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Influence of Obstructive Sleep Apnea Syndrome and Sleep Variables on Cognitive Performance and Psychological Distress in Severely Obese Patients

Olga Ribeiro[1*], Maria Raquel Carvalho[2], Isabel do Carmo[2], Góis Horácio[1], Teresa Paiva[3] & Maria Luísa Figueira[4]

[1] Neuropsychology Unit of Neurology Department, Hospital de Egas Moniz, Lisbon, Portugal

[2] Endocrinology, Diabetes and Metabolism Service, Hospital de Santa Maria, Lisbon, Portugal

[3] CENC—Sleep Medicine Center, Lisbon, Portugal

[4] Psychiatric Department, Hospital de Santa Maria, Lisbon, Portugal

[*] Olga Ribeiro, E-mail: olgaribei@gmail.com

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Abstract

We examined the presence of the Obstructive Sleep Apnea Syndrome (OSAS) and explored associations/correlations between sleep variables, anthropometric measures, cognitive performance, and psychological distress in severely obese patients. We also sought to verify the relationship between the Cognitive Reserve (CR) and the OSAS.

Sixty-one patients who required treatment for severe obesity performed a neuropsychological evaluation and an overnight polysomnography.

Most of the patients were female in the age group of 50 years. The incidence of the OSAS defined by Apnea-Hypopnea Index (AHI) was 65.6%. The Severe Apnea group was the biggest, with a statistically significant number of males, significantly higher anthropometric measures, and with a higher percentage of patients with low CR than the other groups. Cognitive performance was significantly affected by sleep parameters, sleep efficiency and REM sleep duration. Great daytime sleepiness and cognitive complaints were correlated with distress symptoms. The female gender, advanced age, the highest weight, daytime sleepiness, hypertension, and oxygen saturation significantly contributed to the onset of the OSAS.

The incidence of the OSAS is higher in severely obese patients. Anthropometric measures, cognitive performance, and psychological distress symptoms are influenced by sleep parameters and sleep efficiency. There is a high percentage of patients with Severe Apnea and low CR.

Keywords

severe obesity, obstructive sleep apnea syndrome, cognitive performance, cognitive reserve

1. Introduction

The Obstructive Sleep Apnea Syndrome (OSAS) is a common sleep disorder that is characterized by recurrent episodes of upper airway collapse, resulting in intermittent hypoxemia and recurrent arousals from sleep (Young, Peppard, & Gottlieb, 2002). It is present in 41% of the patients with a Body Mass Index (BMI) greater than 28 kg/m^2 and the prevalence can be much higher in the severe obesity reaching 98.6% of the patients with BMI > 40 (Garvey, Pengo, Drakatos, & Kent, 2015).

The OSAS consequences include sleep fragmentation, daytime sleepiness, deterioration of the quality of life, comorbid medical conditions and neurocognitive dysfunction (Chirinos et al., 2014; Gagnon et al., 2014; Karkoulias et al., 2013). Neurocognitive dysfunction has a major impact on the individuals' daily life and professional activities, especially with professional drivers. The last studies are consistent in supporting the presence of impaired attention, delayed visual and verbal memory, visuospatial skills, and impairment of some aspects of executive function and fine motor coordination (Davies & Harrington, 2016).

High intelligence is referred has had a protective effect against the OSAS neuropsychological complications, providing a greater Cognitive Reserve (CR) and allowing a greater tolerance for brain injury before crossing the threshold of clinical impairment (Alchanatis et al., 2005). This is because those individuals with OSAS who have high intelligence may exhibit intact performance on neuropsychological assessments, as they can recruit additional cognitive resources or utilize cognitive strategies that aid in performance, acting as a "buffer" against brain insult and injury (Olaithe, Skinner, Hillman, Eastwood, & Bucks, 2015).

Obesity is also linked to neuropsychological impairment, namely, reduction in attention, learning, memory and executive functions and might be an additional risk factor for neurodegenerative disease such as Alzheimer's disease (Letra, Santana, & Seiça, 2014; Ribeiro et al., 2015; Stanek et al., 2011).

