ORIGINAL ARTICLE

Diagnostic challenges of obstructive sleep apnea syndrome: A comparative study between elderly and younger populations

Défi diagnostique du syndrome d'apnée-hypopnée obstructive du sommeil chez le sujet âgé

Emna Ben Jemia, Sarra Trimech, Amal Saidani, Hend Ouertani, Jihen Ben Amar, Haifa Zaibi

University of El Manar, Faculty of Medicine of Tunis, Charles Nicolles Hospital, Pneumology Department, Tunis, Tunisia

Abstract

Background: Obstructive sleep apnea syndrome (OSAS) in the elderly is common but underdiagnosed pathology due to the accumulated prevalence, atypical symptoms and associated comorbidities. The objective of our study was to determine the clinical and polygraphy characteristics of OSAS in elderly subjects by comparing them to young subjects.

Methods: Retrospective and comparative study conducted in the pulmonology department of Charles Nicolle Hospital in Tunis, including 110 patients with OSAS. They were divided into two groups: Group 1 including 55 subjects aged 65 and over, and Group 2 including 55 young subjects aged between 18 and 64 years. Clinical, and polygraphy data were collected.

Results: The mean age of the elderly subjects was 71 ± 4.6 years, on the other hand the mean age of the young subjects was 50 ± 11 years. Predominance of female sex was in both groups, with less smoking among elders and the absence of alcohol consumption. Physical activity was low in both groups but younger patients were more active (p=0.05). Family obesity was more common among young patients. Comorbidities were more present in the elderly subjects predominantly dyslipidemia (AUC=0.66; p=0.003; CI [0.56-0.76]) followed by high blood pressure (AUC=0.65; p=0.005; CI [0.55-0.75]) and diabetes (AUC=0.62; p=0.021; CI [0.52-0.73]). There was no significant difference between the two groups regarding most of the symptoms but nycturia that was mainly observed among older patients (p=0.017). the AUC was high for the NoSAS score indicating a high discriminant value (0.6; CI [0.51-0.70]).

But other screening tools such as the STOP-BANG, Pichot and Epworth scales showed no superiority among both groups with a confidence interval respectively [0.42-0.64], [0.39-0.61]and [0.36-0.58].

Analysis of the polygraphy recording of OSAHS did not differ between the 2 groups, nor did the severity of the pathology (p>0.05). Treatment of OSAHS did not differ between the 2 groups (p>0.05). Hygienic dietary rules were prescribed for all patients. Positive pressure ventilation was prescribed in more than a third of cases in the 2 groups, and mandibular advancement orthosis (MAO) in one young patient.

Conclusion: Our study highlights the high prevalence of cardiovascular and metabolic co-morbidities in elderly patients being monitored for OSAHS, in addition to the performance of screening scores in the elderly population especially the NoSAS which justifies the importance of a more targeted early detection in this age group for better management.

Keywords: Obstructive sleep apnea syndrome, Elderly, Polysomnography, Prognosis

Résumé

Introduction : Le syndrome d'apnées obstructive du sommeil (SAOS) du sujet âgé est une pathologie fréquente mais sous diagnostiquer en raison de la prévalence accrue, des symptômes atypiques et des comorbidités associées. L´objectif de notre étude était de déterminer les caractéristiques cliniques et polygraphiques du SAHOS chez les sujets âgés en les comparant à des sujets jeunes.

Méthodes : Étude comparative rétrospective menée au service de pneumologie de l'hôpital Charles Nicolle de Tunis, incluant 110 patients ayant un SAOS. Ils étaient repartis en deux groupes : Groupe 1 comportant 55 sujets âgées de 65 ans et plus, et Groupe 2 comportant 55 sujets jeunes âgés entre 18 et 64 ans. Les données cliniques et polygraphiques ont été recueillies.

