Adaptation of the Cognitive Reserve Index Questionnaire (CRIq) for the Greek population

Neurol Sci
DOI 10.1007/s10072-015-2457-x

BRIEF COMMUNICATION

Adaptation of the Cognitive Reserve Index Questionnaire (CRIq) for the Greek population

Pantelis Maiovis[1] · Panagiotis Ioannidis[1] · Massimo Nucci[2] · Anna Gotzamani-Psarrakou[3] · Dimitrios Karacostas[1]

Received: 27 September 2015 / Accepted: 16 December 2015

Abstract Cognitive reserve (CR) is thought to reflect the cumulative brain potential derived from various cognitively demanding activities throughout the entire life. It seems to mediate both one's cognitive performance and clinical expression of different brain pathologies, such as Alzheimer's disease. Many researchers have tried to assess CR by using proxies, such as educational and occupational level, participation in leisure time activities and intelligence, alone or in various combinations. Recently, a new tool for measuring CR status was constructed, the Cognitive Reserve Index questionnaire (CRIq), comprising of all known CR proxies. CRIq also takes into account the amount of time spent during each of these activities, thus capturing the core idea behind CR theory: its active day to day formulation during all age stages. Aim of the present study was to adapt CRIq for the Greek population. The questionnaire was administered to 591 participants (age range 18–89) stratified in three age groups (young adults, middle-aged, elderly). The middle-aged group showed higher total CRI as well as CRI-Education, CRI-WorkingActivity and CRI-LeisureTime scores compared to both other groups, reflecting more years of engagement in all activities. Gender also influenced CRI scores, with men scoring higher than women, again resulting from historical and social perspectives. Overall, the CRIq showed satisfactory internal consistency, was easy to administer and its adaptation process provided solid and interpretable results. The Greek version of CRIq enriches existing dementia research methodology and allows for valid results in an ever growing field.

Keywords Cognitive reserve · Dementia · Education · Cognitive Reserve Index questionnaire

Introduction

Cognitive reserve (CR) is a theoretical concept increasingly studied in current research [1]. In contrast to brain reserve which reflects a more passive model, CR is believed to represent the cumulative brain potential or flexibility derived from participation in diverse cognitively demanding activities along a person's lifespan [2]. It also seems to mediate both one's cognitive performance and the clinical expression of various brain pathologies, mostly Alzheimer's disease (AD) [3]. Many studies have shown that high cognitive reserve could delay AD onset or modify the correlation between AD burden in the brain and clinical severity of the disease [4].

As CR is by definition a theoretical construct, it can only be assessed by proxies, such as educational level, occupational experience, participation in leisure activities or premorbid intelligence. Various researchers have utilised these proxies alone or in combinations resulting in methodological difficulties comparing and generalising studies' results [5]. Recently, to overcome these problems, Nucci et al. constructed and standardised Cognitive Reserve Index Questionnaire (CRIq) as a means of measuring a person's CR [6] (the CRIq in various

✉ Pantelis Maiovis
panmaio@hotmail.com

1 B Department of Neurology, AHEPA University Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece

2 Department of General Psychology, University of Padova, Padova, Italy

3 B Laboratory of Nuclear Medicine, AHEPA University Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece

Published online: 28 December 2015

languages, administration instructions and a file for automatic calculation of scores can be assessed at http://cri.psy.unipd.it). The CRIq encompasses all three possible sources of CR, namely education, working activity and participation in cognitively demanding activities, and provides an index, that is, a total CR score. Furthermore, CRIq takes into account the amount of time spent on each activity of interest. Indeed, recent research indicates that CR is shaped during an active day to day procedure with cumulative effects throughout a person's entire life [3].

In the present study, we aimed to adapt CRIq for the Greek population, as it appears to be an easy and comprehensive tool for measuring one's CR status.

Methods

Participants and procedures

We translated the CRIq into Greek and also conducted a back translation by a bilingual person. CRIq comprises of three sections, education (years of formal and informal education), working activity (years and level of professional occupation) and leisure time (years of frequent attainment of various activities such as driving, reading books or travelling). The questionnaire was administered to 591 participants (age range 18–89, $M = 45.97$, SD = 20.69) (388 female, 65.7 %), in a random selection from as many Greek regions as possible. Participants' exclusion criteria accounted only for major neurologic or psychiatric disorders. We used the same classification scheme as the original paper, dividing our sample in the young adults group (18–44 years old) ($n = 313$, $M = 28.78$, SD = 7.74), the middle-aged group (45–69 years old) ($n = 148$, $M = 56.12$, SD = 7.22) and the elderly group (70–89 years old) ($n = 130$, $M = 75.82$, SD = 4.55).