The overlap of the OSAS and depression may also worsen the severity of the disease; the prevalence of depression in the OSAS's clinical populations varies widely from 7% to 63% (BaHammam et al., 2015; Douglas et al., 2013).

Taken altogether the coexistence of the OSAS, severe obesity, cognitive dysfunction and depression have a major clinical relevance.

The OSAS diagnosis and severity classification is based on daytime and nocturnal symptoms and on a full-night Polysomnography (PSG) (Andreou, Vlachos, & Makanikas, 2009). Continuous Positive Airway Pressure (CPAP) is the most effective treatment and is currently recommended in severely obese patients. CPAP treatment results show selective improvement in neurocognitive deficits whenever proper adherence is achieved (Fonseca Cotta et al., 2012; Sforza & Roche, 2012).

The effectiveness of weight loss in reducing the severity of the OSAS is well known. Dietary interventions in moderately overweight and Bariatric Surgery in severe obesity, are potential contributors to the improvement of the Apnea-Hypopnea Index (AHI) and nocturnal respiratory functions (Tuomilehto, Seppä, & Uusitupa, 2013). Even modest reductions in body weight are associated with changes in the OSAS, with a 10% reduction predicting an approximate change of 26% to 32% in the AHI (Chirinos et al., 2014). However, the OSAS appears to be a public health problem, a barrier to weight loss and its identification is important to provide patients with interventions focused on both weight loss and OSAS treatment (Collins, Meng, & Eng, 2016).

The purpose of this study was to explore the presence of the OSAS and to examine associations and correlations between sleep variables, anthropometric measures, cognitive performance for executive functions and psychological distress in severely obese patients in treatment for weight loss in a Portuguese Referral Centre for the treatment of Severe Obesity.

We hypothesized that: the presence of the OSAS is high and the gravity of sleep events obtained on PSG, is linked to neuropsychological dysfunction, to high anthropometric measures and to high measures of psychological distress; the severity of the OSAS is related to a lower CR.

2. Method

2.1 Participants

After obtaining approval from the Ethics Committee of the Centro Hospitalar de Lisboa Norte (CHLN) for a longitudinal study, we performed a neuropsychological evaluation of a convenience sample of 120 patients who sought treatment for severe obesity between May 2012 and December 2015 at the Morbid Obesity Consultation. From this sample, 61 patients performed an overnight PSG at Pulmonology Department of CHLN.

Patients were eligible for study participation, if they were aged between 18 and 65 years, severely obese (BMI $\geq$ 40 kg/m^2), with 4 or more years of schooling, proposed for treatment of severe obesity, had no known diagnosis of psychiatric and neurological disorders and had non-corrected hearing or vision.

2.2 Instruments

A socio-demographic questionnaire included self-report measures and a battery of pen-paper neuropsychological tests to assess executive functions: attention and working memory (Digit Span from the Wechsler Intelligence Scale for Adults-WAIS-III), fine motor control, learning speed, stress tolerance and sustained attention (Digit Symbol-WAIS-III), processing speed of new data (Search Symbol-WAIS-III), the level of education, culture, and acquired knowledge (Vocabulary-WAIS-III), perceptual activity and visual memory (Rey-Osterrieth Complex Figure-RCF), ability to retain, consolidate, store and retrieve verbal information (Rey Auditory Verbal Learning Test-RAVLT), cognitive flexibility and resistance to interference from external stimuli (Stroop Color and Word Test), attention, visual exploration, hand-eye coordination, processing speed, sequencing and cognitive flexibility (Trail Making Test-TMT) and executive functioning, abstract thinking and the ability to shift cognitive strategies (Wisconsin Card Sorting Test-WCST) (Cavaco et al., 2008, 2015; Fernandes, 2013; Golden, Espe-Pfeifer, & Wachsler-Felder, 2002; Heaton, Chelune, Talley, Kay, & Curtiss, 2001; Rey, 1959; Tulsky et al., 2003).

We also assessed distress symptoms (Hopkins Symptom Checklist-Revised-SCL-90-R) and levels of anxiety and depression (Hospital Anxiety Depression Scale-HADS) (Baptista, 1993; Derogatis, 1994; Pais-Ribeiro et al., 2007).

