Impact of neuropsychological rehabilitation on activities of daily living and community reintegration of patients with traumatic brain injury

Amrita Kanchan, Amool Ranjan Singh¹, Nawab Akhtar Khan², Masroor Jahan¹, Rajesh Raman³, T. S. Sathyanarayana Rao³
Department of Clinical Psychology, All India Institute of Speech and Hearing, Mysuru, Karnataka, ¹Department of Clinical Psychology, Ranchi Institute of Neuropsychiatry and Allied Sciences, Ranchi, Jharkhand, ²Department of Clinical Psychology, JSS Medical College and Hospital, ³Department of Psychiatry, JSS Medical College, JSS Academy of Higher Education and Research, Formerly JSS University, Mysore, Karnataka, India

Objectives: The present study was targeted to observe the impact of neuropsychological rehabilitation on activities of daily living (ADL) and community reintegration of patients with traumatic brain injury (TBI).

Settings and Participants: Based on purposive sampling technique, ten patients with TBI falling in the age range of 20–40 years and fulfilling the inclusion and exclusion criteria were chosen from All India Institute of Speech and Hearing, Mysuru, India.

Design: A quasi-experimental design, i.e., nonequivalent control group design was chosen for the study.

Materials and Methods: Patients were assessed on Luria–Nebraska Neuropsychological Battery for Adults, Cognitive Symptoms Checklist, and Community Integration Questionnaire. Patients in experimental group were given neuropsychological rehabilitation for 6 months. Brainwave-R and Talking Pen were used as rehabilitative tools.

Results: Patients with TBI have significant neuropsychological deficits observed in memory, visuo‑spatial organization, arithmetic, spelling, writing, fine motor coordination, and executive functioning. Neuropsychological deficits have a major impact on ADL and community reintegration. Neuropsychological rehabilitation is effective in rehabilitating neuropsychological deficits, which in turn leads to improvement in ADL and community reintegration.

Conclusion: Neuropsychological rehabilitation should be one of the major goals in rehabilitation procedures for patients with TBI in order to bring overall improvement in them.

Key words: Cognition, Cognitive Symptom Checklist, Luria–Nebraska Neuropsychological Battery for Adults, neuropsychological deficits

Address for correspondence: Dr. Nawab Akhtar Khan, Department of Clinical Psychology, JSS Medical College, JSS Academy of Higher Education and Research, Formerly JSS University, Mysore, Karnataka, India. E-mail: nawab409@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Kanchan A, Singh AR, Khan NA, Jahan M, Raman R, Sathyanarayana Rao TS. Impact of neuropsychological rehabilitation on activities of daily living and community reintegration of patients with traumatic brain injury. Indian J Psychiatry. 2018;60:38-48.
INTRODUCTION

Traumatic brain injury (TBI) has been defined by the Brain Injury Association of America[1] as an insult to the brain, not of a degenerative or congenital nature but caused by an external physical force that may produce a diminished or altered state of consciousness, which results in impairment of cognitive abilities or physical functioning. It can also result in the disturbance of behavioral or emotional functioning. These impairments may be either temporary or permanent and cause partial or total disability or psychosocial maladjustment. To the World Health Organization,[2] TBI is a public health issue because it is one of the largest causes of brain injury, resulting in high rates of morbidity and mortality.[3,5] However, with modern medicine and the progress of techniques for acute treatment of TBI victims, their survival rate is increasing. Consequently, the number of patients who survive with physical and cognitive impairment is growing.[4,8] Whiteneck et al.[6] reported that approximately 65% of patients with moderate-to-severe TBI report long-term problems with cognitive functioning. Cognitive deficits can impact an individual’s ability to perform usual roles at work or homes and thus lead to disability. Selassie et al.[7] found that about 43% of moderate-to-severe TBI patients experience disability in long term, characterized by functional limitations, postinjury symptoms of limit activities, cognitive complaints, and/or mental health problems. In long run, TBI-related cognitive deficits can impair a patient’s ability to perform activities of daily living (ADL) such as driving, meal preparation, and handling money. Although TBI can cause sensory and motor deficits, cognitive and behavioral changes persist for long term.[8] In general, cognitive deficits, rather than any residual physical impairment per se, contribute most to the disruption of meaningful life activities for people with TBI.[9] Deficit in problem-solving has been identified as a significant obstacle to the community integration of TBI survivors.[10] Intact problem-solving abilities are necessary to maintain a home, function in the community, or return to work.[11] Therefore, deficits in such abilities may prevent individuals with TBI from returning to productive personal and vocational lives.[9] Therefore, in rehabilitation process of patients with TBI, the ultimate aim is their community integration. However, successful community integration is underpinned by the quality, uptake, and success of rehabilitation interventions addressing specific life skills (i.e., memory, communication, and motor and social functioning) that assist individuals to regain participation in the society.[12]

