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## ORIGINAL ARTICLES

# Patterns of agitated behaviour during acute brain injury rehabilitation

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**Abstract**

*Objective*: To monitor daily shift-by-shift changes in agitated behaviour during adult brain injury rehabilitation.
*Design*: A prospective, descriptive study.
*Methods*: Eight participants were monitored daily for up to 28 days. The Agitated Behaviour Scale (ABS) evaluated behaviour during three nursing shifts (morning, afternoon, night). Severity of agitation, peak intensity and concomitant behaviours were calculated. Shift differences and patterns of behavioural changes were analysed.
*Results*: Four hundred and seven recordings were taken with the ABS. All participants demonstrated multiple agitated behaviours (between 3–13 concomitant behaviours per person); the most common behaviours were representative of the ABS Disinhibition sub-scale. Weekly peak intensity ranged from 14–55 on the ABS. Mean ABS scores were highest during the afternoon shift and lowest at night. Improved cognition was associated with resolving agitated behaviour; while persistent agitated behaviour was associated with low levels of cognition. Minimal agitated behaviour was observed in participants who emerged from post-traumatic amnesia.
*Conclusions*: Agitated behaviour during acute brain injury rehabilitation has a complex clinical presentation. High levels of agitation observed during the afternoon shift may be associated with low levels of structured activities available at that time, higher levels of environmental stimuli during visiting times and increased cognitive fatigue. Lower cognitive ability was related to consistently higher levels of agitated behaviour and vice-versa.

**Keywords:** *Agitation, cognition, rehabilitation, post-traumatic amnesia*

## Introduction

Agitated behaviour observed during the early stages of brain injury recovery presents a diverse and challenging clinical picture. Variations are observed between and within individuals, at different times of the day and in changing settings. The nature and intensity of agitated behaviour may vary from mildly agitated verbal behaviours that respond to feedback and reorientation, through to severely agitated behaviours including physical aggression [1].

Agitated behaviour is present along a continuum with varying levels of behavioural disturbance characterized by inattention, disinhibition, emotional lability, impulsivity, motor restlessness and aggression [2–6]. The underlying factors that drive agitated behaviour are also thought to shift from an internally driven state of confusion at Rancho Level IV, to behaviours occurring in response to, but often out of proportion to, external stimuli as the person progresses to Rancho Level V [7, 8].

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Research suggests that agitated behaviour during brain injury rehabilitation is associated with limited participation in therapy, difficulty achieving functional goals, prolonged rehabilitation admissions and ultimately poor outcome [3, 5, 9–13]. In particular agitated behaviour is associated with poor cognitive outcome [10, 13, 14] contributing to high care needs after discharge [10, 15]. The impact of agitated behaviour on the rehabilitation process is significant; however, evidence to date does not provide a detailed description of how agitated behaviour changes on a daily basis over time.

Measures of agitated behaviour have either occurred at a single time point in the rehabilitation process, such as at rehabilitation admission [3, 16], or studies have collected daily data and reported mean values or peak scores [2, 10, 12]. This study contributes to knowledge of agitation by providing an in-depth description of daily changes in agitated behaviour over a 1-month period during acute brain injury rehabilitation. Specifically, this study aimed to record agitated behaviour across sequential daily nursing shifts for a period of up to 28 days; to describe shift based changes in agitated behaviour severity and frequency; and to evaluate changes in agitated behaviour as individuals with traumatic brain injury (TBI) emerged from post-traumatic amnesia (PTA).

## Method

This prospective, descriptive study was approved by the local Human Research Ethics Committee. Consent to participate was provided by the Next-of-Kin as all participants were initially in the state of PTA. An option to withdraw consent upon PTA emergence was offered to all participants. The study was conducted at an inpatient, brain injury rehabilitation unit (BIRU) that provides specialist, multi-disciplinary rehabilitation for adults with severe brain injury.

### *Participants and behaviour management*

Consecutive BIRU admissions were screened according to the following selection criteria: first onset of brain injury; presence of PTA according to the Westmead PTA Scale [17]; aged 17–60 years; demonstrating agitated behaviour as defined by Rancho Level IV or V [7], with a planned inpatient admission of at least 4 weeks. Ten patients met the above criteria; from which two patients were transferred to alternate rehabilitation facilities during the study period; therefore eight participants completed the study.

