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Cognitive rehabilitation therapy after acquired brain injury in Argentina: Psychosocial outcomes in connection with the time elapsed before treatment initiation

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Abstract

Primary objective: To examine the effect of cognitive rehabilitation therapy (CRT) on psychosocial outcomes in Argentinean patients with acquired brain injury (ABI), in connection with the time elapsed between injury and treatment initiation.
Research design: Self-reported data from patients in a naturalistic setting was collected before and after CRT.
Methods and procedure: An outpatient sample of 75 Spanish-speaking patients with cognitive disturbances secondary to ABI (49 male/26 female, age: 50.2 ± 20.1 years; education 14.3 ± 3.2 years) completed a set of scales on their daily living activities, memory self-perception, quality-of-life and mood. Single and multi-group analyses were conducted, considering pre- and post- responses and the time elapsed between injury and treatment initiation. The influence of socio-demographic moderators was controlled during comparisons.
Main results: Results suggest an improvement in several psychosocial indicators after treatment. Additionally, correlations and group comparisons showed greater improvement in subjective memory and quality-of-life self-reports in patients who began treatment earlier than those who began treatment after a longer time period.
Conclusions: Overall, results suggest that CRT is associated with positive results in different areas of the psychosocial domain and that post-injury time can mediate this effect.

Keywords

Acquired brain injury, cognitive rehabilitation, post-injury time, psychosocial outcomes

History

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Introduction

Cognitive deficits following acquired brain injury (ABI) can have an adverse impact on the global functioning, self-perception and coping strategies of patients [1]. The health community has shown an increasing interest in examining the impact of cognitive rehabilitation treatments on different aspects of the daily life of patients, including psychosocial, functional and other broad health-related domains.

Cognitive rehabilitation stands as a non-pharmacological treatment option for patients with acquired cognitive deficits. Providing neuropsychological intervention is important, given that current pharmacological treatments are considered mostly symptomatic therapeutic options with modest improvements in cognitive and behavioural scales [2–4]. Cognitive Rehabilitation Therapy (CRT) refers to a wide group of activities and techniques designed to retrain higher brain functions and compensate deficits with newly-acquired strategies [5]. According to Tsaousides and Gordon [6], the goal of CRT is to improve the ability of the person to perform cognitive tasks, but also to enhance psychosocial functioning, by helping to 'cope with affective distress, and increase self-confidence, self-efficacy, and self-awareness' (p. 173). Interventions within CRT involve specific and non-specific means of increasing cognitive and psychosocial performance, like 'brain jogging', solving specific daily-life activities (e.g. learning the name of a new caregiver) or educating patients in strategies and skills in order to optimize functioning (e.g. mnemotechnics) [7, 8]. CRT lays on the intrinsic property of the brain to adapt to different situations and contextual needs, creating dynamic changes at the micro-structural, neuronal and network levels of the nervous system [9]. These adjustments can occur as a physiological consequence of normal psychological processes, such as learning; and it is assumed that they can be helpful in cases of loss of neuron function or brain damage [10, 11].

Recent systematic reviews of evidence-based literature concerning CRT after ABI have found statistically significant improvements with this therapy, especially in patients with traumatic brain injury (TBI) or stroke [12–14]. CRT has become a standard healthcare practice after ABI and practice guidelines have been developed in order to empirically support cognitive impairment treatments. However, the existing scientific evidence has pointed out the need to further analyse the potential moderators of treatment outcomes in this group of patients, as well as the impact of

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this type of interventions on global health indicators, such as the perceived quality-of-life or mood [12, 13].

In this setting, the role of time since injury in patients with ABI undergoing CRT requires further examination. Post-injury time before treatment initiation is identified as a moderating factor of CRT outcomes [5]. Some studies have shown the benefits of early post-acute rehabilitation in comparison with later rehabilitation [15, 16]. However, the idea that changes attributed to cognitive interventions are restricted to a critical time after injury is questionable. According to the latest review by Cicerone et al. [12], several Class I studies have found significant effects of cognitive intervention in patients at least 1 year after injury [17–19] and even at an average of 4 years after injury [20]. In their meta-analysis, Rohling et al. [13] found that studies examining patients with post-injury lapses of less than 1 year presented with a moderate treatment effect, whereas studies examining patients with post-injury lapses of more than 1 year yielded a small but significant effect.