To achieve this, neuropsychological rehabilitation (NR) can be a solution and this can be best achieved through a comprehensive/holistic approach to the treatment of cognitive, emotional, and functional impairments and disability. Evidence exists that holistic/integrated rehabilitation that includes both individualized cognitive and psychosocial interpersonal therapies produces the greatest overall improvements in functioning by persons with TBI.[13] This study was thus targeted to rehabilitate neuropsychological deficits of patients with TBI and to see its impact on ADL and community reintegration. Few studies of comprehensive integrated TBI rehabilitation have assessed treatment effectiveness at the level of community integration and social participation. Sander et al.,[14] using the Community Integration Questionnaire (CIQ), evaluated treatment effects for 24 persons with TBI who were admitted for comprehensive integrated, postacute rehabilitation (including neuropsychological rehabilitation) within 8 months of injury. They found significant improvements after an average of 4 months of treatment on the CIQ total score and on the three subscales measuring home integration, social integration, and productivity. A subsequent analysis of 71 persons with TBI who participated in this program again showed significant improvements on all of the CIQ subscales. The analysis of clinically significant change for individual participants indicated that 46% of the total sample improved on total CIQ scores from pre- to posttreatment, 49% did not make significant change, and 4% showed clinically significant worsening. Thus, the study aims to investigate the impact of neuropsychological rehabilitation on ADL and community reintegration.

MATERIALS AND METHODS

Sample

Based on a purposive sampling technique, ten right-handed patients with open/closed head injury, aged 20–40 years, of either sex, with a significant neuropsychological deficit and with a minimum gap of 1 year after injury, having as a minimum secondary education and with English as the medium of instruction, were chosen from All India Institute of Speech and Hearing (AIISH), Mysuru, India. Patients with mild brain injury, with any comorbid psychiatric condition, with a history of substance dependence, with severe behavioral problems, and with impairment in expressive speech, hearing, vision, or physical amputation after injury, were excluded from the study. Patients under medication pertaining to brain injury were also excluded from the study. The informed consent of the patient and guardian was taken before the intervention process. Based on patient convenience, they were divided into an experimental and control group. Patients in the control group were wait listed and were called for therapy after 6 months of research completion. The human data included in this study were obtained in compliance with the Helsinki declaration.

Screening tools

1. Sociodemographic and clinical data sheet: A semi-structured pro forma was prepared for the study covering all areas of sociodemographic details such as age, sex, domicile, education, employment, and marital status and questions related to comorbid psychiatric disorder, hearing or visual impairment, or severe physical illness in the near past.
2. Handedness scale: Based on this scale, dominant hemisphere is ascertained. It has five items. The participants are asked to indicate their preference of hand in certain daily activity tasks

3. Brief Psychiatric Rating Scale (BPRS): It is an 18-item scale measuring positive symptoms, general psychopathology, and affective symptoms. Each item is rated on a 7-point rating scale and accordingly the severity of psychopathology is ascertained. Rating up till 3 indicates nonpathological intensity of symptoms and 4–7 indicates pathological severity of symptoms

4. Head Injury Behaviour Scale (HIBS): It is a 4-point rating scale which assesses the behavioral excess and behavioral deficits after brain injury. It is both a self-administered rating scale and can be administered by the family members or the relatives

5. Glasgow Coma Scale (GCS): This test is used to assess the severity of TBI. It assesses the performance of the patient in three areas, i.e., eye opening, best motor response, and verbal response. The minimum response of the scale is 3 and the maximum response is 15. The score of 8 or less indicates severe head injury, score of 9–12 indicates moderate brain injury, and 12–15 indicates mild head injury.

Assessment tools

6. Luria–Nebraska Neuropsychological Battery for Adults-Form 1 (LNNB-A): The battery, developed in 1981 by Charles Golden, is appropriate for people aged 13 and older it consists of 269 items in 11 clinical scales (Motor [c1], Rhythm [c2], Tactile [c3], Visual [c4], Receptive Speech [c5], Expressive Speech [c6], Writing [c7], Reading [c8], Arithmetic [c9], Memory [c10], and Intelligence [c11]). The original test has been extended to elicit specific neuropsychological deficits using factor analysis, called factor scales. A total of 28 factor scales have been identified from 11 clinical scales

7. Cognitive Symptoms Checklist (CSC): CSC is a tool to assist in the identification and treatment of problems in five basic cognitive areas: attention and concentration, memory, visual processes, language, and executive functions. Each area of the checklist contains items which reflect day-to-day situations hindered by simultaneous cognitive functions

8. CIQ: CIQ is a brief test to assess the degree to which an individual after TBI can perform appropriate roles within the home and community. The CIQ assesses disability in three domains: home integration (active participation in the operation of the home or household), social integration (participation in social activities outside the home), and productivity (regular performance of work, school, and/or volunteer activities). The maximum possible score is 29, which reflects complete community integration.

