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Assessment of Cognitive Function in Geriatric Patients with Obstructive Sleep Apnea

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Abstract

Background: Obstructive sleep apnea is a growing public healthcare issue in the world that increases with age. It has significant impairments in cognitive function attributed to intermittent hypoxemia and sleep fragmentation. **Aim:** Assess the cognitive function in geriatric patients with Obstructive Sleep Apnea. **Method:** Descriptive research design was used. This study was conducted in the outpatient clinic of the Chest Medicine Department at Main Mansoura University Hospital. A purposive sample of 100 geriatric patients with obstructive sleep apnea was enrolled in the study. Data was collected using 3 tools; Geriatric Patient's Demographic characteristics and Clinical Data Sheet, Mini-Mental State Examination scale, and Epworth Sleepiness Scale. **Results:** The mean score of cognitive function was 22.30±3.79 with 51.0% of the studied elders had mild cognitive function impairment and 14% had severe cognitive function impairment. In addition, a strong negative correlation was found between obstructive sleep apnea severity and geriatric patient's cognitive function ($P<0.001$*). **Conclusion:** Cognitive function impairment was common among geriatric patients with obstructive sleep apnea.**Recommendation:** Designing an educational program for the obstructive sleep apnea geriatric patients about treatment adherence to improve cognitive function and prevent further deterioration.

Keywords: Cognitive function, Obstructive sleep apnea, Geriatric patients.

Introduction

Obstructive Sleep Apnea (OSA) is a respiratory sleep disorder defined by repetitive episodes of full or partial obstruction of the upper airway that occurs during sleep. The resulting obstructions restrict airflow and produced episodic oxygen desaturation, sleep fragmentation, and marked negative intrathoracic pressures[1]. It affects all age groups but increases in prevalence with age. This age related increase in prevalence may be attributable to lengthening of the soft palate, increased parapharyngeal fat deposition[2].

Worldwide, 100 million people have OSA and up to 90% remain undiagnosed and untreated[3]. The prevalence of sleep apnea in the elderly population is as high as 78%. The prevalence is approximately five-fold higher in the elderly population[4].

Obstructive sleep apnea has a negative impact on cognitive functioning. Among the cognitive domains that are simultaneously most affected are attention, memory, and executive functions[5]. Presence of cognitive function decline associated with untreated OSA has negatively impacts patients' quality of life since it interferes with daily activities and social relationships[6].

Obstructive sleep apnea is characterized by the occurrence of recurrent events of upper airway obstruction owing to sleep fragmentation and chronic intermittent hypoxia. Each sleep fragmentation and chronic intermittent hypoxia may influence brain structure and function. Each of the other can independently contribute to neuronal loss in the hippocampus and prefrontal cortex, regions closely related to cognitive dysfunction[7]. Hence, the cognitive function of the geriatric patients with obstructive sleep apnea should be assessed.

Aim of the study

This study aimed to assess the cognitive function in geriatric patients with obstructive sleep apnea.

The aim was achieved through the following steps:

1- Assess the cognitive function in geriatric patients with obstructive sleep apnea.
2- Assess the relationship between OSA severity and cognitive function in geriatric patients with obstructive sleep apnea.

Research questions:

Q1: What is the level of cognitive function in geriatric patients with obstructive sleep apnea?

Q2: What is a relationship between OSA severity and cognitive function in geriatric patients with obstructive sleep apnea?

Method

Research design:

The study followed a descriptive research design.

The study setting :

This study was carried out in the outpatient clinic of the Chest Medicine Department at Main Mansoura University Hospital.

Subjects of the study:

The study included a purposive sample of 100 elderly patients diagnosed OSA. Elderly patients were selected according to certain characteristics; aged 60 year and more, patient diagnosed with OSA, able to communicate, accept to participate in the study, and available at the selected setting during the period of data collection. Exclusion criteria included the patients suffering from; neurological disorders, respiratory

disorder other than OSA, with a history of traumatic brain injury, taking medication that may affect cerebral functioning and patients undergoing treatment for OSA. The sample size was estimated through clincal.com sample size calculator software, at 5% ∞ error (95.0% significance) and 10.0% β error (90.0% power of the study), the average mini-mental state examination among elderly not suffering from OSA was 29.6±0.6, while among elderly suffering from OSA was 29.4±0.8[8]. The calculated sample size was 95 subjects and we could add 5.0% for a better quality of collected data so; the field sample was 100 patients.