2.3 Procedures

Patients were invited to participate in the study and after an explanation of its design, objectives, and procedures; the informed signed consent was obtained.

Anthropometric measurements were taken: weight, height, neck circumference, waist, and hip circumference. Body Mass Index (BMI) was calculated. Blood pressure was measured by the interviewing nurse.

Data relating to vascular risk factors like cholesterol, type II diabetes, and hypertension were collected from the individual medical processes. We collected reports data on the Portuguese Version of Epworth Sleepiness Scale Score (ESS) whose scores varies from 0 to 24 (Henrique & George, 2014). We also included data of snoring, cognitive complaints (attentional/concentration difficulties and poor mental flexibility) and the number of hours of sleep by night on workdays.

Data relating to sleep events were collected from the individual polysomnographic record of nocturnal sleep, conducted in patients during a night of sleep in the laboratory of the Pulmonology Department.

Sleep studies included monitoring of respiratory flow, respiratory effort rate, arterial oxygen saturation, electroencephalogram, electrooculogram and electromyogram of mentus muscles and were reviewed by a pulmonologist with training in sleep disorders.

Each patient was evaluated by a psychologist who had additional training in Neuropsychology and the application of the test battery had a mean duration of 45 minutes.

2.4 Statistical Analysis

The severity of the OSAS was defined as AHI: mild (AHI ≥ 5), moderate (AHI = 15-30), and severe OSAS (AHI ≥ 30) (Medicine, n.d.).

The CR values resulted from the sum of the measures of occupation, school level, Vocabulary of the WAIS-III and physical activity, and were considered high when ≥ 7 and low when below ≤ 6.

Occupation was compared to the Portuguese Classification of Professions (INE, 2010) and converted into a dichotomous variable (no decision-making = 1, with decision-making = 2) (Lojo-Seoane, Facal, Juncos-Rabadán, & Pereiro, 2014).

School level was defined as the number of formal school years completed, stratified into 1 (4 years), 2 (4-9 years), 3 (9-12 years), and 4 (> 12 years).

To analyze participant's vocabulary, we adopted the Portuguese normative data of the WAIS-III and classified the results as 1 if vocabulary was < mean and 2 if vocabulary was ≥ mean.

Physical activity was ranked as 1 when absent, or as 2 when regular (taking part in any activity resulting in energy expenditure at least twice a week in the month preceding the interview).

The significance level was set at (α) ≤ 0.05. We used the ANOVA One-Way test for paired samples. We also used the Two-Tailed Pearson Correlation Coefficient for correlation between sleep variables, cognitive measures, distress symptoms and clinical diagnosis. To analyze the relationship between qualitative variables we used the Chi-Square test of association. We also used multiple Logistic Regression models and ROC curves. The Statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 20.0 for Windows.

3. Results

Of the 61 patients undergoing PSG, most were female, in the age group of more than 50 years, married, with full basic school education and secondary school, employed and with a monthly income inferior to 500 Euros (Table 1).

Table 1. Sociodemographic Characterization (*n* = 61)

	n	%
Gender		
Female	49	80.3
Male	12	19.7
Age		
20-30 years	12	19.7
31-40 years	18	29.5
41-50 years	11	18.0
> 50 years	20	32.8
Marital Status		
Married	34	55.7
Single	8	13.1
Separate	3	4.9
Unmarried Couples	9	14.8
Divorced	6	9.8
Widow	1	1.6
Employment Status		
Employed	31	50.8
Unemployed	22	22.0
Pensioners	6	6.0
Other	2	3.3
Qualifications		
1 ºCycle of basic school	10	16.4
2 ºCycle of basic school	9	14.8

3 ºCycle of basic school	19	31.1
Secondary School	19	31.1
Bachelor	1	1.6
Graduation	2	3.3
Master	1	1.6
Income		
Without Income	5	8.2
< 500 euros	24	39.3
500-750 euros	18	29.5
751-1000 euros	7	11.5
1001-1500 euros	5	8.2
> 1500 euros	2	3.3

Mean BMI of participants was 46.71 ± 5.95 kg/m^2, the mean neck circumference was 42.73 ± 5.02 cm, the mean waist circumference was 128.04 ± 14.37 cm, and the mean hip circumference was 137 ± 10.17 cm.