Many factors may confound the specific influence of time on the effects of CRT. On the one hand, individual variables, such as aetiology, age, gender, severity of injury and differences in spontaneous recovery can moderate results [12]. In addition, different functions may show different recovery rates and some of them may improve even years after damage [21]. On the other hand, problems that may influence CRT adherence and outcomes—such as emotional disturbance and mood disorders—have been pointed out as long-term rather than short-term consequences of ABI [22].

At the same time, as it was mentioned, the goal of CRT extends to enhancing psychosocial functioning, handling distress and increasing self-efficacy [6]. Thus, when assessing the impact of CRT on patients, it is necessary to focus on testing changes in cognitive functions, but also on other clinically relevant outcomes, such as self-perception, social participation and daily functioning. In accordance to the latest systematic reviews, comparatively, more ecological indicators are needed [12]. Therefore, providing large-scale group evidence of global benefits in functional, psychosocial and quality-of-life dimensions could help to better determine the influence of CRT on broad health-related outcomes in patients with ABI.

Taking this into consideration, the aim of this study was to examine the association between CRT and a set of functional and psychosocial variables, assessed in Spanish-speaking patients with cognitive disorders following ABI, in connection with the time elapsed before treatment initiation. The study sample was recruited from Argentina, a population that is under-represented in the research on cognitive rehabilitation.

Method

Participants

An initial sample of 138 patients with cognitive difficulties secondary to ABI was considered for eligibility. Patients participated in comprehensive, post-acute, outpatient CRT at the Neurocognitive Rehabilitation Section of INEBA (Instituto de Neurociencias de Buenos Aires), Argentina. None of the patients had undergone CRT before. Patients began treatment between August 2007 and July 2012. This initial sample ($n = 138$) equalled the total number of patients referred and admitted to the outpatient CRT programme from August 2007 through July 2012 that met the inclusion criteria. Criteria for inclusion included: having a history of ABI and a reliable caregiver to provide information about the patient's clinical history, neuroimages (Computed Tomography Scan or Magnetic Resonance Imaging) consistent with ABI, results of serological laboratory tests without clinically relevant alterations, stable medical, cognitive and behavioural patient condition and absence of changes in drug dosing for cognitive and behavioural symptoms during the rehabilitation programme Only participants that completed follow-up (i.e. those who completed therapy and pre-/post-assessment) and had a maximum time of 54 months between injury and CRT initiation were considered for analyses. The final sample consisted of 75 patients (49 male/26 female, age (Mean ± SD) = 50.2 ± 20.1 years; education = 14.3 ± 3.2 years; Mini-Mental State Examination (MMSE) initial score = 26.2 ± 3.2). ABI aetiologies included stroke ($n = 48$), TBI ($n = 17$) and other aetiologies ($n = 10$, see Figure 1). Similarity in the distribution of other moderators, such as age, gender and severity of damage was analysed in order to determine equality across groups. All participants voluntarily agreed to take part in the study and gave written informed consent in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki. Figure 1 represents the composition of the final sample of participants by aetiology. Table I shows patients' socio-demographic data.

Intervention

CRT consisted of 1-hour sessions of individual treatment with a neuropsychologist, 2 or 3 days a week. Intervention duration ranged from 9–14 weeks, depending on the number of sessions and the amount of days per week assigned to each patient. Frequency and intensity of therapy for each participant were clinically determined and individually adapted based on a previous complete neurological, behavioural and functional assessment and a comprehensive neuropsychological evaluation of the patient, including a global cognitive measure (MMSE) and the assessment of specific cognitive functioning, such as episodic and semantic memory, language, attention, executive function, reasoning and visuo-spatial abilities.

The intervention programme was designed to increase cognitive and social functioning by specific and non-specific strategies. Activities were designed to repeatedly work out the impaired cognitive capacities of each patient under different conditions. Episodic memory encoding strategies which rely on visual imagery, compensatory memory strategy training, visual scanning training, problem-solving skills and fluency techniques were used. The intervention included cognitive rehabilitation exercises and psycho-education techniques on relevant topics, such as executive control of cognitive processes involved in task switching and memory and attention functioning and also the incorporation of strategies to improve meta-cognition (i.e. participants' knowledge

