Treatment of unawareness of deficits in patients with acquired brain injury: a systematic review

Citation for published version (APA):

Schrijnemaekers, A. C., Smeets, S. M. J., Ponds, R. W. H. M., van Heugten, C. M., & Rasquin, S. (2014). Treatment of unawareness of deficits in patients with acquired brain injury: a systematic review. *Journal of Head Trauma Rehabilitation*, 29(5), E9-E30. <https://doi.org/10.1097/01.HTR.0000438117.63852.b4>

Document status and date:

Published: 01/01/2014

DOI:

[10.1097/01.HTR.0000438117.63852.b4](https://doi.org/10.1097/01.HTR.0000438117.63852.b4)

Document Version:

Publisher's PDF, also known as Version of record

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Treatment of Unawareness of Deficits in Patients With Acquired Brain Injury: A Systematic Review

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Objective: To review and evaluate the effectiveness and methodological quality of available treatment methods for unawareness of deficits after acquired brain injury (ABI). **Methods:** Systematic literature search for treatment studies for unawareness of deficits after ABI. Information concerning study content and reported effectiveness was extracted. Quality of the study reports and methods were evaluated. **Results:** A total of 471 articles were identified; 25 met inclusion criteria. 16 were uncontrolled or single-case studies. Nine were of higher quality: 2 randomized controlled trials, 5 single case experimental designs, 1 single-case design with pre- and posttreatment measurement, and 1 quasi-experimental controlled design. Overall, interventions consisted of multiple components including education and multimodal feedback on performance. Five of the 9 high-quality studies reported a positive effect of the intervention on unawareness in patients with some knowledge of their impairments. Effect sizes ranged from questionable to large. **Conclusion:** Patients with ABI may improve their awareness of their disabilities and possibly attain a level at which they personally experience problems when they occur. At present, because of lack of evidence, no recommendation can be made for treatment approaches for persons with severe impairment of self-awareness in the chronic phase of ABI. We recommended developing and evaluating theory-driven interventions specifically focused on disentangling the components of treatment that are successful in improving awareness. High-quality intervention studies are urgently needed using controlled designs (eg, single-case experimental designs, randomized controlled trials) based on a theoretic perspective with a detailed description of the content of the intervention and suitable outcome measures. **Key words:** *awareness, brain injuries, intervention studies, literature review, rehabilitation*

ACQUIRED BRAIN INJURY (ABI) can lead to impairments in physical, emotional, cognitive, and social abilities. Diminished awareness of these impairments—a well-known clinical problem following ABI—is seen as compromise of the ability to appraise one's strengths and weaknesses and the implications for life, presently and in the future.^{1,2} Reported prevalence

ranges from 30% to 97%, depending on multiple factors including the measurement instrument used, severity of injury, and amount of time since injury.^{1,3–9} Areas of diminished functioning about which patients may lack awareness include cognition, behavior, and interpersonal skills as well as the effects their behavior have on others.¹⁰ Frontal lobe dysfunction has often been linked to impaired awareness of deficits, but currently there is no clinical consensus regarding the pathogenesis underlying this phenomenon.^{10–12}

The concept of impaired awareness can be divided into different types of impairment. A practical model defined by Crosson et al¹³ outlines a 3-stage hierarchical model in which *intellectual awareness* represents the ability to understand that a function is impaired or to understand the complications caused by the impairment. *Emergent awareness* is the ability to recognize a problem when it is occurring, which requires the person to reach a level of intellectual awareness similar to that before injury. *Anticipatory awareness* is the ability to foresee that a problem will occur as a result of having some type of deficit. Other models concerning impaired awareness of deficits after ABI also describe 3 components of awareness and show considerable overlap.^{1,14–18} In

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Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site (www.headtraumarehab.com).

The authors declare no conflicts of interest.