Of the total number of patients, 18% had a medical diagnostic of type II diabetes, 9.8% had high cholesterol and 47.5% had hypertension.

Most respondents mentioned being overweight since childhood (42.6%), the majority (49.2%) assigned their obesity to sedentary habits, but a large percentage pointed it also to changes in emotional states (42.6%).

Twenty-one patients (34.4%) had no OSAS (AHI < 5), 12 (19.7%) had mild OSAS, 10 (16.4%) had moderate OSAS and 18 (29.5%) had severe OSAS.

The distribution of Apnea by age groups was similar (χ^2 (9) = 15.959, p = .062), but when compared by gender, there was a statistically significant greater number of males in the Severe Apnea group (58.3% vs. 22.4%), χ^2 (3) = 7.742, p = .049) with significantly higher measures of weight, neck circumference, waist circumference and BMI than the other groups (Table 2).

Table 2. Differences in Anthropometric Measures (*n* = 61)

	WithoutApnea		Mild Apnea		Moderate Apnea		Severe Apnea		
	M	SD	M	SD	M	SD	M	SD	Sig.
Weight (Kg)	116.07	15.18	125.34	16.51	121.08	19.03	132.30	17.78	3.104*
Height (cm)	162.14	9.88	159.92	8.22	162.40	8.50	164.78	10.29	0.651
Neck (cm)	40.17	2.96	42.26	3.69	40.90	2.69	47.06	6.00	9.676***
Waist (cm)	121.52	11.75	131.33	14.28	124.80	17.98	135.28	11.91	3.808*
Hip (cm)	134.90	9.66	138.92	11.16	136.90	9.84	138.22	10.69	0.513
BMI	44.07	3.00	48.78	8.14	45.99	5.86	48.82	6.07	3.748*

* $p \leq 0{,}05$; ** $p \leq 0{,}01$; *** $p \leq 0{,}001$.

The CR was significantly related with Apnea (χ^2 (3) = 10.214, p = .017) with a high percentage of patients with Severe Apnea and low CR.

Sleep parameters:

The mean of REM Sleep was 12.56% ±6.07 mn and the mean of REM Sleep Latency was 151.86 mn ± 94.20.

The mean AHI was 23.14/h ±27.70, the mean of average oxygen saturation ($SatO_2$) was 94.26% ±1.99, the mean of minimum $SatO_2$ was 81.59% ±9.78, and the mean snoring was 25.05%/TTS ±26.49.

The mean daytime sleepiness was 6.34 ± 4.30 with pathological subjective sleepiness (ESS ≥ 10) present in 12 patients (19.67%) (Henrique & George, 2014). From self-reported data, the mean hours of sleep by night was 7.16h ±1.10, 42 patients (68.9%) referred to be snorers, and 20 (32.8%) mentioned cognitive complaints.

There were no statistically significant differences between the different groups of Apnea patients in variables like daytime sleepiness, hours of sleep by night, cognitive complaints, snoring, diabetes and high cholesterol. However, in the group without Apnea there was a significantly high number of patients (17 subjects of the total 21) without hypertension (53.1% vs. 13.8%), (χ^2 (3) = 10.659, p = .014).

Sleep parameters and cognitive functioning:

Results of correlation analysis showed that a high AHI is significantly and negatively correlated with Deferred Recognition of the RAVLT (r = -.297, $p \le 0.05$).

Although weakly, the increase of average SaO_2 was positive and significantly correlated with a Deferred Recognition of the RAVLT (r = .284, $p \le 0.05$) and with RCF (Copy) (r = .342, $p \le 0.01$). It was negative and significantly correlated with Administered Trails of WCST (r = -.304, $p \le 0.05$) meaning that with the increase of average $SatO_{2,}$ patients do not need as many attempts to complete this test.

