except for parasomnia (P<0.001), had a significant relationship with the restless leg syndrome.

Regarding the parasomnia index, the data of 54 patients were analyzed, 17 of whom (32%) presented with parasomnia. Except for insomnia and RLS, there was no significant relationship between parasomnia and other anthropometric, clinical, and demographic variables or other sleep disorders. According to the ESS questionnaire, 12 (2%) patients had degrees of daytime sleepiness. ESS more than or equal to 10 was considered abnormal.

DISCUSSION

There are a few studies investigating the link between pulmonary hypertension and sleep disorders. This is while by evaluating relatively prevalent sleep disorders and their relationships with PAH and demographic characteristics, it is possible to provide effective solutions for PAH-related comorbidities. In this regard, the diagnosis of sleep disorders co-existing with breathing disorders can lead to the administration of effective treatments, improving the prognosis of both pulmonary hypertension and sleep disorders. Accordingly, this study aimed to investigate the prevalence and severity of sleep disorders among patients with pulmonary hypertension and to evaluate the risk factors (demographic, anthropometric, clinical variable, etc.) of obstructive sleep apnea, restless leg syndrome, and other related disorders in patients diagnosed with various types of pulmonary hypertension.

Based on the highest prevalence regarding the disease subtype, the patients were divided into two main groups: IPAH, i.e., PH due to pulmonary artery obstruction, and chronic thromboembolic pulmonary hypertension (CTEPH). In addition, in this study accounted for other subtypes of patients (2, 3).

Similar to previous studies, we observed in the present study that the prevalence of PAH was higher in women. The reason for the higher prevalence of PAH among women is unclear; however, factors such as sex hormones, autoimmune conditions, and the presence of an extra chromosome X have been proposed as possible causes (4, 5).

The average age of people at the time of PAH diagnosis is about 50 years (5, 6), which is consistent with the results of the present study. In contrast to pulmonary hypertension, the prevalence of obstructive apnea is higher in men than in women, which is supported by our data as we observed a higher ratio of moderate to severe obstructive apnea in men with positive (n=15, 48.4%) compared to negative (n=9, 24.3%) STOP-BANG ($P<0.05$) (7-12). The effects of hormones on the flexibility and tone of the muscles of the upper airways, as well as differences in the distribution of fat mass and the anatomy of the parapharyngeal region between men and women, can be the contributing factors to the higher incidence of obstructive apnea among men (7).

The results of various studies support the sensitivity and accuracy of the STOP-BANG in the diagnosis of obstructive apnea, especially the moderate-to-severe form; so, in the present study, a positive screening for STOP-BANG was considered to be diagnostic for obstructive apnea (8, 9).

Various studies have shown a relationship between hypoxemia during sleep disorders and the development of PAH (10-12). It has been shown recently that this relationship can be reciprocal (i.e., PAH can trigger sleep disorders) (13). A possible explanation for the development of sleep breathing disorders due to PAH can be the return of fluids from the lower limbs' veins to the head and neck at night, predisposing to airway obstruction (14).

In previous studies, the incidence of PAH due to obstructive sleep apnea has been reported to be about 40% (15-17), which is in agreement with the incidence rate reported in the present study. Minic et al. (18) reported a prevalence of 71% for sleep disorders of which, 56% were diagnosed as obstructive sleep apnea. In our study, positive STOP-BANG was the most common sleep disorder. On the contrary, Badesch et al. reported that the prevalence of obstructive sleep apnea among 2438 patients with PAH was about 21% (6). The differences in the incidence of obstructive sleep apnea in these studies can be due to variations in diagnostic methods, differences in the body mass index in different populations, and discrepancies in the definition of obstructive sleep apnea and PAH.

Age is one of the most important determinants in the development of obstructive apnea knowing that its incidence rises with age (7). In accordance, the prevalence of the disease is higher among individuals older than 65 years old (19). The average age of patients with pulmonary hypertension in our study was higher in the individuals rendering positive STOP-BANG (i.e., suffering from obstructive apnea) than those with negative STOP-BANG.

