Sleep Medicine 42 (2018) 1–6

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Sensitivity and specificity of Frontal Assessment Battery in newly diagnosed and untreated obstructive sleep apnea patients

Valentina Ladera [a], Paulo Sargento [b, *], Victoria Perea [a], Miguel Faria [c], Ricardo Garcia [a]

[a] Universidad de Salamanca, Spain
[b] Escola Superior de Saúde Ribeiro Sanches, COPElabs, NICiTeS, Portugal
[c] Escola Superior de Saúde Ribeiro Sanches, NICiTeS, Portugal

ARTICLE INFO

Article history:
Received 2 August 2017
Received in revised form
19 October 2017
Accepted 10 November 2017
Available online 24 November 2017

Keywords:
Frontal Assessment Battery
Sensitivity and specificity
Executive dysfunction
Obstructive sleep apnea

ABSTRACT

Background: Executive dysfunction (ED) is often observed in subjects diagnosed with obstructive sleep apnea (OSA), but their assessment requires facilities that are not always available. We aim to evaluate the extent to which Frontal Assessment Battery (FAB) discriminates ED in newly diagnosed, untreated, and without-comorbidity OSA patients.
Methods: Sixty subjects participated in the study. Of these, 40 (31 males and 9 females) were newly diagnosed for OSA through full-night polysomnography (apnea/hypopnea index; $M = 39.01$, $SD = 27.16$), untreated, with a mean age of 54.50 years ($SD = 8.90$), while the remaining 20 (15 males and 5 females) had no symptoms of OSA ($M = 51.60$ years, $SD = 10.70$). The instruments used were the following: Questionnaire for Sleep Apnea Risk, Epworth Sleepiness Scale, Mini-Mental State Examination, and FAB.
Results: The group with OSA exhibited significantly lower values in the FAB global score ($p = 0.003$) and in Conceptualization ($p = 0.001$) and Mental Flexibility ($p = 0.009$) subtests. ROC analysis showed adequate discriminative capacity for the FAB global score (AUC = 0.74) and for Conceptualization (AUC = 0.75) and Mental Flexibility (AUC = 0.70) scores.
Conclusions: The FAB is a short and no-time-consuming tool that can be used to investigate the presence of ED in untreated OSA patients with no comorbidities, providing clinicians with a simple and effective way of detecting the presence of this dysfunction and allowing a more informed decision for the need of a full neuropsychological assessment.

1. Background

Frontal Assessment Battery (FAB) is a short cognitive and behavioral bedside screening battery designed to assess frontal lobe functions, mainly executive functioning [1]. Being widely used, its application in different cultural contexts and languages shows the fairness of its measurement qualities [2–8]. As a screening measure, it shows adequate capacity to evidence cognitive deficits in neurodegenerative disorders [9–12], discriminating between several neurodegenerative disorders or comorbidities [13–16], and points to the deficits in strokes [17] and substance abuse [18,19]. Although, some studies suggest that its overall score may not have a relevant discriminatory power, some of its items are particularly sensitive [20–22], and a joint application of the FAB with global mental state screening measures (eg, Mini-Mental State Examination [MMSE]) increases the amount of information concerning the cognitive and behavioral status in some neurological disorders [23,24].

Obstructive sleep apnea (OSA) is a breathing-related sleep disorder, which is characterized by recurrent episodes of upper airway obstruction occurring during sleep, usually associated with a reduction in oxygen saturation in the blood, disruption of sleep, and excessive daytime sleepiness [25]. OSA is more common in males (with an estimated prevalence of 2–3 men for one woman), especially with obesity, occurring more frequently between 30 and 60 years and increasing in the third age [25–34]. Although the golden standard for diagnosis is polysomnography (PSG) [25], several good discriminatory screening instruments are also available for OSA risk assessment [35–42] and associated excessive daytime sleepiness [43–47].

The presence of executive dysfunction (ED) in OSA, measured by neuropsychological tests and batteries, are well documented

* Corresponding author.
E-mail address: paulo.sargento@erisa.pt (P. Sargento).

https://doi.org/10.1016/j.sleep.2017.11.1122
1389-9457/

[48–54]. However, this dysfunction may be confounded by the presence of some common comorbidities, such as hypertension (for review [55], cardiovascular and cerebrovascular diseases (for review [56,57], obesity [58,59], diabetes, and metabolic syndrome (for review, [60].

Therefore, it is important that the executive functioning assessment in this disorder be performed in subjects with no major comorbidities. Controversially, the literature points to the possibility of reversibility of some of these impairments after continuous positive airway pressure (CPAP) therapy [61–64], and therefore, it is advisable to evaluate the patients before this therapy [54].

According to a meta-analysis performed by Ref. [64]; several domains of executive functioning are affected in OSA, with different impairment degrees (medium to very large), which are independent of age and disease severity. Despite the ED often associated with this disorder, little is known about the discriminatory power of executive functioning screening instruments for OSA patients [65].

The main goal of this study is to evaluate the extent to which FAB discriminates ED in newly diagnosed, untreated, and without-comorbidity OSA patients.