Résultats : L'âge moyen des sujets âgés était de 71 ± 4,6 ans, tandis que celui des sujets jeunes était de 50 ± 11 ans. La prédominance du sexe féminin était dans les deux groupes, avec moins de tabagisme chez les personnes âgées et l'absence de consommation d'alcool. L'activité physique était faible dans les deux groupes, mais les jeunes patients étaient plus actifs (p=0,05). L'obésité familiale était plus fréquente chez les jeunes patients. Les comorbidités étaient plus présentes chez les sujets âgés, principalement la dyslipidémie (AUC=0,66 ; p=0,003 ; IC [0,56-0,76]) suivie par l'hypertension artérielle (AUC=0,65 ; p=0,005 ; IC [0,55-0,75]) et le diabète (AUC=0,62 ; p=0,021 ; IC [0,52-0,73]). Il n'y avait pas de différence significative entre les deux groupes pour la plupart des symptômes, à l'exception de la nycturie qui était principalement observée chez les patients plus âgés (p=0,017). L'AUC était élevée pour le score NoSAS, ce qui indique une valeur discriminante élevée (0,6 ; IC [0,51-0,70]). Mais d'autres outils de dépistage tels que les échelles STOP-BANG, Pichot et Epworth n'ont pas montré de supériorité dans les deux groupes avec un intervalle de confiance respectivement de [0,42-0,64], [0,39-0,61] et [0,36-0,58].

Le traitement du SAHOS ne diffère pas entre les 2 groupes (p>0,05). Des règles hygiéno-diététiques ont été prescrites à tous les patients. Une ventilation en pression positive a été prescrite dans plus d'un tiers des cas dans les 2 groupes, et une orthèse d'avancée mandibulaire (OAM) chez un jeune patient.

Conclusion : Notre étude met en évidence la forte prévalence des comorbidités cardiovasculaires et métaboliques chez les patients âgés suivis pour un SAHOS, en plus de la performance des scores de dépistage chez la population âgée essentiellement le NoSAS ce qui justifie l'importance d'un dépistage précoce et plus ciblé chez les sujets âgés pour une meilleure prise en charge.

Mots-clés : Syndrome d'apnées obstructives du sommeil, Sujet âgé, Polysomnographie, Pronostic

Correspondance
Emna Ben Jemia
Service de pneumologie, Hôpital Charles Nicolle, Tunisie. Faculté de médecine de Tunis, Université Tunis El Manar
Email: dremna.benjemia@gmail.com

LA TUNISIE MEDICALE-2026; Vol 104 (03): 439-443 DOI: 10.62438/tunismed.v104i03.5632

This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0) which permits non-commercial use production, reproduction and distribution of the work without further permission, provided the original author and source are credited.

Introduction

Obstructive sleep apnea (OSA) is a prevalent sleep-related breathing disorder characterized by recurrent episodes of complete or partial obstruction of the upper airway during sleep. This obstruction leads to significant disruptions in breathing, which can result in reduced oxygen saturation levels and fragmented sleep patterns. The condition is associated with various symptoms, including loud snoring, excessive daytime sleepiness, and cognitive impairments.

OSA in the elderly presents specific diagnostic challenges due to its increased prevalence as it was highlighted in a systematic review by Chamara V. Senaratna et al. that for an apnea hypopnea index (AHI) ≥5 events/h, the prevalence of OSA increased with increasing age and, in some elderly groups, was up to 90% in men and 78% in women (1). This sleep disorder among elderly people also presents challenges due the frequency of atypical symptoms and associated co-morbidities. Despite its serious consequences, OSA appears to be under-diagnosed and under-treated in geriatric practice (2). This can be attributed to a lack of awareness among healthcare professionals, patients and their families. Complications associated with OSA are mainly cardiovascular and neuropsychological, which underlines the importance of better recognition and appropriate treatment in this vulnerable population. We aimed to identify clinical and polygraphy features of OSA in elderly subjects by comparing them with those of younger subjects. Different scoring tools were used in order to screen this sleep disorder among the which STOP-BANG score with its sensitivity that often exceeds 80% in diverse populations making it important when a quick assessment is required (3) and the No SAS score with its simplicity making it advantageous in areas where traditional screening methods may be lacking (4).

