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Understanding the Connection Between Obstructive Sleep Apnea (OSA) and Rapid Eye Movement Sleep

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Abstract:

Background: Obstructive Sleep Apnea (OSA) is characterized by the presence of airflow interruptions in the airways during sleep. The relationship between OSA and Metabolic Syndrome (MS) is close and bidirectional, with a higher prevalence of SM observed in patients with OSA. Objective: This study was interesting to analysis the correlation between obstructive sleep apnea (OSA) and rapid eye movement sleep. Patients and methods: We conducted a cross-sectional study of 110 patients to determine the extent of the relationship between obstructive sleep apnea (OSA) and rapid eye movement sleep, as most of the ages were between 30 - 50 years, which were collected from different hospitals in Iraq for the period from March 2, 2022, to August 28, 2023. This study identified data and parameters for sleep disturbance scores and apnea time scores and their impact on quality of life in the long term. Results: The results of polysomnographic parameters in the patient group found TST (min) was 374.5 ± 66.8, MAI (MA/h) was 24.7 ± 8.5, NREM 1 (min) was 123.41 ± 49.62, NREM 2 (min) was 182.58 ± 54.83, TST. (min) was 365.2 ± 56.8, MAI (MA/h) was 10.3 ± 4.6, NREM 1 (min) was 57.92 ± 27.35, NREM 2 (min) was 208.75 ± 41.75. According to the results of the Trial Making Test (TMT) in the patient group, TMT – A for males was 50.25 ± 12.46 and 57.41 ± 19.20 for females, while TMT – B was 105.37 ± 49.18 for males and 134.58 ± 50.40 for females. According to the results of the Trial Making Test (TMT) in the control group, TMT – A for males was 23.17 ± 6.44 and 25.41 ± 3.35 for females,

while TMT – B was 27.51 ± 4.33 for males and 29.28 ± 5.52 for females. Conclusion: Improving knowledge of the relationship between sleep apnea is basic and important to enhance the quality of life of patients who suffer from it. Besides TMT performance, our results found that men had slightly better performance compared with women on TMT-B for both groups.

Keywords: Obstructive sleep apnea (OSA); Rapid eye movement sleep; TMT; and Quality of life.

Introduction

Excessive alcohol consumption and smoking exacerbate the symptoms of obstructive sleep apnea (OSA), which is manifested by an increased frequency of apnea and hypopnea. Sleep problems begin in childhood or adolescence [1 – 3]. The term "obstructive sleep apnea" (OSA) refers to the temporary cessation or cessation of breathing resulting from the obstruction of the upper airways due to an anatomical functional change. Causing reduced or stopped airflow to the lungs, resulting in decreased oxygen (hypoxia) and increased carbon dioxide in the blood (hypercapnia) [4 – 6]. This happens frequently during sleep, up to 30 times (or more) per hour. The frequency of these obstructions, i.e., the number of apnea-hypopnea episodes per hour of sleep or the apnea-hypopnea index (AHI), is the most widely used classification criterion for the severity of OSA. [7 – 9]

Thus, an AHI of less than five apneas per hour is considered normal, and between 5 and 15 apneas per hour defines mild OSA: Between 15-30 moderate apneas/hour, and finally more than 30 severe apneas/hour [10 – 13]. OSA is a syndrome characterized by recurrent episodes of complete or partial obstruction of the upper airways, which presents with recurrent pharyngeal collapse during sleep and leads to nocturnal apnea (nocturnal hypoxia), sleep fragmentation, and sympathetic arousal [14,15]. The duration of each obstructive apnea episode is variable and can be up to 30-40 seconds. If the airway obstruction is incomplete, it is called sleep apnea, and episodes of apnea and hypopnea may coexist throughout the night. Hypopnea refers to shallow breathing lasting ≥10 seconds associated with hypoxemia and/or agitation. [16]

