Clinical Profile and Diagnosis of Obstructive Sleep Apnea Syndrome using Overnight Polysomnography in a Tertiary Care Hospital

Pokharel M, Shrestha BL, Dhakal A, Rajbhandari P, Shrestha KS, KC AK, Bhattarai A, Karki DR

Department of Otorhinolaryngology and Head and Neck Surgery,

Kathmandu University School of Medical Sciences

Dhulikhel Hospital, Kathmandu University Hospital

Dhulikhel, Kavre, Nepal.

Corresponding Author

Monika Pokharel

Department of Otorhinolaryngology and Head and Neck Surgery,

Kathmandu University School of Medical Sciences

Dhulikhel Hospital, Kathmandu University Hospital

Dhulikhel, Kavre, Nepal.

E-mail: monikapokharel@hotmail.com

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ABSTRACT

Background

Obstructive sleep apnea is a highly prevalent yet largely under-diagnosed disease that poses a significant burden on the healthcare system.

Objective

To determine the role of predictors for Obstructive sleep apnea syndrome and its severity in Nepalese population.

Method

Prospective and analytical study conducted in the Department of Otorhinolaryngology and Head and Neck surgery at Kathmandu University Hospital between March 2018 and June 2020. A total of 85 adult patients with Obstructive sleep apnea with an Epworth sleepiness score greater than 10 were included. Overnight polysomnography was done and scoring of sleep associated events were done according to the American Academy of Sleep Medicine criteria. Participants were classified as simple snoring and mild, moderate or severe Obstructive sleep apnea syndrome groups depending on the Apnea Hypopnea Index values. Relationship of Apnea hypopnea index was analyzed with age, neck circumference, body mass index and Epworth Sleepiness score.

Result

Simple snoring was seen in 18(21.17%) patients, 14(16.47%) had mild Obstructive sleep apnea, 13(15.29%) had moderate Obstructive sleep apnea, whereas the severe group consisted of 40(47.05%) patients. The minimum Epworth Sleepiness Score was 10 and the maximum was 25. The Apnea hypopnea index correlated positively with Body mass index (p=.010) and Epworth sleepiness score (p<.001). However, Apnea hypopnea index had no association with age (p=.437) and neck circumference (p=.118).

Conclusion

Health professionals need to be extremely vigilant while examining patients presenting with Obstructive Sleep Apnea. Polysomnography is the investigation of choice in the early identification of this treatable disease.

KEY WORDS

Apnea hypopnea index, Obstructive sleep apnea, Polysomnography

INTRODUCTION

Obstructive sleep apnea syndrome (OSA) represents a global health problem and is increasing in prevalence. There is profound morbidity, impairment of quality of life and costs related to this highly prevalent yet largely under-diagnosed disease. The prevalence of OSA has been estimated to be 14% in men and 5% in women.[1]

If undiagnosed and untreated, it has deleterious consequences such as atrial fibrillation, resistant hypertension, insulin resistance and stroke.[2,3] Other associated features are hypersomnolence, declines in daytime function leading to higher rates of job- related and motor vehicle accidents, depression, sexual impotence, gasping, nocturia and morning headaches. Bed partner may report snoring or witnessed apneas, work-place errors and death.[4-8]

OSA poses a significant burden on the healthcare system, with increased healthcare utilization. Hence, it is very crucial to assess it timely and rigorously. Polysomnography (PSG) is the gold standard investigation which aids in its early identification.[9] Despite the rapidly growing prevalence, OSA remains a very scarcely researched topic in Nepal.

Our study aims to determine the role of predictors for OSA and severity in Nepalese population with the help of PSG.

METHODS

We conducted a single center, prospective, analytical study in the Department of Otorhinolaryngology and Head and Neck surgery at the Kathmandu University Dhulikhel Hospital between March 2018 and June 2020. Ethical approval was obtained from Kathmandu University School of Medical Sciences Institutional Review Committee.