Methods

A retrospective and comparative study was conducted over a period of 1 year and 3 months (1st January 2023 - 1st April 2024) including 110 patients with OSA in the Pneumology Department of Charles Nicolle Hospital in Tunis. All patients had an OSA confirmed by ventilatory polygraphy realized through admitting patients for one night at the hospital where they wear a small portable device that records various parameters during sleep including 2 belts (one around the chest and the other worn around the abdomen to measure thoracic and abdominal movements), a nasal cannula to capture airflow, an oximeter to measure blood oxygen levels and a sensor used to record snoring and other breathing sounds.

The collected data is analyzed to determine the apnea-hypopnea index (AHI), the apnea index (AI) and hypopnea index (HI) which are the number of apneas and hypopneas experienced per hour of sleep as well the oxygen desaturation index (ODI) which categorizes the severity of sleep apnea.

The diagnosis and the severity of the disease were based on the AASM criteria (5). Patients with central apnea syndrome and/or other non-respiratory sleep disorders (narcolepsy, hypersomnia) were not included. Several scores were used, STOPBANG and NoSAS score to assess the risk of obstructive sleep apnea based on specific clinical parameters, Epworth scale to assess an individual's level of daytime sleepiness and Pichot fatigue scale to evaluate the level of fatigue experienced by individuals. Sociodemographic, clinical and polygraphy results were collected. We divided patients into two groups according to age. Group 1: comprising 55 patients aged 65 and over and Group 2: comprising 55 patients aged between 18 and 64. We carried out a comparative analytical study between the 2 groups. A variable was significant if it has a p-value <0.05.

Results

One hundred-ten patients with a confirmed OSA were included in the study. The average age of the patients was 61± 11 years, with an average age of 71 ± 4.6 years for the group 1 compared to 50 ± 11 years for the group 2. Females were predominant in both groups, with less tobacco use among the younger subjects and similar alcohol consumption across both groups. Although physical activity is low in both groups, younger patients were more active (p=0.05). Family history of obesity was more prevalent among the younger patients (p=0.03). In contrast, older patients exhibited a higher number of comorbidities. Specifically, high blood pressure (p=0.0001), atrial fibrillation (p=0.05), diabetes (p=0.007), and dyslipidemia (p=0.001) characterizing the clinical presentation of the older subjects.

Regarding the risk of OSA in elderly population, the AUC was high for high blood pressure, diabetes and dyslipidemia indicating a high discriminant value. This prediction was slightly greater for dyslipidemia (0.66; p=0.003; CI [0.56-0.76]) followed by high blood pressure (0.65; p=0.005; CI [0.55-0.75]) and diabetes (0.62; p=0.021; CI [0.52-0.73]).

Demographic data and patient history are summarized in Table 1.

The nocturnal symptoms of OSA primarily included nocturnal snoring and nocturia. There was no significant difference between the two groups regarding nocturnal snoring whereas nycturia was mainly observed among older patients(p=0.017). Parasomnias, such as sleep paralysis, restless legs syndrome, nightmares, and somnambulism were present in both groups without notable differences. These symptoms adversely impacted the quality of life for the patients' partners, resulting in younger patients more frequently sleeping separately (p=0.02). The impact of OSA was primarily assessed using the Epworth Sleepiness Scale and the Pichot Fatigue Score. Daytime sleepiness was found to be high in both groups (p=0.7), with one-third of the patients scoring above 10 on the Epworth scale. Similarly, daytime fatigue, as measured by the Pichot score, was reported by 25% of the patients. The STOP-BANG screening score was similar

in both groups. However, the NoSAS score was higher in group 1 (p=0.007).

Table 1. Demographic data and patient history in group 1 and group 2

		Group 1	Group 2	p-value
Gender (%)	Male	20	10.9	0.1
	Female	80	89.1	
Tabacco smoking (%)	27.3		21.8	0.5
Alcohol consumption (%)	3.6		5.5	0.6
Physical exercises (%)	3		13	**0.05**
Family obesity (%)	38.2		58.2	**0.03**
High blood pressure (%)	89.1		58.2	**0.001**
Myocardial infarction (%)	3.6		9.1	0.2
Atrial fibrillation (%)	20		7.3	**0.05**
Heart failure (%)	3.6		7.3	0.4
Cerebrovascular accidents (%)	3.6		3.6	0.1
Diabetes (%)	67.3		41.8	**0.007**
Dyslipidemia (%)	72.7		40	**0.001**
Glaucoma (%)	7.3		1.8	0.3
Asthma (%)	20		10.9	0.1
Insomnia (%)	65.5		47.3	0.08