Tool of data collection:-

Three tools were used for data collection:

Tool 1: Demographic and clinical data structured interview sheet

It consists of three parts:

Part I: Demographic characteristics of the geriatric patients with obstructive sleep apnea which include age, sex, marital status, residence, level of education, and occupation.

Part II: Medical history of geriatric patients with obstructive sleep apnea such as family history, symptoms of the disease, medical diseases, and medication used.

Part III: Clinical data related to disease including body weight, height, body mass index (BMI), Neck circumference, polysomnography data, and obstructive sleep apnea severity.

Tool 2: Epworth sleepiness scale (ESS)

The Epworth Sleepiness Scale was developed by **Johns (1991)**[9]. It is a valid instrument used to measure excessive daytime sleepiness. It was translated into Arabic and was approved for validity and reliability by **Ahmed et al (2014)**[10]. The subject self-rates on how likely it is that he/she would doze in 8 different situations. The scoring of the answers is ranged from 0-3, with 0 being "Would never doze" and 3 being "high chance of dozing" The total score ranged from 0 to 24 points. The score higher than 10 is usually used to denotes excessive day time sleepiness.

Tool 3: Mini-Mental State Examination (MMSE) scale

It was developed by **Folstien (1999)**[11]. It is one of the commonly used for assessing the older adult's cognitive function. Mini-Mental State Examination (MMSE) scale includes11 items that investigate the long-term memory, orientation to soundings, attention, calculation naming, repetition, registration, language, praxis, and copying of a design. It was translated into Arabic by **Elokl (2008)**[12], and the validity and reliability (r =.093) were assured by **Abd El Moniem (2012)**[13]. The total scoring key as follow: 24-30 = normal cognitive function, 18-23 = mild cognitive impairment, and 0-17= severe cognitive impairment.

Data collection process:

Preparatory phase:-

1. An official letter was obtained from the Dean of Faculty of Nursing, Mansoura University to the responsible authorities to obtain their approval& cooperation.
2. Tool I (Demographic and Clinical data structured interview schedule) was developed by the researcher based on relevant literature.
5. The Arabic version of tool II (Epworth Sleepiness Scale (ESS) was used by the researcher in this study. The reliability of this scale was assured by means of r coefficient (r= 0.87).
6. The Arabic version of tool (Mini-Mental State Examination (MMSE) scale) was used by the

researcher in this study. The reliability of the scale was assured by means of r coefficient (r= 0.73).

7. Study tools (tool I, tool II, and tool III) were tested for content validity by a jury of five experts in the fields of Gerontological Nursing and Medical-Surgical Nursing. Accordingly, their recommended modifications had been done and the final forms were used for data collection.
8. A pilot study was conducted on 10% of the sample size of elderly patients from the same mentioned setting before starting data collection to check and confirm the applicability of the study tools and the necessary modifications were done. These elderly patients were excluded from the study sample and the results of the study.

Operational phase: -

1. after an explanation of the purpose of the study for each patient who fulfills the study criteria, and obtained a necessary verbal consent. Then, the necessary data were collected using the study tools.
2. According to the schedule of the outpatient clinic of the Chest Medicine Department at Main Mansoura University Hospital, The researcher visited the clinic 3 days per week. The time appropriated to complete the study tools lasted for 30 to 40 minutes.
3. Every elderly patient was interviewed individually which was included in the study by the researcher to collect the necessary information via all study tools in the outpatient clinic of the Chest Medicine Department and reviewing patient's records.
4. The researcher started the interview by introducing herself to the eligible geriatric patient, giving a brief idea about the aim and nature of the study. Then the necessary data was taken.
5. The data collection started from the beginning of December 2019 till the end of March 2020**.**

Ethical considerations:

Ethical approval was taken from the Research Ethics Committee of the Faculty of Nursing – Mansoura University. Elderly patient's verbal consent to participate in the study was obtained after an explanation of the aim, nature, benefits, risks, and compensation of the study. Privacy of the study subjects and confidentiality of the collected data was assured and were only used for the study. Each elderly patient was assured that the participation is voluntary, and they were informed that they have the right to withdraw from the study at any time without any consequences or penalty.