A total of 85 patients who were more than or equal to 18 years of age with clinically diagnosed OSA with an Epworth sleepiness score greater than 10 undergoing diagnostic evaluation by PSG were included in our study. Exclusion criteria were patients under the age of 18 years, pregnancy, a sleep disorder other than OSA and subjects under treatment with continuous positive airway pressure. Patients with a recent history of airway surgery, airway cancer, decompensated cardiopulmonary disease were also excluded. Similarly, patients with overlap syndrome, chronic kidney disease, neuromuscular disease with repercussion on ventilator mechanics, neuropsychiatric illness that could compromise the validity of questionnaire and patients on medications known to affect sleep or neurocognitive function were not enrolled.

A detailed history and clinical examination was performed. With the help of a study questionnaire the demographic data, presenting symptoms, symptoms of co-morbidities, general medical history, medication use, alcohol use, smoking habits and sleep hygiene were recorded.

Position of maxilla and mandible including retrognathia and micrognathia, and presence or absence of any abnormality in facial characteristics were noted. Assessment of nose was done for any external nasal deformity, nasal valve adequacy, position of nasal septum, turbinate size, condition of nasal mucosa, presence or absence of nasal polyps, rhinorrhea or purulence. In oral cavity, size of tongue and tonsil, position and elongation of palate and uvula, modified Mallampati score, dentition and crowding of oropharynx was noted. In the neck, neck circumference (NC), redundant cervical adipose tissue and hyoid position was noted. Weight was measured with light clothing and after removal of shoes. NC was measured using a measuring tape at the level of middle of the neck through cervical spine process and superior line of the cricothyroid membrane with the patients awake and in the standing upright position and stated in centimeters. Patients were asked to look straight ahead, with shoulders down, but not hunched during the measurement. All the antropometric measurements were done twice and averaged to get a more precise value. Body Mass Index (BMI) was calculated as measured weight (in kilograms) divided by height (in meters) squared. Blood pressure was measured in sitting and supine position after resting for five minutes. The left arm of the patient was placed at the level of the right atrium in each position during measurement.

Laryngeal examination was done by fiberoptic nasopharyngolaryngoscopy to rule out any laryngeal tumours. Epworth sleepiness score (ESS) was used to evaluate the subjective level of daytime sleepiness.[10]

Written informed consent was obtained from each patient following a detailed explanation of the objectives and protocol of the study. A clinical data proforma was filled up.

Overnight PSG was conducted at Kathmandu University Hospital in the sleep laboratory. All the PSG studies were supervised and attended by an experienced sleep technician. Participants arrived in early evening. A 48-channel PSG recording system (Miniscreen pro device) was used to assess sleep state and respiratory and cardiac parameters. PSG was performed by the same sleep technician during the whole period of study. Data was analysed by using software. The parameters monitored were electroencephalography, electrooculography, chin and anterior tibialis electromyography, electrocardiography, inductance plethysmography (to detect abdominal and thoracic movements), pulse oximetry, nasal pressure monitoring using nasal pressure transducer, snoring intensity using acoustic sensor (microphone), oronasal thermal airflow using thermisitor, blood pressure, pulse and body position. The various events of PSG record were inspected visually for abnormal breathing episodes. All the PSG records were scored and read by the same sleep technician and verified by the same otorhinolaryngologist trained in sleep medicine over the entire period of study in order to avoid inter observer bias. All tests lasted for a minimum of six hours. The scoring of sleep and associated events was done according to American Academy of Sleep Medicine criteria.[11,12]

Apnea was identified as reduction in airflow greater than ≥ 90% as recorded by oronasal thermisitors or nasal pressure cannulas lasting for ≥ 10 seconds. Hypopnea was identified when reduction in airflow ≥ 30% as recorded by nasal pressure cannulas lasting ≥ 10 sec with reduction in saturation at least ≥ 4% from baseline SpO_2% prior to event. Apnea-hypopnea index (AHI) was defined as the number of apneas and hypopneas per hour of sleep, confirmed by electroencephalogram (EEG). Arousal was defined as a sudden change in the electroencephalography frequency, with alpha and theta activity or waveforms having frequency > 16 Hertz and a duration of 3-15 seconds. Respiratory effort related arousals (RERA) were identified as a sequence of breaths lasting for at least 10 seconds, characterized by an increased respiratory effort or flattening of nasal pressure waveform, followed by arousal from sleep, which does not meet the criteria for an apnea or hypopnea event.[12,13]

Sleep stage scoring was done in 30 seconds epochs and respiratory events scoring was done in 2 minute epochs. Participants were classified into four groups on the basis of Apnea Hypopnea Index (AHI) determined from the PSG records as simple snoring group (AHI < 5 events/hour), mild OSA group (AHI-5 to 15 events/hour), moderate OSA group (AHI-16 to 30 events/hour) and severe OSA group (AHI- ≥ 30 events/hour).