Therapy tools

9. Brainwave-R – cognitive strategies and techniques for brain injury rehabilitation: This series has been designed to assist in the cognitive rehabilitation of individuals with brain injuries. It consists of a large array of exercises (mainly pen and paper based), which are organized into five modules, i.e., attention, visual processing, information processing, memory, and executive functions. The five Brainwave-R modules are hierarchically presented according to Luria’s theory of brain function, which suggested that complex behavioral processes are distributed throughout the brain in functional systems. The purpose of each module can be summarized as follows:

1. Attention – this module aims to develop focused, sustained, selective, and alternating attention skills in order to optimize arousal and alertness levels

2. Visual processing – this module aims to develop more accurate saccadic eye movements, visual scanning skills, visual attention, figure–ground discrimination, pattern recognition, visual memory, and the ability to mentally manipulate visual information. It also reinforces the exercises on attention completed in the previous module

3. Information processing – this module is divided into two sections. Part 1 aims to develop ordered, sequenced thinking skills. Part 2 aims to develop the ability to work more quickly, under time constraints and with more complex information

4. Memory – this module has been designed to teach the client about memory processes and emphasizes the use of strategies to compensate for memory problems

5. Executive functions – this module also has been divided into two sections. Part 1 teaches the client about executive functions and strategies that can be used to compensate for deficits in this area. Part 2 provides a choice of projects for the client to organize, plan, and execute using the strategies taught in Part 1.

10. The Talking Pen: Talking Pen is an instrument for developing fine motor skills through pattern tracing. It is most often used to diagnose and develop gross and fine motor skills, hand–eye coordination, laterality, directionality, auditory perception, form perception, ocular pursuits, and spatial relationships.

Research design

A quasi-experimental design, i.e. nonequivalent control group design was chosen for the study.

Procedure

Patients with TBI were identified from AIISH OPD and were initially screened using sociodemographic data sheet, Handedness scale, BPRS, GCS, and HIBS. Patients fulfilling the inclusion and exclusion criteria were assessed on LNNB-A. Once the pretest was conducted, they were either
alotted to the experimental group or the control group. Patients were explained the relevance and need of the study and were asked to sign the consent form (the entire research was completed in accordance with the Helsinki declaration). Therapy was carried out on an individual basis for 6 months. Target areas and the number of therapy sessions varied with every month. A co-therapist from among the family member was also chosen who could guide the patient in carrying out homework at home. Various intervention strategies were used from Brainwave-R and Talking Pen to remediate the patients’ neuropsychological deficits. The process involved in therapy is described below:

• 1st month – target areas: attention, visual processing, and fine motor co-ordination activities will be introduced
  • Therapy sessions – 45-min session for 5 days in a week with homework for the remaining 2 days
• 2nd month – target areas: Memory training will be introduced (revision of attention, visual processing, and fine motor co-ordination activities)
  • Therapy sessions – 45-min session for 4 days in a week with homework for the remaining 3 days.
• 3rd month – Target areas: information processing activities will be introduced (revision of memory and fine motor co-ordination activities)
  • Therapy sessions – 45-min session for 3 days in a week with homework for the remaining 4 days
• 4th month – target areas: executive functioning activities will be introduced (revision of information processing and fine motor co-ordination activities)
  • Therapy sessions – 45-min session for 3 days in a week with homework for the remaining 4 days
• 5th month – target areas: revision of information processing and executive functioning activities
  • Therapy sessions – 45-min session for 2 days in a week with homework for the remaining 5 days
• 6th month – Target areas: revision of executive functioning activities (patient’s participation in community activity will be encouraged)
  • Therapy sessions – 45-min session for 1 day in a week with homework for the remaining 6 days.

RESULTS

The results of the study are discussed below. On LNNB-A, based on the age and education level of each patient, a “critical level” was calculated, this acts as the cutoff score for the patient. All the scores above this critical level are deficit areas and scores which lie below it are areas which are intact.

Table 1 elaborates the percentage of patients with TBI above and below the critical level on clinical scale. On analyzing the table, it was found that patients have more problems in motor, visual, expressive speech, writing, reading, memory, arithmetic, and intelligence scales. No major deficit was observed in rhythm, tactile, and receptive speech subscales.

Table 2 highlights the percentage of patients with TBI above and below the critical level on factor scale. Results reveal that TBI survivors had difficulty in fine motor speed, visual acuity and naming, visual spatial organization, reading complex material and spelling, verbal memory, complex

### Table 1: Percentage of traumatic brain injury survivors with major deficits in clinical scale of Luria–Nebraska Neuropsychological Battery for Adults

| Clinical scales                  | Percentage of patients below critical level (n=10) | Percentage of patients above critical level (n=10) |
|---------------------------------|--------------------------------------------------|--------------------------------------------------|
| Motor scale (c1)                | 60                                               | 40                                               |
| Rhythm scale (c2)               | 100                                              | -                                                |
| Tactile scale (c3)              | 90                                               | 10                                               |
| Visual scale (c4)               | 20                                               | 80                                               |
| Receptive speech scale (c5)     | 90                                               | 10                                               |
| Expressive speech scale (c6)    | 40                                               | 60                                               |
| Writing scale (c7)              | 40                                               | 60                                               |
| Reading scale (c8)              | 40                                               | 60                                               |
| Arithmetic scale (c9)           | 20                                               | 80                                               |
| Memory scale (c10)              | 20                                               | 80                                               |
| Intelligence scale (c11)        | 30                                               | 70                                               |