Statistical analysis:

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 22. Quantitative variables were presented as number and percent. A descriptive analysis was done in the form of frequencies, mean, and standard deviation. While analytical statistics was done using Independent t –test and one-way ANOVA test. Pearson's correlation coefficient was used to quantify association between different variables. $P \leq 0.05$ was considered statistically significant. Regression to detect the most independent/ affecting factor for MMSE scales was done.

Results:

Figure 1: Presented that 51.0% of the studied elders patients had mild cognitive function impairment and only 14% had

severe cognitive function impairment. The total mean score of cognitive function was 22.30±3.79.

Figure 2: Presented that 76.0% of the studied elders patients had EDS and only 24.0% had normal day time sleepiness. The total mean score of daytime sleepiness was 15.14±5.86.

Table 1: shows the distribution of the studied elderly patients with obstructive sleep apnea according to their PSG findings. REM of the studied elderly patients ranged from 0.0 to 74.50 % from total sleep with a mean (REM) of 9.71 ± 13.83. The light sleep stage ranged from 25.50 to 100.0 % with a mean light sleep of 86.42 ± 12.53and the deep sleep stage (N3) ranged from 0. 0 to 28.70 % with a mean deep sleep of 5.11 ± 7. 30. Regarding the total sleep time (TST) of the studied elderly patients ranged from 2.0 to 6.0 hours with a mean (TST) of 4.87 ± 1.08.

As regards obstructive sleep apnea severity indicated by Apnea-Hypopnea Index (AHI), it was observed that 78.0% had severe obstructive sleep apnea, 14.0% had moderate obstructive sleep apnea and only 8.0% had mild obstructive sleep apnea. Moreover, the number of desaturation (NOD) ranged from 0.0 to 783.0 with a mean of 297.63 ± 165.78, and the sleep time with O2 saturation <90% ranged from0.0 to 100.0% with a mean of 39.06 ± 32.52, and the arousal index ranged from 16.0 to 736.0 events with a mean arousal index of 180.01 ± 118.83.

Table 2: Shows that, the age of the studied patients was ranged from 60 to 82 years. Females constituted 61.0% of the studied patients. 82.0% were married. Illiteracy was prevailing among 55.0% and only 12.0% of them had high education. 55.0% were residing in rural areas and 68.0% were not working at current. Moreover, sex affect significantly on mean cognitive function score. Indicating that female had greater cognitive function impairment than male (P=0.049*). Also, the cognitive function of the studied elders significantly associated with level of education, and older adults' current work (P≤ 0.05).

Table 3: Shows that 65.0% of the studied elderly didn't use a denture, and 69.0% of them were taking caffeine. 73.0% of the study's elderly were not smoking. 96.0% of the studied elders were obese. Moreover, there is statistically significant relation was found between mean cognitive function score and older adults' using denture, smoker older adults (P≤ 0.05).

Figure 3: Presents that there is a statistically negative significant correlation between daytime sleepiness and cognitive function (p=0.001*).

Figure 4: Illustrate that there is a statistically negative significant correlation between cognitive function and OSA severity (p<0.001*).

Table 4: Shows the multivariate linear regression model for cognitive function, it was noticed from the table that the OSA severity was a significant independent predictor for cognitive function impairment p<0.001* and responsible for 51% of cognitive function variation R2 = 0.51.

Discussion

It is well known that untreated OSA has common severe health consequences that are difficult to manage in primary care. It's not only a life-threatening illness, it's associated with severe comorbid conditions includes cognitive function decline[14].