All study participants received usual management for agitation including participation in multi-disciplinary rehabilitation in a secured-ward environment. Where pharmacological intervention was indicated, the first line of treatment for seven of the eight participants was clonazepam; ranging from 1–6 mg daily in six participants and given in escalating doses to 15 mg/day in one very agitated subject. Sleep initiation was considered to be a secondary issue in three of the eight participants who were prescribed temazepam ranging in dose from 10–20 mg/night. The second line of pharmacological management for three participants was haloperidol. This was administered in PRN stat doses of 1.0–2.5 mg to two subjects and as a regular 15 mg/day in divided doses for one subject.

In addition to pharmacological management, all study participants were involved in a daily structured programme of alternating activity and rest periods, multi-disciplinary behaviour management, 1:1 supervision when required, clear redirection and reassurance was provided throughout functional tasks and daily care. Environmental stimuli were controlled to limit over-stimulation. Five participants required use of physical restraint such as a safety vest at times throughout the study due to physical restlessness. One participant was nursed with his bed on the floor to reduce falls risk.

### *Measures and procedures*

Nursing staff administered the Agitated Behaviour Scale (ABS) [18] at the end of each shift (three recordings per day). The ABS consists of 14 items representing three sub-scales: aggression, disinhibition and lability. Items within each behavioural scale are rated from 1 (absent) to 4 (present to an extreme degree). While scores may range from 14–56, previous studies have used a cut-off score $>21$ to categorize individuals as agitated [10, 12]. The ABS is a valid and reliable measure specifically developed to serially assess agitation during the acute period of recovery from TBI [2, 9, 18]. Inter-rater reliability of the ABS is well established ($r = 0.92$) [16]. In-house training sessions were provided to nursing staff throughout the study period to aid rater reliability. Agreement between staff with respect to interpretation of ABS items was regularly reviewed in training sessions.

PTA status was measured by occupational therapy staff using the Westmead PTA Scale (WPTAS) [17]; a daily, prospective measure of orientation and recall, with demonstrated reliability [19] and validity [17, 20, 21]. The WPTAS includes nine questions and three recall picture cards. Participants were deemed to have emerged from PTA on the first day of scoring three consecutive scores of 12/12.

Daily ABS and PTA ratings commenced at rehabilitation admission and continued for up to

28 days. This time frame was selected based on previous research on mean duration of agitated behaviour in acute TBI rehabilitation [12, 13]. Testing ceased earlier if minimum ABS scores were achieved consistently for 1 week and PTA testing ceased when three consecutive daily scores of 12/12 were achieved.

Agitation was considered to be present based on ABS criteria: achieving three or more total ABS scores >21 in 48 hours [10, 12]. Severity of agitation was determined by the number of behaviours concomitantly reported, peak intensity and intensity average. Peak intensity represents the highest total ABS score; while average intensity is the mean of the three highest total ABS scores [12].

Daily ABS scores were recorded for each shift (Morning shift = 07:00–15:30, Afternoon shift = 13:30–22:00, Night shift = 21:30–07:30) and graphed to provide a longitudinal representation of changing agitated behaviour. ABS mean scores were calculated by shift. The relative contribution of each factor (aggression, disinhibition and lability) towards the total scores was separately graphed. Differences between shift means were not analysed statistically due to the high level of serial dependency evident in ratings collected across multiple shifts on sequential days. ABS scores achieved before and after PTA emergence were compared. The small number of participants emerging from PTA prevented statistical analysis of these differences; therefore all presented analyses are descriptive.

## Results

Demographic information is presented in Table I. The sample had sustained severe brain injury, primarily traumatic in nature, and was recruited to this study 5 weeks post-injury. Half the sample was functioning at Rancho Level IV and half at Rancho Level V.