### Table 2: Percentage of traumatic brain injury survivors with major deficits in factor scale of Luria–Nebraska Neuropsychological Battery for Adults

| Factor scales                  | Percentage of patients below critical level (n=10) | Percentage of patients above critical level (n=10) |
|--------------------------------|--------------------------------------------------|--------------------------------------------------|
| Kinesthetic-based movement (M1) | 80                                               | 20                                               |
| Drawing speed (M2)              | 70                                               | 30                                               |
| Fine motor speed (M3)           | 20                                               | 80                                               |
| Spatial-based movement (M4)     | 90                                               | 10                                               |
| Oral motor skills (M5)          | 80                                               | 20                                               |
| Rhythm and pitch perception (RH1) | 100                                              | -                                                |
| Simple tactile sensation (T1)   | 80                                               | 20                                               |
| Stereognosis (T2)               | 90                                               | 10                                               |
| Visual acuity and naming (V1)   | 30                                               | 70                                               |
| Visual spatial organization (V2) | 30                                               | 70                                               |
| Phonemic discrimination (R1)     | 100                                              | -                                                |
| Relational concepts (R2)        | 60                                               | 40                                               |
| Concept recognition (R3)        | 90                                               | 10                                               |
| Verbal-spatial relationships (R4) | 100                                              | -                                                |
| Simple phonetic reading (E1)    | 60                                               | 40                                               |
| Word repetition (E2)             | 80                                               | 20                                               |
| Reading polysyllabic words (E3) | 50                                               | 50                                               |
| Reading complex material (RE1)  | 40                                               | 60                                               |
| Reading simple material (RE2)   | 40                                               | 60                                               |
| Spelling (W1)                   | 30                                               | 70                                               |
| Motor writing skill (W2)        | 50                                               | 50                                               |
| Arithmetic calculations (A1)    | 20                                               | 80                                               |
| Number reading (A2)             | 60                                               | 40                                               |
| Verbal memory (ME1)             | 10                                               | 90                                               |
| Visual and complex memory (ME2) | 20                                               | 80                                               |
| General verbal intelligence (I1) | 80                                               | 20                                               |
| Complex verbal arithmetic (I2)  | 10                                               | 90                                               |
| Simple verbal arithmetic (I3)   | 30                                               | 70                                               |
and visual memory, and simple and complex arithmetic. The results also reveal that most of the patients had intact kinesthetic-based movement, drawing speed, spatial-based movements, oral motor skills, tactile sensation, and have no symptoms of stereognosis. In addition, there was no deficit observed in phonemic discrimination, concept recognition, verbal spatial relations, word repetition, and reading simple and complex materials. In arithmetic skills, they are fair in number reading and had intact general verbal intelligence.

The results also reveal that patients with TBI have difficulty in tasks which require selective, sustained, divided, and simultaneous attention. For example, on a railway station, patients may have difficulty in listening the announcement, reading a newspaper for a considerable time period, focusing on a discussion of two persons at a time, or focusing on tasks when there are many distracters.

Table 3 reveals various ADL affected by attention deficit in patients with TBI. The results reveal that patients with TBI have difficulty in tasks which require selective, sustained, divided, and simultaneous attention. For example, on a railway station, patients may have difficulty in listening the announcement, reading a newspaper for a considerable time period, focusing on a discussion of two persons at a time, or focusing on tasks when there are many distracters.

On memory checklist of CSC, it was found that patients have difficulty in memorizing spatial aspects, for example, remembering where keys are kept. Prospective memory tasks are affected. The results reveal that patients with TBI have difficulty in encoding and retaining information and this is turn leads to impairment in receptive and expressive communication and handling personal details.

In visual processing checklist, not much deficit was observed. The results reveal that patients with TBI have difficulty in ADL which requires quick scanning of visual space; they also have difficulty in visual discrimination, differentiating between figure and background, and understanding the spatial relationship between two objects.

In comparison to other areas, it is found that patients have reported more deficits in ADL related to executive functioning. The results reveal that patients with TBI have difficulty in executing the tasks effectively. They have difficulty in initiating the task, and once initiated, they are unable to process the tasks quickly, and further organizing, planning, and reasoning any situation are difficult for the patients.

Finally, in language checklist, it was found that TBI survivors have difficulty in reception and expression of information in both verbal and written forms. If we analyze properly, it is apparent that TBI survivors have more problem in executing their language.