The present study revealed that more than half of the studied elderly patients had a mild level of cognitive function impairment. This result agrees

with a study done In France by Attier-Zmudka et al., (2020)[15] and in Germany by Gronewold, Haensel, Kleinschnitz, Frohnhofen & Hermann, (2019)[16] who reported that OSA is an emerging cognitive function impairment risk factor. On contrary, a study done in Spain by Sánchez-de-la-Torre, Campos-Rodriguez, and Barbé, (2013)[17] found that, no significant association between OSA and cognitive function impairment in elderly subjects having OSA.

Concerning daytime sleepless, the present study revealed that most of the studied patients had higher daytime sleepiness. This result agrees with a study done in Turkey by Balcan & Ozsancak Ugurlu, (2017)[18] and In Italy by Angelelli et al., (2020)[19] who found that most of the studied elders were sleepy. In contrast a study done in France by Sforza, Pichot, Martin, Barthélémy & Roche, (2016)[20] reported that only 15% of the patients had EDS.

The majority of the studied patients in the present study had severe obstructive sleep apnea. This result may be justified as; the increase in AHI with aging may be related to the increase in weight and the total number of respiratory arousals was significantly decreased in elderly with OSA. The result of this study is in agreement with a study done in Japan by Hongyo et al, (2016)[21] and in Brazil by Zhao, Viana, Ma & Capasso, (2018)[22] who found that the severity of OSA in elderly patients increased with aging.

The present study showed that OSA was encountered more among elderly women than men. This result may be justified by; loss of the protective effects of female reproductive hormones after menopause. This result agrees with studies done in Italy by Silvestri et al., (2019)[23]. In contrast, a study was done in the USA by Heinzer et al., (2015)[24] reported that the prevalence of OSA is higher in the elderly men than women.

Regarding age of the studied geriatric patients, it was observed that age is the most important risk factor for developing OSA. This result agrees with a study done in Italy by Sunwoo et al., (2018)[25]. Also, a study was done in Egypt by Abbas, Zayed & Awad, (2020)[26] who reported that OSA is more common with increasing age.

Cognitive function of elderly patients with OSA may depend on several factors in term of demographic characteristics. The present study pointed that; females had greater problems than males. This result can be assumed to women were often more sensitive than male patients to OSA than to sleep apnea effects, symptoms, emotional impairment, and lower perceived disease understandability. This result is supported by a study done in in the USA by Lal, DiBartolo, Kumbhare, Strange & Joseph, (2015)[27]. Moreover, the study result revealed that illiterate elderly patients had cognitive function impairment. This result is supported by another study done in Korea by Ju et al., (2012)[28]. Also, current workers had greater cognitive function impairment than others. This result may be due to excessive daytime sleepiness and altered circadian rhythms may negatively impact the ability to learn, employment, and quality of life. This result is in accordance with a study done in Arizona by Silva et al., (2020)[29] that found that there is a significant relationship between cognitive function score and work performance of elderly individuals OSA.

Moreover, the elderly denture use had greater cognitive function impairment. This result may be justified by the masticatory stimulation with

natural occlusion has been suggested to improve brain blood flow. So, poor chewing contributes to cognitive function decrease. This result supported by a study done in the USA by Oh et al., (2018)[30]. In contrast, a study done in Italy by Yusop, Mohamad, Mohammad & Abdullah, (2017)[31] found there is no significant relationship was found between denture presence and cognitive function. Also, smoking patients had greater cognitive function impairment. This result can be attributed to chronic smoking may lead to decreased hypoxia sensitivity in patients with OSA and cause brain damage. This result is supported by a study done in China by Lin et al., (2015)[32] who found that smoking patients with OSA had cognitive function decline.

The present study showed a statistically negative significant correlation between daytime sleepiness and cognitive function. The same result was reported in a study done in Brazil by Werli et al., (2016).[33] In contrast, a study done in Canada by Mery et al., (2105)[34] found that there is no relationship between EDS and cognitive function impairment. Moreover, the present study revealed a statistically negative significant correlation between OSA severity (AHI) and cognitive function. The same result was reported in a study done in China by Liu et al., (2020)[35] who found that there are was a statistically negative significant correlation between cognitive function and AHI.

