

# Edinburgh Cognitive and Behavioral ALS Screen (ECAS)-Italian version: regression based norms and equivalent scores

M. Siciliano<sup>1,2,3</sup>, F. Trojsi<sup>2</sup>, L. Trojano<sup>1,4</sup>, F. Piscopo<sup>1</sup>, A. D'Torio<sup>1</sup>, M. Patrone<sup>1</sup>, G. Basile<sup>1</sup>, C. Femiano<sup>2</sup>, M. Monsurrò<sup>2</sup>, G. Tedeschi<sup>2</sup>, G. Santangelo<sup>1,5</sup>

1. Department of Psychology, Second University of Naples, Caserta 81100, Italy.
2. Department of Medical, Surgical, Neurological, Metabolic and Aging Sciences, Second University of Naples (SUN), Naples 80138, Italy.
3. Department of Neuroscience, Reproductive and Odontostomatologic Sciences, University "Federico II", Naples 80131, Italy.
4. Salvatore Maugeri Foundation, Scientific Institute of Telesse, Telesse Terme 82037 (BN), Italy.
5. IDC-Hermitage-Capodimonte, Naples 80131, Italy.

## Introduction

Cognitive and behavioral changes in Amyotrophic Lateral Sclerosis (ALS) are now recognized as an integral feature of the disease, but the cognitive status of most ALS patients remains unknown because administration of comprehensive neuropsychological batteries or screening tests may not be feasible for patients with severe difficulties with speech, writing and drawing, which are commonly implied in neuropsychological assessment. On the basis of the above considerations, the Edinburgh Cognitive and Behavioural ALS Screen (ECAS) has been recently developed for identifying cognitive and behavioral changes in ALS patients. The present study was designed to provide normative data stratified by age, education and sex in a sample of healthy subjects.

## Methods

ECAS consists of 15 tasks exploring the following cognitive domains: i) executive functions and social cognition, assessed by means of reverse digit span task, alternation task, sentence completion task, and social cognition task; ii) verbal fluency, assessed by verbal fluency task for words beginning with the letter "S", and verbal fluency task for 4-letter words starting with the letter "C"; iii) language, assessed by means of naming, comprehension, and spelling tasks; iv) memory, assessed by means of immediate recall, delayed recall, and delayed recognition tasks; v) visuospatial abilities, assessed by dot counting, cube counting, and number location tasks. We administered the verbal fluency tasks either in spoken (n= 156) or in written version (n= 121), to produce a balanced normative dataset. We selected for the study subjects who had no past or current history of neurologic or psychiatric diseases. Subjects were also excluded from analysis if their adjusted score at the Montreal Cognitive Assessment (MoCA) was lower than or equal to 15.5. Raw scores achieved by participants on the ECAS and its sub-scores were entered into several linear regression analyses in order to check the influence of each demographic variable. Based on results of the best regression model, correction factors were developed to compute the adjusted score for each subject by adding or subtracting the contribution of the concomitant variables from the original score. Since the use of adjusted scores is more informative when it is standardized, we have converted adjusted scores into five-point ordinal scale or Equivalent Scores (ES).

## Results

The influence of age and education was significant for all sub-scores. We computed the correction grid for any combination of age (by 10-year steps), and educational level (according to the Italian schooling system) to allow adjustment of raw scores of newly tested individuals (Table 1). The score interval corresponding to each ES, the density of observations and the cumulative frequency of each ES are shown in Table 2 for ECAS total score, and its sub-scores.

## Conclusions

The present study provided Italian clinicians with normative data for ECAS total score, and its sub-scores, allowing to fully exploiting this tool. Since age and education influence performance on ECAS total score and on sub-scores, specific reference values must be considered in research and clinical contexts.

## References

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**Table 1.** Correction grid for ECAS total score and its sub-scores, according to age, education, and gender.

Education (years)	Age (years)				
	30-39	40-49	50-59	60-69	70-79
<b>ECAS total score</b>					
1 - 5	13.64	15.69	18.15	21.23	25.35
6 - 8	1.65	3.7	6.16	9.24	13.36
9 - 13	-6.64	-4.59	-2.14	0.93	5.05
>13	-	-12.36	-9.90	-6.82	-2.70
	14.41				
<b>ALS-SPECIFIC</b>					
1 - 5	10.97	12.56	14.47	16.87	20.07
6 - 8	1.42	3.01	4.92	7.32	10.52
9 - 13	-5.19	-3.6	-1.68	0.7	3.9
>13	-	-9.78	-7.87	-5.47	-2.27
	11.37				
<b>ALS NON-SPECIFIC</b>					
1 - 5	2.55	3.03	3.60	4.31	5.27
6 - 8	0.16	0.63	1.2	1.92	2.87
9 - 13	-1.5	-1.02	-0.45	0.25	1.21
> 13	-3.05	-2.57	-2	-1.29	-0.33

**Table 2.** Equivalent scores (ES) for adjusted values on Edinburgh Cognitive and Behavioural ALS Screen (ECAS) total score, and its sub-scores.

ES	Interval	Cumulative frequency	Density
<b>ECAS total score</b>			
0	≤67.91	8	8
1	67.92-84.2	28	20
2	84.3-94.52	73	45
3	94.53-103.83	139	66
4	>103.83	277	138
<b>ALS-SPECIFIC</b>			
0	≤47.94	8	8
1	47.95-60.6	28	20
2	60.7-70.15	73	45
3	70.16-77.59	139	66
4	>77.59	277	138
<b>ALS NON-SPECIFIC</b>			
0	≤15.6	8	8
1	15.61-20.97	28	20
2	20.98-24.16	73	45
3	24.17-26.67	139	66
4	>26.67	277	138