Characteristics and Clinical Presentations of Patients at the Siriraj Snoring Clinic

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ABSTRACT

Objective: To describe characteristics and clinical presentations of patients in Siriraj snoring clinic and to analyze their relationships with obstructive sleep apnea (OSA) severity.

Methods: Three hundred and seventy-three patients'self-administered questionnaires regarding sleep problems recorded between January 2012 and December 2013 and 275 polysomnographic reports were reviewed.

Results: Among 373 respondents, there were 247 males (66.2%) and 126 females (33.8%), with an average age of 48 years and body mass index of 28.2 kg/m^2. Their most common complaints and comorbidities were snoring ≥3 nights/week (87.9%), worrying about complications from apnea (72.4%), dyslipidemia (36.7%), hypertension (34.3%), and diabetes mellitus (12.1%), respectively. Using apnea-hypopnea index (AHI) of ≥5 and ≥30 events/hour, there were 76.7% and 38.5% of patients diagnosed as OSA and severe OSA, respectively. While using respiratory disturbance index (RDI) with similar cut-off, almost everyone (98.8%) and 60.2% of patents will be diagnosed as OSA and severe OSA, respectively. Characteristics significantly associated with AHI ≥15 events/hour were snoring ≥3 nights/week, witnessed apneas, and nocturia ($p < 0.05$). The comorbidities which significantly associated with OSA group were hypertension, diabetes, and dyslipidemia. There were only weak significant relationships between AHI (and RDI) with ESS and quality of life.

Conclusion: The most common complaints in our clinic were loud snoring and worrying about OSA consequences, not excessive daytime sleepiness. Based on RDI criteria, almost everyone were diagnosed as OSA; however, it had poor relationship with patients'symptoms, comorbidities and quality of life. Thus, for better OSA evaluation, we should use data from several aspects, not only AHI nor RDI for proper patient management.

Keywords: Obstructive sleep apnea; clinical presentation; characteristic; prevalence (Siriraj Med J 2020; 72: 202-208)

INTRODUCTION

Obstructive sleep apnea (OSA) is a common disorder that is characterized by narrowing of the upper airway, which leads to abnormal ventilation during sleep.[1] Despite inconsistences in OSA-related epidemiologic data due to differences among the populations being studied and differences in how the disease was identified, substantial evidence has been reported that strongly suggests that untreated OSA may lead to several adverse effects, including cardiovascular diseases, impaired neurocognitive function, decreased quality of life, and increased risk of accidents.[2-8]

Young, *et al.* studied middle-aged adults in the United States and found a prevalence of OSA [defined as apnea-hypopnea index (AHI) ≥5 events/hour (hypopnea

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defined as ≥4% oxygen desaturation)] as high as 9% in women and 24% in men.[9] In the same study, the prevalence of OSA syndrome (OSAS) was only 2% in women and 4% in men when OSAS was defined as AHI ≥5 events/hour plus self-reported hypersomnolence. However, a subsequent study by that group found that the prevalence of OSAS plus symptoms of daytime sleepiness had significantly increased over time to 14% in men and 5% of women.[10] In Thailand, the prevalence of OSA and OSAS was reported to be 11.4% (males 15.4%, females 6.3%) and 4.4% (males 4.8%, females 1.9%), respectively.[11] In spite of these reported high rates of prevalence, it is estimated that 93% of women and 82% of men with moderate to severe OSA remain undiagnosed.[12]

The current gold standard method for diagnosing OSA is attended polysomnography (PSG) or type I sleep study that is performed in a sleep lab. However, routine use of PSG in every snoring patient and in every patient with suspected OSA is impractical due to its high cost, long waiting lists, and intensive labor requirements. Furthermore, its reliability and usefulness are increasingly questionable because the results from the sleep study may not associate with the clinical presentations of the patients, i.e. symptoms, signs and quality of life. Waiting for the diagnosis and treatment based on only AHI from the PSG is, thus, possibly inappropriate. To date, the concept of personalized diagnosis and treatment has become more popular. Putting several aspects of information, not only PSG data, may be a better way of patient approach. Understanding comprehensively on the characteristics and clinical presentation of patients may guide us to improve service for the better care.