In the multivariate linear regression model, the current study approved that obstructive sleep apnea severity (AHI) was a significant independent predictor for cognitive function impairment and responsible for 51% of cognitive function variation. This result is supported by a study done in China by He et al., (2016)[36] and another study was done in China by Liu et al., (2020)[35] who approved through multiple linear regression that cognitive function score was significantly positively correlated with OSA severity lead to impaired neurocognitive function in patients with OSA.

V. Conclusion

Based on the results of the present study, it can be concluded that, cognitive function impairment is common among geriatric patients with obstructive sleep apnea. The cognitive function of elderly patients may depend on several factors including age, sex, level of education, current work, denture use, and smoking. In addition, statistically negative correlations between elderly cognitive function with OSA severity and excessive day time sleepiness. Also, obstructive sleep apnea severity was a significant independent predictor for cognitive function impairment.

IV. Recommendations

1- Designing an educational program for the obstructive sleep apnea geriatric patients about treatment adherence to improve their cognitive function.

2- Implementation of an intervention program for nursing staff about problems faced in caring for patients with obstructive sleep apnea to help them to provide optimal care and early screening of cognitive function problems in order to prevent further deterioration.

Acknowledgment

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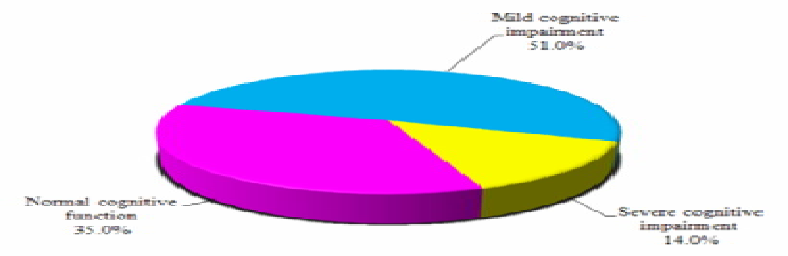

Figure 1: Distribution of the studied elderly patients with obstructive sleep apnea according to their cognitive function.

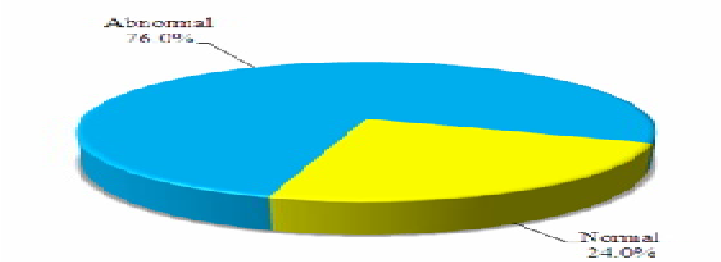

Figure 2: Distribution of the studied elderly patients with obstructive sleep apnea according to day time sleepiness.

Table 1: Distribution of the studied elderly patients with obstructive sleep apnea according to their Polysomnography data (n-=100)

Patient's Polysomnography data	**Min. – Max.**	**Mean ± SD.**
Sleep stages		
Rabid eye movement (REM) (%)	0.0 – 74.50	9.71 ± 13.83
Light sleep (%)	25.50 – 100.0	86.42 ± 12.53
Deep sleep (%)	0.0 – 28.70	5.11 ± 7.30
Sleep measures		
Total sleep time (hours)	2.0 – 6.0	4.87 ± 1.08
Apnea hypopnea index (AHI)	**No.**	**%**
Mild (AHI ≥5≤15)	8	8.0
Moderate (AHI >15≤ 30)	14	14.0
Sever (AHI>30)	78	78.0
Apnea hypopnea index (AHI)	5.0 – 179.80	56.54 ± 29.93
O2 saturation		
Number of desaturation (NOD)	0.0 – 783.0	297.63 ± 165.78
Sleep time with 02 saturation <90%	0.0 – 100.0	39.06 ± 32.52
Arousal index	16.0 – 736.0	180.01 ± 118.83

