

# A new tool for evaluation of Cognitive Reserve: validation of the Italian Version of Cognitive Reserve Scale

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**Introduction:** The concept of Cognitive Reserve (CR) provides an explanation for differences between individuals in susceptibility to age-related brain changes or pathology related to Alzheimer's disease, whereby some people can tolerate more of these changes than others and maintain function. Individuals with higher CR are more able to cope with cerebral impairment than ones with a lower CR. Taking into account abovementioned assumptions, evaluating CR becomes relevant in clinical routine using an instrument, which allows investigating the frequency of participation in brain-stimulating activities across the lifetime. The aim was to investigate psychometric properties of the Italian version of the Cognitive Reserve Scale (I-CRS) (Leon et al., 2011), which measures how much individuals engage in stimulating cognitive activities throughout their lifetime.

**Results:** The internal consistency of the I-CRS was high (Cronbach's alpha= 0.73). The I-CRS score correlated significantly and moderately with educational years ( $r=0.340$ ;  $p<0.0001$ ) and DAS score ( $r=-0.319$ ;  $p<0.05$ ). Significant and poor association between I-CRS score and MMSE ( $r=0.175$ ;  $p<0.001$ ), MoCA ( $r=0.200$ ;  $p<0.001$ ), ACM ( $r=0.187$ ;  $p<0.001$ ), Im-RAVLT ( $r=0.251$ ;  $p<0.001$ ), Del-RAVLT ( $r=0.250$ ;  $p<0.001$ ), BDI-II ( $r=-0.113$ ;  $p<0.05$ ) scores were found. As for gender, women ( $n=281$ ) had significantly higher mean scores on CRS than man ( $n=278$ ;  $F=26.13$ ;  $p<0.001$ ). Significant association was found between CRS score and age ( $F=15.42$ ;  $p<0.001$ ): elderly had lower mean scores than young adults and adults, but no difference was found between young adults and adults. Subjects with high level of education ( $>8$  years) had higher mean scores on CRS than subjects with low level of education ( $<8$  years;  $F=49.1$   $p<0.001$ ). Participants with high occupational attainment had higher I-CRS scores than individuals with low occupational attainment ( $F=7.18$ ;  $p=0.001$ ).

**Conclusions:** The I-CRS is a reliable tool for measuring CR. Socio-demographic characteristics (i.e., gender, age, educational level and occupational attainment) are associated with I-CRS scores. The positive association between I-CRS and cognitive variables supported the active model of CR, which postulated that high cognitive reserve allows subjects to solve more successfully cognitive tasks.

**Methods:** A sample of 559 healthy subjects underwent the I-CRS; subjects have to complete each one several times, according to their age, because the CRS was divided into three different life stages (young adulthood: 18-35; adulthood: 36-64; late adulthood:  $>65$ ). All subjects underwent Mini Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), Immediate and delayed recall of Rey Auditory Verbal Learning Test (Im- and Del-RAVLT, respectively), Constructional apraxia test (ACM), Dimensional Apathy Scale (DAS), Beck Depression Inventory II (BDI-II).

## Correlation between I-CRS and sociodemographic, cognitive and behavioural variables

Test	Means $\pm$ d.s.	R	p
Age (years)	49.26 $\pm$ 20.3	-0.214	< 0.001
Gender		0.212	< 0.001
Educational level (years)	12.8 $\pm$ 4.7	0.340	< 0.001
Years of job	19.53 $\pm$ 17.51	0.340	< 0.001
Main job	1.92 $\pm$ 1.38	0.77	0.070
MMSE	28.8 $\pm$ 1.58	0.175	<0.001
MOCA	25.6 $\pm$ 3.5	0.293	<0.001
ACM	13.16	0.187	<0.001
RAVLT-immediate	45.3 $\pm$ 12.6	0.251	<0.001
RAVLT-delayed	10.8 $\pm$ 3.5	0.250	<0.001
BDI-I	10.7 $\pm$ 10.8	-0.126	>0.05
BDI-II	10.1 $\pm$ 8.7	-0.113	<0.05
DAS	22.7 $\pm$ 8.9	-0.319	<0.001

MMSE: Mini Mental State Examination; MOCA: Montreal Cognitive Assessment; ACM: Constructional apraxia test; RAVLT: Rey Auditory Verbal Learning Test; BDI: Beck Depression Inventory; DAS: Dimensional Apathy Scale.

## ANOVA: I-CRS and age

Age (years)	N	Means $\pm$ ds	F	p
18-35	191	51.9 $\pm$ 9.4	15.42	< 0.001
36-64	181	51.38 $\pm$ 11.6		
$\geq 65$	187	49.58 $\pm$ 10.89		

## ANOVA: I-CRS and gender

Gender	N	Means $\pm$ ds	F	p
Maschi	278	47.2 $\pm$ 11.04	26.1	<0.001
Femmine	281	51.8 $\pm$ 10.26		

## ANOVA: I-CRS and main jobs

Main jobs	N	Means $\pm$ d.s.	F	p
High	92	49.5 $\pm$ 10.2	7.18	0.001
Medium	92	49.8 $\pm$ 10.5		
Low	371	48.5 $\pm$ 10.9		

**References:** Leon I, Garcia-Garcia J, Roldan-Tapia L (2014) Estimating Cognitive Reserve in Healthy Adults Using the Cognitive Reserve Scale. PLoS ONE 9(7): e102632. doi:10.1371/journal.pone.0102632