Although the Snoring Clinic at our center has been established for a decade, data relating to the characteristics and clinical presentations of the patients that attend our clinic are scarce. Accordingly, the aim of this study was to determine the characteristics and clinical presentations of the patients that attend the Siriraj Snoring Clinic, and to investigate association between the identified characteristics and presentations, and severity of obstructive sleep apnea.

MATERIALS AND METHODS

This retrospective chart review included patients aged ≥18 years who sought treatment for sleep problems at a snoring clinic of the Department of Otorhinolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University during January 2012 to December 2013. Siriraj Hospital is a 2,300-bed national tertiary referral hospital that is located in Bangkok, Thailand. This study period was selected, because it fell just before PSG scoring definition was changed.[13] The data obtained from patients in the snoring clinic included demographic and clinical data, sleep history, Epworth Sleepiness Scale (ESS) and functional outcomes of sleep questionnaire (FOSQ) data. The PSG data including AHI and respiratory disturbance index (RDI) were obtained from the electronic medical record (hospital intranet). Among patients that had PSG results (AHI and RDI) available for review, those results were investigated for association with ESS and FOSQ scores. Patients with missing or incomplete sleep history and/or physical findings were excluded. The protocol for this study was approved by Siriraj Institutional Review Board (Si 728/2016).

Epworth sleepiness scales

The Epworth Sleepiness Scale (ESS)[14] is an eight-item questionnaire assesses a person's likelihood of falling asleep during eight common situations. Scoring ranges from 0 to 3 for each item for a total possible score of 24 points. A higher score indicates a higher level of sleepiness. In this study, we used the validated Thai version of the ESS.[15]

Functional Outcomes of Sleep Questionnaire (FOSQ)

The Functional Outcomes of Sleep Questionnaire (FOSQ) is a disease-specific health-related quality of life questionnaire. It consists of 30 items that focus on five domains of normal daily life, including general productivity (8 items), vigilance (7 items), social outcome (2 items), activity level (9 items), and sexual relationship (4 items). The mean of each subscale and a global score was reported in a set of scores ranging from 1 to 4 and 5 to 20, respectively. A lower score reflects a greater level of dysfunction or worse quality of life. In this study, we use the validated Thai version of the FOSQ.[16]

Polysomnography (PSG)

Standard technician-attended PSG in this study included the recording of electroencephalography (EEG), electrooculography (EOG), submentalis (chin) electromyography (EMG), electrocardiogram (ECG), thermistors for nasal and oral airflow, thoracic and abdominal impedance belts for respiratory efforts, pulse oximetry, microphone for snoring, and sensors for leg and sleep position. Sleep stages and respiratory parameters were scored according to the recommendations of the American Academy of Sleep Medicine (AASM) manual (2007).[13] Apnea was defined as a 90% drop in oronasal thermal flow lasting at least 10 seconds. Hypopnea was defined as 30% or greater drop in airflow for 10 seconds or longer associated with ≥ 4% oxygen desaturation.

Respiratory event-related arousal (RERA) was defined as is an event during which patients take a series of breaths with increasing respiratory effort that leads to an arousal from sleep that does not satisfy the criteria for apnea or hypopnea. Severity of OSA was classified as mild degree (mild OSA) when the AHI [defined as average of apnea events plus hypopnea events per hour (h) of sleep] was within the range of 5 to 14 events/h. Moderate OSA and severe OSA was defined if the AHI was from 15 to 30 events/h and more than 30 events/h, respectively. Respiratory Disturbance Index (RDI) was defined as the average number of respiratory disturbances (i.e., obstructive apneas, hypopneas, and RERAs) per hour.