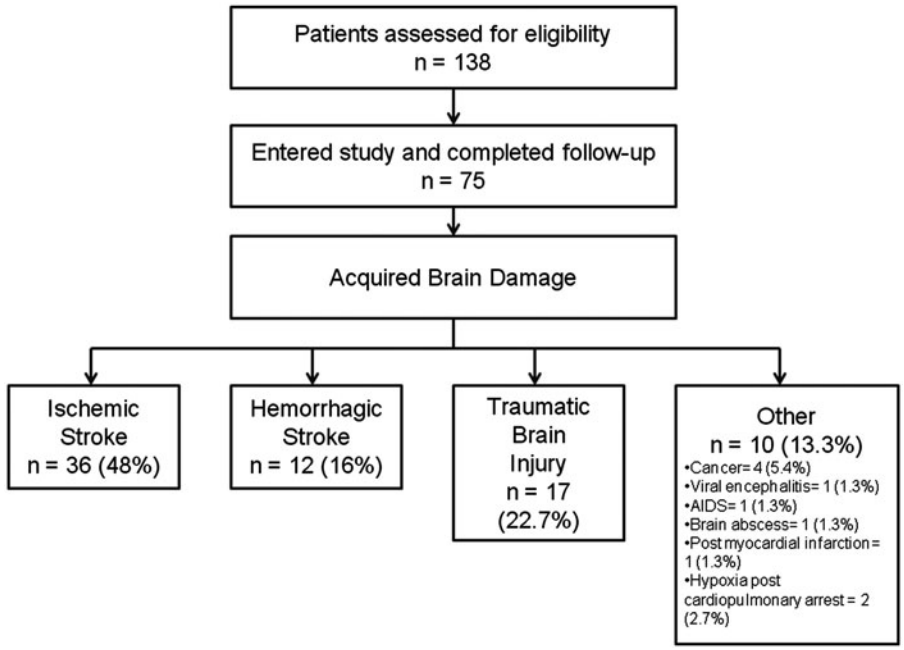

Figure 1. Sample composition and occurrence (%) by aetiology.

Table I. Socio-demographic data.

	Total	Ischaemic stroke	Haemorrhagic stroke	TBI	Others	*p*
n (%)	75 (100)	36 (48)	12 (16)	17 (22.7)	10 (13.3)	
Gender (F/M)	26/49	13/23	3/9	3/14	3/7	
Age (years)	50.2 (SD 20.15)	63.3 ± 15.9	45.9 ± 15.5	30.52 ± 11.6	41.6 ± 16.8	0.0001[a,b]
Education (years)	14.3 (SD 3.2)	14.4 ± 3.3	15 ± 2.8	14.4 ± 3.2	13.2 ± 3.5	0.79[c]
Number of sessions	27.6 (SD 9.5)	24.8 ± 8.6	30 ± 8.8	28.9 ± 9.1	32.6 ± 12.1	0.08[c]
Initial MMSE	26.2 (SD 3.2)	26.6 ± 2.5	25.2 ± 3.7	26.9 ± 3.1	24.6 ± 4.5	0.36[c]

Age, education, initial MMSE and number of sessions results expressed as mean ± standard deviation.
[a]ANOVA.
[b]Post-hoc Bonferroni: Ischemic *vs.* Haemorrhagic ($p = 0.006$), *vs.* TBI ($p = 0.0001$) and *vs.* Others ($p = 0.001$). Other comparisons: $p > 0.05$.
[c]Kruskal-Wallis *H* test.

on cognitive processes such as memory or attention) and cognitive self-efficacy (i.e. the notion that participants can exert different types of control over their cognition). Training also included providing instructions on how to use the strategies in daily life, monitoring eventual therapeutic gains in everyday activities and promoting the use of external aids (i.e. calendars, agendas, routines, checklists). For each set of exercises, three levels of difficulty progression were outlined. For the psycho-education tasks, slides with simple definitions, strategies and suggestions on how to incorporate them into the patients' daily life were used.

Although the intervention included three different stages of activities, the treatment plan was targeted at each participant's specific areas of impaired cognitive functioning, in line with current cognitive rehabilitation guidelines [12]. Thus, the duration of each patient in each treatment stage, as well as the frequency of a certain type of exercise could vary depending on the clinical needs of each case. During an initial stage, patients were provided with selective and sustained attention, simple episodic memory (recall of short, simple narratives) and fluency exercises. This approach was most often used for improving elementary domains of cognition, such as useful memory, language fluency and attention. During the middle stage, exercises aimed to promote episodic memory encoding strategies which rely on visual imagery (e.g. mnemotechnics), compensatory memory strategy training (e.g. external aids), visual scanning training and training in problem-solving and executive control were used, while continuing to exercise elementary cognitive domains. In the final stage, the intervention focused on psycho-educating patients to increase their knowledge on cognitive functions, monitor their cognitive difficulties and try to exert some control over their cognition by generalizing the results and monitoring eventual therapeutic gains in everyday activities.

