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Frontal assessment battery in a Brazilian sample of healthy controls: normative data

Bateria de avaliação frontal em uma amostra brasileira de controles saudáveis: dados normativos

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ABSTRACT

Objective: To show data on the performance of healthy subjects in the Frontal Assessment Battery (FAB), correlating with gender, age, education, and scores in the Mini-Mental State Examination (MMSE). **Methods:** Two hundred and seventy-five healthy individuals with mean age of 66.4±10.6 years-old were evaluated. Mean total FAB scores were established according to the educational level. **Results:** Mean total FAB scores according to the educational level were 10.9±2.3, for one to three years; 12.8±2.7, for four to seven years; 13.8±2.2, for eight to 11 years; and 15.3±2.3, for 12 or more years. Total FAB scores correlated significantly with education (r=0.47; p<0.0001) and MMSE scores (r=0.39; p<0.0001). No correlation emerged between FAB scores, age, and gender. **Conclusion:** In this group of healthy subjects, the Brazilian version of the FAB proved to be influenced by the education level, but not by age and gender.

Key words: frontal lobe, prefrontal cortex, cognition, aging, neuropsychological tests.

RESUMO

Objetivo: Avaliar o desempenho de indivíduos brasileiros saudáveis na Bateria de Avaliação Frontal (FAB) correlacionado com gênero, idade, educação e escores do Exame do Mini-Mental (MMSE). **Métodos:** Foram avaliados 275 controles saudáveis com média de idade de 66,4±10,6 anos. Os escores médios foram estabelecidos de acordo com o nível educacional. **Resultados:** Os escores médios da FAB em relação ao nível educacional foram 10,9±2,3 para um a três anos; 12,8±2,7 para quatro a sete anos; 13,8±2,2 para oito a 11 anos e 15,3±2,3 para 12 ou mais anos. Os escores totais da FAB se correlacionaram significativamente com o nível educacional (r=0,47; p<0,0001) e com os escores do MMSE (r=0,39; p<0,0001). Não foram observadas correlações significativas entre os escores da FA, o gênero e a idade. **Conclusão:** Na presente amostra, a versão brasileira da FAB sofreu influência do nível de escolaridade, mas não da idade e do gênero.

Palavras-Chave: lobo frontal, córtex pré-frontal, cognição, envelhecimento, testes neuropsicológicos.

Executive functions are mental processes involved in the generation of goal-directed behaviors, which may be expressed through mental or motor acts. They are considered to control formulation, planning, carrying out, and effective performance of goal-oriented actions. Executive functions are frequently impaired after frontal lobe or basal ganglia damage, and their evaluation is performed with time-consuming neuropsychological tests[1].

The Frontal Assessment Battery (FAB) has been proposed as a brief diagnostic tool to be used at bedside in cases of dysexecutive syndrome[2]. It can be performed in approximately ten minutes. Since its publication, the FAB has been largely used in several groups of patients, such as Alzheimer's disease[3], frontotemporal dementia[4], Parkinson's disease[5], Huntington's disease[6], and other conditions[7].

The capacity of the FAB to evaluate executive functions has been shown in two studies, where FAB scores were correlated with other measures of executive functions, such as phonemic and semantic verbal fluency, number of perseverative errors in the Wisconsin Card Sorting Test, and time to complete the A and B parts of the Trail Making Test[2,5]. Additionally, performance on the FAB correlates inversely

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with hypoperfusion in medial and dorsolateral frontal cortex, in patients with behavioral variant of frontotemporal degeneration[8].

Recently, normative FAB scores for Portuguese subjects have been proposed. The authors evaluated 122 healthy controls using an adapted version of the Brazilian one of the FAB[5].

The aim of the present study was to evaluate the performance of a Brazilian sample of healthy controls on the FAB, correlating their scores to age, gender, schooling and those from the Mini-Mental State Examination (MMSE), as well as to present scores according to the educational level.

METHODS

We cognitively evaluated healthy volunteers recruited from the community and caregivers or relatives of patients evaluated at the Behavioral and Cognitive Neurology Unit of the Faculty of Medicine of Federal University of Minas Gerais and at the Movement Disorders and Behavioral Neurology Unit of the Faculty of Medicine of the University of São Paulo at Ribeirão Preto. Participants had no history of neurological or psychiatric disorders, they were not depressed at the time of the evaluation and were not taking benzodiazepines, antidepressants, antipsychotics, or other medications able to influence their cognitive performances.

All participants were submitted to the MMSE, the Brazilian version of the FAB and the Cornell Scale of Depression (CSD) or the Geriatric Depression Scale (GDS)[9-12]. Performance in the MMSE, adjusted to the educational level, had to be greater than or equal to 21 for one to three years of schooling, greater than or equal to 24 for four to seven years and greater than or equal to 26 for individuals with eight or more years of schooling[9]. Score on the CSD had to be less than or equal to seven points and on GDS, lower than five in order to rule out depression[11,12].