The minimum $SatO_2$ was also positive and significantly correlated with Deferred Recognition of the RAVLT (r = .373, $p \le 0.01$) and Digit Symbol (r = .275, $p \le 0.05$). It was negative and significantly correlated with the percentage of non-perseverative errors of the WCST (r = -.282, $p \le 0.05$) which means that with increasing of minimum $SatO_2$ this particular kind of errors has decreased.

Sleep Efficiency showed to be negative and significantly correlated with Microarousals Índex (r = -.570, $p \le 0.01$), REM Sleep Latency (r = -.313, $p \le 0.05$), and positively and significantly correlated with Learning to Learn of WCST (r = .256, $p \le 0.05$).

Microarousals Index was positive and significantly correlated with a neck circumference (r = .292, $p \le 0.05$), waist circumference (r = .286, $p \le 0.05$), Dessaturation Índex (r = .740, $p \le 0.01$) and Diabetes (r = .286, $p \le 0.05$) and negatively and significantly correlated with average Sat O_2 (r = -.429, $p \le 0.01$) and minimum $SatO_2$ (r = -.357, $p \le 0.01$).

The mean of REM Sleep was decreased and was positive correlated with Deferred Recognition (r = .251, $p \le 0.05$), Digit Span (backward) (r = .276, $p \le 0.05$) and with Learning to Learn of WCST (r

= .290, $p \leq 0.05$).

Patients with Severe Apnea showed significantly lower Deferred Recognition ($F(3, 57) = 3.149$, $p = .032$) compared with patients without Apnea.

Patients with mild Apnea presented significantly lower Resistance to Interference compared with patients without Apnea ($F(3, 57) = 2.986$, $p = .039$) meaning that they need more time to complete this task.

Distress symptoms:

Regarding distress symptoms, results showed that high daytime sleepiness was correlated with greater Global Severity Index ($r = .293$, $p \leq 0.05$) somatization ($r = .285$, $p \leq 0.05$), interpersonal sensitivity ($r = .264$, $p \leq 0.05$), anxiety ($r = .351$, $p \leq 0.01$) and paranoid ideation ($r = .258$, $p \leq 0.05$) of SCL-90-R.

There were no significant differences regarding cognitive complaints between man and women. However, globally, cognitive complaints were significantly associated with more anxiety and depression, somatization, obsessive-compulsion, interpersonal sensitivity, phobic anxiety, paranoid ideation and psychoticism (Table 3).

Table 3. Differences between Cognitive Complaints, and Anxiety, Depression and Distress Symptoms (*n* = 61)

	Without Cognitive complaints		With cognitive complaints		
	M	DP	M	DP	t
HADS anxiety	8.12	.62	11.60	.78	-3,319**
HADS depression	6.37	.50	8.85	.80	-2,744**
Global Severity Index	.89	.08	1.39	.13	-3,576***
Positive Symptom Distress Index	1.66	.07	1.82	.10	-1,267
Somatization	13.68	1.26	18.40	1.73	-2,169*
Obsessive-compulsive	11.34	.92	17.50	1.48	-3,671***
Interpersonal sensitivity	9.10	1.04	15.30	1.53	-3,377***
Depression	13.54	1.26	22.40	2.13	-3,796***
Anxiety	7.32	.91	12.30	1.67	-2,847**
Hostility	5.00	.77	6.65	.93	-1,292
Phobic anxiety	2.76	.47	5.80	.93	-2,927**
Paranoid ideation	5.24	.55	8.05	.96	-2,723**
Psicoticism	4.32	.65	8.90	1.30	-3,152**

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Multiple logistic regression series were carried out to assess the relationship between sociodemographic and anthropometric measures as predictors of Apnea with results suggesting that gender (β = -3.164, χ^2_{Wald} (1) = 4.305, p = .038), age (β = .121, χ^2_{Wald} (1) = 4.305, p = .005) and weight (β = .095, χ^2_{Wald} (1) = 4.305, p = .034) were the independent variables which significantly estimate the likelihood of subjects having Apnea. Thus, the female gender, the advanced age, and the highest weight are variables that significantly contributed to the onset of the OSAS in our sample.