Table 8 highlights the results of CIQ. The mean scores of subscales reveal that after TBI all the survivors (both experimental and control groups) had difficulty in integrating back to community. Maximum deficit was observed in integrating back to job (subscale productivity), this was followed by difficulty in social integration. In comparison to other two areas, home integration of patients was comparatively better. The table also reveals that before the intervention there was no significant difference between experimental and control groups and patients of both the groups were experiencing the same amount of deficit in all the three subscales of CIQ.

| Area of attention | Items (I have difficulty in…) | Percentage of patients with deficits (n=10) |
|-------------------|-------------------------------|---------------------------------------------|
| External distractors  – visual | Focusing on a task when there is sudden movement around | 40 |
| | Focusing on a task when there is a lot of movements happening around | 80 |
| | Focusing on a task when there is too much detail or clutter | 60 |
| | Focusing on a task when there is a sudden loud noise | 50 |
| | Focusing on a task when there is more than one person speaking at a time | 40 |
| | Focusing on a task when a television/radio is playing in the background | 40 |
| External distractors  – auditory | Focusing on a task when in a large area like mall | 40 |
| | Staying focused in place where there are many sights and sounds | 50 |
| Sustained attention | Staying interested in a task for several hours | 40 |
| | Have difficulty in reading a chapter | 30 |
| | Have difficulty in reading a novel | 60 |
| | Staying focused in a telephone conversation | 30 |
| Divided attention | Shifting concentration between two things | 30 |
| | Shifting concentration among three or more things | 40 |
| | Shifting concentration from unimportant to important information | 70 |
| Simultaneous attention | Doing several task at the same time | 70 |
| | Tracking several actions at the same time | 50 |
| | Driving, paying attention to the other drivers, reading road signs, and following directions at the same time | 40 |
| | Following two or speakers at the same time | 40 |
Before analyzing the effect of NR on experimental and control groups, it is important to compare the groups before the intervention. The results assessed through Mann–Whitney U test reveal that before the intervention, two groups were similar to each other on all the clinical scales. Patients of both the groups had similar type of deficit and were matched to each other. Subscales such as rhythm (c2), tactile (c3), and receptive speech (c5) are excluded from the table as there was no major deficit observed in these three subscales. It is clear from Table 9 that before the intervention there was no significant difference between the two groups. However, between-group analysis conducted after the intervention revealed that there was significant improvement in visual, expressive speech, arithmetic, memory, and intelligence scales, but there was no statistical difference in reading, writing, and motor scales.

Similarly, both the groups were compared on factor scale; the comparison was made for those areas which were impaired in patients. Out of 28 factors, 11 scales were mainly deficient in patients of both the groups. Therefore, comparison was made for only these 11 scales. The results [Table 10] revealed that before the intervention there was no significant difference between both the groups on all the 11 scales. Between-group analysis of factor scale revealed that after the intervention, two groups were significantly different in visual acuity and naming, arithmetic, verbal memory, visual and complex memory, and simple verbal arithmetic [Table 10]. However, there was no group difference in fine motor speed, visual spatial organization, spelling, motor writing skills, and reading of complex material and complex arithmetic skills. As it is visible that there was no group difference in some of the factor scales of LNNB-A, in order to reach to any appropriate conclusion, within-group comparison was carried out using Wilcoxon signed-rank test in which each patient’s score is compared individually at pre- and posttest levels, and it was found that some of the subscales revealed that there was significant improvement in visual, reading, writing, and motor scales.

Table 11 reveals the effect of NR on ADL as assessed through CSC. The results reveal that in experimental group there was significant improvement in all the subscales of CSC, i.e., attention, memory, visual processing, executive functioning, and language after NR. In control group, it was found that across time span, there was significant improvement in attention and language of patients without any interventional procedures; however, the amount of improvement was comparatively less than that experienced by patients of experimental group.

Table 12 reveals the comparison of experimental and control groups after the intervention. The results reveal...
that before the intervention, both the groups had the same amount of deficit in community integration [Table 8]. However, in posttest, it was found that after intervention, there was significant integration of patients back to their community, i.e., their home, society, and work. In contrast, there was no improvement found in control group after 6 months of gap as suggested by their mean rank.

DISCUSSION

The study reveals that there were major neuropsychological deficits in patients with TBI as deciphered through
LNNB-A [Tables 1 and 2]. Major deficits have been found in various scales such as motor, visual, expressive speech, writing, reading, memory, arithmetic, and intelligence scales, and also significant deficits have been seen in various factor scales such as fine motor speed, visual acuity and naming, visual spatial organization, reading complex material and spelling, verbal memory, complex and visual memory, and simple and complex arithmetic. The association between neuropsychological deficits and ADL is clearly visible through the results of CSC. Though cognitive...
Table 12: Between-group analysis of Community Integration Questionnaire postassessment

| CIQ-subscale          | Mean±SD Experimental group (n=5) | Mean±SD Control group (n=5) | Mann–Whitney U-test Mean rank | Z-score |
|-----------------------|---------------------------------|-----------------------------|-------------------------------|---------|
| Home integration      | 8.40±0.894                      | 5.60±2.19                   | 7.30                          | 3.70    | 1.946* |
| Social integration    | 7.00±1.00                       | 4.20±1.92                   | 7.50                          | 3.70    | 2.108* |
| Productivity          | 6.40±1.817                      | 3.75±1.25                   | 7.50                          | 3.70    | 2.135* |