2. Method

2.1. Design and procedures

This study is based on a transversal design with two quasi-randomized group's one-time comparison. All subjects were volunteers (not paid) who gave their informed consent to the study's objectives. This study was approved by the scientific and ethical committee of the clinical institutions where the subjects were diagnosed and treated for OSA.

2.2. Participants

Sixty individuals participated in the study. Of these, 40 (31 males and nine females) were newly diagnosed for OSA through full-night PSG (apnea/hypopnea index; $M = 39.01$, $SD = 27.16$; *Range* = 5–115), untreated, with a mean age of 54.50 years ($SD = 8.90$), recruited from the Division of Pulmonology in three different Portuguese public hospitals (from 68 subjects initially recruited, 28 were excluded because of major comorbidities: untreated hypertension [13], diabetes or metabolic syndrome [2], and cardiac [61] or cerebrovascular disorders [35]). The diagnosis of OSA was established for all patients by a pulmonologist at the first consultation after the nocturnal PSG performed in the sleep laboratory. This consultation took place, on average, two weeks after the PSG. The remaining 20 participants (15 males and 5 females) had no symptoms of OSA ($M = 51.60$ years old, $SD = 10.70$) and scored below the cut-off score in a screening measure for the risk of OSA (Questionnaire for Sleep Apnea Risk [QSAR] [42]; and in a measure of excessive daytime sleepiness (Epworth Sleepiness Scale [ESS]; [66]. None of the participants used psychotropic drugs or presented a psychiatric diagnosis and concerning mood disorders, although 27.5% of patient group scored >13 in Beck Depression Inventory II (presence of mild to moderate depressive symptoms; [67]. Gender distribution was similar in both groups ($\chi^2(1) = 0.047$, $p = 0.829$).

Groups with and without OSA showed no significant difference in age ($t_{(58)} = -1.111$, $p = 0.271$), schooling years ($t_{(58)} = 1.466$, $p = 0.148$), and MMSE score MMSE [68]; ($t_{(58)} = -0.622$, $p = 0.537$). The group with OSA showed significantly higher results in the QSAR ($t_{(58)} = 6.272$, $p < 0.001$) and ESS ($t_{(58)} = -2.556$, $p = 0.013$). Detailed results are shown in Table 1.

Table 1
Gender distribution and mean differences for groups with and without OSA.

	Without OSA ($n = 20$)		With OSA ($n = 40$)		*t (58)*	*p*
	M	SD	M	SD		
Age	51.60	10.70	54.50	8.90	1.111	0.271
Schooling	9.20	3.24	7.53	4.56	1.466	0.148
QSAR	8.55	2.39	13.70	3.25	6.272	0.000
ESS	5.45	2.91	9.33	6.44	2.556	0.013
MMSE	28.55	1.19	28.35	1.17	0.622	0.537
					χ^2	*p*
Sex					0.047	0.829
Male	15		31			
Female	5		9			

2.3. Measures

2.3.1. Questionnaire of sleep apnea risk

The QSAR is a self-report questionnaire, freely available online [42], developed by the sleep disorders center of the University of Maryland as a screening tool for the risk of OSA. This instrument consists of five items describing the main features of the disorder, including symptoms observed by the patients or by others, anthropometric characteristics, daytime sleepiness (global score of ESS), and previous clinical conditions. The four initial items of the scale are scored from one to four, whereas item five, "previous medical history" is scored as one (none), two (one previous clinical condition), three (two to three previous clinical conditions), and four (>4 clinical conditions). The total score is computed through the sum of item responses and represents a measure of sleep apnea risk (range 5–20, with higher results indicating greater sleep apnea risk). This measure showed adequate metric properties, with a cut-off point of 10.5 [42].

2.3.2. Epworth Sleepiness Scale

The ESS [66] is a self-report questionnaire that consists of eight items, rated on a four-point scale, ranging from zero to three. The global score is computed through the sum of item responses and represents a measure of subjective daytime sleepiness (range 0–24, with higher results indicating greater propensity to fall asleep). Daytime sleepiness is considered excessive when the score is above nine points.

2.3.3. Mini-Mental State Examination

The MMSE [68] is a short screening measure of the mental status, with 30 items organized in five dimensions: Orientation (ten items), Registration (three items), Attention and Calculation (five items), Recall (three items), Language (eight items) and Constructive Skills (one item). The items are considered correct (one point) or incorrect (zero points), and the final score corresponds to the number of correct items (with values ranging from 0 to 30). In this study, the cut-off points for the Portuguese version [69] were used.

2.3.4. Frontal Assessment Battery

The FAB consists of six subtests exploring the following: (a) Conceptualization (*similarities*), (b) Mental Flexibility (*lexical fluency*), (c) Motor Programing (*motor series "Luria" test*), (d) Sensitivity to Interference (*conflicting instructions*), (e) Inhibitory Control (*Go/No-Go*), and (f) Environmental Autonomy (*prehension behavior*) [1]. Subtests are coded according to an increasing ordinal criterion related to the valued construct (from zero, completely wrong subtest; to three, completely correct subtest). The final result is the sum of the six subtests (with values ranging from 0 to 18), and the higher the score, the better is the frontal functioning.