Table I. Participant demographic information.

| Variable | *n* | |
|---|---|---|
| Age: *M* (SD) years | 8 | 34 (13) |
| Sex: Male : Female | 8 | 4:4 |
| GCS, *Median* (IQR) | 7 | 6 (4) |
| Mode of injury: | | |
| Closed TBI | 6 | 75% |
| Penetrating TBI | 1 | 12.5% |
| Hypoxic | 1 | 12.5% |
| PTA duration: *M* (SD) days | 6 | 71 (34) |
| Time from injury to data collection: *M* (SD) days | 8 | 37 (17) |
| Rancho Level Cognitive Functioning: Level IV : Level V | 8 | 4 : 4 |

GCS = Glasgow Coma Scale, TBI = traumatic brain injury, PTA = post-traumatic amnesia, SD = standard deviation, IQR = inter-quartile range.

In total, 407 recordings were taken with the ABS, representing 194 morning shifts, 109 afternoon shifts and 104 night shifts. All participants demonstrated multiple agitated behaviours. The most commonly recorded behaviours were poor attention, impulsivity, repetitive verbal or motor behaviours and restlessness, all of which load on the Disinhibition sub-scale. As such, the Disinhibition sub-scale contributed most to the overall ABS Total score. Being uncooperative or resisting care was the most frequently reported behaviour from the Aggression sub-scale, while rapid, loud or excessive talking and sudden changes in mood were most frequently reported from the Lability sub-scale. The contribution of the Lability and Aggression sub-scales towards ABS Total scores was minimal.

Participants demonstrated great variation in intensity peak and average scores, number of concomitant behaviours and compliance with the ABS criterion (refer to Table II). The breakdown of peak intensity into weekly segments proved more useful than an overall peak intensity score. Weekly peak intensity ranged from 14–55 from a possible score of 56 on the ABS. Average intensity was spread over a similar score range, 18–53. Five of the eight participants met the cut-off criterion of three or more total ABS scores >21 in 48 hours [10, 12]. Participants who met the criterion cut-off were stratified from mild to severely agitated [9], as seen in Table II.

Visual analysis revealed two distinct patterns of agitated behaviour. Participants functioning at Rancho Level V, who emerged from PTA during the study (Participants 2, 3 and 4), demonstrated a gradual decrease in agitated behaviour over the study period. Mean ABS scores were lower following PTA emergence in all three cases: The average ABS score for Participant 2 during PTA = 17, post-PTA emergence = 14; for Participant 3, the average ABS score reported during PTA = 26, post-PTA emergence = 17; and the average ABS score for Participant 4 during PTA = 16 and post-PTA emergence = 14. Few agitated behaviours were reported in participants who had emerged from PTA. This behavioural pattern is evidenced by Participant 3 in Figure 1. Agitation generally reduced over time was minimal after PTA emergence and ceased completely on day 19.

In contrast, study participants with lower initial levels of cognitive functioning, at Rancho Level IV and who did not emerge from PTA during the study, demonstrated higher ABS scores that persisted across the study period. For example, Participant 5 (Figure 2) consistently exceeded the ABS cut-off score of 21 during the morning and afternoon shifts.

Table II. Individual participant ABS information: criterion, peak intensity, concomitant behaviours and average severity.

| ID | Rancho Level | ABS criterion achieved | ABS severity rating | Peak intensity | | | | Intensity average | Concomitant behaviours |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wk 1 | Wk 2 | Wk 3 | Wk 4 | | |
| 1 | V | No | – | 21 | 17 | 18 | 16 | 20 | 4 |
| 2 | V | No | – | 27 | 18 | 15 | 14 | 23 | 6 |
| 3 | V | Yes | Moderate | 36 | 23 | 20 | 14 | 33 | 12 |
| 4 | V | No | – | 19 | 17 | 14 | 14 | 18 | 3 |
| 5 | IV | Yes | Severe | 47 | 52 | 55 | 52 | 53 | 13 |
| 6 | IV | Yes | Severe | 46 | 42 | 49 | 38 | 46 | 13 |
| 7 | IV | Yes | Mild | 28 | 26 | 21 | 24 | 27 | 5 |
| 8 | IV | Yes | Mild | 24 | 21 | 20 | 14 | 23 | 6 |