The statistical analyses was carried out by using the Statistical Package for Social Science software (IBM SPSS Statistics 21, Chicago, USA). The relationship between age and AHI, AHI and neck circumference, AHI and BMI, AHI and ESS was done by using Pearson correlation coefficient. The relationship between severity of OSA in between groups and age was analysed by the help of One-way ANOVA test. A p-value < 0.05 was considered to be statistically significant.

RESULTS

Of the 85 patients evaluated, 72(84.7%) were males and 13(15.3%) were females. The minimum age was 20 and maximum was 68 years. Table 1 shows the socio demographic characteristics of patients. Simple snoring group consisted of 18(21.17%) patients, mild OSA group consisted of 14(16.47%) patients, moderate OSA group comprised of 13(15.29%) patients whereas severe OSA group consisted of 40(47.05%) patients. The minimum ESS was 10 and maximum was 25. The predominant sleep position encountered with OSA was supine in 46(54.1%) patients, followed by left lateral position in 22(25.9%) and right lateral in 17(20%) patients respectively. There were 21(24.7%) patients with Diabetes mellitus and 31(36.5%) were hypertensive. The mean ± SD of age, BMI AHI, NC, ESS are presented in table 2.

Table 1. Sociodemographic variables of patients

Variable		Frequency	Percentage
Sex			
	Male	72	84.70
	Female	13	15.30
Age group (years)			
	20-30	12	14.11
	31-40	35	41.17
	41-50	16	18.82
	51-60	19	22.35
	61-70	3	3.52
Profession			
	Driver	19	22.35
	Engineer	15	17.64
	Housewife	12	14.11
	Restaurant worker	8	9.41
	Student	7	8.23
	Teacher	6	7.05
	Farmer	5	5.88
	Politician	4	4.71
	Receptionist	3	3.52
	Singer	2	2.35
	Chartered accountant	2	2.35
	Doctor	2	2.35

Table 2. Age, AHI, BMI, NC and Epworth Sleepiness score of the patients (N=85)

Variable	Mean	Standard Deviation	Median	Minimum	Maximum
Age (years)	41.46	11.06	38	20	68
AHI (per hour)	33.88	0.73	27.50	0.40	98.90
BMI (kg/m^2)	31.79	5.90	31	18	45.34
NC (cm)	41.95	3.62	42	34	57
ESS	15.78	4.64	14	10	25

AHI correlated positively with BMI (p = .010) (fig. 1). Likewise, there was a significant interaction between AHI and ESS (p < .001). However, when age was correlated AHI (p=.437), no statistical significance was achieved. Similarly, no association was observed between AHI and NC (p=.118). The mean plot between age and severity of OSA has been presented in figure 2.

DISCUSSION

We found that the most frequently affected age group was between 31-40 years. In the current study we did not observe any relationship between age and prevalence of OSA. Our results are similar to the findings of a study done in African Americans.[14] Our observation contradicts those of some of the formerly published literature.[15-17] These differences may be attributable to socio demographic and geographic differences between the study populations.

Table 3. **Severity of OSAS in patients**

Severity of OSA	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Mild	14	47.29	10.908	2.915	40.99	53.58	32	68
Moderate	13	44.00	11.818	3.278	36.86	51.14	26	62
Severe	40	41.08	9.355	1.479	38.08	44.07	27	60
No OSA	18	35.94	12.211	2.878	29.87	42.02	20	66
Total	85	41.46	11.064	1.200	39.07	43.85	20	68