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DOI: 10.1097/01.HTR.0000438117.63852.b4

2 models,^{16,17} the psychological factor of denial is prominent. Taken together, these models include cognitive components (basic cognitive abilities to perceive, understand, and recognize situations), higher-order cognitive components (self-regulation and anticipation), and a psychological component (with denial on 1 side of the spectrum and acceptance on the other).

The implications associated with impaired awareness of deficits include diminished motivation for treatment (as the patient may not recognize or acknowledge the need for intervention),¹⁹ worse treatment adherence and performance,^{20,21} and an unfavorable short- and long-term employment outcome.^{22,23} By contrast, patients with more intact intellectual awareness achieve better independent living skills.²⁴ Herein lies the challenge of treating patients with awareness problems.

Currently, there are no well-established clinical guidelines for treating unawareness of deficits after ABI,²⁵ despite an array of studies that have evaluated different treatments to improve awareness of deficits. The objective of this article is to review the available treatment methods for impaired awareness and to provide a comprehensive summary of their effectiveness. The current review differs from previous reviews^{26–28} in that it has no restriction on the type of brain injury, intervention, study design, and number of participants; it comprises a broad spectrum of research of interventions that aim to improve awareness of deficits. The following questions are addressed: (i) which interventions have been investigated and what are their specific characteristics and (ii) how effective were these interventions?

METHODS

Selection of articles

A systematic literature search was performed using the electronic databases PsycINFO (1887 to October 2012), PubMed (1953 to October 2012), Embase (1989 to October 2012), The Cochrane Library (1890 to October 2012), and PsychBITE (1940 to October 2012). Free text words as well as index terms were combined. The search strategy used 3 categories: diagnosis (ABI), the specific condition (unawareness of deficits), and intervention. The search was limited to human studies (adolescents and adults) and articles published in peer-reviewed journals. See Table, Supplemental Digital Content 1, available at <http://links.lww.com/JHTR/A87>, for a detailed description of the specific search strategies used for each database.

Articles were selected if they described an intervention study for improving awareness of deficits in adults (16 years or older) with ABI, and if they had a study design with at least pre- and postintervention measurements. Studies published in languages other than English, Dutch, German, or French were excluded. Further-

more, studies were excluded if the primary aim of the intervention was related to visuospatial or somatosensory neglect. Neglect is based on impaired mechanisms of visual attention and, hence, represents a specific demarcated area that lies outside the scope of this review.

Studies were independently selected on the basis of title, abstract, and full text by the first 2 authors (A.C.S. and S.S.). In cases of disagreement, a third author (S.R.) made the final decision. The reference lists of the selected articles were examined for other potentially relevant studies. If appropriate, the specific study cited was tracked down and included in the review.

Data extraction

Data extraction was based on the checklist of items to consider from the Cochrane manual,²⁹ together with data extraction methods from similar reviews.^{30,31} The following study characteristics were extracted from the articles: design of the study, number of patients, type of intervention, effects on the awareness, and functional outcome measures. The overall effect of each intervention was summarized as positive (+), no effect (0), or negative (–).³² Results were considered to be positive when statistically significant at the $P < .05$ level. If no statistical test results were available, the interpretation of the effect was based on the interpretations made by the authors of the study in question.

In addition, we calculated effect sizes. For independent group studies (eg, RCTs), the standardized difference between means, Hedge's g , was calculated where possible (effect size = $[(\text{Mean}_{\text{experimental group, postmeasurement}} - \text{Mean}_{\text{experimental, pre}})/\text{SD}_{\text{experimental, pre}}] - [(\text{Mean}_{\text{control, post}} - \text{Mean}_{\text{control, pre}})/\text{SD}_{\text{control, pre}}]$).³³ An effect size of 0.2 is considered small, 0.5 medium, and 0.8 large.³⁴ For single-case studies (eg SCED), the percentage of nonoverlapping data (PND)³⁵ was used as a measure of effect size. For calculating the PND, the highest data point in the baseline phase needs to be identified. The PND is then determined by calculating the percentage of data points during the intervention phase exceeding this level. A PND smaller than 50% reflects minimally effective treatment, 50% to 70% reflects questionable effectiveness, 70% to 90% is fairly effective and more than 90% reflects a highly effective treatment. Although the PND is often used to determine the effect of treatment in single-case studies, this method is sensitive to floor/ceiling effects and lacks discrimination ability for highly effective treatments (eg, cannot detect slope changes). This should be taken into account when interpreting the PND.