Nocturnal and diurnal symptoms are illustrated in table 2. The ROC curve analysis (Figure 1) showed that the area under curve (AUC) was high for the NoSAS score indicating a high discriminant value (0.6; CI [0.51-0.70]). Other screening tools: STOP-BANG, Pichot and Epworth scales showed no superiority among both groups with a confidence interval respectively [0.42-0.64], [0.39-0.61] and [0.36-0.58].

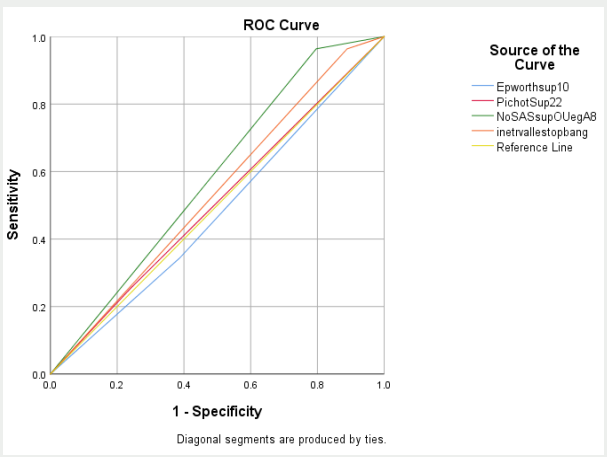


Figure 1. ROC curve of OSA screening tools according to age

The physical examination consisted of anthropometric measurements and an ENT examination. Abdominal obesity did not differ between the 2 groups, nor did the ENT examination. The most frequent ENT abnormality was narrow oropharynx. Whereas, patients in G2 showed larger neck circumference (39 cm ± 4.3). Patients in G1 had mainly a BMI of 30kg/ m2 and above vs a BMI of 40 Kg/m2 and above in G2 with no significant difference (p=0.5).

Table 2. Functional complaints and screening scores in both groups

		Group 1	Group 2	p-value
Snoring (%)		82.5	78	0.1
Excessive daytime sleepiness (%)		72.7	58.2	0.1
Nocturia (%)		83.6	63.6	0.017
restless legs (%)		34.5	30.9	0.6
sleep paralysis (%)		21.8	18.2	0.6
Nightmares (%)		32.7	32.7	1
Somnambulism (%)		12.7	14.5	0.7
Separate bedroom (%)		16.4	34.5	0.02
Morning headache	(%)	72.7	80	0.3
Epworth scale >10	(%)	34.5	38.2	0.7
Pichot score > 22	(%)	25	28.9	0.6
NoSAS score > 8 (%)		96.4	79.6	0.007
STOP-BANG score (%)	<3	3.6	10.9	
	>=3	96.4	89.1	0.1

Table 3. Physical examination findings

		Group 1	Group 2	p-value
Waist circumference (cm)		128± 12.25	131 ± 9.5	0.3
Neck circumference (cm)		35.4± 4.9	39 ± 4.3	0.06
Body Mass Index (Kg/m²)	18-25	1.8%	0%	
	25-30	10.9%	0%	
	>=30	58.2%	18.2%	0.5
	>=40	29.1%	81.8%	
	Narrow orophaynx	5.5%	12.7%	0.1
ENT abnormality	Tonsil hypertrophy	5.5%	5.5%	1
	Deviated nasal septum	2%	0%	0.3
	Macroglossia	1.8%	1.8%	1

Ventilatory polygraph recordings were of satisfactory quality in all patients. We classified the severity of the OSA according to the Apnoea Hypopnea Index (AHI). There was no significant difference between the two groups, with equal distribution according to AHI severity grade: mild OSA (36.4% vs.36.4%), moderate (29.1% vs. 16.4%) and severe (34.5% vs.47.3%) (p>0.05). SAOHS was desaturating with a mean desaturation index at 26.2 ± 19 in Group 1 vs 26.77 ± 20,4 in Group 2 (p=0.3). Positional OSA was more frequent in younger patients, with no significant difference.