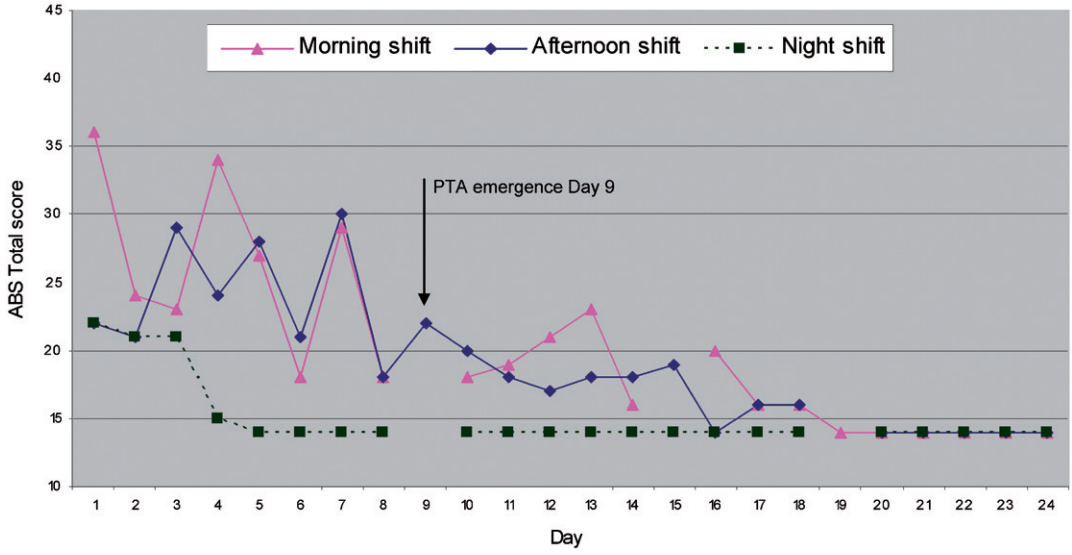


Figure 1. Participant 3—daily ABS scores for each shift.

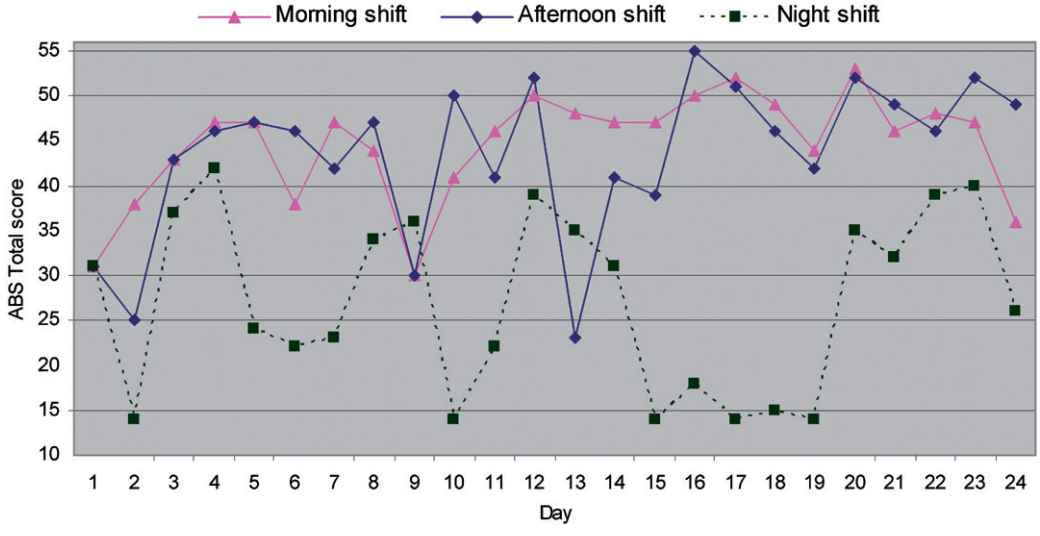


Figure 2. Participant 5—daily ABS scores for each shift.