Further data extractions focused on both patient and intervention characteristics. Patient characteristics included age and sex, in- or outpatient setting, etiology

of ABI, time since onset, severity of ABI, and baseline functioning at the beginning of treatment. The following intervention characteristics were extracted: aim(s) of intervention, content of intervention, disciplines involved, and duration/intensity of the intervention.

Quality assessment

Studies were divided into high- and moderate-quality studies following predefined criteria. Studies were considered to be of high quality if they used an independent groups pre-post design (ie, patients were assigned to treatment and control groups and assessed pre- and posttreatment) or if they used single subject designs with multiple pre- and posttreatment measurements (ie, single-case experimental designs). Studies were considered to be of moderate quality or less if they did not fulfill the aforesaid criteria (ie, single group pre-post designs or single-case designs with 1 pre- and posttreatment measurement). The results of the high-quality studies are thoroughly described. The results of the moderate-quality studies are described in summary. To accurately provide a critical appraisal of the validity and applicability of the reviewed results, treatments were assessed using the CONSORT 2010 checklist of information that is to be included when reporting an RCT³⁶ and the CONSORT Statement extension for nonpharmacologic trials.³⁷

RESULTS

The literature search identified 471 articles that were evaluated according to the aforesaid inclusion criteria. Ultimately, 25 articles met the full inclusion criteria and were used for this review (see Figure 1). Reasons for exclusion included the following: the studies did not address awareness of deficits (eg, studies of awareness of risk factors for specific diseases in the normal population), the studies primarily focused on visuospatial or somatosensory neglect, or the studies were not intervention studies.

Of the 25 included studies, 2 were RCTs,^{25,38} 6 were single-case experimental designs,³⁹⁻⁴⁴ 1 was a quasi-experimental controlled trial,⁴⁵ 10 were uncontrolled pre-post measurements,^{6,46-54} and 6 were case studies.⁵⁵⁻⁶⁰ Nine studies fulfilled the criteria to be considered high quality and are further presented in the tables. Studies of moderate quality are briefly described in the text.

Study characteristics

High-quality studies

The study characteristics of the 9 high-quality studies are described in Table 1. The high-quality studies consisted of single-case experimental designs

Figure 1. Flowchart of the selection of articles.

($N = 4$),^{39-41,43} RCTs ($N = 2$),^{25,38} a quasi-experimental controlled design ($N = 1$),⁴⁵ and single-case designs with multiple pre- and posttreatment measurements ($N = 2$).^{42,44} The number of participants in the experimental groups ranged from 1 to 17 with a mean of 7. Three studies reported follow-up measurements.⁴²⁻⁴⁴

Awareness was measured with the Awareness Questionnaire (AQ) discrepancy score (the difference in scores between the patient and an informant; $N = 4$),^{38,39,42,44} the AQ patient score ($N = 1$),⁴⁵ the self-awareness of deficit interview (SADI; $N = 2$),^{25,39} the self-regulation skills interview (SRSI; $N = 3$),^{38,42,44} the assessment of awareness of disabilities ($N = 2$),^{38,41} the Competency Rating Scale difference score ($N = 1$),⁴³ the difference in predicted versus actual scores on a memory test ($N = 1$),⁴⁰ and the percentage of correct answers on ABI questions ($N = 1$).⁴³