Statistical analysis

SPSS Statistics for Windows version 18 (SPSS Inc., Chicago, IL, USA) was used to perform all statistical analyses. Continuous data are presented as mean ± standard deviation, and categorical data are shown as frequency and percentage. One-way ANOVA with Bonferroni post hoc test and Chi-square test was used to compare continuous data and categorical data between groups, respectively. Spearman's correlation coefficient analysis was used to compare between PSG findings (AHI or RDI) and both FOSQ scores and ESS scores. Statistical significance was determined at a p-value less than 0.05.

RESULTS

During January 2012 to December 2013, there were 373 patients (247 males and 126 females) with mean age of 48 ± 13.6 years (range: 18-88) who visited our snoring clinic and completed sleep history questionnaire. The mean body mass index (BMI) and ESS score of all participants was 28.2 ± 6.2 kg/m^2 and 10.0 ± 4.9, respectively. There were 306 patients who completed the FOSQ, and 350 patients who completed the ESS questionnaire. The most common reasons that patients reported for seeking care at our clinic were snoring at least 3 nights per week (328 patients, 87.9%), worrying about complications from apnea (270 patients, 72.4%), and lacking of energy / tiring during wake time (253 patients, 67.8%),. The three most common comorbidities among this cohort were dyslipidemia (137 patients, 36.7%), hypertension (128 patients, 34.3%), and diabetes (45 patients, 12.1%).

Using one-way ANOVA, there were statistically significant differences of BMI, ESS, AHI, and RDI among various groups of OSA severity. Subsequent analyses with Bonferroni post hoc test demonstrated that ESS scores were significantly different between severe OSA and non-OSA groups and between severe OSA and mild OSA groups. In addition, BMI were significantly different among all groups, except for mild OSA and moderate OSA groups. The clinical characteristics that associated with moderate-to-severe OSA classified by AHI (≥15 events/h) were snoring at least 3 nights per week, snoring bothering other people, witnessed apneas, and nocturia (p<0.05). The sole characteristic that associated with moderate-to-severe OSA classified by RDI (≥15 events/h) was worrying about complications from apnea (p<0.05).

The comorbidities that had statistical significance in the OSA group according to AHI (AHI ≥5 events/h) were hypertension, diabetes, and dyslipidemia. The sole comorbidity that had statistically significant correlation in the OSA group according to RDI (RDI ≥5 events/h) was hypertension.

The clinical presentations and polysomnographic findings of participants are demonstrated in Tables 1 and 2.

Polysomnographic findings

There were a total 275 patients (177 males and 98 females) who underwent PSG. Of those, 229 underwent full-night PSG, and 46 underwent split-night PSG. PSG findings revealed a diagnosis of OSA according to AHI criteria in 211 (76.7%) patients, a diagnosis of mild OSA in 49 patients (17.8%), moderate OSA in 56 patients (20.4%), and severe OSA in 106 patients (38.5%). Using RDI with a similar cut-off point as AHI to diagnose OSA, 238 patients (98.8%) were diagnosed as OSA, 39 patients (16.2%) as mild OSA, 54 patients (22.4%) as moderate OSA, and 145 patients (60.2%) as severe OSA.

Correlation between FOSQ scores, ESS, and polysomnographic findings

There was no statistically significant difference between FOSQ scores and severity of OSA as shown in Table 3. Spearman's correlation coefficient analysis was used to compare between FOSQ scores, ESS, and polysomnographic findings (both AHI and RDI). Spearman's correlation coefficients between ESS, FOSQ domain scores, and FOSQ global score, and AHI and RDI are demonstrated in Table 4. Scatter diagrams showing correlation between ESS and AHI, and between ESS and RDI are given in Fig 1.

DISCUSSION

OSA is a highly prevalent disorder among general population. Its common nighttime manifestations include snoring, choking at night, witnessed apneic episodes, nocturia, and frequent arousals; and, its common daytime

TABLE 1. Characteristics of 275 patients who underwent polysomnography stratified by OSA severity.