Statistical

The raw scores of the three sections of the CRIq (namely CRI-Education raw, CRI-WorkingActivity raw, CRI-LeisureTime raw) were strongly correlated with age ($r = -0.639$ for education, $r = 0.506$ for working activity and $r = 0.557$ for leisure time). We accounted for this age effect by standardising raw subscores using linear models with each subscore as the dependent variable and age as the predictor variable, thus providing standardised CRIq scores for each section and for the total CRIq score (CRI) (transposed at a scale with $M = 100$, SD = 15). CRI total scores were classified into five levels: low (<70), medium low (70–84), medium (85–114), medium high (115–130, high (>130) (Table 1). Differences between groups were examined using t tests or ANOVA's with Bonferroni correction for multiple post hoc comparisons. All statistical analyses were conducted using SPSS 20.0.

Results

Among the 591 participants of the study, there were no subjects with a low CRI score (Table 1). CRI-Education raw score was higher in the young adults group ($M = 26.19$, SD = 7.79) than the middle-aged ($M = 18.71$, SD = 7.27) and the elderly group ($M = 7.39$, SD = 6.39). The most frequently recorded occupation level was professional work (28.6 % of the total sample, 39 % of the young adults group), while in particular, the middle-aged and the elderly group reported skilled and unskilled manual work more frequently (47 and 65 %, respectively). As for the leisure time section, "using new technologies", "household tasks" and "social life" were among the most frequently reported activities. There were also gender differences, with women showing slightly higher CRI-Education raw score but much lower CRI-WorkingActivity and CRI-LeisureTime raw scores (Table 2).

Table 1 Classification of CRI score categories according to age group and gender

CRI	Age group											
	Young adults				Middle-aged				Elderly			
	Female		Male		Female		Male		Female		Male	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Low	0	0	0	0	0	0	0	0	0	0	0	0
Medium low	18	7.9	1	1.2	6	7.5	0	0	40	50	26	52
Medium	194	85.1	69	81.2	53	66.3	49	72.1	39	48.8	11	22
Medium high	15	6.6	13	15.3	12	15	13	19.1	1	1.3	5	10
High	1	0.4	2	2.4	9	11.3	6	8.8	0	0	8	16

CRI cognitive reserve index score

Table 2 Classification of CRI-Education, CRI-WorkingActivity and CRI-LeisureTime raw scores according to gender

	Female		Male	
	M	SD	*M*	SD
CRI-Edu raw	20.65	10.28	19.3	10.84
CRI-Work raw	38.98	37.43	70.37	49.43
CRI-Leis raw	133.71	85.08	191.66	97.93

CRI cognitive reserve index, *CRI-Edu raw* CRI-Education raw score, *CRI-Work raw* CRI-WorkingActivity raw score, *CRI-Leis raw* CRI-LeisureTime raw score

Total CRI score correlated strongly with all three subscores ($r = 0.776$, 0.844, 0.785 for the correlations with CRI-Education, CRI-WorkingActivity and CRI-LeisureTime respectively). On the contrary, inter-subscores correlations were low (CRI-Education–CRI-WorkingActivity $r = 0.506$, CRI-Education–CRI-LeisureTime $r = 0.362$, CRI-WorkingActivity–CRI-LeisureTime $r = 0.528$).

Age significantly influenced both total CRI scores and each particular subscore (Table 3). The middle-aged group showed higher CRI score ($M = 109.53$, SD = 15.01) compared to the young ($M = 99.41$, SD = 11.47) and the elderly group ($M = 90.62$, SD = 16.12) ($F = 34.8$, $p < 0.01$-all post hoc comparisons significant at the 0.05 level). The middle-aged group also showed higher CRI-Education ($F = 6.43$, $p < 0.05$), CRI-WorkingActivity ($F = 43.52$, $p < 0.01$) and CRI-LeisureTime subscores ($F = 26.47$, $p < 0.01$) compared to the other two age groups (all post hoc comparisons within groups significant at the 0.05 level). This age interaction accounted for a substantial amount of the CRI and CRI subscores variance (eta-squared from 4.8 to 22 %).