TABLE 1 Study characteristics^a

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)
Chandrashekar and Benshoff ⁴⁵ USA	17/19	Quality of Life and Awareness Training (QLAT)	Quasi experimental controlled design	AQ: E: pre 41.88; post 44.65; 4.1% change, ns C: pre 45.68; post 50.58; 7.2% change, ns	Wisconsin HSS: E: pre 166.87; post 164.65; -1% change, ns C: pre 167.92; post 161.45; -2.7%, ns	0 (-) statistical	0 (-) statistical
Cheng and Man ²⁵ Hong Kong	11/10	Awareness Intervention Program	RCT	SADI: E: pre 5.5; post 0.07; -60.3% change, $P = .003$ C: pre 5.1; post 3.6; -17% change, $P = .011$	FIM: E: pre 67; post 104.8; 30% change, $P = .003$ C: pre 75.3; post 100; 19.6% change, $P = .05$ Lawton IADL: E: pre 4.4; post 14.3; 36.7%, $P = .003$ C: pre 4.6; post 9.6; 18.5% change, $P = .012$	+ (1.7) statistical	+ FIM (0.5), Lawton IADL (0.8) statistical
Goverover et al ³⁸ USA	10/10	Occupation- based training protocol embedded within the practice of IADLs	Single blind RCT	AAD: E: pre 14.6; post 16.7; 7.2% change C: pre 16.5; post 14.7; -6.2% change, interaction ns SRSI: E: pre 7.4 ^b ; post 6.2; -12% change C: pre 7.4 ^b ; post 7.7, 3% change, interaction $P < .001$ AQ-Discrepancy: E: pre 11.6; post 10.4; -0.7% change C: pre 13.3; post 13.5; 0.1% change, interaction ns	AMPS process (Rasch): E: pre 0.56; post 0.87 C: pre 0.77; post 0.64; interaction $P < .01$ AMPS motor (Rash): E: pre 1.1; post 1.51; C: pre 1.5; post 1.76; interaction ns CIQ: E: pre 13.9; post 13.3; -2% change C: pre 14.7; post 13.6; -3.7% change, interaction ns	+ SRSI (1.0) 0 AAD (0.5), AQ (0.2) statistical	+ AMPS process (1.0) 0 AMPS motor (0.1) 0 CIQ (0.0) statistical

(continues)

TABLE 1 Study characteristics^a (Continued)

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)
Owensworth et al ³⁹ Australia	1	Metacognitive contextual intervention	SCED	SADI pre 6; post 5; -11.1% change, nt AQ-Discrepancy pre 18; post 10; -4.7 % change, nt	Error frequency (observation): cooking pre (average baseline) 21; during treatment period (average) 11.8; maintenance (average) 11; 44% change (baseline- treatment), 6.7% change (treatment- maintenance) volunteer work pre (average baseline) 12.3; during treatment period (average) 7.5; 39% change	0 (-) <i>observed</i>	+ error frequency (PND 100%) <i>observed</i>
Rebmann and Hannon ⁴⁰ USA	3	Feedback	SCED	Differences between subjects' predicted and actual scores on the Brief Multiparametric Memory Test: scores not reported, only graphs, nt.	...	+ (PND 65%) <i>observed</i>	...
Tham et al ⁴¹ Sweden	4/0	Feedback Task specific	SCED A1-B-A2	AAD: no scores reported No. 1, no. 2: stable baseline, clinically meaningful change in level of awareness between A1 and B, maintained changes in the A2 phase	Unilateral neglect (letter cancellation and baking tray task) decreased in three participants Sustained attention improved in 2 participants.	+ (PND 100%) <i>Clinically meaningful change (logits, statistical)</i>	+ ADL ability (PND 92%-100%) 0 unilateral neglect (PND 67%-83%) sustained attention (PND 67%) <i>observed</i> (continues)

TABLE 1 Study characteristics^a (Continued)