In the same way, OSA treatment OSA didn't differ between groups. Hygienic dietary rules were prescribed for all patients. Positive pressure ventilation was prescribed in more than a third of cases and a mandibular advancement orthosis was prescribed in one young patient.

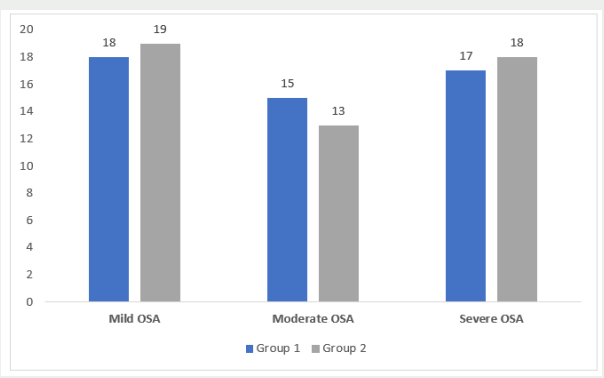


Figure 2. OSA severity according to age

Discusssion

Obstructive sleep apnoea (OSA) is a condition characterized by episodes of partial or total obstruction of the sleep characterized by episodes of partial or total obstruction of the upper airways, leading to a disturbance in ventilation during sleep. This syndrome is recognized as a public health problem due to its increasing prevalence and serious health consequences (2). The diagnosis of OSA is based primarily on nocturnal ventilatory polygraphy, which measures the Apnoea/ Hypopnoea Index (AHI). A score greater than or equal to 5 per hour is considered indicative of the disease (6). Its prevalence is estimated at 4% in men and 2% in women between the ages of 30 and 60 years (7). Epidemiological studies have reported a high prevalence of OSA as high as 60% in individuals over 65 years of age (8,9) and is more common in males (5). On the other hand, recent studies have observed a greater prevalence of OSA in elderly females, which may be attributed to hormonal changes following menopause (10). Tobacco is known to have an inflammatory effect on the upper airways, which reduces muscle tone in respiratory tissues. This reduction is believed to exacerbate obstructive sleep apnea (OSA) and increase the frequency and severity of apneic episodes (11). Wetter and al. (12) found that 25% of individuals with severe OSA were regular smokers. Additionally, other studies have indicated that approximately 30-40% of people with OSA consume alcohol regularly in the evening. This consumption can worsen OSA symptoms, as alcohol also decreases airway muscle tone, heightening the risk of upper airway collapse and leading to a greater frequency of apneas(10,13). In several studies, authors have shown the predominance of cardiovascular co-morbidities in elderly subjects, as is the case in our population. During OSA, intermittent hypoxia activates the sympathetic nervous system and alters endothelial function, both of which are responsible for cardiovascular complications (14,15). In addition, the combination of metabolic co-morbidities increases the frequency of occurrence of OSA by 4 to 5 times, whatever the age group, since these conditions modify respiratory dynamics, increase fat mass around the airways, promote inflammation and disrupt the mechanisms regulating breathing during sleep (16,17). In addition to these cardiovascular and metabolic pathologies, in a meta-analysis, 50% of asthma patients had a OSA (18). Hence the importance of screening for SAOHS in all asthma patients, especially those with poor asthma control or severe asthma.

Nocturnal symptoms did not differ between the two groups, except for their impact on couple relationships, which was more significantly affected in younger individuals (often leading to separate sleeping arrangements). Studies indicate that untreated obstructive sleep apnea can severely impair patients' quality of life. Associated symptoms, such as apnea, snoring, and fatigue, can disrupt the sleep of partners, resulting in increased tension within the relationship. Partners of patients with OSA frequently report decreased marital satisfaction and heightened conflict. Sharing a bed becomes problematic when one partner suffers from sleep disturbances, often leading to nighttime separations to avoid disruptions (5). Moreover, OSA can have psychological effects on both partners. The stress and anxiety associated with managing a chronic condition can exacerbate tensions in the relationship. Patients may experience reduced self-esteem due to their symptoms, affecting intimacy and their ability to form emotional connections. Additionally, partners may feel helpless in witnessing their loved one's suffering, which can lead to frustration. Although OSA is common in the elderly, daytime sleepiness may be less pronounced in this population. This could be due to adaptation mechanisms or increased tolerance to sleep disturbances. Older people may also have different sleep patterns that influence their perception of daytime sleepiness (8). Elderly patients had higher OSA screening scores, this finding was concomitant with a study done to compare the performance between the STOP BANG questionnaire and the Epworth score, they concluded that the STOP BANG questionnaire was more efficient and effective as a screening tool for elderly subjects as well as for all age groups (9).