After excluding cases with high AHI and hypoventilation, the STOP-BANG status in this study was determined using a questionnaire and based on positive responses to the three questions: "Do you wake up several times during sleep?", "Do you feel sleepy during the day?" and "Do you snore during sleep?". Considering the high prevalence (45%) of obstructive apnea, as the most common sleep disorder observed in this study, and taking into account the high probability of obstructive apnea among individuals with positive STOP-BANG, it is important to investigate sleep breathing disorders in patients with PAH, even in those who give negative responses to routine diagnostic questions for obstructive sleep apnea.

About 36.5% of patients in this study had systemic hypertension. The cause of this association is not clearly understood, but it is thought that pulmonary hypertension can be a reflection of the systemic elevation of blood pressure. In such cases, pulmonary hypertension can be resolved by the proper treatment of systemic hypertension (20). Nevertheless, some researchers believe that systemic hypertension in the absence of left heart dysfunction and

diastolic dysfunction cannot cause PAH. Systemic hypertension is one of the most important cardiovascular diseases and an independent risk factor for obstructive sleep apnea (18, 21-23). Our results showed that the ratio of people with hypertension was significantly higher in the STOP-BANG positive (52%) than negative (17%) group, which was similar to the values reported by Ahbab et al. (24) and Nieto et al. (25).

It has been noted that in people younger than 60 years of age, a reduction in sleep duration to less than five hours increases the risk of developing systemic hypertension even if weight and blood sugar are controlled (26). Other causes of systemic hypertension in individuals with obstructive sleep apnea include systemic inflammation, oxidative stress, endogenous vasoactive factors, endothelial dysfunction, increased sympathetic activity, and metabolic deregulation (27).

Another point worth mentioning is the existence of symptoms such as nausea, nocturnal dyspnea, and interrupted sleep in patients with PAH, which can also mimic the symptoms of sleep-breathing disorders such as obstructive sleep apnea. Sometimes, these symptoms can be linked to an underlying disease, which may cause conditions like sleep apnea to be overlooked. On the other hand, considering the higher mortality and lower quality-of-life of patients suffering from obstructive sleep apnea and PAH, the diagnosis of sleep breathing disorders becomes crucial. So, it is recommended to screen patients with PAH for sleep-breathing disorders using the Stop Bang questionnaire (28).

Obstructive apnea and insomnia are both sleep disorders that commonly occur together (29). Respiratory apneas can lead to night-time awakenings, leading to chronic insomnia (30). Krakow et al. reported that frequent night awakenings, as the main complaint of individuals suffering from insomnia, are caused by respiratory events (31). The concept of this argument agrees with the model (i.e., the stress-response model) proposed by Spielman et al. (32).

Another hypothesis is that respiratory events can boost sympathetic activity and lead to hyperarousal, which are key factors in the development of insomnia (33). In this study, the mean insomnia index (based on the ISI questionnaire) was obtained as 9.5 in STOP-BANG negative patients and 13.6 in STOP-BANG positive patients (i.e., those with obstructive apnea), indicating a statistically significant difference. The coexistence of obstructive sleep apnea and insomnia can increase the risk of cardiovascular diseases (34).

Regarding the association of the mentioned variables with the etiology of PAH, studies indicate that mPAP, quality of life, and pulmonary vascular resistance are lower, while cardiac output is higher in patients with CTEPH compared to those with IPAH (35). According to studies, advanced age and higher BMI are major contributors to the development of CTEPH following PTE (36). In the present study, out of the assessed variables, only BMI was significantly higher in the CTEPH group than in other groups, which can be related to the higher incidence of thromboembolic events in overweight people compared to normal-weight individuals.

Restless leg syndrome is a movement disorder with a prevalence of about 5%-20% in adults. This condition has negative impacts on sleep, daily activities, and quality of life. Regarding the link between this syndrome and cardiovascular events, such as PAH, it has been proposed that increased sympathetic activity contributes to both complications (37). Also, some researchers have suggested that RLS-related hypoxia may be a culprit linking this condition to pulmonary hypertension (38). It is noteworthy that the 25% prevalence of RLS found in this study is significantly higher than the rate reported in the general population of our country (39).