Pre-/post-CRT measures

Patients' responses to a group of tests administered before and after treatment, aimed at assessing patients' own perceptions of their memory problems, daily functioning, mood (anxiety and depression) and quality-of-life were collected. Functional, cognitive and quality-of-life indicators were assessed with a group of questionnaires and scales, specifically selected for the present study. All questionnaires presented a self-administration format, but a neuropsychologist monitored and assisted the participant during completion, in order to ensure an adequate understanding of the items and answer options. The neuropsychologists who monitored and assisted the

patients in the completion of the questionnaires were different from the neuropsychologists who were involved in the CRT sessions.

The following questionnaires were used:

- Subjective Memory Questionnaire (SMQ; *Cuestionario de Olvidos Cotidianos*) [23]: Spanish adaptation of the Questionnaire d'Auto-evaluation de la Memoire [24]. The goal of this questionnaire is to assess everyday memory complaints. It consists of 68 questions that examine difficulties in remembering information associated with nine areas: recent conversations (Conversations); movies and books (Movies); common distractions (Distractions); faces, names and details of familiar people (People); handling new objects (Uses); socio-historical events (News); places and spatial information (Places); prospective activities (Actions); and autobiographical information (Personal Life). Additionally, the questionnaire includes two questions to assess memory difficulties in a broad sense (Global Difficulties). Each question provides six answer options on a Likert scale format (never, rarely, sometimes, quite often, very frequently and always). The maximum score for each area varies, as does the number of questions in each area. SMQ has been previously used within Spanish-speaking communities to examine memory complaints in neuropsychological patients [25, 26].
- World Health Organization Quality of Life Brief Evaluation Instrument [27]: this questionnaire assesses the self-perceived quality-of-life and is a shorter version of the original instrument [28]. It consists of 26 items, which measure the following broad health domains: Physical, Psychological, Social Relationships and Environment. Additionally, it includes two broad questions, which can be considered a fifth domain: General Health. Instructions ask to select between five answer options, which vary in frequency and which are presented on a Likert scale. Higher scores indicate better quality-of-life.
- Basic Activities of Daily Living Scale–Adapted version [29–31]: this scale was originally designed by Katz et al. [30] and assesses different basic aspects of the activities of daily living, namely bathing, dressing, toileting, transferring, continence and feeding. In this work a modified extended version was used, in which each activity is rated on a Likert scale from 0–4. The sum of all items is used to describe ADL activities, ranging from 0 (dependent) to 24 (totally independent).
- Instrumental Activities of Daily Living Scale–Short version (IADLS): this scale assesses independent living skills [32]. These skills are considered different from the basic activities measured by the BADLS, since they focus on the individual's functional skills necessary to live in the community. The scale consists of five items that examine different functional areas (use of phone, transportation, shopping, ability to handle money and responsibility for own medications). Instructions ask to rate the level of autonomous functioning. Individual item scores range on a scale from 2 (low function, dependent) to 0 (high function, independent). Total score ranges from 0–10.
- Beck Depression Inventory (BDI): this scale evaluates the presence and severity of a wide spectrum of depression symptoms. The questionnaire consists of 21 groups of statements with four descriptors from where to choose. Descriptors depict symptom intensity on a severity scale ranging from low to high. For each item, the patient is asked to select the descriptor that better reflects his or her mood in the last 7 days. Individual item scores range from 0–3. Total score ranges from 0–63 (0–9: No Depression; 10–15: Mild; 16–24: Moderate; 25–63: Severe). BDI has been previously used for assessing mood in patients with ABI, proving to be an effective screening tool for self-reported symptoms of depression following brain injury [33, 34].
- Hospital Anxiety and Depression Scale (HADS): this scale, developed to assess the levels of depression, anxiety and emotional distress felt by patients under clinical treatment [35], consists of 14 items that examine symptom frequency and severity, with responses scored on a scale ranging between 0 (low) and 3 (high). Items are split into two sub-scales (anxiety–HADA and depression–HADD) that range from 0–21, with higher scores indicating an increase in the severity of self-perceived symptoms (0–7: normal; 8–10: mild; 11–14: moderate; 15–21: severe). Patients are asked to answer on the basis of how they felt during the past week.
- Visual-Analogue Scale: this scale aims at assessing the patient's level of complaint regarding his or her cognitive deficits. It consists of one question (How much do your cognitive symptoms bother you?) and a continuous line, ranging from 0 (Nothing) to 9 (I can't bear them). Patient is asked to choose one point in the continuum.