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)
Toglia et al ⁴⁴ USA	4	Multicontext approach	Single subject with baseline (2 subjects) pre (2 subjects) and post/1 mo FU pre1 = 4 wk before pre2 = just before post1 = immediately after post2 = 4 wk after	No. 3: stable baseline, clinically meaningful change in level of awareness between A1 and B, came close to maintaining change No. 4: no stable baseline, clinically meaningful change in level of awareness between A1 and B, maintained changes in the A2 phase AQ-Discrepancy (change scores): No. 1: 8.5, 5% change, nt No. 2: -3, -1.8% change, nt No. 3: -5, -2.9% change, nt No. 4: -1, -0.6% change, nt no raw scores reported SRSI: Awareness: No. 1: pre1 10; pre2 10; post1 8; post2 9.5; -4.5% change (pre1-post2), nt No. 2: pre1 10; pre2 10; post1 6.5; post2 6; -36.4% change (pre1-post2), nt No. 3: pre2 8; post1 5.5; post2 7.5; -4.5% change (pre2-post2), nt	ADL ability (AMPS) improved in all 4 participants. BRIEF-A: decrease of ~1 standard deviation, no scores reported, nt EFPT: mean decrease of 3-5 points No. 1: pre1 5; pre2 4; post1 1; post2 2; -12.5% change (pre1-post2), nt No. 2: pre1 12; pre2 10; post1 7; post2 6; -24% change (pre1-post2), nt No. 3: pre2 9; post1 3; post2 4; -20% change (pre2-post2), nt No. 4: pre2 6; post1 2; post2 0; -24% change (pre2-post2), nt MET errors: mean decrease of 5 points	0 SRSI awareness (PND 100%), AQ (-) observed +EFPT, MET BRIEF-A (PND 100%), 0 SRSI strategy use (PND 100%) observed	(continues)

TABLE 1 Study characteristics^a (Continued)

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)	
Toglia et al ^{42c} USA	1/0	Multicontext approach	Single subject design with repeated pre-post measures (4 wk before and after)	SRSI awareness pre1 10; pre2 10; post 1 8; post 2 9.5; -4.5% change pre2-post2), nt. AQ dif. Score: pre1 22; pre2 30; post 1 24; post 2 45;12.9% change, nt.	No. 4: pre2 6; post1 2.5; post2 2.5; -31.8% change (pre2-post2), nt	No. 1: pre1 10; pre2 9; post1 2; post2 3; -54% change (pre1-post2), nt No. 2: pre1 12; pre2 11; post1 7; post2 7; -38% change (pre1-post2), nt No. 3: pre2 8; post1 2; post2 6; -15% change (pre2-post2), nt No. 4: pre2 7; post1 1; post2 2; -38% change (pre2- post2), nt SRSI Strategy behavior: No. 1: pre1 10; pre2 10; post1 8; post2 9; -9.1% (pre1-post2), nt No. 2: pre1 8.3; pre2 7.6; post1 5; post2 4.6; -33.6% change (pre1-post2), nt No. 3: pre2 6.6; post1 4.3; post2 3.3; -30% change (pre2-post2), nt No. 4: pre2 7.6; post1 1.3; post2 2.3; -48.2% change (pre2-post2), nt	0 SRSI awareness (PND 100%), MET AQ (PND 0%) <i>observed</i>	+ EFPT (PND 100%), MET (PND 100%), BRIEF informant (PND 0%)
					(continues)			

(continues)