CRI scores and subscores were also differentiated according to gender (Table 3). Among all participants, men showed higher CRI ($t = 5.9$, $p < 0.01$), CRI-Education ($t = 2.54$, $p < 0.01$), CRI-WorkingActivity ($t = 6.11$, $p < 0.01$) and CRI-LeisureTime scores ($t = 4.92$, $p < 0.01$) than women, although this effect was weaker in the middle-aged group, where only CRI-WorkingActivity interacted with gender ($t = 2.628$, $p = 0.009$).

Discussion

In this study, we present results of the adaptation of the CRIq in Greece. All three original sections were included and scores were calculated after proper standardisation for the Greek population. The size of the sample was comparable to the original Italian one, and as representative as possible given its convenience nature.

CRI correlated strongly with each subscore, while inter-subscore correlations were low to modest, indicating that

Table 3 Classification of total CRI score and CRI subscores according to age group and gender

Age group	Young adults			Middle-aged			Elderly		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
CRI-Edu M(SD)	98.78 (17.13)	106.34 (14.90)	100.83 (16.87)	104.39 (13.06)	102.12 (10.14)	103.34 (11.82)	93.59 (8.23)	95.04 (15.41)	94.15 (11.5)
CRI-Work M(SD)	97.99 (7.9)	102.45 (12.1)	99.20 (9.42)	104.34 (20.65)	112.38 (15.74)	108.03 (18.93)	87.44 (9.29)	100.94 (21.78)	92.63 (16.63)
CRI-Leis M(SD)	97.14 (7.94)	101.98 (12.07)	98.46 (9.47)	110.45 (15.4)	112.84 (16.16)	111.55 (15.75)	86.76 (15.67)	96.64 (17)	90.56 (16.83)
CRI M(SD)	97.52 (10.86)	104.47 (11.58)	99.41 (11.47)	108.02 (17.15)	111.29 (11.91)	109.53 (15.01)	86.68 (9.93)	96.94 (21.43)	90.62 (16.12)

CRI cognitive reserve index score, *CRI-Edu* CRI-Education score, *CRI-Work* CRI-WorkingActivity score, *CRI-Leis* CRI-LeisureTime score

the three sections of the CRIq gathered rather distinct information and all contributed meaningfully to the total CRI score.

The middle-aged group showed statistically higher scores in all indices, reflecting the effect of greater time spent in educational, occupational or leisure time activities compared to younger people. Elderly people on the other hand showed the lowest score in all indices, as their educational and occupational level was substantially lower, due to intrinsic social and historical factors. Furthermore, the abovementioned factors as well as physical health decline could explain lower engagement of the elderly in leisure time activities.

Finally, men exhibited higher CRI score than women due to greater occupational and leisure time activities engagement, again reflecting social and occupational differences.

Overall, CRIq was easy to administer, showed satisfactory internal consistency and provided interpretable results inside the context of the Greek society, comparable with those of the Italian study, as both countries share a largely common historical and socioeconomic background. Its ability to gather information from all three potential CR sources in a way that takes into account the amount of time spent and the frequency of each activity, gives CRIq an advantage over previously applied CR proxies. CRIq especially captures the core idea behind CR construction: its' active and continuous formulation, thus consisting of a dynamic tool, easily applied to all ages. The Greek version of CRIq, with the standardisation process used, allows for future valid research results in Greece in the ever growing dementia prevention area.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Stern Y (2009) Cognitive reserve. Neuropsychologia 47:2015–2028
2. Stern Y (2002) What is cognitive reserve? Theory and research application of the reserve concept. J Int Neuropsychol Soc 8:448–460
3. Stern Y (2012) Cognitive reserve in ageing and Alzheimer's disease. Lancet Neurol 11:1006–1012
4. Valenzuela MJ, Sachdev P (2006) Brain reserve and dementia : a systematic review. Psychol Med 36:441–454
5. Nucci M, Mapelli D, Mondini S (2012) The Cognitive Reserve questionnaire (CRIq): a new instrument for measuring the cognitive reserve. Aging Clin Exp Res 24:218–226
6. Jones RN, Manly J, Glymour MM, Rentz DM, Jefferson AL, Stern Y (2011) Conceptual and measurement challenges in research on cognitive reserve. J Int Neuropsychol Soc 17:593–601