The pathophysiological and metabolic changes and the steric load they can cause translate into changes in the pulsations of specific regulatory pathways, including appetite, satiety, and anxiety [17]. The prevalence of sleep apnea in the United States is estimated to be 15% in men and 5% in women for people aged 30 to 70 years. Sleep apnea occurs in 41% of patients with a BMI greater than 28. It is also common in older adults, smokers, coronary artery disease, stroke, high blood pressure, and diabetes. Sleep apnea is a common disease in alcoholics because it increases the collapse of the upper respiratory tract and contributes to a high body mass index. [18,19]

In the last two decades, the prevalence of the disease has increased to 10% among men aged 30 to 49 years, 17% among men aged 50 to 70 years, 3% among women aged 30 to 49 years, and 9% Among women in this age group, 9%. From 30 to 49 years. Among women aged 50 to 70 years. Moderate and severe sleep apnea are underdiagnosed. In the United States, studies indicate that this syndrome affects 4% to 24% of men and 2% to 9% of women, so much so that it is estimated that 20% of middle-aged adults have mild OSA, and 80%. of cases remain undiagnosed. [20 - 23]

Patients and methods

A cross-sectional study was conducted for 110 patients to determine the extent of the relationship between obstructive sleep apnea (OSA) and rapid eye movement sleep, as most of the ages ranged between 30 - 50 years and were collected from different hospitals in Iraq for the period from March 2, 2022, to August 28, 2023. This study collected clinical and demographic data on the characteristics of patients, which included age, gender, body mass index, comorbidities, smoking factor, and education level.

This study showed a comparison of 110 patients between the patient group, which included 70 people, and the control group, which included 40 people. Moreover, this study demonstrated the clinical results of the determinants and basic measures for diagnosing sleep disorders, which included the TST SpO2 < 90% (min), vascular burden index, Epworth sleepiness scale, Beck Depression Inventory-II, and Beck Anxiety Inventory.

This study identified polysomnographic outcomes and parameters whose clinical data included TST (min), MAI (MA/h), NREM 1 (min), NREM 2 (min), NREM 3 (min), NREM (%), and REM. (min), REM duration < 30. In addition. Our study recorded the rate of apnea indices (AHI), which were classified as mild, where the AHI rate was less than 15; moderate, with an AHI rate between 15-30; and severe, where the AHI rate was higher than 30. Also, the results of the trial-making test (TMT) were determined and distributed to both men and women for both groups. To further examine the findings, this study determined the association results between AHI and TMT.

This study evaluated the results of the quality of life of the people participating in the study to compare between the patient group and the control group, which included standards measuring physical function, psychological function, social function, and daily activities. The Clinical Patient Outcomes Methodology was designed and implemented by SBS, version 22.0.

Results

Table 1: Clinical demographic characteristics outcomes of patients observed in this study.

Characteristics	Number of patients [n=110]	Percentage [%]
Age, years		
30 – 34.5	20	18.18%
35 – 39.5	24	21.82%
40 – 45.5	30	27.27%
46 – 50	36	32.73%
Sex		
Male	70	63.64%
Female	40	36.36%
BMI, $[kg/m^2]$		
28.5 – 30	24	21.82%
30.5 – 32	30	27.27%
> 32.0	56	50.91%
Smoking status		
Smokers	44	40.0%
Non-smokers	66	60.0%

Comorbidities		
Hypertension		
Yes	77	70.0%
No	33	30.0%
Diabetes		
Yes	44	40.0%
No	66	60.0%
Stroke		
Yes	23	20.91%
No	87	79.09%
Coronary heart disease		
Yes	17	15.45%
No	93	84.55%
Obesity		
Yes	75	68.18%
No	35	31.82%
Education status		
Elementary	11	10.00%
Secondary	33	30.00%
College/University	66	60.00%

