

Original article



APPLICATION OF THE TOTAL SCORE FOR THE CERAD BATTERY IN BULGARIAN DEMENTED AND CONTROL SUBJECTS

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ABSTRACT

Background: The lack of a total numeric score of the CERAD neuropsychological battery may to some extent limit the possibilities for presenting the cognitive status and the degree of dementia.

The objective of the present study is to apply the CERAD battery in a Bulgarian population of demented and control subjects, to compute the total score for each participant, and to compare the performance of the two groups.

Methods: a total of 164 subjects, 134 patients with dementia and 30 controls, were assessed using the Bulgarian version of the CERAD battery. The total score was calculated according to the method described by Chandler et al. Mean values were compared using independent samples t-test. ROC curves were built, and the area under the curve was calculated.

Results: The total score for the whole sample has a mean value of 63.4520.56. After correction for age and education $\bar{x}=79.51\pm 20.24$. The total score is significantly lower in the demented subjects compared to the control group, for both raw and corrected score. The area under the ROC curve shows values of 0.988 and 0.986 before and after correction, respectively.

Conclusion: The statistically significant difference between the results of demented and control subjects, with and without correction for age and education, support the good applicability and high informative value of the instrument. The results of ROC analysis demonstrate the high value of the battery for diagnosing dementia.

Keywords: CERAD, dementia, neuropsychological assessment, total score,

BACKGROUND

The CERAD battery [1] is among the best known and commonly used in dementia centres [2, 3]. It has been developed for assessment of dementia and for follow-up of disease evolution. It is composed of 7 tests, most of which are well-known and are often used separately [4]. The ver-

bal fluency test requires the subjects to name animals. It measures verbal production, semantic memory, and speech. A 15-item naming test follows, which is a short form of the Boston Naming Test. It includes three groups consisting of five items each: with the low, middle, and high frequency of use, respectively. The third component is MMSE, followed by three trials of a word list task. Constructional praxis is also assessed by copying 4 geometric shapes. Then recall of the word list is required. The battery ends with the word recognition task, where 10 unknown words are mixed up with the words from the list previously used for the recall task. Some forms of the test include an additional component: drawing the shapes from the constructional praxis task by memory.

Though the CERAD battery has initially been developed for diagnosing patients with Alzheimer's disease, it is also suitable for assessment of patients with different potential neurocognitive disorders and for aiding the differential diagnosis with Alzheimer's disease [4, 5]. Normative data for adults between 50 and 89 years of age have been developed on the basis of comparison between demented and control subjects and have been published in the literature [6].

The lack of a total numeric score of the CERAD neuropsychological battery may to some extent limit the possibilities for presenting the cognitive status and the degree of dementia. Description of the results for each of the assessed domains is needed. In order to facilitate the process, a method for evaluation of a total score has been proposed [7]. The total value can be obtained by summing the scores of all components and has a maximum of 100. Due to the known dependence of the result on age and education, tables allowing its correction have been created.

The aim of the present study is to apply the CERAD battery in a Bulgarian population of demented and control subjects, to compute the total score for each participant, and to compare the performance of the two groups, testing the capacity of the method to provide adequate information for cognitive impairment.

SUBJECTS AND METHODS

A total of 164 subjects, 134 patients with dementia in Alzheimer's disease and 30 controls, were assessed using the Bulgarian version of the CERAD battery. The CERAD total score was calculated for each subject according to the method described by Chandler et al., both raw and corrected for age and education. Mean values of the two groups were compared using independent samples t-test. ROC curves were built, and the area under the curve was calculated.

RESULTS

The total score of the CERAD battery, calculated according to the methods proposed by Chandler et al. for the whole sample of 164 subjects has a mean value of 63.45 ± 20.56 . After correction for age and education $\bar{x} = 79.51 \pm 20.24$.

Mean values, standard deviations, minimum and maximum are shown in Table 1, separately for the demented and the control subjects.