The accumulation of fat around the neck and pharynx in obese patients contributes to the obstruction of the upper airways during sleep. This issue is exacerbated by aging, which can lead to decreased muscle tone and impaired lung function. In a cohort of 6167 participants, the neck circumference to height ratio was a good screening tool for different age groups (19)which was concordant with our findings. In our study, the analysis of the polygraphy recording and the severity of OSA did not differ according to age, as was the case in a Turkish study (20). The absence of significant difference in AHI with aging may be due to the study population characteristics including healthier elderly individuals who do not exhibit typical age-related increases in AHI , the study done by Seifen et al. (21) showed that OSA severity may increase with age due to the increasing accumulation of comorbidities in males .The small sample size may also explain the absence of a significant difference in AHI with aging as it may limit the ability to detect changes which could result in suggesting no significant difference when one actually exists.

However, Durán et al. found a correlation between AHI and age with an odds ratio of 2.2 for each increase of 10 years (22). Our study showed that there were no significant differences in treatment approaches between the two groups. Most patients had received standard

dietary advice, and continuous positive airway pressure (CPAP) was prescribed in a similar manner in both cohorts. This is in line with current recommendations, which advocate CPAP as the first-line treatment for severe OSA, regardless of age.

It so seems important to manage OSA as a chronic disorder that requires a long-term care involving multiple disciplines (pulmonologists, cardiologists, psychiatrists, nutritionists…). Including questions about this sleep disorder in routine health evaluations may be of use for a more efficient screening among elderly patients who tend to underreport most of their symptoms so an oriented history and physical examination with recourse to scores especially the NoSAS seems of a great importance.

It is essential as well to encourage patient participation in treatment decisions for a better adherence to therapy.

This study has limitations such as, aforementioned, the small size of sample which means having a larger margin of error, making it difficult to come to precise conclusions, the absence of a full polysomnography evaluation (Electroencephalography that records electrical activity in the brain, monitoring eye movement…) and the biases such as the recall and selection biases that should be taken into consideration as we relied on pre-existed records lacking few information.

Conclusion

Our study highlights the high prevalence of cardiovascular and metabolic co-morbidities in elderly patients being monitored for OSAHS, in addition to the performance of screening scores in the elderly population especially the NoSAS which justifies the importance of a more targeted early detection in this age group for better management.

