Arq Neuropsiquiatr 2011;69(5):778-784

Low educational level effects on the performance of healthy adults on a Neuropsychological Protocol suggested by the Commission on Neuropsychology of the Liga Brasileira de Epilepsia

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ABSTRACT

Objective: To assess cognitive measures and impact of education on cognitive performance (CP) of low educational levels healthy adults (LELHA) on a Neuropsychological Protocol (NP) suggested by the Liga Brasileira de Epilepsia. **Method:** 138 subjects from an Education Program for Adults divided into two, age and gender matched groups of 69 subjects, answered the NP: Group 1 (mean of 6.9±2.95 months of formal education) and Group 2, 47.8±10 months. Data were compared as z-scores. **Results:** The mean IQ was 77.1±5.50 and 79.4±3.30 in Groups 1 and 2, respectively (p=0.001). Both performed below the normal curve and Group 1 worse than 2. CP correlated with schooling, especially executive functions (54.1% vs 36.2%) and language (52.9% vs 25.7%). **Conclusion:** LELHA showed significant cognitive impairment in verbal and visuospatial areas. If these results had been obtained in epilepsy patients they would be interpreted as global cognitive impairment.

Key words: neuropsychological evaluation, neuropsychological protocol, low educational levels, Liga Brasileira de Epilepsia.

Efeitos de baixo nível de escolaridade no desempenho de adultos saudáveis em um protocolo neuropsicológico sugerido pela Comissão de Neuropsicologia da Liga Brasileira de Epilepsia

RESUMO

Objetivo: Avaliar o desempenho cognitivo e o impacto do nível de educação formal em indivíduos adultos saudáveis com baixa escolaridade (IASBE) em um protocolo neuropsicológico (PN) sugerido pela Liga Brasileira de Epilepsia. **Método:** 138 indivíduos do programa EJA - Educação para Jovens e Adultos, divididos em 2 grupos de 69 sujeitos pareados por idade e sexo (6,9±2,95 vs 47,8±10 meses de escolaridade) responderam ao PN. Dados foram convertidos em z-scores. **Resultados:** O QI médio foi 77,1±5,50 e 79,4±3,30 nos Grupos 1 e 2, respectivamente (p=0,001). Ambos tiveram resultados abaixo da curva normal e o Grupo 1 mostrou pior desempenho do que o 2, especialmente nas funções executivas (54,1% vs 36,2%) e linguagem (52,9% vs 25,7%). **Conclusão:** IASBE apresentaram comprometimento cognitivo tanto em tarefas verbais como visuoespaciais. Se estes resultados tivessem sido obtidos em pacientes com epilepsia seriam interpretados como indicativos de disfunção cognitiva global.

Palavras-Chave: avaliação neuropsicológica, protocolo neuropsicológico, baixo nível de escolaridade, Liga Brasileira de Epilepsia.

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Support
This work was partly funded by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ, Brasil) and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)

Conflict of interest
The authors report no conflict of interest

Received 12 February 2011
Received in final form 8 June 2011
Accepted 16 June 2011

Neuropsychological data have long been shown to correlate with focal areas of brain dysfunction in patients with epilepsy and to predict the cognitive outcome following epilepsy surgery, particularly when combined with other variables such as structural brain pathology, age of seizure onset and language lateralization[1]. By localizing cognitive dysfunction, neuropsychological findings, mapping the functional deficit zone, can reinforce or question data from other sources used to localize the site of the epileptogenic zone.

Neuropsychological assessment is indicated in all patients being considered for epilepsy surgery worldwide and has also been included among the items of the minimal protocol for presurgical evaluation of all epilepsy types in Brazil[2], where higher prevalence of epilepsy has been found especially in more deprived social classes[3].

The importance of educational level (EL) on neuropsychological tests performance has been related in several kinds of abilities, such as memory, language, problems solving and constructional praxis as well as motor and calculation abilities. For the interpretation of results in cognitive tasks, education must be taken up. However, differentiation of what is an educational variable and what is a cognitive deficit is a hard process. If neuropsychological evaluation does not take enough care, it can suggest a neurological pathology where there are only educational deprivation[4].

Presently, in Brazil, the number of illiterates is around 16 million people with 15 years of age and more. When the concept of "functional illiterate" is added to this number, it can rise until more than 30 million Brazilian citizens[5].