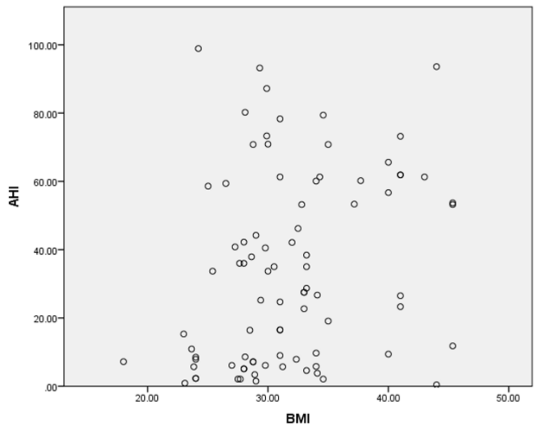

Figure 1. **Correlation between AHI and BMI**

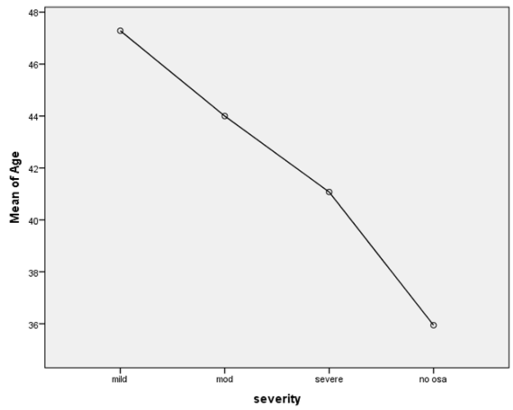

Figure 2. **Mean plot between age and severity of OSAS**

There was a predominance of male population in our study which is consistent to previous studies and contrary to another study where the authors found that the prevalence of OSA was more in females.[18-20] This may be due to the variable pattern of distribution of adipose tissue in men ,who exhibit a predominantly central fat deposition pattern around the neck, trunk, and abdominal viscera compared with women.[21,22]

In approximately 56% to 75% of patients with OSA, the frequency and duration of apneas are influenced by body position.[23,24] In the present study, the most frequently observed sleep position that was associated with OSA was supine. This is in accordance with study by Ravesloot et al.[25]

Apnea-hypopnea index (AHI) has been used as the main parameter to stratify the severity of the disease. We observed a strong association between AHI and BMI (p=.010). Our findings are in accordance to previous studies in literature.[26-28]

The Epworth sleepiness scale (ESS) is a widely used screening tools in the clinical evaluation of obstructive sleep apnea. It has eight items on a 3 -point Likert scale, with the total score ranging from 0-24 that rate a person's likelihood of dozing off in daily situations. A score greater than 10 suggests excessive daytime sleepiness.[10,29] In a study performed at the Mayo Clinic Center for Sleep Medicine, the authors found that ESS is less associated with the presence of sleep disordered breathing in women compared with men which is in contrast to our study.[30]

Some authors found that a large neck circumference was predictive of OSA in the general population.[31] Likewise, Guilleminault et al. in their research stated that increases in visceral fat with age may also account for an increase in sleep apnea prevalence in middle-aged and older men and in postmenopausal women.[32] However, in our study, no association was observed between AHI and neck circumference (p = .118). No convincing reasons have been mentioned in previous literature to support our finding.

We would also like to mention some strengths of our study. We included only the patients who underwent an attended in-laboratory PSG. To the best of our knowledge this is the only study highlighting the importance of Polysomnography in diagnosis of OSA and determining the role of predictors like age, BMI, NC, AHI in OSA in Nepali population.

Our study also has some limitations. This was a single center study. We hope that in future much large scaled community based studies will be conducted to further substantiate the observations of this study.

CONCLUSION

The public health burden posed by OSA is substantial. There is very high prevalence of OSA in Nepali population. However, it remains largely undiagnosed due to lack of awareness in general population. There is apparent lack of available resources for diagnosis and treatment of OSA in Nepal which is inadequate in meeting the growing demands. Health professionals need to be extremely vigilant while examining patients who present with multitude of symptoms suggesting OSA. Polysomnography is a useful investigation which helps in diagnosis of this treatable disease.