Characteristics	Non-OSA (N=64)	Mild OSA (N=49)	Moderate OSA (N=56)	Severe OSA (N=106)	*p*-value
Male gender	34 (12.4%)	25 (9.1%)	36 (13.1%)	82 (29.8%)	0.10
Female gender	30 (10.9%)	24 (8.7%)	20 (7.3%)	24 (8.7%)	0.10
BMI (kg/m^2)	24.8 ± 3.9	28.0 ± 4.4	27.8 ± 3.8	30.1 ± 7.0	***<0.001****
Age (years)	47.0 ± 14.5	50.9 ± 13.9	50.5 ± 11.0	48.8 ± 12.8	0.30
ESS score	9.1 ± 5.2	9.1 ± 4.9	10.8 ± 4.7	10.9 ± 4.9	***0.04****
AHI	2.4 ± 1.4	9.4 ± 2.9	21.7 ± 4.3	58.2 ± 27.7	***<0.001****
RDI	15.8 ± 10.7	26.1 ± 13.5	39.7 ± 10.4	66.2 ± 20.9	***<0.001****

Data presented as number and percentage or mean ± standard deviation

**The p-values of <0.05 indicate statistical significance.*

Abbreviations: OSA, obstructive sleep apnea; AHI, apnea-hypopnea index; BMI, body mass index; ESS, Epworth Sleepiness Scale; RDI, respiratory disturbance index

TABLE 2. Clinical presentation among all study participants (N=373), and among patients who underwent polysomnography (n=275).

Symptoms	All patients N (%)	AHI <15 N (%)	AHI ≥15 N (%)	*p*-value
Worrying about complications from apnea	270 (72.4)	76 (27.6)	121 (44.0)	0.18
Social consequences due to snoring	235 (63.0)	67 (24.4)	114 (41.5)	0.06
Excessive daytime sleepiness	185 (49.6)	49 (17.8)	86 (31.3)	0.11
Snoring ≥3 nights per week	328 (87.9)	94 (34.2)	151 (54.9)	***0.009****
Snoring bothering other people	132 (35.4)	34 (12.4)	69 (25.1)	***0.035****
Nocturnal choking/gasping	204 (54.7)	57 (20.7)	98 (35.6)	0.10
Witnessed apneas	158 (42.4)	34 (12.4)	86 (31.3)	***<0.001****
Morning headache / Feeling dry	249 (66.8)	68 (24.7)	109 (39.6)	1.47
Lacking energy / Tiring during wake time	253 (67.8)	74 (26.9)	110 (40.0)	0.68
Falling asleep while driving	140 (37.5)	36 (13.1)	74 (26.9)	***0.02****
Deficits in cognition and vigilance	196 (52.5)	58 (21.1)	88 (32.0)	0.63
Nocturia	126 (33.8)	32 (11.6)	66 (24.0)	***0.034****

**The p-values of <0.05 indicate statistical significance between AHI <15 and AHI ≥15 events/h*

Abbreviation: AHI, apnea-hypopnea index

TABLE 3. FOSQ domain and global scores stratified by OSA severity (N=275).

	Non-OSA	Mild OSA	Moderate OSA	Severe OSA	*p*-value
General productivity	2.9 ± 1.1	3.0 ± 0.8	3.3 ± 0.7	3.0 ± 0.9	0.44
Social outcome	3.5 ± 0.9	3.5 ± 0.9	3.6 ± 0.9	3.3 ± 1.2	0.46
Activity level	3.1 ± 0.7	3.1 ± 0.7	3.3 ± 1.1	2.9 ± 0.7	0.13
Vigilance	2.7 ± 1.2	2.9 ± 1.3	2.9 ± 1.1	2.8 ± 1.3	0.78
Sexual relationship	1.8 ± 1.5	2.2 ± 1.67	2.4 ± 1.6	2.3 ± 1.4	0.16
FOSQ global	14.0 ± 4.1	14.8 ± 3.8	15.4 ± 3.5	14.3 ± 4.1	0.32

The data were presented in mean ± standard deviation (SD) with p-values (p < 0.05, it will indicate statistical significance).
Abbreviations: FOSQ, functional outcomes of sleep questionnaire; OSA, obstructive sleep apnea; AHI, apnea-hypopnea index

TABLE 4. Spearman's correlation coefficients between ESS, FOSQ domain scores, and FOSQ global score, and AHI and RDI.