The neuropsychological evaluation (NE) protocol used by several Brazilian epilepsy surgery centers is variable given the great number of tests that investigates the same function. Based on traditional NE, the Neuropsychology Commission of the Liga Brasileira de Epilepsia (LBE) suggested minimal criteria[6]. To evaluate the intellectual level, the use of an intelligence scale was recommended and Wechsler Adult Intelligence Scale - WAIS (R or III) for adults was suggested; to language, tests that evaluates fluency, naming, expression and comprehension; to verbal and non-verbal memory and executive functions, tests that demand concentrated attention, flexibility and planning.

The objective of this study was to compare the performance of a low EL healthy adult (LELHA) population in a neuropsychological protocol based on the recommendation of the LBE, with normative data of the American Table (AT) once for most of them, there are no normative data for a Brazilian population.

METHOD

Subjects

One hundred and thirty eight healthy adult subjects random selected from a reading and learning program (EJA-Educação para Jovens e Adultos) had a NE. After UNIFESP Ethical Committee approval (CEP 0239/09), the evaluation was done in schools during classing time, and, after signing informed consent, each right-handed subject was evaluated individually in a private room. Exclusion criteria included substance abuse, medical or psychiatric conditions that could affect cognitive functioning and developmental learning disorder. Each evaluation lasted about 1.5 hours and was applied in two days, one session each day.

With respect to EL, individuals were divided into two groups: Group 1 was constituted by those registered in EJA segment 1 which correspond to the primary level (1st-4th years of formal education); Group 2 enrolled subjects from EJA segment 2 corresponding to the secondary level (5th-9th years).

Neuropsychological tests

Subjects were submitted to a comprehensive NE comprising three tests based on the Wechsler Adult Intelligence Scale- Revised (WAIS-R)[7], Wechsler Memory Scale-Revised (WMS-R)[8] and additional tasks from the Compendium of Neuropsychological Tests[9,10]. These tests were designed to measure a broad range of abilities and are on accordance with the battery suggested by the Commission on Neuropsychology of the LBE[6]. A random sequence of tasks was applied.

Intellectual functions

A standard clinical measure of intelligence was administered (estimated Intelligence Quotient) from Wechsler Scale, equivalent for sum of scaled scores of subtests Vocabulary and Block Design, WAIS-R[7,10]. The WAIS-R is advised to be administered to individuals with age range of 16 to 74 years of both genders and can be applied to individuals from 0 (zero) education years. EL exerts a significant influence on the quality of responses[11].

Attention and executive functions

Attention and executive functions were evaluated through with Digit Span (WAIS-R) forward and backward, Block Design (WAIS-R) and the copy of the Rey Complex Figure (RCF). RCF should be administered to individuals from four education years and age range from 6 to 93 years. Age contributes to performance in this task and copy score increases with age, the rate of increase slowing between ages 12 and 16 years, with adult levels being reached at about age 17. Some studies suggest little decrement in copy scores with advancing age. The influence of education in this task is less certain[9,10].

Language

The Boston Naming Test (BNT) was used to assess the visual naming ability. It is recommended to be administered to individuals with age range from 5 to 97 years of both genders and can be applied to subjects who are illiterate. EL and IQ exert a significant influence on the performance[10]. Cross-sectional studies suggest that age also affect performance and the scores increase in childhood, improving up to about the fourth decade of life, and declining subsequently, particularly after 70 years of age[9,10].

The phonological fluency test (FAS) was used to assess phonemic fluency, the Animal Naming test to address semantic fluency, and the Vocabulary subtest of the WAIS-R to assess the development of language, knowledge, semantic storage and mental abilities. The FAS and Animals are recommended to be administered to individuals with age range from 16 to 95 years of both genders, and from zero years of schooling[10]. EL and IQ exert a significant influence on both, phonemic and semantic fluency tasks, and higher levels of education are associated with a better performance. Yet, education accounts for more variance (about 14%) than age (about 9%)[9,10].

Memory

To assess verbal memory, we used Logical Memory, I and II (immediate and delayed recall) and for visual memory, Visual Reproduction I and II (immediate and delayed recall). Both tests are part of the Wechsler Memory Scale-Revised[8,10]. These tasks are administered to individuals with age range from 16 to 74 years, of both genders and from zero years of schooling. Additionally, for spatial memory, the RCF, immediate and delayed recall, were also employed.

Verbal learning

The Rey Auditory Verbal Learning Test (RAVLT) was used[9,10]. This test is administered to individuals with age range from 16 to 89 years, of both genders, and from one year of education[12]. Performance tends to be better with higher IQ and EL. The evidence indicates that certain RAVLT scores improve as a function of age in children and tend to decrease in adults with advancing age[9,10].