Procedure

Patients were asked to complete the scales on cognitive, functional and quality-of-life areas, before and after CRT. The administration of the complete set of questionnaires took between 60–90 minutes and it was split into 2 days, both at baseline and end-point assessments.

Statistical analysis

Data were analysed with the Statistical Package for Social Sciences (SPSS), version 14 for Windows. Means, standard deviations, medians and ranges were calculated for quantitative variables and the distribution of frequencies was obtained for qualitative variables. All significant p values are less than 0.05.

Demographic and clinical information (age, education, number of sessions and initial MMSE) was initially grouped and screened by aetiology with one-way ANOVA or Kruskal-Wallis H tests, depending on the fit of the distributions to the normality assumption. Post-hoc tests using the Bonferroni adjustment were used to further analyse the significant main effect found by aetiology on age.

In order to determine CRT effects on the sample of ABI patients, two sets of analyses were conducted. The first set focused on the sample as a single group. Wilcoxon Signed Ranks tests were conducted to compare the raw scores of each

scale in baseline (pre-) and end-point (post-) assessments. The number of participants ($n = 75$) may vary in the analysis of one scale to another, due to failure to complete the scales post-therapy (sample sizes are reported in all cases).

The second set of analyses focused on the examination of the influence of time since injury as a moderator of results. The difference between the rates of the first and last assessment for each scale was calculated and used as an indicator of pre-/post-CRT change in participants' responses. Time since injury was computed in months. In order to identify a preliminary association, correlation coefficients between time and pre-/post-CRT differences were calculated. Kolmogorov-Smirnov normality test showed that distributions were outside the limits of normality ($p < 0.05$). Accordingly, a non-parametric procedure, the Spearman's rank order correlation coefficient (i.e. Spearman's rho), was performed to address any potential associations.

Then, two comparisons of scores were conducted by splitting the sample into groups. The first comparison split the sample into patients with less or more than 1 year lapsing between ABI and CRT initiation ($\leq$12 months vs. >12 months), whereas the second comparison contrasted only the groups representing the extreme quartiles of time since injury ($\leq$5 months vs. >30 months, see Table II for the descriptive statistics). Before drawing these comparisons, the groups were analysed according to their socio-demographic characteristics (gender, age, level of education and severity), in order to determine their similarity as well as any potential confounding variables. The association between gender and group was tested with a Chi-square independence test. Differences in age (years), level of education (stratified in four levels) and severity (MMSE initial scores) by group were analysed with Mann-Whitney tests. These preliminary analyses revealed a significant difference among groups by age (see results below). Therefore, it was decided to compare participants grouped by time since injury via one-way analyses of covariance (ANCOVA) on the pre-/post-CRT differences, with group as factor and age as covariate. Although most of the distributions did not respond to normality, the decision to use a parametric test was founded on two reasons. First, it was considered important to provide a method to statistically control for the potential confounding effect of age on results, in particular considering the lack of a control group. Second, it has been proposed that parametric ANCOVA is relatively robust to violations of normality in fairly large groups [36, 37] and when errors are not heteroscedastic [38]. In this study, group size ranged from $n = 18$–39. In addition, Levene's tests were conducted to examine the homogeneity of error variances ($p > 0.05$), thus allowing one to check for the assumption of homocedasticity.

Table II. Descriptive statistics for time since injury.

Group	*n*	*M* (SD)	Mdn	Minimum	Maximum
Total sample	75	17.2 (14.6)	11	2	54
$\leq$12 months	39	6.3 (3.2)	5.5	2	12
>12 months	36	31.7 (10.7)	31	14	54
$\leq$5 months (first quartile)	23	3.7 (1.17)	3.5	2	5
>30 months (last quartile)	18	38.6 (7.3)	39.5	30	54

Results

Single-group pre-/post-CRT outcomes

Wilcoxon Signed Ranks tests revealed significant differences ($p < 0.05$) on the pre- and post-CRT scores for several SMQ sub-scales (Global Difficulties, Conversations, Movies, Distractions, People, News and Personal Life), three out of six WHOQoL-BREF sub-scales (Physical Health, Psychological Health and Global Health) and HAD (Depression and Anxiety). Table III presents medians and ranges (minimum and maximum values) for baseline (pre-CRT) and end-point (post-CRT) scores and *Z*-values (Wilcoxon) and significance levels for each pair of pre-/post-CRT difference. It should be taken into account that the interpretation depends on whether the baseline scores indicate deficit (i.e. BDI) or improvement (i.e. quality-of-life) in a certain area.