Concerning other variables, patients with high daytime sleepiness (β = .259, χ^2_{Wald} (1) = 4.034, p = .045), hypertension (β = 2.752, χ^2_{Wald} (1) = 5.531, p = .019) and low minimum $SatO_2$ (β = -.323, χ^2_{Wald} (1) = 7.218, p = .007) were more likely to have OSAS.

CR did not show to be a significant predictor for the appearance of the OSAS.

Regarding the cutoff values of anthropometric measurements evaluated with ROC curves from which Apnea can appear, for women, measures were: neck circumference = 40.5 cm and BMI = 41.22 kg/m^2. For men, these were neck circumference = 45.5 cm and BMI = 43.80 kg/m^2.

4. Discussion

In this study we determined a representative sample of most candidates to the treatment of severe obesity in Portugal: they were predominantly female, middle-aged and low-income (Ribeiro et al., 2015).

The incidence of the OSAS defined by AHI of 65.6%, follows retrospective studies which emphasize that it can be near 70% in those patients who are severely obese (Lopes Neto, Brandao, Loli, Leite, & Weber, 2013).

Literature frequently assumes that high intelligence offers some protection against cognitive decline related to the OSAS in the form of increased CR (Yaouhi et al., 2009). In our study, most patients were relatively educated and this could be a reason why the results show minor neuropsychological impairments. Although CR did not seem to be a significant predictor for the appearance of the OSAS, it was significantly decreased in the Severe Apnea group, indicating these patients as the most vulnerable patients and those who have fewer resources to cope with daytime challenges (Yaouhi et al., 2009).

The OSAS severity is increased in men and the distribution among the age group shows similar results as described in the literature which reports that the gravity of the OSAS is frequently lower in female patients, who show specific symptoms and medical comorbidities, resulting from the influence of gonadotrophic hormones during sleep (Basoglu & Tasbakan, 2017).

We obtained higher means of anthropometric measures in the Severe Apnea group comparing with the other three groups, reinforcing the anatomical contribution of obesity to the gravity form of Apnea as a risk marker for cardiovascular diseases, in particular the systemic arterial hypertension, shown in 47.5% of our patients and cited as the most prevalent morbidity among patients with the OSAS (Gonçalves, Thatiane, & Godoy, 2011; Remya et al., 2016; Theodorou et al., 2014).

We did not find significant correlations between sleep parameters and symptoms of depression, anxiety or distress. However, the increase in the AHI and the decrease in minimum $SatO_2$ seems to affect particular aspects of episodic memory, like Deferred Recognition, an important component in the differentiation of cortical dementias (such as Alzheimer Dementia) and subcortical dementias (Cotta et al., 2012).

Attention and visual perception seem to be strongly correlated with the decreased in minimum $SatO_2$ and in average $SatO_2$ highlighting the influence of hypoxia in vigilance, in perceptual activity and in cognitive flexibility. In fact, the negative correlation with the non-perseverative errors task, may be associated with the reduced capacity of change strategy and generate alternative behaviours, an executive function that can easily suffer the influence of cardiovascular factors such as hypertension and may indicate possible frontal lobe impairment (Werli et al., 2016). Both the AHI and $SatO_2$, are described as essential factors of the OSAS, that can independently lead to neuronal loss in the hippocampus and prefrontal cortex areas closely associated with memory processes and executive functions (Sforza & Roche, 2012).

The Severe Apnea group was the only group where we observed a significantly decrease in the memory task, maybe because the AHI was the parameter chosen to classify patients; it was not very high and it is not always the most consensual measures underlying harmful mechanisms of the OSAS.

Unlike other studies using the SCL-90-R, we found that patients with great daytime sleepiness and cognitive complaints have increased values of anxiety, depression, obsession and interpersonal sensitivity symptoms (BaHammam et al., 2015). Actually, recent research refers that the OSAS can be associated with less vigour, diminished interest or pleasure, decreases in social contacts, poor compliance with treatments and less ability to perform cognitive tasks requiring alternative options, for instance, eating behaviour (Sforza, de Saint Hilaire, Pelissolo, Rochat, & Ibanez, 2002). This phenomenon, however, seems to be retroactive since weight gain and localized adipose tissue distribution can also trigger sleep problems and daytime sleepiness showing similar symptomatic specificities.