	Spearman's correlation coefficient	*p*-value (AHI)	Spearman's correlation coefficient	*p*-value (RDI)
Epworth Sleepiness Scale (ESS)	0.2	***<0.002****	0.12	***<0.003***
General productivity	-0.04	0.56	-0.02	0.76
Social outcome	-0.08	0.25	-0.02	0.76
Activity level	-0.14	***0.03****	-0.15	***0.03***
Vigilance	-0.05	0.50	0.02	0.74
Sexual relationship	0.13	0.06	0.12	0.11
FOSQ global	-0.002	0.97	0.01	0.85

**The p-values of <0.05 indicate statistical significance.*
Abbreviations: ESS, Epworth Sleepiness Scale; FOSQ, functional outcomes of sleep questionnaire; AHI, apnea-hypopnea index; RDI, respiratory disturbance index

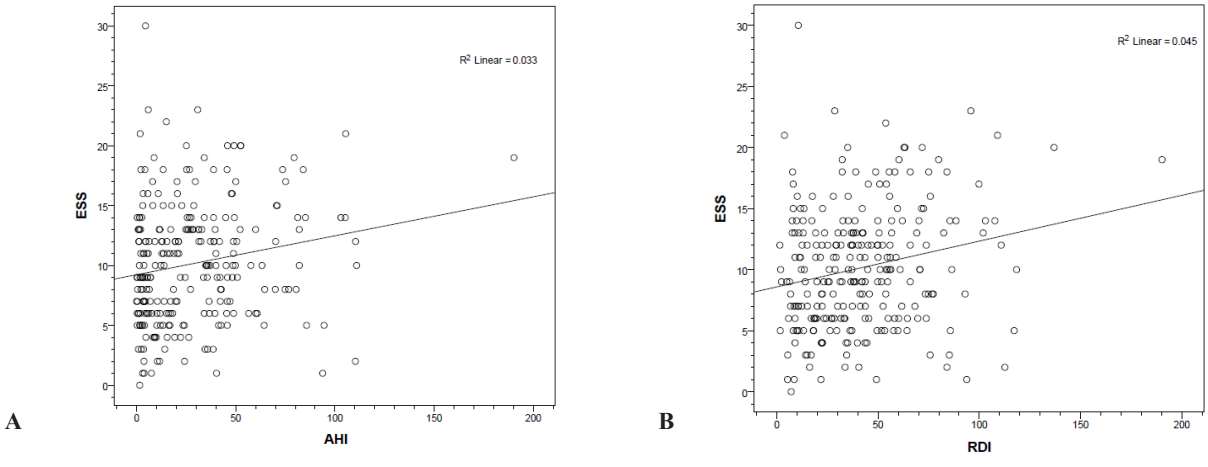

Fig 1. **(A)** Scatter diagrams showing correlation between Epworth Sleepiness Scale (ESS) and apnea-hypopnea index (AHI), and **(B)** between ESS and Respiratory Disturbance Index (RDI).

manifestations include excessive daytime somnolence, poor concentration, poor memory, mood changes, and irritability.[17] Not surprisingly, the results of this study showed the most common reason that patients visit our clinic is because of snoring problems. The second most common clinical manifestation was worrying about adverse consequences of untreated OSA, which is different from the second most common cause of seeking treatment reported in previous studies.[18,19] Increasing public awareness about this disease may be one of the reasons why there is such a long waiting list for PSG at our center. Contrary to what we had earlier hypothesized, excessive daytime sleepiness (EDS), although reported as a complaint by 49.6% of patients, was not one of the most commonly reported complaints. Although our results showed ESS scores to be significantly correlated with OSA severity to a modest degree, the level of excessive daytime sleepiness among our cohort was probably not severe enough to motivate them to seek medical attention. Furthermore, it was probably that some patients frequently complained of fatigue, tiredness, and lack of energy rather than sleepiness.[20]