Overall, participants showed an improvement in their answers to several scales and sub-scales after CRT. In particular, participants scored less memory difficulties and an improvement in quality-of-life and mood scales after receiving cognitive neuropsychological treatment, in comparison to baseline values.

Table III. Median and range (min–max) for baseline (pre-) and end-point (post-) scores for each scale and *Z*-values and significance level for the comparison of each pair of pre-/post-CRT scores (Wilcoxon Signed Ranks).

		Pre-CRT		Post-CRT		
	n	Mdn	Min–Max	Mdn	Min–Max	*Z*
SMQ						
Global Difficulties	*75*	*3*	*1–6*	*3*	*1–6*	*−2.5***
Conversations	*75*	*12*	*6–27*	*11*	*6–32*	*−2.7***
Movies	*75*	*8*	*4–21*	*8*	*4–24*	*−1.8**
Distractions	*75*	*13*	*5–24*	*11*	*6–23*	*−1.9**
People	*75*	*13*	*7–23*	*11*	*7–32*	*−1.9**
Uses	75	4	2–7	3	1–12	−1.4
News	*75*	*9*	*4–21*	*8*	*4–24*	*−2.9***
Places	*75*	*12*	*7–26*	*11*	*7–23*	*2.1**
Actions	75	12	5–27	10	6–27	−1.1
Personal Life	*75*	*12*	*6–29*	*10*	*6–36*	*−1.8**
BDI	73	5	0–26	6	0–18	−1.1
HAD						
Depression	*45*	*3.5*	*0–16*	*3*	*0–15*	*−2***
Anxiety	*46*	*4*	*0–20*	*3*	*0–21*	*−1.9**
WHOQoL-BREF						
Global	*71*	*3*	*1–5*	*3*	*1–5*	*−1.9**
Physical	*71*	*23*	*14–34*	*24*	*13–35*	*−2**
Psychological	*71*	*20*	*13–29*	*21*	*15–30*	*−1.9**
Environment	71	29	19–51	30	16–40	−0.82
Social Relationships	71	10	5–15	10	5–15	−2.1
BADL	74	24	10–24	24	8–24	−0.77
IADL	75	1	0–8	1	0–10	−1.3
V-A scale	14	2.5	0–8	2	0–9	−0.92

SMQ, Subjective Memory Questionnaire; BDI, Beck Depression Inventory; HADA, Hospital Anxiety Scale; HADD, Hospital Depression Scale; WHOQoL-BREF, Quality-of-Life Brief Evaluation; BADL, Basic Activities of Daily Living; IADL, Instrumental Activities of Daily Living; V-A, Visual Analogue Scale.
*$p < 0.05$; **$p < 0.01$.
Significant differences are shown in italics.

Analyses of pre-/post-CRT differences, in connection with time since injury prior to CRT

Spearman's Rank Order correlations were run to determine the relationship between time and pre-/post-CRT differences. Results indicated significant, low-to-moderate correlations in three MSQ sub-scales [Conversations: $r_s(75) = -0.23$, $p = 0.05$, Movies: $r_s(75) = -0.26$, $p = 0.02$, and Places: $r_s(75) = -0.26$, $p = 0.02$] and the Visual Analogue Scale [$r_s(14) = -0.57$, $p = 0.03$] and a marginally significant, low correlation in the Social Relationships domain of WHOQoL-BREF [$r_s(71) = 0.2$, $p = 0.06$]. Overall, these correlations indicated that pre-/post-CRT benefits tended to decrease as time since injury prior to CRT increased. No other significant correlations were found

Comparisons of scores were then conducted by splitting the sample into two groups. Based upon the findings of Rohling et al. [13], it was decided to divide the sample into patients who had begun CRT within 1 year after ABI and patients who had begun CRT later than 1 year ($\leq$12 months vs. >12 months). Table II shows the descriptive statistics for time since injury in the total sample and when split into groups. Before comparing means as a function of time, both groups were adjusted for gender, age, level of education and severity, in order to determine similarity across both groups. A Chi-square independence test revealed no significant association between gender and $\leq$12 months and >12 months groups [χ^2 (1, $n = 75$) = 0.054, p = n.s.]. Differences of age, level of education and severity were analysed with Mann-Whitney tests for two independent groups. Only age showed a significant difference [$U = -2.6$, $p = 0.009$, $r = -0.03$]. In particular, patients in the $\leq$12 months group (Mdn = 43) were significantly younger than patients in the >12 months group (Mdn = 53). Therefore, it was decided to include age as a covariate in the main analyses, while assuming similar patterns across groups for other individual variables (i.e. gender, severity and level of education).