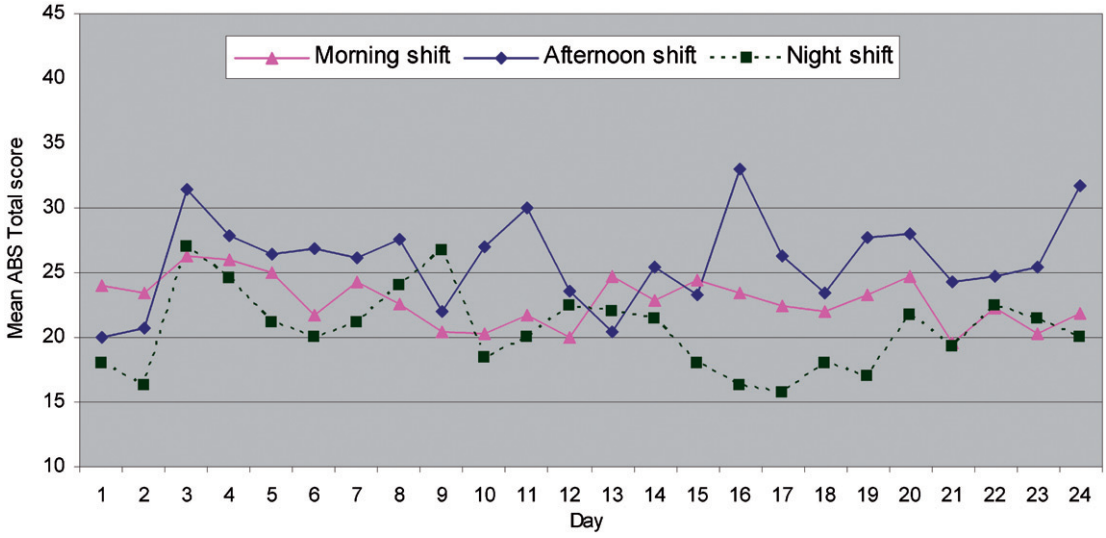


Figure 3. Daily ABS scores (mean of all participants) during each nursing shift.

ABS scores for Participant 5 consistently exceeded the ABS cut-off score of 21.

*Change in agitated behaviour between shifts*

Daily variations and fluctuations in agitated behaviour are clearly evident in Figure 3, demonstrating the mean daily shift ABS of all participants. A trend towards higher levels of agitation during the afternoon shift was evident. Agitated behaviour was least evident at night. The mean ABS Total score during the afternoon shift = 24 (SD = 12), morning shift = 22 (SD = 10) and night shift = 19 (SD = 8). The mean afternoon and morning shift scores exceeded the cut-off criterion of >21, while the night ABS mean score remained sub-threshold, even though agitated behaviour levels on several nights during the early stages of rehabilitation did exceed the threshold. As stated in Methods, statistical analysis of shift differences was not conducted due to data serial dependency.

## Discussion

This study contributes to a clearer understanding of the individual patterns of agitation observed in an inpatient brain injury rehabilitation unit. Daily agitated behaviour was prospectively measured in eight participants, whilst simultaneously monitoring PTA status.

Agitation is typically associated with the PTA period, which is characterized by disturbed orientation, memory and attention [22–24]. In this study, all participants were recruited to the study whilst in PTA. It is therefore not surprising that the most frequently recorded behaviours from the ABS in this study included poor attention, impulsivity, perseveration and restlessness. This cluster of behaviours is characteristic of the non-directed type agitation observed during PTA and may be evident in situations where patients are responding primarily to their own internal state of confusion or experiencing difficulty understanding the demands of the surrounding environment [7, 25–27]. Study participants demonstrated several concomitant behaviours, highlighting the complexity of the agitation phenomenon and the need for clinical staff to use a tool such as the ABS to accurately describe the presentation of individual patients.

As participants progressed towards PTA emergence, agitated behaviour decreased. The converse was also found. Participants who did not emerge from PTA demonstrated the highest daily agitated behaviour scores throughout the study period. These observations support earlier studies that have linked cognition and agitation [10, 13, 14, 25, 28]. However, the directional nature of the relationship between agitation and cognition remains unclear, that is, does improved cognition precede a reduction in agitation or is a reduction in agitation necessary prior to making cognitive gains. In either case, it is likely that interventions targeting improved cognition may have a secondary benefit in reducing agitation.