Parasomnias can occur at any age (40). In the present study, we witnessed no statistically significant difference in the incidence of parasomnia in various age groups. The overall prevalence of parasomnia among adults has been reported to vary between 4% and 67% (41). Obstructive apnea and other sleep breathing disorders have been suggested to trigger parasomnias (42). In this study, although parasomnia and RLS were observed to be significantly related to each other, such a link cannot be

affirmed due to the lack of possibility for evaluating parasomnia-associated nightmares in the patients, which is one of the limitations of this study.

In the study of Dauvilliers and Buguet, the insomnia index (ISI) correlated with RLS, but such an association was not observed in our study. According to the ESS questionnaire, daytime sleepiness was observed in 12 (2%) of our patients, which was lower than the net average (4% to 6%) in society (43).

Addressing the limitations of this study, it is important to note that central sleep apneas were not assessed. Future research should consider investigating this aspect. Furthermore, since nighttime nightmares, along with several other criteria, are used to classify parasomnia, it would be beneficial for future studies to utilize a comprehensive questionnaire that includes these criteria.

CONCLUSION

Considering the well-known relationship between obstructive sleep apnea and pulmonary hypertension, as well as the 45% prevalence of positive STOP-BANG observed in this study (indicating the coexistence of obstructive sleep apnea and PAH), it is important to complete this questionnaire for patients with pulmonary hypertension. The results of this study showed a high rate of STOP-BANG positivity in patients with PAH; so, more than 45% of patients fulfilled diagnostic criteria in the initial screening and even after excluding cases with more evident symptoms of obstructive apneas. Therefore, in addition to the need for completing the aforementioned questionnaire, all patients with PAH are recommended to undergo polysomnography to timely diagnose and treat obstructive sleep apnea and, reduce the complications of both disorders.

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APPENDIX

Sleep Disorder Assessment Tool

The Stop-BANG Questionnaire (Assessment of Obstructive Apnea)

This questionnaire consists of eight items, and obtaining a score higher than three raises the possibility of the person suffering from obstructive sleep apnea. A positive response to three or more questions of the Stop-Bang questionnaire will place the person in the high-risk group for obstructive sleep apnea; otherwise, the subject will be considered to be low-risk.

Insomnia Severity Index (ISI) (Insomnia Assessment)

The items of the ISI questionnaire scrutinize the symptoms of insomnia and their negative impacts on people's lives within the past two weeks. This questionnaire contains seven questions evaluating the severity of sleep-onset disorder, difficulties in remaining asleep, early awakening, sleep satisfaction, interference with daily activities, and the awareness of others regarding one's sleep issues, which may cause them to become concerned.

Each question is scored based on a 5-point Likert scale from 0 to 4, and the total score of the questionnaire is from 0 to 28. A higher score in this questionnaire reflects more severe insomnia; so, a score of 0-7 indicates no insomnia, a score of 14-8 indicates subclinical insomnia, a score of 21-15 indicates moderate insomnia, and a score of 22-28 shows severe insomnia.

Parasomnia Diagnosis

The presence or absence of parasomnia was decided based on the existence of each of the following symptoms: abnormal events or experiences during sleep, including tooth-grinding, strange behaviors, walking and talking during sleep, and having nightmares (requiring specific criteria).

ESS Questionnaire (Daytime Sleepiness Assessment)

This questionnaire comprises eight questions, and the participant is requested to rate his/her dozing and sleepiness during doing the activities noted in the questionnaire (i.e., reading, watching television, sitting at rest in a public place such as a theater, resting in evening, conversing with a person, sitting after having lunch, and sitting behind the role in traffic) from 0 to 3. A score equal to or above ten was considered abnormal.

The RLS Questionnaire (Assessing RLS and Sleep-related Movement Disorders)

The following four questions were used to assess RLS and sleep-related movement disorders:

1. Have you ever had an unpleasant sensation such as numbness, tingling, or pain, in your legs that causes you to move suddenly?
2. Do the symptoms occur while resting, and do they resolve by moving?
3. Do the symptoms exacerbate at night, especially when resting, compared to the morning?
4. Does moving the legs (or walking and rubbing them together) improve the symptoms?

Restless legs syndrome was considered to be likely when positive responses (i.e., yes) were given to the above four questions, and the symptoms had been experienced more than five times a month.