One-way analyses of covariance (ANCOVA) were conducted on the pre-/post-CRT differences with Group [$\leq$12 months ($n = 39$) vs. >12 months ($n = 36$)] as factor and age as covariate. Levene's test failed to show significance in all the comparisons ($p < 0.05$), thus the assumption of homogeneity of variances between groups was accepted. Results showed a significant effect of group, with medium-to-large effect sizes in three MSQ sub-scales [Conversations: $F(1,72) = 3.4$, $p = 0.06$, $\eta^2 = 0.045$; Uses: $F(1,72) = 4.47$, $p = 0.03$, $\eta^2 = 0.06$; Places: $F(1,72) = 4.01$, $p = 0.04$, $\eta^2 = 0.054$], the Social Relationships domain of WHOQoL-BREF [$F(1,68) = 4.72$, $p = 0.03$, $\eta^2 = 0.065$] and the Visual Analogue Scale [$F(1,11) = 11.6$, $p = 0.006$, $\eta^2 = 0.514$]. An observation of means revealed that the $\leq$12 months group showed significant greater improvement (greater pre-/post-CRT differences), in comparison with the >12 months group (see Table IV).

Finally, a new series of analyses were conducted to compare groups represented by the sample's extreme quartiles [$\leq$5 months ($n = 23$) vs. >30 months ($n = 18$), see Table II]. Traditionally, studies have compared groups presenting gradual or continuous differences in post-injury time frames. Thus, the goal was to test the hypothesis of a critical time window for CRT in ABI patients, by contrasting groups with extremely different post-injury time until institution of treatment. ANCOVAs were conducted on the pre-/post-CRT differences, with Extreme Quartile Group ($\leq$5 months vs. >30 months) as factor and age as covariate. The assumption of homogeneity of variances (Levene's test) was accepted ($p > 0.05$). Results revealed a significant effect of Extreme Quartile Group in the Global Difficulties and Conversations MSQ sub-scales [Global Diff.: $F(1, 38) = 7.08$, $p = 0.01$, $\eta^2 = 0.157$; Conversations: $F(1, 38) = 3.8$, $p = 0.05$, $\eta^2 = 0.09$] and WHOQoL-BREF's Social Relationships domain [$F(1, 37) = 4.5$, $p = 0.04$, $\eta^2 = 0.11$]. An analysis of means revealed that the $\leq$5 months group showed greater improvement in scales, as compared to the >30 months group. In other words, extreme groups with post-injury time differences of more than 2 years showed similar, but fewer differences across scales than the $\leq$12 months vs. >12 months comparison (see Table V).

Discussion

This study aimed at examining the effect of CRT in patients with cognitive disorders following ABI and at determining if the time elapsed between injury and treatment initiation had an influence on the psychosocial and functional indicators assessed. Overall, the results suggest that: (a) CRT is associated with improvements in several psychosocial domains, including self-reported quality-of-life, memory

Table IV. Group ($\leq$12 months *vs.* >12 months) means and standard deviations for pre- and post-CRT scores and ANCOVA results for pre-/post-CRT differences as a function of group.

	$\leq$12 months				>12 months					
	Pre-CRT		Post-CRT		Pre-CRT		Post-CRT		ANCOVA	
Scale	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*F* (gl)	η^2
SMQ										
Conversations	12.8	4.9	10	3.7	13.6	4.8	13.3	4.9	3.4 (1,72)*	0.045
Uses	3.4	1.5	2.75	1.2	3.9	1.2	4	1.9	4.47 (1,72)**	0.06
Places	11.8	5.08	9.7	3	13.07	4.7	12.9	4.1	4.01 (1,72)**	0.054
WHOQoL-BREF										
Social Relationships	10.6	2.6	11.2	2.7	9.5	2	9.18	1.72	7.72 (1,68)**	0.065
V-A scale	3.3	2.8	2.5	2.2	1.7	2.3	3.1	2.8	11.6 (1,11)***	0.514

SMQ, Subjective Memory Questionnaire; WHOQoL-BREF, Quality-of-Life Brief Evaluation; V-A, Visual Analogue Scale.
Only data associated to significant and marginally significant differences are shown.
*$p < 0.06$; **$p < 0.05$; ***$p < 0.01$.

Table V. Extreme quartile group (≤5 months *vs.* >30 months) means and standard deviations for pre- and post-CRT scores and ANCOVA results for pre-/post-CRT differences as a function of extreme quartile group.