Statistical analysis

Initially, the results (mean±SD) of all neuropsychological tests of both groups were compared. For this comparison, the Student t test was used for continuous and the McNemar test was utilized for the categorical variables. The association between months of education and each neuropsychological test was done through Spearman's coefficient. Then, raw scores on all tests were converted to adjusted z scores (mean=0, SD=1) using multiple regression techniques. Later, a summary impairment index was calculated for each subject. This index represents the proportion of test scores that are outside normal limits, representing the degree of cognitive morbidity exhibited by each low educated individual[13]. To determine the abnormality of each test, different parameters were used. A more conservative parameter considers the test abnormal when ≥2.0 SD from 0 (obtained in the normal curve). Less conservative approaches use ≥1.5 and ≥1.0 SD as parameters. The impairment index conveys the advantage of limiting the total number of comparisons conducted, therefore, reducing the probability of type 1 error. Analysis was performed using SPSS 10.0 and MINITAB 14.1 and p values <0.05 were considered statistically significant.

RESULTS

Characteristics of the sample

The mean age of the 138 subjects, 92 (66.7%) women, was 40.7±9.23 (range, 21-57). The participants were divided into two groups, matched by age and gender, according to the number of months of formal education. Each group was constituted by 69 individuals, 46 (66.7%) women. Group 1 (EJA Segment 1) had a mean of 6.9 months±2.95 of formal education and Group 2 (EJA Segment 2) had a mean of 47.8 months±10.74 (p<0.001).

Cognitive profile

When results (mean±SD) of both groups were compared, Group 1 performed worse in the majority of tests evaluating language, verbal memory, visual memory and executive functions (Table). Deficits in verbal learning were determined through decreased scores on the RAVLT. In this cognitive function, the difference between the two groups was not statistically significant in three out of nine steps of the tests. This was also found in one test measuring executive function: Digit span (backward).

The estimated mean IQ was below the normal range and within the borderline intellectual functioning (BIF), defined as an IQ ranging between 71 and 84[14]. The mean IQ was 77.1±5.50 and 79.4±3.30 in Groups 1 and 2, respectively (p=0.001).

When the adjusted z scores were used to calculate the impairment index, Group 1 had a greater percentage of abnormal tests than Group 2 (p<0.05). This was true either with less conservative parameters (test considered abnormal when result ≥1.0 SD) or with more conservative approaches (≥1.5 and ≥2.0 SD), as showed in Fig 1.

The mean of the z scores obtained from the sample

Table. Results of Groups 1 (EJA Segment 1) and 2 (EJA Segment 2) in raw scores (mean±SD) of specific domains of neuropsychological tests.

Test / Cognition function	Group 1 (Mean±SD)	Group 2 (Mean±SD)	p value
IQ (WAIS-R)	77.1±5.50	79.4±3.30	<0.001
Language			
FAS	14.2±6.13	17.1±2.39	<0.001
Animals	8.7±3.13	11.9±2.79	<0.001
Boston Naming Test	45.7±5.43	49.0±3.21	<0.001
Vocabulary (WAIS-R)	23.8±6.47	26.3±5.91	0.016
Verbal memory (WMS-R)			
Logical Memory I	14.5±4.12	16.6±2.58	<0.001
Logical Memory II	8.8±3.43	11.6±2.60	<0.001
Visual memory (WMS-R)			
Visual Reproduction I	21.1±5.88	26.1±4.18	<0.001
Visual Reproduction II	17.0±3.38	20.0±2.63	<0.001
Rey Complex Figure I	17.9±7.55	20.1±3.75	<0.011
Rey Complex Figure II	13.2±6.26	17.5±3.30	<0.001
Executive function/IQ/Attention			
Block Design (WAIS-R)	15.2±0.69	18.6±0.45	<0.001
Rey Complex Figure Copy	26.7±5.66	28.8±2.95	<0.003
Stroop I	30.7±11.42	18.7±3.47	<0.001
Stroop II	36.7±13.84	24.1±4.70	<0.001
Stroop III	47.6±14.30	44.0±8.36	0.066
Trail A	80.2±20.89	52.1±6.74	<0.001
Trail B	173.3±89.46	123.2±32.47	<0.001
Numbers (WAIS-R)	9.3±2.78	10.2±1.86	0.006
Digit span (forward)	4.3±0.89	4.3±0.63	0.802
Digit span (backward)	3.0±0.75	3.5±0.61	<0.001
Verbal learning			
RAVLT I	5.6±1.64	6.5±1.20	<0.001
RAVLT II	6.5±1.50	7.8±0.98	<0.001
RAVLT III	7.7±1.37	8.9±0.92	<0.001
RAVLT IV	8.8±1.58	9.7±1.24	<0.001
RAVLT V	10.4±1.74	9.8±1.25	0.022
RAVLT - Total	39.0±6.78	42.7±2.51	<0.001
RAVLT - Interference	5.3±1.23	5.1±1.02	0.378
RAVLT VI	7.6±2.18	7.7±1.68	0.817
RAVLT - 30 minutes	8.3±2.27	8.2±1.80	0.621
RAVLT - Recognition	13.6±1.55	14.0±1.03	0.044