REFERENCES

1. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. *Am J Epidemiol*. 2013 May 1;177(9):1006-14.
2. Jullian-Desayes I, Joyeux-Faure M, Tamisier R, Launois S, Borel AL, Levy P, et al. Impact of obstructive sleep apnea treatment by continuous positive airway pressure on cardiometa- bolic biomarkers: a systematic review from sham CPAP randomized controlled trials. *Sleep Med Rev.* 2015;21:23-38.
3. Digby GC, Baranchuk A. Sleep apnea and atrial fibrillation; 2012 update. *Curr Cardiol Rev*. 2012;8:265-72.
4. Liu L, Kang R, Zhao S, Zhang T, Zhu W, Li E, et al. Sexual dysfunction in patients with obstructive sleep apnea: a systematic review and meta-analysis. *J Sex Med*. 2015;12: 1992-2003.
5. Ustun B, Westover MB, Rudin C, Bianchi MT. Clinical Prediction Models for Sleep Apnea: The Importance of Medical History over Symptoms. *J Clin Sleep Med*. 2016;12(2):161-168. doi:10.5664/jcsm.5476
6. Epstein LJ, Kristo D, Strollo PJ Jr, Friedman N, Malhotra A, et al. Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. *J Clin Sleep Med*. 2009 Jun 15;5(3):263-76. PMID: 19960649; PMCID: PMC2699173.
7. Basoglu OK, Tasbakan MS. Gender differences in clinical and polysomnographic features of obstructive sleep apnea: a clinical study of 2827 patients. *Sleep Breath*. 2017 Feb. 14 [Epub ahead of print]. doi: 10.1007/ s11325-017-1482-9.
8. Laratta CR, Ayas NT, Povitz M, Pendharkar SR. Diagnosis and treatment of obstructive sleep apnea in adults. *CMAJ.* 2017;189(48):E1481-E1488. doi:10.1503/cmaj.170296
9. Zhan X, Fang F, Wu C, Pinto JM, Wei Y. A Retrospective Study to Compare the Use of the Mean Apnea-Hypopnea Duration and the Apnea-Hypopnea Index with Blood Oxygenation and Sleep Patterns in Patients with Obstructive Sleep Apnea Diagnosed by Polysomnography. *Med Sci Monit.* 2018;24:1887-1893. Published 2018 Mar 31. doi:10.12659/msm.909219
10. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep.* 1991 Dec;14(6):540-5.
11. Thornton AT, Singh P, Ruehland WR, Rochford PD. AASM criteria for scoring respiratory events: interaction between apnea sensor and hypopnea definition. *Sleep.* 2012;35(3):425-32. Published 2012 Mar 1. doi:10.5665/sleep.1710
12. Berry RB, Budhiraja R, Gottlieb DJ, Gozal D, Iber C, et al. Rules for scoring respiratory events in sleep: update of the 2007 AASM Manual for the Scoring of Sleep and Associated Events. Deliberations of the Sleep Apnea Definitions Task Force of the American Academy of Sleep Medicine. *J Clin Sleep Med.* 2012;8(5):597-619. Published 2012 Oct 15. doi:10.5664/jcsm.2172
13. Findley LJ, Suratt PM, Dinges DF. Time-on-task decrements in "steer clear" performance of patients with sleep apnea and narcolepsy. *Sleep.* 1999 Sep 15;22(6):804-9.
14. Johnson DA, Guo N, Rueschman M, Wang R, Wilson JG, Redline S. Prevalence and correlates of obstructive sleep apnea among African Americans: the Jackson Heart Sleep Study. *Sleep*. 2018;41(10):zsy154. doi:10.1093/sleep/zsy154
15. Tishler PV, Larkin EK, Schluchter MD, Redline S. Incidence of sleep-disordered breathing in an urban adult population: the relative importance of risk factors in the development of sleep-disordered breathing. *JAMA.* 2003 May 7;289(17):2230-7. doi: 10.1001/ jama.289.17.2230. PMID: 12734134.
16. Bixler EO, Vgontzas AN, Ten Have T, Tyson K, Kales A. Effects of age on sleep apnea in men: I. Prevalence and severity. *Am J Respir Crit Care Med*. 1998 Jan;157(1):144-8. doi: 10.1164/ajrccm.157.1.9706079. PMID: 9445292.