The daily, prospective data collection technique enabled an in-depth study of each participant. This individual approach highlighted fluctuations between days and between shifts that can otherwise be masked in group studies or by methods based solely on calculating average values [2, 10, 12]. Individual spikes in ABS scores that were inconsistent with the participant's overall pattern of

behaviour could be rapidly identified. Daily data collection methods provided a significant advantage over data collection measures based on a single time point in the rehabilitation process [3, 16] and were clinically useful for monitoring the effects of pharmacological and non-pharmacological interventions.

With respect to shift variations, agitated behaviour was noted more frequently during morning and afternoon shifts, when known agitation triggers such as ambient noise, interactions with others, physical restrictions and tactile stimulation involved with nursing care are more frequently experienced [29–31]. Agitation was lowest at night, confirming findings from earlier studies in adults with brain injury during acute rehabilitation [2] and in residential care facilities [32].

As with Corrigan and Bogner's [2] early work, agitated behaviour peaked during the afternoon shift. Several factors may be associated with this observed increase in agitation. First, it is hypothesized that an increase in agitated behaviour during the afternoon shift may relate to fewer structured activities occurring at this time of day when daily therapy has typically ceased. Secondly, increased agitation may be associated with increased levels of environmental stimulation as visitors begin to arrive on the rehabilitation ward. Finally, cognitive fatigue, which typically increases throughout the day, may further contribute to the observed increase in agitation during the afternoon shift. Cognitive fatigue is associated with the constant effort needed to meet the demands of everyday tasks and to compensate for slowed information processing and attentional deficits [33], factors known to be present in agitated patients.

Higher scores on the Disinhibition sub-scale were evident in the afternoon shift, primarily contributing to the overall increase in ABS Total score. This finding raises the possibility of tailoring intervention techniques towards the specific agitated behaviours observed during each nursing shift. It is hypothesized that disinhibited behaviours such as poor attention, impulsivity, perseveration and restlessness may be closely related to the triggers apparent at this time of day such as lack of structure, increased environmental stimuli and cognitive fatigue. Interventions specifically targeting these triggers such as environmental modification to minimize over-stimulation, rest periods throughout the day to reduce fatigue, more structured interactions with staff and visitors, a planned 'cooling down' period from daily schedules and extending the time period during which therapy activities are available to patients may prove to be effective [4, 26, 27, 29, 34–40]. Current evidence for these interventions is anecdotal at best, however adoption of data collection techniques as outlined in this study may enable more accurate and detailed evaluation of treatment efficacy.

### *Clinical utility*

Staff reported the use of a structured observational measure, in this case the ABS, to be useful in describing the type, frequency and severity of agitated behaviour and was perceived to be a valuable addition to existing behaviour monitoring processes. However, the use of a pre-defined 'cut-off' score for defining agitation highlighted a discrepancy between clinical reporting of agitation and recorded agitation using the ABS. All participants were referred to this study based on a clinical rating of Rancho Level IV or V, yet only five of the eight participants met the ABS criterion for agitation [10, 12]. Previous clinical studies have identified that even low levels of agitation (below the ABS threshold) can substantially disrupt rehabilitation progress [3], therefore the clinical utility of such a cut-off requires further examination.

### *Limitations*

This study was limited by small subject numbers, therefore findings and observations reported here should not be over-generalized. Statistical analysis was limited by serial dependency within the ABS data. While serial dependency was anticipated given the thrice daily data collection methods adopted; the level of dependency may have been artificially elevated by staff having access to ABS data recording sheets from the previous shift. However; if the observed serial dependency is not an artefact of the measurement process, this suggests that the variability observed in agitated patients is most evident between individuals rather than within individuals.

## Conclusion

This study contributes to a clearer understanding of the individual patterns of agitated behaviour observed during acute brain injury recovery. The diverse clinical presentation of agitation has been highlighted in this study, with several concomitant behaviours observed in each study participant, ranging in intensity from mild to severe. Reporting of daily ABS scores on a shift-by-shift basis was invaluable for signalling individual patient inconsistencies.