SD – Standard deviation; CIQ – Community Integration Questionnaire. *P<0.05

Deficits are a sort of invisible injury, their impact is clear in day-to-day skills. The results of the study reveal that patients with TBI have difficulty in daily skills which require cognitive competence. In consistent to the above findings, Kaplan and Corrigan[25] have also found cognitive functions and motivation as strong predictors of functional outcome in terms of ADL. Kathleen et al.[26] found that cognitive impairment can result in significant impairment in all aspects of clients’ life, i.e., self-care, independent living skills, work, leisure, and social and interpersonal skills. Researchers have reported that cognitive impairment was a major reason for dressing difficulties in patients with acquired brain injury in acute phase.[27,28] The level of orientation influences basic ADL, instrumental ADL, and social activities in acute as well as chronic patients with acquired brain injury.[29] In a study conducted by Mokashi[30] to find correlation between cognition and ADL in patients with acquired brain injury, it was found that there was a positive correlation between cognition and ADL with significance of P<0.01.

Table 11 further reveals improvements in experimental group in various tasks of CSC; however, there was no significant improvement in control group on various tasks. Improvement in various tasks of CSC can be directly associated with NR as there was significant improvement in experimental group in various areas of LNNB-A [Tables 9 and 10]. These results are consistent with the findings of Ho and Bennett[31] who found that after cognitive rehabilitation there was significant improvement in cognition and functional performance as indicated by ratings on the behavioral rating scales, i.e., individuals who participated in rehabilitation treatment showed a significant improvement in their ADL and cognitive functioning on selected neuropsychological tests. Similarly, an ECRI Institute[32] evidence report evaluated the efficacy of cognitive rehabilitation (CR) therapy for the treatment of mild, moderate, or severe TBI and its impact on ADL. The analysis included twenty published articles from 18 randomized controlled trials (n = 1088). It was found that adults with TBI who received comprehensive, holistic CR reported significant improvement on the measures of quality of life and ADL, compared to patients who received a less intensive form of therapy.

In contrast to the above findings, there are studies which reported noneffectiveness of NR on ADL. Hoffmann et al.[33] conducted a systematic review to determine whether interventions for cognitive impairment following acquired brain injury may improve functional performance of basic and/or instrumental ADL. Four studies with 376 participants were included in the review. There was no statistical difference between groups in basic ADL performance in any of the four studies, or in instrumental ADL. It is thus evident that there exists contradictory evidence in support of effectiveness of NR in improving ADL. However, the current study supports the view that NR improves ADL of patients with TBI.

The current study also found that, after TBI, patients had difficulty in integrating back to community life [Table 8]. CIQ reveals that patients with TBI had maximum impairment in their productivity, i.e., work and in their social life. Home integration was also affected, but it was comparatively better than the other two areas. There were slight variations in the present result as reported by Zhang et al.[34] and Gontkovsky et al.,[35] they found that patients with TBI had maximum impairment in productivity followed by home integration and finally social integration. This inconsistency in finding can be the result of cultural variations. If we analyze the items of subsection home integration, it contains items which involve cooking and taking care of children; however, in Indian culture, males are not supposed to carry out these activities at home and they are more involved in social activities. Carrying out household activities is the job of females of the family. This is the reason that patients have lesser problem in integrating in their home and more problems in social integration. However, there is no doubt that TBI survivors have problems in integrating back to work. It decreases their probability of employment after injury, lengthens the timing of their return to work as full time professional, and decreases the likelihood that they will return to the same position.[36] They also avoid participating in any volunteer activity. Social isolation is the next profound life change for persons with TBI; it leads to deterioration in their ability to maintain friendships/form new social relationships[37] and enjoy leisure time or perform public activity such as paying the bill. The study also indicates that impairment in community integration persists years after injury. In the current study, the minimum time gap since injury was 1 year and maximum was 3 years, but all the patients had the same amount of deficit in
reintegrating back to community, indicating that there is no major improvement in community reintegration in patients with TBI (when not exposed to any intervention). This is consistent with the findings of Willemsen-van Son et al.,[38] they found that several domains of CIQ had shown small improvements between years 1 and 3 postinjury, but the improvements seen were transient and nonsustained at 36 months after injury. In addition, most domains never reached back to their preinjury levels.

The results of the present study also reveal that after NR there was significant improvement in community reintegration of patients with TBI [Table 8]. The role of NR in work-related activity is obvious as cognition is very important for any work, the person should attend the stimuli, retain the information in his/her mind, plan it, organize it, and finally execute the task. If any one of the tasks is missing, the job remains incomplete. It is justifiable to understand the role of NR in productivity subscale.[39,40] Once the person is able to work properly, it improves the self-confidence and self-esteem of the person which in turn motivates him/her to mingle and interact with people around and therefore improves social reintegration of patients with TBI. Improvement in cognition improves judgment, decision-making, and role understanding, and thus helps in home integration of patients with TBI. Improvement in community integration after comprehensive neuropsychological/cognitive rehabilitation is consistent with the study of Cicerone et al.[41] and Malec.[42] Similarly, Sander et al.[13] using the CIQ, evaluated treatment effects for 24 persons with TBI who were admitted for comprehensive integrated, postacute rehabilitation within 8 months of injury. They found significant improvements after an average of 4 months of treatment on the CIQ total score and on the three subscales measuring home integration, social integration, and productivity.