17. Young T, Shahar E, Nieto FJ, Redline S, Newman AB, Gottlieb DJ, et al. Sleep Heart Health Study Research Group. Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study. *Arch Intern Med.* 2002 Apr 22;162(8):893-900. doi: 10.1001/archinte.162.8.893. PMID: 11966340.
18. Veasey SC, Rosen IM. Obstructive Sleep Apnea in Adults. *N Engl J Med*. 2019;380(15):1442-1449. doi:10.1056/NEJMcp1816152
19. Patil S, Schneider H, Gladmon E, Magnuson T, Smith PL, O'Donnell CP, et al. Obesity and upper airway mechanical control during sleep. *Am J Respir Crit Care Med*. 2004;169:A435.
20. Johnson DA, Guo N, Rueschman M, Wang R, Wilson JG, Redline S. Prevalence and correlates of obstructive sleep apnea among African Americans: the Jackson Heart Sleep Study. *Sleep.* 2018;41(10):zsy154. doi:10.1093/sleep/zsy154
21. Ledoux M, Lambert J, Reeder BA, Despres JP. Correlation between cardiovascular disease risk factors and simple anthropometric meas- ures. Canadian Heart Health Surveys Research Group. *CMAJ.* 1997;157:S46–S53.
22. Legato MJ. Gender-specific aspects of obesity. *Int J Fertil Womens Med*. 1997;42:184–97.
23. Ravesloot MJ, van Maanen JP, Dun L, de Vries N. The undervalued potential of positional therapy in position-dependent snoring and obstructive sleep apnea-a review of the literature. *Sleep Breath*. 2013;17(1):39–49.
24. Richard W, Kox D, den Herder C, Laman M, van Tinteren H, de Vries N. The role of sleep position in obstructive sleep apnea syndrome. *Eur Arch Otorhinolaryngol*. 2006;263(10):946–50.
25. Ravesloot MJ, Frank MH, van Maanen JP, Verhagen EA, de Lange J, de Vries N. Positional OSA part 2: retrospective cohort analysis with a new classification system (APOC). *Sleep Breath*. 2016;20(2):881–8.
26. Kum RO, Ozcan M, Yılmaz YF, Gungor V, Yurtsever Kum N, Unal A. The Relation of the Obstruction Site on Muller's Maneuver with BMI, Neck Circumference and PSG Findings in OSAS. *Indian J Otolaryngol Head Neck Surg.* 2014;66(2):167-72. doi:10.1007/s12070-014-0699-1
27. Kang HH, Kang JY, Ha JH, Lee J, Kim SK, Moon HS, Lee SH. The associations between anthropometric indices and obstructive sleep apnea in a Korean population. *PLoS One*. 2014 Dec 4;9(12):e114463. doi: 10.1371/journal.pone.0114463. PMID: 25474257; PMCID: PMC4256422.
28. Cizza G, de Jonge L, Piaggi P, Mattingly M, Zhao X, Lucassen E, et al. Neck circumference is a predictor of metabolic syndrome and obstructive sleep apnea in short-sleeping obese men and women. *Metabolic syndrome and related disorders.* 2014 May 1;12(4):231-41. doi:10.1089/met.2013.0093
29. Jenkinson C, Davies RJ, Mullins R, Stradling JR. Comparison of therapeutic and subtherapeutic nasal continuous positive airway pressure for obstructive sleep apnoea: a randomised prospective parallel trial. *Lancet.* 1999; 353:2100–2105.
30. Lipford MC, Wahner-Roedler DL, Welsh GA, Mandrekar J, Thapa P, Olson EJ. Correlation of the Epworth Sleepiness Scale and Sleep-Disordered Breathing in Men and Women. *J Clin Sleep Med*. 2019;15(1):33-8. Published 2019 Jan 15. doi:10.5664/jcsm.7564.
31. Carmelli D, Swan GE, Bliwise DL Relationship of 30-year changes in obesity to sleep-disordered breathing in the Western Collaborative Group Study. *Obes Res*. 2000;8(9):632-7. doi:10.1038/oby.2000.81
32. Guilleminault C, Stoohs R, Kim YD, Chervin R, Black J, Clerk A. Upper airway sleep-disordered breathing in women. *Ann Intern Med.* 1995;122:493–501.
33. Tom C, Roy B, Vig R, Kang DW, Aysola RS, Woo MA, et al. Correlations between Waist and Neck Circumferences and Obstructive Sleep Apnea Characteristics. *Sleep Vigil*. 2018;2(2):111-8. doi:10.1007/ s41782-018-0041-1.