Agitation reduced as cognition improved, particularly as participants emerged from PTA. Poor attention, impulsivity, perseveration and restlessness contributed most to overall Agitated Behaviour Scores. These behaviours were most evident during the afternoon shift when few structured activities

were available to patients, when environmental stimuli are often high and when patients are typically cognitively fatigued. Interventions specifically targeting these triggers such as environmental modification, a planned afternoon 'cooling down' period and extending the time period during which therapy activities are available to patients may prove to be effective and require further research.

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## References

1. Beaulieu C, Wertheimer JC, Pickett L, Spierre L, Schnorbus T, Healy W, Palmer C, Jones A. Behavior management on an acute brain injury unit: Evaluating the effectiveness of an interdisciplinary training program. Journal of Head Trauma Rehabilitation 2008;23:304–311.
2. Corrigan JD, Bogner JA. Factor structure of the Agitated Behavior Scale. Journal of Clinical & Experimental Neuropsychology 1994;16:386–392.
3. Lequerica AH, Rapport LJ, Loeher K, Axelrod BN, Vangel Jr SJ, Hanks RA. Agitation in acquired brain injury: Impact on acute rehabilitation therapies. Journal of Head Trauma Rehabilitation 2007;22:177–183.
4. Lombard LA, Zafonte RD. Agitation after traumatic brain injury: Considerations and treatment options. American Journal of Physical Medicine & Rehabilitation 2005;84: 797–812.
5. Sandel ME, Mysiw WJ. The agitated brain injured patient. Part 1: Definitions, differential diagnosis, and assessment. Archives of Physical Medicine & Rehabilitation 1996;77: 617–623.
6. Bogner JA, Corrigan JD. Epidemiology of agitation following brain injury. Neurorehabilitation 1995;5:293–297.
7. Hagen C. The expert's corner. Proper use of the Rancho Levels of Cognitive Functioning. Re-Learning Times 2001;8:1.
8. Hagen C, Malkmus D, Durham P. Levels of cognitive functioning. Rehabilitation of the head injured adult: Comprehensive cognitive management. Downey: Professional Staff Association of Rancho Los Amigos Hospital, Inc.; 1979. pp 87–88.
9. Bogner JA, Corrigan JD, Bode RK, Heinemann AW. Rating scale analysis of the Agitated Behavior Scale. Journal of Head Trauma Rehabilitation 2000;15:656–669.
10. Bogner JA, Corrigan JD, Fugate L, Mysiw WJ, Clinchot D. Role of agitation in prediction of outcomes after traumatic brain injury. American Journal of Physical Medicine & Rehabilitation 2001;80:636–644.
11. Burnett DM, Kennedy RE, Cifu DX, Levenson J. Using atypical neuroleptic drugs to treat agitation in patients with a brain injury: A review. Neurorehabilitation 1999;13: 165–172.
12. Kadyan V, Mysiw WJ, Bogner JA, Corrigan JD, Fugate LP, Clinchot DM. Gender differences in agitation after traumatic brain injury. American Journal of Physical Medicine & Rehabilitation 2004;83:747–752.
13. Nott MT, Chapparo C, Baguley IJ. Agitation following traumatic brain injury: An Australian sample. Brain Injury 2006;20:1175–1182.
14. Corrigan JD, Mysiw WJ, Gribble MW, Chock SK. Agitation, cognition and attention during post-traumatic amnesia. Brain Injury 1992;6:155–160.
15. Reyes RL, Bhattacharyya AK, Heller D. Traumatic head injury: Restlessness and agitation as prognosticators of physical and psychologic improvement in patients. Archives of Physical Medicine & Rehabilitation 1981;62:20–23.
16. Bogner JA, Corrigan JD, Stange M, Rabold D. Reliability of the Agitated Behavior Scale. Journal of Head Trauma Rehabilitation 1999;14:91–96.
17. Shores EA, Marosszeky JE, Sandanam J, Batchelor J. validation of a clinical scale for measuring the duration of post traumatic amnesia. Medical Journal of Australia 1986; 144:569–572.
18. Corrigan JD. Development of a scale for assessment of agitation following traumatic brain injury. Journal of Clinical & Experimental Neuropsychology 1989;11:261–277.
19. Geffen G, Bishop K, Connell J, Hopkins P. Inter-rater reliability of the Westmead Post-traumatic Amnesia (PTA) scale. Australian Occupational Therapy Journal 1994;41: 31–36.
20. Shores EA. Further concurrent validity data on the Westmead PTA Scale. Applied Neuropsychology 1995;2: 167–169.
21. Geffen GM, Encel JS, Forrester GM. Stages of recovery during post-traumatic amnesia and subsequent everyday memory deficits. NeuroReport 1991;2:105–108.
22. Ahmed S, Bierley R, Sheikh JI, Date ES. Post-traumatic amnesia after closed head injury: A review of the literature and some suggestions for further research. Brain Injury 2000;14:765–780.
23. Tate RL, Perdices M, Pfaff A, Jurjevic L. Predicting duration of posttraumatic amnesia (PTA) from early PTA measurements. Journal of Head Trauma Rehabilitation 2001;16: 525–542.
24. Weir N, Doig EJ, Fleming JM, Wiemers A, Zemljic C. Objective and behavioural assessment of the emergence from post-traumatic amnesia (PTA). Brain Injury 2006;20: 927–935.
25. Corrigan JD, Mysiw WJ. Agitation following traumatic head injury: Equivocal evidence for a discrete stage of cognitive recovery. Archives of Physical Medicine & Rehabilitation 1988;69:487–492.
26. Riedel D, Shaw V. Nursing management of patients with brain injury requiring one-on-one care. Rehabilitation Nursing 1997;22:36–39.
27. Wilson JC, Dailey W. The practice of behavioural treatment in the acute rehabilitation setting. In: Giles GM, Clark-Wilson J, editors. Rehabilitation of the severely brain-injured adult: A practical approach. 2nd ed. Cheltenham: Stanley Thornes (Publishers) Ltd; 1999. p 54.
28. van der Naalt J, van Zomeren AH, Sluiter WJ, Minderhoud JM. Acute behavioural disturbances related to imaging studies and outcome in mild-to-moderate head injury. Brain Injury 2000;14:781–788.
29. Pryor J. What environmental factors irritate people with acquired brain injury? Disability and Rehabilitation 2004;26: 974–980.
30. Fluharty G, Glassman N. Use of antecedent control to improve the outcome of rehabilitation for a client with frontal lobe injury and intolerance for auditory and tactile stimuli. Brain Injury 2001;15:995–1002.