TABLE 1 *Study characteristics^a (Continued)*

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)
Zhou et al ⁴³ USA	3/0	Neurobehavioral rehabilitation program and game format training	SCED/ 2 and 4 wk FU	CRS difference score No. 1: base 32; phase1 34; phase2 21; phase3 21; −3.9% change (baseline-phase 3), nt No. 2: base 44; phase1 25; phase2 31; −4.6% change (baseline-phase2), nt No. 3: base 17; phase1 19; phase2 26; phase3 27;3.5% change (base-phase3), nt Knowledge of ABI residuals % correct responses: No. 1: behavior: base 60%; treatment 33%; FU 50%, nt cognition: base 16.5%; treatment 54.8%; FU 91.5%, nt	BRIEF informant rating pre1 61; pre2 63; post1 52; post2 56, nt. MET: pre1 2; pre2 3; post1 10; post2 6; 30.8% change, nt EFPT: pre1 12; pre2 10; post1 0; post2 6; −23.1% change, nt CRS (Patient feelings of competency) No. 1: base 10; phase1 21; phase2 24; phase3 14; 2% change (base-phase3), nt No. 2: base 24; phase1 18; phase2 12; 6.4% change (base-phase2), nt No. 3: base 50; phase1 37; phase2 23; phase3 18; 17% change (base-phase3), nt	0 CRS difference score (PND 50%) + % correct responses (PND 81 % behavior; 80% cognition; 36% physical) <i>observed</i>	0 SRSI strategy (PND 100%) FU: trend toward return to baseline <i>observed</i> 0 CRS (patient feelings of competency) (PND 63%) <i>observed</i>

(continues)

TABLE 1 Study characteristics^a (Continued)

Author/s country	N (E/C)	Intervention	Design/FU	Awareness outcome (E: score/C: score)	Other Outcome Measures (E: score/C: score)	Effect on awareness ^b (ES)	Effect on other outcomes (ES)
				Physical: base 16.4%; treatment 62.4%; FU 49.5%, nt			
				No. 2: behavior: base 22%; treatment 84.2%; FU 84.5%, nt			
				cognition: base 67.3%; treatment 96.3%; FU 91.5%, nt			
				physical: base 60.8%; treatment 83.4%; FU 83%, nt			
				No. 3: behavior: base 38.6%; treatment 84.3%; FU 91.5%, nt			
				cognition: base 48.1%; treatment 92.3%; FU 75%, nt			
				physical: base 47.8%; treatment 95.9%; FU 91.5%, nt			

Abbreviations: C, control group; E, experimental group; ES, effect size; FU, follow-up; na, not applicable; ns, not significant; nt, not tested; PND, percentage of nonoverlapping data; RCT, randomized controlled trial; SCED, single-case experimental design.

^aSee Document, Supplemental Digital Content 2, available at <http://links.lww.com/JHTR/A88>, for an explanation of abbreviations and interpretation of outcome measures.

^bPretest SRSI scores originally were reported as raw scores instead of average scores.

^cThis case study was part of the larger case series study of Toglia et al.⁴⁴

Other outcome measures focused on sustained attention,⁴¹ executive functioning,^{42,44} neglect,⁴¹ motor and process skills,³⁸ activities of daily living,^{25,39} level of functional independence,²⁵ community integration,³⁸ feelings of competency,⁴³ and quality of life.⁴⁵ The specifics of the functional outcome measures appear in Table 1.

In 3 of the 9 studies, the effect of the intervention on awareness was statistically significant (Hedge's $g = 1.0$ – 1.7 ; PND 100%).^{25,38,41} In 2 studies, the effects were not statistically tested, but the authors reported a positive treatment effect on awareness (PND 36%–81%).^{40,43} However, in these studies, the positive treatment effects appeared to be task specific.^{40,43} Statistically significant improvements on other outcome measures were seen in functional independence (Hedge's $g = 0.5$),²⁵ activities of daily living (Hedge's $g = 0.8$),²⁵ and process skills (Hedge's $g = 1.0$).³⁸