QI: intelligence quotient; RAVLT: Rey Auditory Verbal Learning Test; WAIS-R: Wechsler Adult Intelligence Scale Revised; WMS-R: Wechsler Memory Scale. EJA: educação para jovens e adultos; SD: standard deviation; FAS: phonological fluency test.

performance varied from –0.13±0.66 in RAVLT-I in Group 2 individuals to –9.65±6.07 in Stroop test I in those of Group 1. This range was too low from the expectation for a healthy population (nearly zero in z score) homogenously distributed throughout the tests. Fig 2 illustrates the mean adjusted z scores of each neuropsychological test grouped by cognitive function (verbal memory, visual memory, language, executive function, attention and verbal learning). The only mean z score above zero was RAVLT recognition in both Groups (Group 1: mean 0.28±0.77 and Group 2: mean 0.47±0.52). The distribution of z scores in all neuropsychological tests was different from the normal distribution (mean, 0; SD, 1) ($p<0.02$ in all tests) and is shown in Fig 2.

Considering only the most conservative parameter

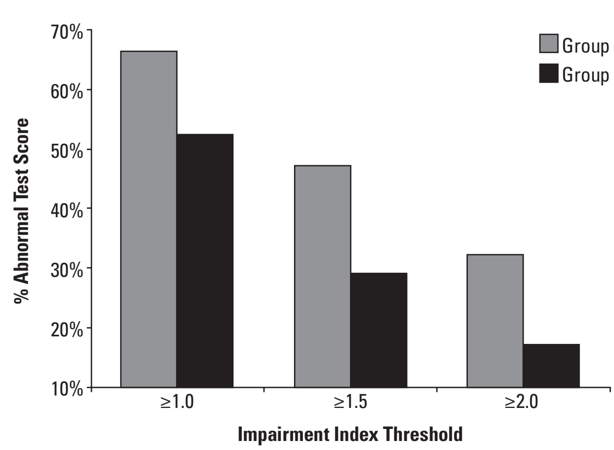

Fig 1. Percentage of abnormal tests as a function of impairment index.