31. Plylar PA. Management of the agitated and aggressive head injury patient in an acute hospital setting. Journal of Neuroscience Nursing 1989;21:353–356.
32. Cohen-Mansfield J, Marx MS, Rosenthal AS. A description of agitation in a nursing home. Journal of Gerontology 1989;44:77–84.
33. Kohl A, Wylie G, Genova H, Hillary F, DeLuca J. The neural correlates of cognitive fatigue in traumatic brain injury using functional MRI. Brain Injury 2009;23: 420–432.
34. Radomski MV. Traumatic brain injury. In: Trombly Latham CA, Radomski MV, editors. Occupational therapy for physical dysfunction. 6th ed. Baltimore: Lippincott, Williams & Wilkins; 2008.
35. Ducharme JM. A conceptual model for treatment of externalizing behaviour in acquired brain injury. Brain Injury 1999;13:645–668.
36. Giles GM, Clark-Wilson J. Functional skills training following severe brain injury. In: Giles GM, Clark-Wilson J, editors. Rehabilitation of the severely brain-injured adult. 2nd ed. Cheltenham, Glos: Stanley Thornes (Publishers) Ltd; 1999. pp 97–134.
37. Bermann DE, Bush T. Treatment of sensory-perceptual and cognitive deficits. In: Kovich KM, Bermann DE, editors. Head injury a guide to functional outcomes in occupational therapy. Rockville. Maryland: Aspen Publishers; 1988. pp 45–65.
38. Herbel K, Schermerhorn L, Howard J. Management of agitated head-injured patients: A survey of current techniques. Rehabilitation Nursing 1990;15:66–69.
39. Mysiw WJ, Jackson RD, Corrigan JD. Amitriptyline for posttraumatic agitation. American Journal of Physical Medicine & Rehabilitation 1988;67:29–33.
40. Gurka JA. Structured programmes – dealing with the agitated patient. Brain Injury 2005;19(Suppl 1):1–133.