References

1. Senaratna CV, Perret JL, Lodge CJ, Lowe AJ, Campbell BE, Matheson MC, et al. Prevalence of obstructive sleep apnea in the general population: A systematic review. Sleep Med Rev. 2017 Aug 1;34:70–81.
2. Ketata W, Feki W, Yangui I, Msaad S, Ayoub A. [Obstructive sleep apnea syndrome in the elderly]. Rev Pneumol Clin. 2014 Aug;70(4):223–32.
3. Chung F, Abdullah HR, Liao P. STOP-Bang Questionnaire: A Practical Approach to Screen for Obstructive Sleep Apnea. Chest. 2016 Mar;149(3):631–8.
4. Marti-Soler H, Hirotsu C, Marques-Vidal P, Vollenweider P, Waeber G, Preisig M, et al. The NoSAS score for screening of sleep-disordered breathing: a derivation and validation study. Lancet Respir Med. 2016 Sep 1;4(9):742–8.
5. Young T, Peppard PE, Gottlieb DJ. Epidemiology of Obstructive Sleep Apnea. Am J Respir Crit Care Med. 2002 May;165(9):1217–39.
6. Kapur VK, Auckley DH, Chowdhuri S, Kuhlmann DC, Mehra R, Ramar K, et al. Clinical Practice Guideline for Diagnostic Testing for Adult Obstructive Sleep Apnea: An American Academy of Sleep Medicine Clinical Practice Guideline. J Clin Sleep Med JCSM Off Publ Am Acad Sleep Med. 2017 Mar 15;13(3):479–504.
7. The Occurrence of Sleep-Disordered Breathing among Middle-Aged Adults | New England Journal of Medicine [Internet]. [cited 2025 Feb 16]. Available from: https://www.nejm.org/doi/full/10.1056/NEJM199304293281704
8. Current challenges in the diagnosis and treatment of obstructive sleep apnea syndrome in the elderly [Internet]. [cited 2025 Feb 16]. Available from: https://www.mp.pl/paim/issue/article/15283
9. Godoy PH, Nucera APC dos S, Colcher A de P, de-Andrade JE, Alves D da SB. Screening for obstructive sleep apnea in elderly: performance of the Berlin and STOP-Bang questionnaires and the Epworth Sleepiness Scale using polysomnography as gold standard. Sleep Sci. 2022;15(Spec 1):203–8.
10. Yang S, Guo X, Liu W, Li Y, Liu Y. Alcohol as an independent risk factor for obstructive sleep apnea. Ir J Med Sci. 2022 Jun;191(3):1325–30.
11. Ioannidou D, Kalamaras G, Kotoulas SC, Pataka A. Smoking and Obstructive Sleep Apnea: Is There An Association between These Cardiometabolic Risk Factors?—Gender Analysis. Medicina (Mex). 2021 Oct 20;57(11):1137.
12. Wetter DW, Young TB, Bidwell TR, Badr MS, Palta M. Smoking as a Risk Factor for Sleep-Disordered Breathing. Arch Intern Med. 1994 Oct 10;154(19):2219–24.
13. Peppard PE, Austin D, Brown RL. Association of alcohol consumption and sleep disordered breathing in men and women. J Clin Sleep Med JCSM Off Publ Am Acad Sleep Med. 2007 Apr 15;3(3):265–70.
14. Dong JY, Zhang YH, Qin LQ. Obstructive sleep apnea and cardiovascular risk: Meta-analysis of prospective cohort studies. Atherosclerosis. 2013 Aug 1;229(2):489–95.
15. Schulz R, Grebe M, Eisele HJ, Mayer K, Weissmann N, Seeger W. [Obstructive sleep apnea-related cardiovascular disease]. Med Klin Munich Ger 1983. 2006 Apr 15;101(4):321–7.
16. Lam JCM, Lam B, Lam CL, Fong D, Wang JKL, Tse HF, et al. Obstructive sleep apnea and the metabolic syndrome in community-based Chinese adults in Hong Kong. Respir Med. 2006 Jun;100(6):980–7.
17. Kumari S, Chaudhary SC, Sawlani KK, Gupta KK, Usman K, Reddy HD, et al. Obstructive Sleep Apnea in Metabolic Syndrome. Ann Afr Med. 2024 Oct 1;23(4):710–6.
18. Kong DL, Qin Z, Shen H, Jin HY, Wang W, Wang ZF. Association of Obstructive Sleep Apnea with Asthma: A Meta-Analysis. Sci Rep. 2017 Jun 22;7(1):4088.
19. Peng M, Chen R, Cheng J, Li J, Liu W, Hong C. Application value of the NoSAS score for screening sleep-disordered breathing. J Thorac Dis. 2018 Aug;10(8):4774–81.
20. Yalim SD. OBSTRUCTIVE SLEEP APNEA IN ELDERLY. Turk J Geriatr. 2022 Dec 31;4.
21. Seifen C, Pordzik J, Bahr K, Große-Brüggemann L, Ludwig K, Hackenberg B, et al. Accumulating Comorbidities May Promote Increasing Severity of Obstructive Sleep Apnea with Aging in Males but Not in Females. J Pers Med. 2022 Dec 29;13(1):79.
22. Durán J, Esnaola S, Rubio R, Iztueta A. Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 yr. Am J Respir Crit Care Med. 2001 Mar;163(3 Pt 1):685–9.