CONCLUSION

The study thus clearly indicates that neuropsychological deficits have an impact on ADL and community reintegration of patients with TBI, and NR is effective in improving neuropsychological deficits of patients with TBI which in turn improves the ADL and community reintegration of patients with TBI. It can thus be concluded that NR should be incorporated in rehabilitation goals of patients with TBI so that these patients can achieve all-round improvement, and an attempt is made to help patients to reach to their premorbid level. The study has to be, however, extended to larger sample size and maintenance effect of NR has to be evaluated. The effects of co-existing factors such as anxiety and depression were also not controlled in the study.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Brain Injury Association of America. Definition: Traumatic Brain Injury, 2011. Available from: http://www.biausa.org/Pages/types_of_brain_injury.html#tbi. [Last accessed on 2017 Oct 25].
2. WHO. Neurological Disorders Public Health Challenges WHO Press, Geneva, Switzerland: WHO Library Cataloguing-in-Publication Data; 2006.
3. Gouveia PA, Fabricio AM. Neuropsychological Evaluation in Traumatic Brain Injury. In: Andrade VM, Santos FH, Bueno OF, editors. Neuropsychology Today, São Paulo: Artes Médicas; 2004, p. 297-305.
4. Koizumi MS, Lebrão ML, Mello-Jorge MH, Primerano V. Morbidity and mortality due to traumatic brain injury in São Paulo City, Brazil, 1997. Arq Neuropsiquiatr 2000;58:81-9.
5. Marquez de la Plata CD, Hart T, Hammond FM, Frol AB, Hudak A, Harper CR, et al. Impact of age on long-term recovery from traumatic brain injury. Arch Phys Med Rehabil 2008;89:896-903.
6. Whitehead GG, Gerhart KA, Cusick CP. Identifying environmental factors that influence the outcomes of people with traumatic brain injury. J Head Trauma Rehabil 2004;19:191-204.
7. Selassie AW, Zolosnja E, Langlois JA, Miller T, Jones P, Steiner C, et al. Incidence of long-term disability following traumatic brain injury hospitalization, United States, 2003. J Head Trauma Rehabil 2008;23:123-31.
8. Consensus conference. Rehabilitation of persons with traumatic brain injury. NIH consensus development panel on rehabilitation of persons with traumatic brain injury. JAMA 1999;282:974-83.
9. Cicerone KD, Dahlberg C, Kalmar K, Langenbahn DM, Malec JF, Bergquist TF, et al. Evidence-based cognitive rehabilitation: Recommendations for clinical practice. Arch Phys Med Rehabil 2000;81:1596-615.
10. Ben-Yishay Y, Prigatano GP. Cognitive remediation. In: Rosenthal M, Gelfand LB, Bond MR, Miller JD, editors. Rehabilitation of the Adult and Child with Traumatic Brain Injury. 2nd ed. Philadelphia: Davis; 1990. p. 393-409.
11. Adamovich BL. Cognition, language, attention, and information processing. In: Kreutzer JS, Wehman PH, editors. Cognitive Rehabilitation for Persons with Traumatic Brain Injury. Baltimore: Paul H. Brookes Publishing; 1991. p. 75-86.
12. Von Cramon DY, Matthies-Von Cramon G, Mai N. Problem solving deficits in brain-injured patients: A therapeutic approach. Neuropsychol Rev 1991;1:45-64.
13. McCabe P, Lippert C, Weiser M, Hilditch M, Hartridge C, Villameure J, et al. Community reintegration following acquired brain injury. Brain Inj 2007;21:231-57.
14. Sander AM, Roebuck TM, Struchen MA, Sherrer M, High WM Jr. Long-term maintenance of gains obtained in postacute rehabilitation by persons with traumatic brain injury. J Head Trauma Rehabil 2001;16:356-73.
15. Annett MA. Classification of hand preference by association analysis. Br J Clin Psychol 1970;61:303-21.
16. Overall JE, Gorham DR. The brief psychiatric rating scale. Psychol Rep 1962;10:799-812.
17. Smith LM, Godfrey HP. Family Support Program and Rehabilitation: A Cognitive Behavioural Approach to Traumatic Brain Injury. Appendix E. New York: Plenum press; 1995. p. 191-3.
18. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974;2:81-4.
19. Golden CJ. Diagnosis and Rehabilitation in Clinical Neuropsychology. Springfield, IL: Thomas; 1981.
20. O’Hara C, Harrell M, Bellingrath E, Liscia K. Cognitive Symptom Checklists. Odessa, FL: Psychological Assessment Resources; 1993.
21. Willer B, Rosenthal M, Kreutzer S, Gordon A, Rempel R. Assessment of community integration following rehabilitation for traumatic brain injury. J Head Trauma Rehabil 1993;8:7-5.
22. Malia KB, Bewick KC, Raymond MJ, Bennet TL. Cognitive Strategies & Techniques for Brain Injury Rehabilitation. Texas: Pro ed inc.; 2002. [Last assessed on 2017 Dec 15].