The FAB consists of six subtests: similarities, lexical fluency (letter s), motor series, conflicting instructions, go / no-go, and prehension behavior. The maximum score for each subtest is three points (with higher scores indicating better performance) and the total score of test is calculated by adding the scores of the six subtests (maximum score=18).

We stratified our sample into four groups, according to years of education (one to three years; four to seven years; eight-11 years; 12 or more years). The total scores of the FAB were correlated to age, gender, educational level, and the scores of the MMSE. In addition, each subtest was also correlated to age and education. Spearman correlation coefficients were calculated between the different variables. Mean total scores of the battery were established according to the educational level. Statistical significance was defined as p-values <0.01. Statistical analysis was performed using the SPSS software 19.

The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais and the one of the University of São Paulo at Ribeirão Preto. All participants signed the approved written informed consent.

RESULTS

We evaluated 275 individuals (163 female and 112 male), aged 66.4±10.6 years-old (range: 44 to 91 years-old), with mean educational level of 8.9±5.1 years (range: 1 to 24 years). The average time for administration of the FAB was ten minutes. The mean total FAB score was 13.6±2.7, ranging from 5 to 18. The mean MMSE score±standard deviation was 27.1±1.7. Mean total FAB scores, according to educational level, are presented in Table 1.

While the total FAB scores correlated significantly with the educational level (r=0.44, p<0.0001), no significant correlation was found between either gender (r=0.09; p=0.13) or age (r=-0.13; p=0.03). FAB sub items analysis showed that most of them correlated with educational levels (Table 2). Palmar prehension behavior did not correlate with any variable analyzed (Table 2). Indeed, the multivariate variance analysis showed that the only sociodemographic variable that influenced significantly all FAB scores was years of formal education (SS=347.2; MS=115.8; F=20.1; p<0.001).

Total FAB scores also correlated significantly with MMSE (r=0.40; p<0.0001). When analyzing FAB and MMSE scores in different groups of schooling, the strongest correlation was found in the group with one to three years of education (r=0.54; p=0.008), while the weakest correlation emerged in the group with 12 or more years (r=0.09; p=0.45).

Table 1. Summary statistics of the FAB total scores according to educational level.

Educational level	n	Mean (SD)	Range	25th centile	50th centile	75th centile
1 to 3 years	23	10.9 (2.3)	7.0–16.0	9.0	11.0	13.0
4 to 7 years	104	12.8 (2.7)	5.0–18.0	11.0	13.0	15.0
8 to 11 years	74	13.8 (2.2)	9.0–18.0	12.0	14.0	15.0
12 or more years	74	15.3 (2.3)	9.0–18.0	14.0	16.0	17.0
Total	275	13.6 (2.7)	5.0–18.0	12.0	14.0	16.0

FAB: Frontal Assessment Battery.

DISCUSSION

In this study, the FAB was administered to a group of 275 healthy subjects, with no signs of cognitive impairment or depression. The test was administered easily and rapidly.

Performance on the FAB was influenced by education, particularly the subtests "Similarities", "Lexical fluency" and "Conflicting Instructions". As described before, these items are influenced by schooling[13,14]. We did not observe a correlation between the subtest "Motor series" and education, which has been previously described[15]. This discrepancy may have occurred due to the inclusion of illiterates in this other study, most of whom had great difficulties in performing the task.

We have found a significant association between the performance on the FAB and on the MMSE, in contrast to previous results[2]. Since the MMSE does not formally evaluate executive functions, these results might be considered unexpected. However, this association was strong in the group of subjects with less formal education and it tended to weaken in the groups with more schooling. We might speculate that less-educated subjects recruit broader brain regions, including those classically related to executive functions, in order to perform the MMSE.

In conclusion, the Brazilian version of the FAB was well-understood by cognitively healthy subjects and may be a feasible instrument for brief assessment of executive functions in the clinical setting. As the scores are education-dependent, the battery scores should be interpreted with caution in individuals with few years of schooling.

Table 2. Spearman's correlation coefficients (r) between FAB scores, age, schooling, and MMSE.

FAB scores	Age	Schooling	MMSE
Total	-0.14	0.47**	0.39**
Similarities	0.10	0.43**	0.28**
Lexical fluency	0.02	0.29**	0.20**
Motor series	-0.28**	0.10	0.16*
Conflicting instructions	-0.03	0.36**	0.23**
Go No Go	-0.13	0.18*	0.24**
Prehension behavior	-0.09	-0.03	0.01

*p<0.01; **p<0.001; FAB: Frontal Assessment Battery; MMSE: Mini-Mental State Examination.

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