The prevalence of OSA (AHI ≥5 events/h) in our snoring clinic was 76.7%, which is higher than in general population.[9-11,21] This was not unexpected because most patients in our study were symptomatic and/or were at high-risk for being diagnosed as OSA which are different from general population. However, if we used RDI criteria (RDI ≥5 events/h), almost every patient (98.8%) would be diagnosed as OSA, and more patients would be diagnosed as severe OSA. Moreover, our study revealed the characteristics associated with moderate to severe OSA by AHI (AHI ≥15 events/h) to be snoring at least 3 nights per week, snoring that bothers other people, witnessed apneas, and nocturia ($p<0.05$); whereas, the only characteristic associated with moderate to severe OSA by RDI (RDI of ≥15 events/h) was worrying about complication from apnea. This may imply that AHI scored by the recommended hypopnea criteria (30% drop of airflow associated with ≥4% desaturation) from the AASM manual 2007 seems to be more clinically relevant and more specific to OSA symptoms than RDI or possibly AHI from currently recommended hypopnea criteria of AASM manual 2012.

The comorbidities that were different between OSA and non-OSA patients when using AHI were hypertension, diabetes, and dyslipidemia; while no difference in comorbidities was observed between OSA and non-OSA patients when using RDI. Furthermore, no relationship was observed between OSA and cardiovascular diseases, which is different from the findings of other studies.[22-24] Regarding quality of life, we found only a weak relationship between activity level and AHI/RDI, which was slightly different from some studies.[25,26] All of these findings suggest that RDI or AHI alone should not be used to diagnose OSA. Alternatively, whether AHI or RDI are used, they should be used in conjunction with data relating to other aspects of the disease such as patient symptoms, comorbidities, and quality of life.

Limitations

The mentionable limitations of this study include its retrospective design and the fact that we included subjective patient-reported questionnaire data. Further prospective study is needed to confirm and further elucidate the associations between severity of OSA, and patient characteristics and clinical presentations in order to improve diagnosis, treatment, and outcomes. The strength of this study is its relatively large sample size, with a significant proportion of those patients having PSG results available for analysis.

CONCLUSION

This study showed that most common chief complaints of patients in our clinic were loud snoring and worrying about adverse consequences of untreated OSA, but not EDS. Furthermore, the clinical characteristics that associated with AHI ≥ 15 events/h were snoring at least 3 nights per week, snoring bother other people, witnessed apneas, and nocturia. Using criteria of AHI of ≥ 5 events/h, seventy-six percent of patients were diagnosed as OSA. However, if using criteria of RDI ≥ 5 events/h, almost every patients will be diagnosed as OSA. Given the only weak relationship between AHI (and RDI) with ESS and quality of life. AHI combined with other patient factors was found to be superior to RDI alone for diagnosis of OSA.