Table 2: Relationship between demographic characteristics, and cognitive function of the studied elderly patients with obstructive sleep apnea

Items	N= 100	Cognitive function Mean ± SD	Test of significant
Age			
60–	57	22.39 ± 3.91	**F(p)**
65–	21	22.62 ± 4.06	0.217(0.884)
70	17	21.88 ± 3.69	
More than 75	5	21.40 ± 1.52	
Sex			
Female	61	21.70 ± 3.92	**t(p)**
Male	39	23.23 ± 3.42	1.994*(0.049*)
social status			
Married	82	22.33 ± 3.86	**F(p)**
Widow	12	21.50 ± 3.75	0.566(0.570)
Divorced	6	23.50 ± 2.88	
Educational level			
Illiterate	55	21.27 ± 3.34	**F(p)**
Read and write	33	23.24 ± 4.09	5.347*(0.006*)
High education	12	24.42 ± 3.63	
Residence			
Rural	55	21.87 ± 3.74	**t(p)**
Urban	45	22.82 ± 3.83	1.250(0.214)
Current work			
No	68	21.63 ± 3.80	**t(p)**
Yes	32	23.72 ± 3.41	2.646*(0.010*)

T: Student t-test F: F for ANOVA test

P: p-value for the association between different categories

*: Statistically significant at $p \leq 0.05$

Table 3: Relationship between health -related history, and cognitive function of the studied elderly patients with obstructive sleep apnea

Items	N= 100	Cognitive function Mean ±SD	Test of significant
Using a denture			
No	65	23.02 ± 3.90	**t (p)**
Yes	35	20.97 ± 3.23	2.650 (0.009*)
Taking caffeine			
Yes	69	22.30 ± 4.17	**t (p)**
No	31	22.29 ± 2.81	0.020(0.984)
Smoking			
No	73	21.77 ± 3.84	**t (p)**
Yes	27	23.74 ± 3.29	2.366*(0.020*)
BM I (Kg/m)			
Obese(≥30)	96	22.20 ± 3.80	**F(p)**
Over weight (25-29.99)	3	24.67 ± 3.51	0.872(0.421)
Normal weight(18.5- 24.99)	1	25.0	

T: Student t-test F: F for ANOVA test

P: p-value for the association between different categories

*: Statistically significant at $p \leq 0.05$

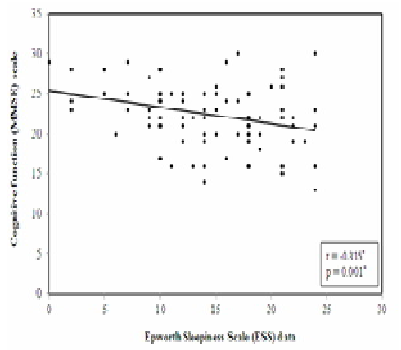

Figure 3: Correlation between day time sleepiness and their cognitive function

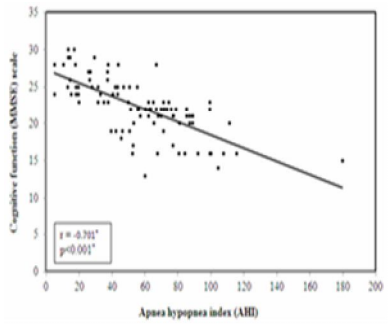

Figure 4: Correlation between OSA severity (AHI) and their cognitive function

Table 4: Multivariate Linear regression model for the cognitive function level

Cognitive function	B	Beta	T	P
Day time sleepiness	-0.094	-0.145	1.972	0.051
Obstructive sleep apnea severity (AHI)	-0.084	-0.664	9.040*	<0.001
$R^2 = 0.511$, $F = 50.710^*$, $p < 0.001^*$				

F,p: f, and p values for the model
R2: Coefficient of determination
Beta: Standardized Coefficients
B: Unstandardized Coefficients
t: t-test of significance *: Statistically significant at $p \leq 0.05$

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