23. Wayne Engineering. The Talking Pen; 1974. Available from: http://www.wayneengineering.com. [Last assessed on 2018 Jan 05].
24. Luria A. Recovery of Functions after Brain Injury. New York: Macmillan; 1962.
25. Kaplan CP, Corrigan JD. The relationship between cognition and functional independence in adults with traumatic brain injury. Arch Phys Med Rehabil 1994;75:643-7.
26. Kathleen M, Golizk Z, Toglia JP. In Willard and Spackman’s Occupational Therapy, 9th ed. Neistadt ME, Elizabeth CB (Eds). Lippincott Williams and
27. Walker CM. Dressing after a stroke: A survey of current occupational therapy practice. Br J Occup Ther 2003;66:263-8.
28. Walker CM, Sunderland A, Sharma J, Walker MF. The impact of cognitive impairment on upper body dressing difficulties after stroke: A video analysis of patterns of recovery. J Neurol Neurosurg Psychiatry 2004;75:43-8.
29. Pedersen PM, Jørgensen HS, Nakayama H, Raaschou HO, Olsen TS. Orientation in the acute and chronic stroke patient: Impact on ADL and social activities. The Copenhagen Stroke Study. Arch Phys Med Rehabil 1996;77:336-9.
30. Mokashi SP. Relationship between cognitive deficits and the ability to perform the activities of daily living in stroke patients. Indian J Occup Ther 2005;37:3-9. Available from: http://www.medind.nic.in/iba/t05/i1/ibat05i1p3.pdf. [Last accessed on 2018 Jan 02].
31. Ho MR, Bennett TL. Efficacy of neuropsychological rehabilitation for mild-moderate traumatic brain injury. Arch Clin Neuropsychol 1997;12:1-11.
32. ECRI Institute. Cognitive Rehabilitation for the Treatment of Traumatic Brain Injury. Plymouth Meeting (PA): ECRI Institute Health Technology Assessment Information Service; 2010. Available from: http://www.ecri.org. [Last accessed on 2017 Jan 15].
33. Hoffmann T, Bennett S, Koh CL, McKenna K. A systematic review of cognitive interventions to improve functional ability in people who have cognitive impairment following stroke. Top Stroke Rehabil 2010;17:99-107.
34. Zhang L, Abreu BC, Gonzales V, Seale G, Masei B, Ottenbacher KJ, et al. Comparison of the community integration questionnaire, the Craig handicap assessment and reporting technique, and the disability rating scale in traumatic brain injury. J Head Trauma Rehabil 2002;17:497-509.
35. Gotkovsky ST, Russum P, Stokic DS. Comparison of the CIQ and CHART short form in assessing community integration in individuals with chronic spinal cord injury: A pilot study. NeuroRehabilitation 2009;24:185-92.
36. Temkin NR, Corrigan JD, Dikmen SS, Machamer J. Social functioning after traumatic brain injury. J Head Trauma Rehabil 2009;24:460-7.
37. Sander AM, Struchen MA. Interpersonal relationships and traumatic brain injury. J Head Trauma Rehabil 2011;26:1-3.
38. Willemse-van Son AH, Ribbers GM, Hop WC, Stam HJ. Community integration following moderate to severe traumatic brain injury: A longitudinal investigation. J Rehabil Med 2009;41:521-7.
39. Millis SR, Rosenthal M, Lourie IF. Predicting community integration after traumatic brain injury with neuropsychological measures. Int J Neurosci 1994;79:165-7.
40. Hanks RA, Rapport LJ, Millis SR, Deshpande SA. Measures of executive functioning as predictors of functional ability and social integration in a rehabilitation sample. Arch Phys Med Rehabil 1999;80:1030-7.
41. Cicerone KD, Mott T, Azulay J, Friel JC. Community integration and satisfaction with functioning after intensive cognitive rehabilitation for traumatic brain injury. Arch Phys Med Rehabil 2004;85:943-50.
42. Malec JF. Impact of comprehensive day treatment on societal participation for persons with acquired brain injury. Arch Phys Med Rehabil 2001;92:885-95.

---

**Staying in touch with the journal**

1) **Table of Contents (TOC) email alert**
   Receive an email alert containing the TOC when a new complete issue of the journal is made available online. To register for TOC alerts go to [www.indianjpsychiatry.org/signup.asp](http://www.indianjpsychiatry.org/signup.asp).

2) **RSS feeds**
   Really Simple Syndication (RSS) helps you to get alerts on new publication right on your desktop without going to the journal’s website. You need a software (e.g. RSSReader, Feed Demon, FeedReader, My Yahoo!, NewsGator and NewzCrawler) to get advantage of this tool. RSS feeds can also be read through FireFox or Microsoft Outlook 2007. Once any of these small (and mostly free) software is installed, add [www.indianjpsychiatry.org/rssfeed.asp](http://www.indianjpsychiatry.org/rssfeed.asp) as one of the feeds.