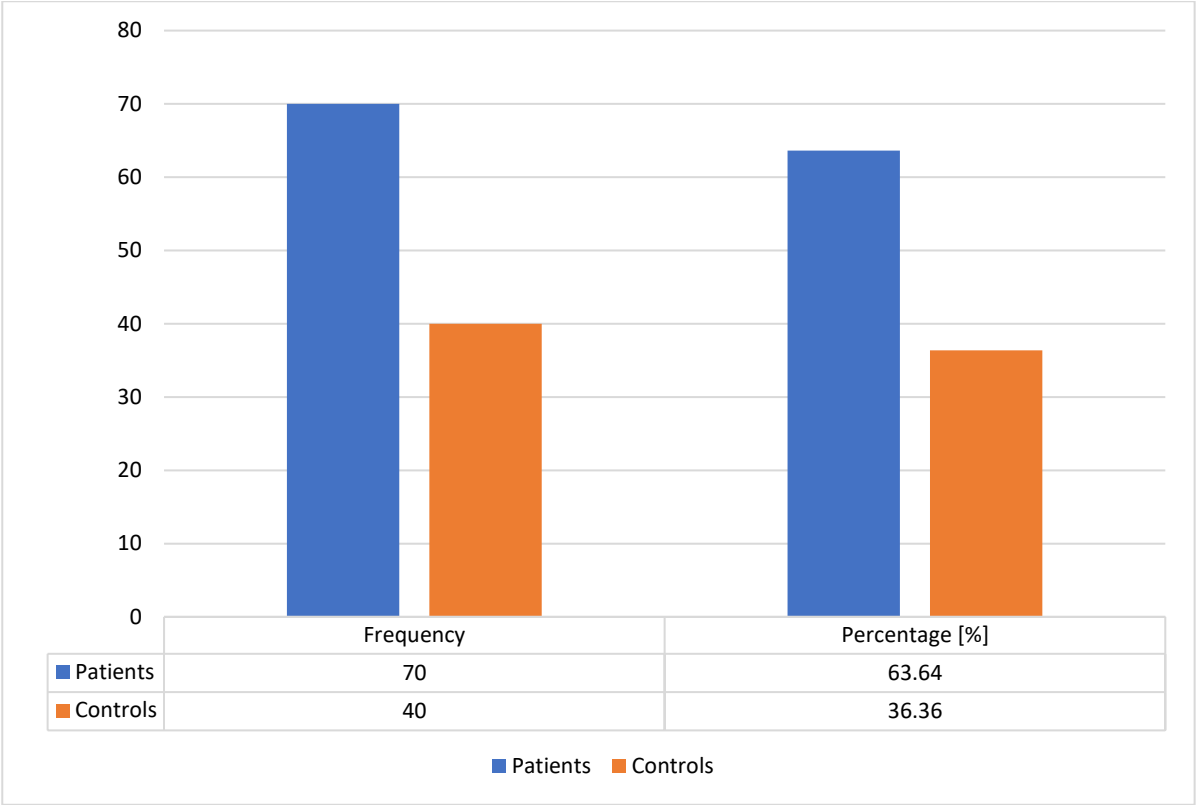

Figure 1: Distribution of clinical data in terms of patients and controls.

Table 2: Determine basic scales of diagnosing sleep disorders.			
Variables	Patients [70]	Controls [40]	P - value
TST SpO2 < 90% (min)	33 [30%]	4 [3.64%]	< 0.0001
Vascular burden index	1.6 ± 1.1	1.1 ± 0.87	0.013
Epworth sleepiness scale	8.61 ± 4.58	7.92 ± 4.83	0.0446
Beck depression inventory II	7.4 ± 5.3	5.5 ± 5.4	0.0323
Beck anxiety inventory	4.7 ± 4.1	4.8 ± 4.7	0.0369

Table 3: Determine polysomnographic parameters.			
Variables	Patients [70]	Controls [40]	P - value
TST (min)	374.5 ± 66.8	365.2 ± 56.8	0.0027
MAI (MA/h)	24.7 ± 8.5	10.3 ± 4.6	0.0025
NREM 1 (min)	123.41 ± 49.62	57.92 ± 27.35	0.0023
NREM 2 (min)	182.58 ± 54.83	208.75 ± 41.75	< 0.001
NREM 3 (min)	60.56 ± 13.54	12.45 ± 4.67	0.046
NREM (%)	87.38 ± 4.62	80.78 ± 5.68	0.0438
REM (min)	54.25 ± 23.67	59.60 ± 14.62	0.0425
REM duration < 30	22 [20%]	0 [0%]	< 0.001