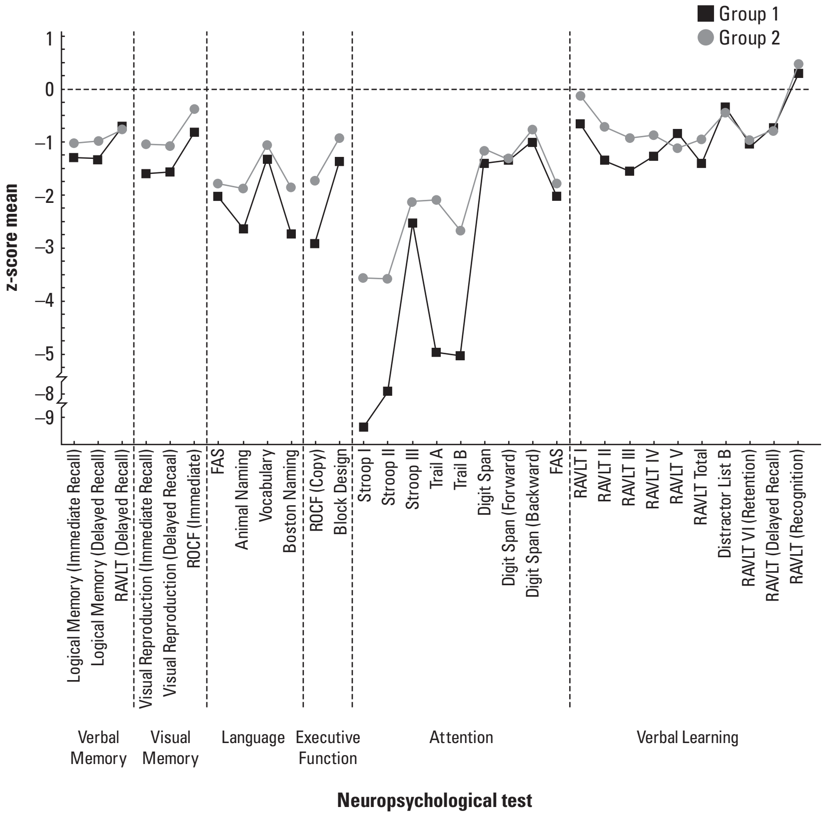

Fig 2. Mean z scores for verbal memory, visual memory, language, executive function, attention and verbal learning in both Groups of healthy adult subjects.

(z score ≥2 SD), the most impaired cognitive areas were executive functions (54.1% vs 36.2% in Groups 1 and 2, respectively) and language (52.9% vs 25.7% in Groups 1 and 2, respectively). These data are resumed in Fig 3.

DISCUSSION

The prevalence of epilepsy, the most common serious chronic neurological condition, is higher in developing world[15] and deprived social classes[3]. The aim of this study was to determine the impact of EL on cognitive profile in Brazilian LELHA.

Subjects had a mean IQ score of 77 (Group 1) and 79 (Group 2), indexes below the mean of the general population and should be classified in the BIF range defined as IQ between 71 and 84[14]. Individuals with BIF are considered at risk of shortcomings, particularly during school and working life.

In a Brazilian study emphasizing the difficulties in NE of patients with temporal lobe epilepsy, Mader[16] stated that the definition of the functional deficit zone during presurgical evaluation was impossible in 20 (47%) of 42 patients with BIF or inferior IQ.

In the interpretation of BIF besides socio-cultural factors, the linguistic and cultural gap relative to the sample population of test standardization, i.e. the U.S. population should be considered[7]. In addition, three more factors may have influenced the poor performance of this

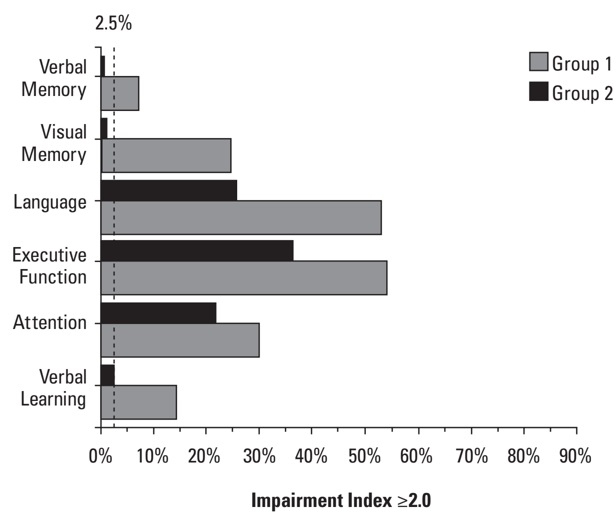

Fig 3. With the use of the most conservative estimate (defined as z score ≥2.0), approximately half of the tests measuring language and executive functions, the most impaired cognitive areas, were abnormal for Group 1 while one third and one fifth of the tests, measuring executive functions and language, respectively, were abnormal for Group 2 .

population[17]: [A] Subjects who never attended school and had no opportunity to learn skills usually operated on cognitive tests; [B] Individuals who are not accustomed to the situation of "taking exams to test knowledge"; [C] Individuals for whom the situation of testing is irrelevant since it does not represent a value in their community. Thus, abnormal low performance on these tests may not mean that these subjects present a truly cognitive deficit.

The entire group of Brazilian LELHA tested performed below the expected level in all but one tests, the RAVLT recognition a data that suggests the inadequacy of the evaluation protocol proposed by the Commission of Neuropsychology of the LBE[6] for measuring cognitive function. Similar results were observed by Manly et al.[18], when comparing cult and illiterate older adults not demented in an epidemiological study of normal aging and dementia in a community in the north of Manhattan. Illiterate subjects showed poorer performance on neuropsychological tests than those literate, but did not differ in recall of words. The RAVLT test can be applied to individuals with schooling from one year, but the time for formal education influences the quality of responses[12]. Thus, while memory and verbal learning as measured by RAVLT in these individuals have been shown to be significantly below to those of general population, the use of semantic clues in the administration of the RAVLT recognition might have facilitated the identification of stimuli presented, since memory recognition is necessary to discriminate between a stimulus previously presented among new or old items. On the other hand, recognition is aided by two processes of memory: recollection and familiarity, different from each other in processing speed and specificity of information[19]. Recall is the ability to retrieve a qualitative information (where and when), while familiarity is the ability to assess the strength of contextual memory or of an item, both reflecting different processes of recovery[20]. We postulate that the familiarity factor may have played a facilitating role in this passage of RAVLT. Moreover, life experience of adults may have contributed to these findings[21].