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REFERENCES

1. Harly Greenberg VL, Steven M. Scharf. Obstructive Sleep Apnea: Clinical Features, Evaluation, and Principles of Management. In: Meir Kryger OR, editor. Principles and practice of sleep medicine ,Sixth edition. Philadelphia, PA Elsevier; 2017.p.1110-24.
2. Baldwin CM, Griffith KA, Nieto FJ, O'Connor GT, Walsleben JA, Redline S. The association of sleep-disordered breathing and sleep symptoms with quality of life in the Sleep Heart Health Study. Sleep 2001;24:96-105.
3. Parish JM, Somers VK. Obstructive sleep apnea and cardiovascular disease. Mayo Clin Proc 2004;79:1036-46.
4. Park JG, Ramar K, Olson EJ. Updates on definition, consequences, and management of obstructive sleep apnea. Mayo Clin Proc 2011;86:549-54.
5. Punjabi NM, Newman AB, Young TB, Resnick HE, Sanders MH. Sleep-disordered breathing and cardiovascular disease: an outcome-based definition of hypopneas. Am J Respir Crit Care Med 2008;177:1150-5.
6. Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, et al. Sleep apnea and cardiovascular disease: An american heart association/american college of cardiology foundation scientific statement from the american heart association council for high blood pressure research professional education committee, council on clinical cardiology, stroke council, and council on cardiovascular nursing in collaboration with the national heart, lung, and blood institute national center on sleep disorders research (national institutes of health). J Am Coll Cardiol 2008;52:686-717.
7. Yaffe K, Laffan AM, Harrison SL, Redline S, Spira AP, Ensrud KE, et al. Sleep-disordered breathing, hypoxia, and risk of mild cognitive impairment and dementia in older women. JAMA 2011;306:613-9.
8. Yaggi HK, Concato J, Kernan WN, Lichtman JH, Brass LM, Mohsenin V. Obstructive sleep apnea as a risk factor for stroke and death. N Engl J Med 2005;353:2034-41.
9. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993;328:1230-5.
10. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol 2013;177:1006-14.
11. Neruntarat C, Chantapant S. Prevalence of sleep apnea in HRH Princess Maha Chakri Srinthorn Medical Center, Thailand. Sleep Breath 2011;15:641-8.
12. Young T, Evans L, Finn L, Palta M. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. Sleep 1997;20:705-6.
13. Iber C, Ancoli-Israel S, Chesson A. Quan SF, for the American Academy of Sleep Medicine: The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications. Westchester: American Academy of Sleep Medicine; 2007.
14. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14:540-5.
15. Banhiran W, Assanasen P, Nopmaneejumruslers C, Metheetrairut C. Epworth sleepiness scale in obstructive sleep disordered breathing: the reliability and validity of the Thai version. Sleep Breath 2011;15:571-7.
16. Banhiran W, Assanasen P, Metheetrairut C, Nopmaneejumruslers C, Chotinaiwattarakul W, Kerdnoppakhun J. Functional outcomes of sleep in Thai patients with obstructive sleep-disordered breathing. Sleep Breath 2012;16:663-75.
17. Pang KP, Terris DJ. Screening for obstructive sleep apnea: an evidence-based analysis. Am J Otolaryngol 2006;27:112-8.
18. Stansbury RC, Strollo PJ. Clinical manifestations of sleep apnea. J Thorac Dis 2015;7:E298-310.
19. Frank Y, Kravath RE, Pollak CP, Weitzman ED. Obstructive sleep apnea and its therapy: clinical and polysomnographic manifestations. Pediatrics 1983;71:737-42.
20. Chervin RD. Sleepiness, fatigue, tiredness, and lack of energy in obstructive sleep apnea. Chest 2000;118:372-9.
21. Peppard PE, Hagen EW. The Last 25 Years of Obstructive Sleep Apnea Epidemiology-and the Next 25? Am J Respir Crit Care Med 2018;197:310-2.
22. Peppard PE, Young T, Palta M, Skatrud J. Prospective study of the association between sleep-disordered breathing and hypertension. N Engl J Med 2000;342:1378-84.
23. Peker Y, Kraiczi H, Hedner J, Loth S, Johansson Å, Bende M. An independent association between obstructive sleep apnoea and coronary artery disease. Eur Respir J 1999;14:179-84.
24. MacGregor M, Block AJ, Ball Jr WC. Topics in clinical medicine: serious complications and sudden death in the Pickwickian syndrome. Johns Hopkins Med J 1970;126:279-95.
25. Vidal S, Ferrer M, Masuet C, Somoza M, Ballarín JIM, Monasterio C. Spanish version of the Functional Outcomes of Sleep Questionnaire: scores of healthy individuals and of patients with sleep apnea-hypopnea syndrome. Arch Bronconeumol 2007;43:256-61. [Article in Spanish]
26. Rey de Castro J, Rosales-Mayor E, Weaver TE. Reliability and Validity of the Functional Outcomes of Sleep Questionnaire - Spanish Short Version (FOSQ-10SV) in Peruvian Patients With Obstructive Sleep Apnea. J Clin Sleep Med 2018;14:615-21.