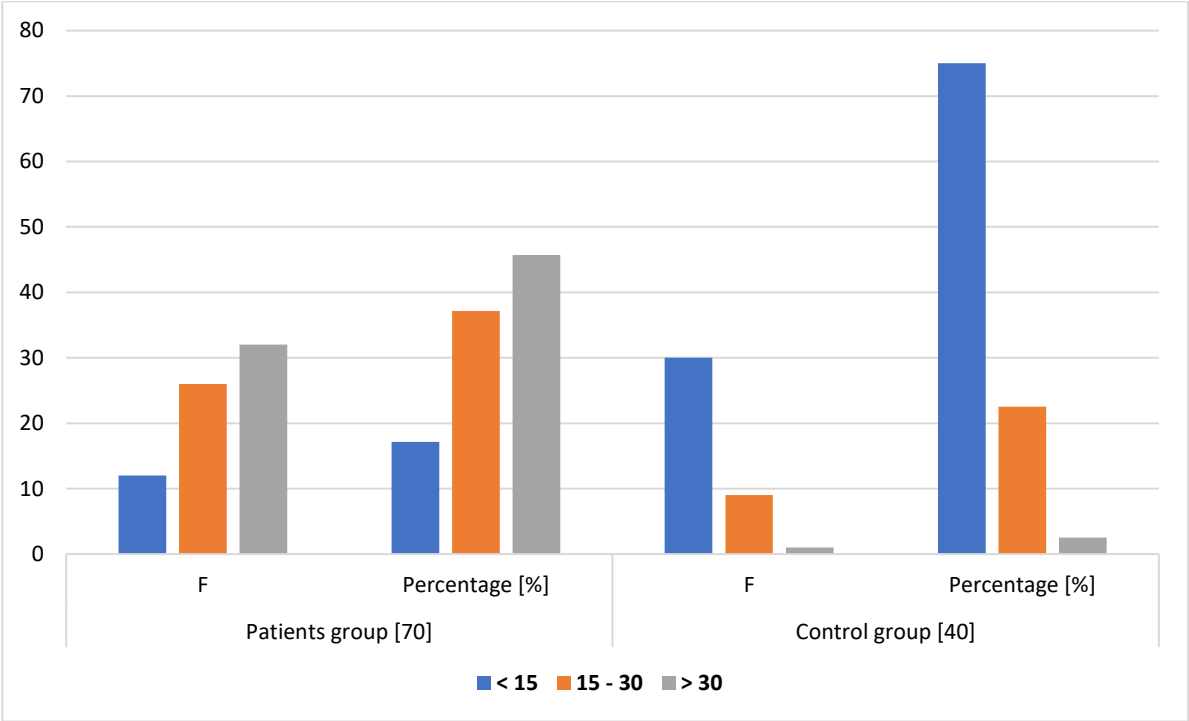

Figure 2: Classification of AHI in terms of mild, moderate, and severe.

Table 4: Determine the effect of sex on the Trial Making Test (TMT) dynamic in both groups.

Variables	**Sex**		
Patients group	Males	Females	P – value
TMT – A (mean ± SD)	50.25 ± 12.46	57.41 ± 19.20	< 0.001
TMT – B (mean ± SD)	105.37 ± 49.18	134.58 ± 50.40	< 0.001
Control group			
TMT – A (mean ± SD)	23.17 ± 6.44	25.41 ± 3.35	0.0428
TMT – B (mean ± SD)	27.51 ± 4.33	29.28 ± 5.52	0.0477

Table 5: Assessment of general health of quality–life associated with patients

Domains	Patients group	Controls Group	P – value
Physical function	67.35 ± 7.64	87.64 ± 6.24	< 0.001

Psychological function	62.14 ± 8.53	85.54 ± 5.67	< 0.001
Social function	72.38 ± 9.57	88.68 ± 7.88	< 0.001
Daily activities	77.69 ± 5.34	89.52 ± 4.81	> 0.001

Table 6: Correlation findings between AHI and TMT.