In our series, despite a significant overall deficit in the entire population, the comparison of the cognitive performance of the two groups of individuals allowed the observation that the number of months of schooling influenced the performance in executive functions, verbal memory, visual memory, language and constructive praxis.

When comparing intra-group performances in verbal and visual functions we observed that subjects in Group 1 achieved worse performance in verbal tasks. A Mexican group[22] also found that Maya illiterate indigenous of the Yucatan province showed better performance in visuospatial perceptual tasks (a copy of a semi-complex figure) and had lower scores on subtests related to verbal memory than illiterate individuals of a control group. The authors attributed these results to the fact that Indian culture demands of its subjects visuospatial skills for their economic survival as farmers and craftsmen. Moreover, according to Foss et al.[23], verbal skills are more dependent on the EL, since during the training at school it is through language that we learn concepts and notions.

In our study, a poor performance was also evident in executive functions, assessed by the tests: FAS, Stroop test I and II, Trail A and B and numbers (total and backward). When the results in this area were compared, there was a statistically significant difference in all results, except in Digit Span (forward) and Stroop test III. Hamdan and Hamdan[24] examining the influence of age and EL on Trail (A and B) test performance in 318 healthy adults aged between 18 and 81 years, divided according to education, reported that the less educated group needed more time to complete the task suggesting that at least more than two years of formal education would be necessary for the test completion. Hashimoto et al.[25] study with older people concluded that there is a need for at least six years of schooling to the test set. Also, Elst et al.[26] evaluated the influence of age, gender and EL in the Stroop test in adults, divided into groups according to education, observing that the lower the EL, the worse the performance. The same was reported by Moering et al.[27] in whose research EL significantly influenced the performance of executive functions such as processing speed, and formal education facilitates intellectual performance. These findings corroborate those of our study. On the other hand, Banhato and Nascimento[28] found no difference between participantLanguage performance was impaired in both groups; once more, intragroup comparison showed that Group 1 individuals were the most impaired and the performance in semantic fluency (Animals), an average of 8.7 and 11.9 for Groups 1 and 2, respectively, was inferior to the results found by other Brazilian studies using healthy adults[29,30]. Ostrosky-Solis et al.[4] studied the relation of the EL of normal subjects aged 16 to 85 years and education ranging from illiterate to four years of schooling and found no difference between them in the phonological fluency test (FAS) while Mansur et al.[31] in a study using the Boston Naming Test, concluded that the lower the EL, the worse the performance to name.

With regard to verbal and visual memory, our findings are similar to those of Ardila et al.[32], who studied performance on visuospatial tests and memory of 200 normal adult individuals with 0 to 17 years of schooling. In the test of Logical Memory, immediate and delayed recall, the illiterate group performed worse than the group with higher education. The same impairment was found in subjects' performance on the test of the RCF (immediate recall). Foss et al.[33] evaluated 60 healthy elderly subjects with 1 to 15 years of schooling. The less educated group performed poorer on the majority of tests, which also corroborates our findings, although our sample was comprised by younger individuals.

Our data showed that EL influences the overall performance of LELHA on NE performed according to the assessment protocol suggested by the Commission of Neuropsychology of the LBE[6].

It is necessary to emphasize that if these results had been obtained in patients with epilepsy they would be interpreted as bilateral, global cognitive deficits with greater impairment in verbal cognitive functions suggesting a dominant hemisphere dysfunction.

This variable should be taken into account during the correction and interpretation of NE and may even prevent their interpretation. Government and research policies are necessary for professionals in the area of Neuropsychology to perform cultural adaptation and validation of neuropsychological tests used internationally allowing the measurement of cognitive capacity of the Brazilian population attended in Epilepsy Centers.

LELHA showed worse performance in both, language and memory areas, when their results were compared to data from normality (American standards), which strengthens the argument that tests used to assess cognitive functions in this population are inadequate. As this profile of schooling is very prevalent in Brazil, studies are urgently needed to standardize instruments to allow reliable evaluation of cognitive function.

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