Table 1. Total score for the CERAD battery in demented and control subjects

	Demented subjects		Control group	
	Total score	Corrected total score	Total score	Corrected total score
Mean	59.87	76.24	79.40	94.13
SD	20.907	20.827	7.054	6.474
Minimum	0	9	58	73
Maximum	91	105	92	106

The total score is significantly lower in the demented subjects compared to the control group, $p=0.001$ (Table 2).

Table 2. Comparison of the mean values of the CERAD total score in demented and control subjects using independent samples t-test

Groups (count)	\bar{x}	SD(\pm)	t	df	p	Difference \bar{x}	Difference SE	95% CI	
								From	To
Demented subjects (134)	59.87	20.91	-8.81	138.5	0.001	-19.53	2.22	-23.91	-15.14
Control group (30)	79.4	7.05							

The degree of significance ($p=0.002$) remains high after correction of the result for age and education (Table 3).

Table 3. Comparison of the mean values of the corrected total score of CERAD in demented and control subjects using independent samples t-test

Groups (count)	\bar{x}	SD(\pm)	t	df	p	Difference \bar{x}	Difference SE	95% CI	
								From	To
Demented subjects (134)	76.24	20.82	-8.31	146.7	0.002	-17.90	2.15	-22.15	-13.64
Control subjects (30)	94.13	6.47							

The area under the ROC curve for the total score of the CERAD battery shows values of 0.988 and 0.986 before and after correction for age and education, respectively. In both cases, there is a statistically significant difference when comparing to the area of 0.5, which reflects the null hypothesis (Figure 1, Table 4).

Fig. 1. ROC-curve for the CERAD battery, raw and corrected total score

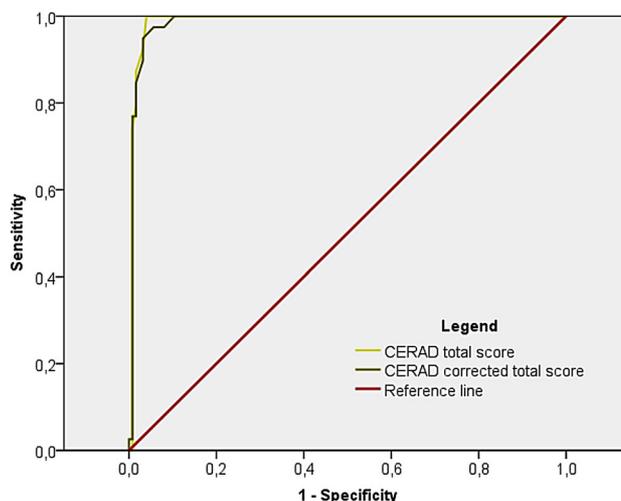


Table 4. Area under the ROC-curve for the CERAD battery, raw and corrected total score

	Area	p	95% CI	
CERAD – raw	0.988	<0.001	0.972	1.000
CERAD – corrected	0.986	<0.001	0.970	1.000

DISCUSSION

In this study, we applied the method for assessment of a total score of the CERAD battery, introduced by Chandler et al. [7]. It allows the result of this verbose neuropsychological assessment to be represented as a single numerical value. The statistically significant difference between the results of demented and control subjects, with and without correction for age and education, support the good ap-

plicability and high informative value of the instrument. The results of ROC analysis demonstrate the high value of the battery for diagnosing dementia.

CONCLUSION:

The availability of a single score for the CERAD battery not only assures a more convenient form for presentation and analysis of the results but can be useful for the establishment of the diagnosis according to respective criteria. Being quick and easy to calculate, the total score should be recommended as a useful addition to the classical method of calculating multiple scores.

Abbreviations:

CERAD - The Consortium to Establish a Registry for Alzheimer's Disease.

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Please cite this article as: Dimitrov I, Aleksandrov I, Ivanov B, Kaprelyan A, Arnaudova M. Application of the total score for the CERAD Battery in Bulgarian demented and control subjects. *J of IMAB*. 2017 Oct-Dec;23(4):1718-1720. DOI: <https://doi.org/10.5272/jimab.2017234.1718>

Received: 29/05/2017; Published online: 16/10/2017



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