We can also speculate that in our sample the reference to changes in emotional states as functioned as a trigger for obesity, established in 42.6% of the patients, and can be linked to depression symptoms, for which the relationship to the OSAS is pointed out as the most likely bidirectional (Douglas et al., 2013).

Cognitive efficacy difference during the Stroop Interference Test between patients without Apnea and patients with mild Apnea may suggest less resistance to interference—skills that depend largely on cingulate areas and regions of the lateral prefrontal cortex. This can mean a significant difference in concentration that decreases with the gravity of the OSAS in the response to environmental stimuli.

We found a significant correlation between sleep efficiency and microarousals (sleep fragmentation) and Learning to Learn of the Wisconsin test, one of the most sensitive instruments for detecting and evaluating executive functions and identifying frontal lobe lesions (Heaton et al., 2001). Uninterrupted sleep seems to improve learning and cognitive functioning.

The REM Sleep was also positively correlated with recognition, working memory and learning according to the literature that suggests that the REM Sleep reinforces associations between neuronal populations which not only enhances various forms of memory but also optimizes cognitive processes relying on multiple association areas (Zerouali, Jemel, & Godbout, 2010).

In our study, cutoff points regarding the BMI and neck circumference were found higher than the values in the literature and we can speculate they can be related to the small sample of the OSAS patients. Further studies should be undertaken to determine and validate cutoffs among larger samples for Portuguese patients.

Our sample size was a constraint to establishing a significant impact on neuropsychological results. We believe that a large sample could bring us a more clinically significant neurocognitive effect, especially in Moderate and Severe Apnea groups.

As we have undertaken a longitudinal study, we did not include a control group necessary for comparison of CR and neurocognitive measures in groups with Apnea but without severe obesity. A significant and low CR was present in the subgroup of Severe Apnea underlying the lesser protection that these patients may experience against adverse neurocognitive deficits. Low CR can also be a deterrent to psychological and nutritional interventions for weight loss, perpetuating obesity, one of the most important risk factors for the OSAS.

The duration of the OSAS condition can be a question to include before sleep evaluation because cognitive deficits may be dependent not only on the severity but also on the extent of the pathology. Early diagnosis and treatment of the OSAS are important steps to prevent neurocognitive consequences and other medical conditions.

So, despite being representative, this study doesn’t enable data to be generalized. Yet, it may have important practical implications because our results pointed out that the presence of the OSAS is higher in severely obese patients; it affects a few aspects of their neurocognitive functioning with particular emphasis on attention, visual perception, memory, learning and cognitive flexibility. In addition, it brings daytime sleepiness and cognitive complaints that are related to the presence of distress symptoms.

Although CPAP is the best treatment for the OSAS, widespread psychological and nutritional counselling on distress symptoms and lifestyles may introduce a significant improvement in weight. This is particularly relevant in groups with mild Apnea whose compliance with the CPAP is frequently far from the optimal level (Partinen et al., n.d.).

5. Conclusion

Our results show that the incidence of the OSAS is high in severely obese and its gravity is increased in man. The Severe Apnea group had the highest anthropometric measures comparing with the three other groups, reinforcing the importance of anatomical fat distribution as a risk mark of the presence of comorbidities. Attention, visual-perception, episodic memory, learning and cognitive flexibility seems to be influenced by sleep variables and sleep efficiency, essential factors in the OSAS’ appearance and contributes for neuronal lesions. The CR was decreased in the Severe Apnea group, indicating these patients as the most vulnerable group coping with daytime difficulties. Daytime sleepiness and cognitive complaints were the parameters that significantly influenced the appearance of distress symptoms and can play an important role in weight worsening.

Psychology and nutritional interventions can be important tools for monitoring, evaluation and intervention programs contributing to the decrease of psychopathological symptomatology and key anthropometric measurements in severely obese patients with the OSAS.

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