AHI	TMT < 30	TMT > 30
0 – 5	+ 0.2	- 0.08
6 – 14	+ 0.53	- 0.97
15 – 30	- 0.91	+ 0.88

Discussion

Our clinical results showed that patients in the age group (46 - 50) years had the highest infection category with a rate of 36 cases, followed by patients in the age group (40 - 45.5) years with 30 cases, (35 - 39.5) years with 24 cases, and patients in the category (30). - 34.5 years included 20 cases, male patients included 70 patients, and females included 40 patients. Body mass indexes showed a BMI between (28.5 in 30) included 24 patients, a BMI between (30.5 - 32) included 30 patients, and a BMI > 32.0 included 56 Patients; the percentage of patients who were smokers was 40% and non-smokers were 60%. The most prominent comorbidities, which included high blood pressure, were 70%, diabetes was 40%, and obesity were 68.18%. The sample data divided the patients into two groups, where the patient group was 70 cases, and the control group was 40 cases. Furthermore, the study results determined that the polysomnographic parameters in the patient group were TST (min) was 374.5 ± 66.8, MAI (MA/h) was 24.7 ± 8.5, NREM 1 (min) was 123.41 ± 49.62, NREM 2 (min) was 182.58 ± 54.83, NREM 3 (min) was 60.56 ± 13.54, NREM (%) was 87.38 ± 4.62, REM (min) was 54.25 ± 23.67, REM duration < 30 was 20%. For the control group, TST (min) was 365.2 ± 56.8, MAI (MA/h) was 10.3 ± 4.6, NREM 1 (min) was 57.92 ± 27.35, NREM 2 (min) was 208.75 ± 41.75, NREM 3 (min) was 12.45 ± 4.67, NREM (%) was 80.78 ± 5.68, REM (min) was 59.60 ± 14.62, REM duration < 30 was 0%. The results of AHI were recorded as mild (< 15) were 12 cases, moderate (15 - 30) were 26 cases, severe (> 30) were 32 cases in the patient group while mild (< 15) were 30 cases, and moderate (15 - 30)) were 9 cases, severe (>30) was 1 case.

According to the results of the Trial Making Test (TMT) in the patient group, TMT – A for males was 50.25 ± 12.46 and 57.41 ± 19.20 for females, while TMT – B was 105.37 ± 49.18 for males and 134.58 ± 50.40 for females. According to the results of the Trial Making Test (TMT) in the control group, TMT – A for males was 23.17 ± 6.44 and 25.41 ± 3.35 for females, while TMT – B was 27.51 ± 4.33 for males and 29.28 ± 5.52 for females. As for the clinical quality of life results, we found that both the physical aspect was 67.35 ± 7.64 in the patient group and 87.64 ± 6.24 were in the control group, and the psychological aspect was 62.14 ± 8.53 in the patient group and 85.54 ± 5.67 were in the control group.

The last studies agreed almost the first evidence of a correlation between AHI (Apnea-Hypopnea Index) throughout REM sleep as well as cognitive performance in older individuals, specifically in activities linked to attention, where these data indicate that apnea occurring within REM sleep may influence cognitive performance [24]. This American study emphasized the need of taking into thought the sequence of apnea occurrences in sleep in which assessing its possible influence on cognitive health. Some studies showed that REM sleep can serve a broader spectrum of tasks where the symptoms of laryngopharyngeal reflux in individuals with OSA found a steady reduction as the length of REM sleep decreased. [25,26, 27, 28]

Conclusion

This study demonstrated that the development of the concept of the relationship between sleep apnea is an essential and influential factor in improving the quality of life of patients. Our results recorded a negative relationship between AHI during REM sleep with a decrease in the duration of REM sleep in all patients who have Obstructive sleep apnea (OSA), especially in older adults, which greatly affects cognitive function and general health. In addition, results were found that men perform slightly better compared to women on the TMT-B in both groups.

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