	≤5 months				>30 months					
	Pre-CRT		Post-CRT		Pre-CRT		Post-CRT		ANCOVA	
Scale	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*F* (gl)	η^2
SMQ										
Global Difficulties	3	1.08	2.4	0.99	3.5	0.98	3.6	1.19	7.08 (1,38)**	0.157
Conversations	12.4	4.8	9.7	3.7	13	3.8	13	5.7	3.8 (1,38)*	0.09
WHOQOL-BREF										
Social Relationships	10.8	3.1	11.04	3.2	10.1	1.8	9.3	1.5	4.5 (1,37)*	0.11

SMQ, Subjective Memory Questionnaire; WHOQoL-BREF, Quality-of-Life Brief Evaluation.
Note: Only data associated to significant differences are shown.
*$p = 0.01$; **$p < 0.05$.

functioning and mood and (b) time elapsed since injury seems to mediate this effect.

In the first set of analyses, which examined pre-/post-CRT outcomes of the sample as a single group, baseline vs. end-point comparisons showed that, after receiving CRT, improvements were observed in the way patients described their memory functioning, mood and quality-of-life. Analyses of the pre-/post-CRT scores showed a significant improvement in more than half (8/10) of the sub-scales examining subjective memory, half of the sub-scales (3/6) examining quality-of-life and both depression and anxiety sub-scales of HAD. These results indicate that CRT may represent a treatment option to improve relevant broad health-related outcomes in ABI patients, such as self-perception, social participation and daily functioning. Taking into account that personal beliefs may affect not only the way subjects perceive their cognitive capacities, but also how they benefit from and take advantage of the strategies provided during treatment, these results may have significant clinical implications.

In the second set of analyses, the study focused on the examination of the influence of time since injury prior to CRT as a moderator of outcomes. Consistent with the latest reviews of the evidence-based literature in ABI patients, the results suggest that post-injury time could mediate CRT effects. In particular, it was shown that scores rated by patients in some of the scales presented greater pre-/post-CRT differences, depending on the time elapsed after injury. Analyses of the pre-/post-CRT differences indicated that patients who had initiated CRT in a shorter post-injury time reported a greater improvement in the perception of memory and quality of social relationships, as compared to patients who had initiated CRT after longer periods of time. Overall, this tendency was observed both in the correlation analyses and in the two group comparisons. However, the comparison of baseline and end-point scores revealed a less discriminated pattern (although similar), when comparing the ≤5 months vs. >30 months groups, than when comparing the ≤1 year vs. >1 year groups. This may be considered an unexpected finding and it may be showing a possible effect of spontaneous recovery on the considered outcomes. In relation to this, it may be possible that participants in the <1 year group were experiencing spontaneous recovery that may have contributed to the difference between their pre- and post-test scores. Whereas this study can be described as a naturalistic investigation addressing the effect of CRT on psychosocial functioning, its findings should be confirmed in controlled studies. Additionally, it must be considered that the extreme quartiles comparison showed differences only in sub-scales related to social interactions (e.g. Conversations sub-scale of MSQ and Social Relationships domain of WHOQoL-BREF). It is possible that the patients who entered the programme with less than 5 months of time since injury may had less functional deficits associated to interactions than the patients at the other extreme of the sample (>30 months). This finding needs further examination, since it may have significant implications concerning the relative emphasis on interpersonal behaviours involved in CRT treatment of patients with long post-injury CRT, while suggesting the need to consider using holistic cognitive rehabilitation programmes [17, 39] in ABI patients with long post-injury lapses, which may focus on the interpersonal domain more directly during rehabilitation.

As mentioned before, the aim of this study was to perform an initial assessment of the association between CRT and psychosocial functioning in Argentinean ABI patients, a population that is under-represented in the research on cognitive rehabilitation. However, the lack of a placebo group and of comparison with other types of interventions must be mentioned as a limitation. Additionally, further research should determine the extent to which changes observed in self-reports correlate with actual changes in daily life. As a strategy to compensate for these methodological limitations, the influence of potential moderators was considered and controlled during analyses. Moreover, the size of the sample and the relative similarity of distributions of socio-demographic data and potential moderators allowed an analysis of the influence of post-injury time by groups, adding value to the results.

In brief, the findings suggest that cognitive rehabilitation therapy in ABI relates with positive effects on several psychosocial aspects, such as patients' self-perception of their memory functioning, mood and quality-of-life. In addition, these results imply that some of these effects may be greater for patients beginning treatment within moderately short post-acute time periods after brain injury (i.e. ≤1 year).

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