Moderate-quality studies

The moderate-quality studies consisted of uncontrolled pre-post studies ($N = 10$)^{6,46–54} and single-case designs ($N = 6$).^{55–60} The mean number of participants was 22, and sample sizes ranged from 1 to 86. Awareness outcome was mostly determined using the SADI ($N = 4$)^{51,52,57,58} and the Patient Competency Rating Scale ($N = 3$),^{6,57,58} the discrepancy between estimated and actual task performance ($N = 3$),^{54,59,60} the AQ ($N = 2$),^{46,51} the Clinicians Rating Scale for evaluating Impaired Self-Awareness and Denial of Disability after brain injury ($N = 2$),^{46,58} and the SRSI ($N = 2$).^{47,50} In 7 of the 16 moderate-quality studies, the effect of the intervention on at least 1 awareness outcome was statistically significant ($P < .05$).^{46–48,50,51,53,54} In 5 studies, there was an observed (ie, not statistically tested) positive effect on awareness.^{55,57–60} However, here again these observed positive effects were related to task-specific improvement^{55,58–60} and reflected only in 1 study an increase in awareness of deficits.⁵⁷ Positive effects on other outcomes included decreased depressive symptoms⁴⁶ and distress,^{48,51} decreased behavioral problems,⁵⁰ increased psychosocial well-being⁴⁷ and psychosocial functioning,⁵⁰ strategy use,⁴⁷ self-regulation,⁵⁰ and a more cooperative attitude to accept assistance or participate in treatment.^{56,58}

Patient characteristics

High-quality studies

Detailed patient characteristics of the high-quality studies are described in Table 2. All participants were adults aged 20 to 76 years; the approximate mean age was 45 years, and the majority (median 63%) were men. In 5 of the 9 high-quality studies, patients experienced a

TBI^{25,39,42,44,45} and in 1 study, the patients had a stroke.⁴¹ In the remaining studies, the etiology of the brain injury was mixed (eg, TBI, stroke, anoxia).^{38,40,43} Severity of brain injury was mentioned in 4 studies^{25,38–40} and ranged from moderate to severe on the basis of the Glasgow Coma Scale, posttraumatic amnesia, or duration of coma. In 7 studies, patients were in the chronic phase after injury (>6 months postinjury) at the start of the awareness intervention.^{38–40,42–45} In addition, in 7 studies, patients received outpatient treatment.^{38–42,44,45} In the 2 studies in which patients were hospitalized, 1 group was in the subacute phase²⁵ and the other was in the chronic phase⁴³ after injury.

The high-quality studies differed in patients' level of baseline functioning prior to treatment. Cheng and Man²⁵ reported moderate baseline Functional Independence Measure scores (experimental group score = 67; control group score = 75) and Lawton instrumental activities of daily living (IADL) scores (experimental group score 4.4; control group score 4.6). Tham⁴¹ reported the baseline score on the Mini-Mental State Examination (MMSE), which ranged from 22 to 27. (See Document, Supplemental Digital Content 2, available at <http://links.lww.com/JHTR/A88>, for the specifics of these scales). In the other studies, patients were independent in basic activities of daily living³⁸ or had basic self-care skills,^{42,44} had difficulty managing multistep IADL,⁴² participated in volunteer work,³⁹ showed global cognitive decline,³⁹ had severe to moderate sensory and motor deficits,⁴¹ had a moderate level of disability,⁴⁴ or showed serious aggressive behavior.⁴³ In 2 studies, no baseline level of functioning was reported.^{40,45}

Baseline levels of impaired awareness varied across studies. In 2 studies, therapists recommended patients for awareness treatment based on clinical judgment of evidence of impaired self-awareness.^{38,43} In one study, patients were included if they underestimated their memory deficits (incongruence between predicted memory performance and actual performance),⁴⁰ and in another study, patients had a SADI score greater than 0 (mean SADI score at baseline was 5).²⁵ Furthermore, studies reported high SRSI scores (range: 6–10),^{42,44} high SADI scores (8),³⁹ and a large difference score on the AQ (range: 22–30)⁴² at baseline. In 2 studies, baseline levels of awareness were not specified.^{41,45}

Moderate-quality studies

In moderate-quality studies, patients had an approximate mean age of 40 years (range: 19–70 years) and the majority (median 68%) were male. Most studies used patients with different types of ABI (eg, TBI, stroke, hypoxia, infection).^{6,46–48,50–54,56–58,58} Three studies used patients with TBI,^{55,59,60} and 1 study included only patients who had a stroke.⁴⁹ Severity of brain injury was

TABLE 2 Patient characteristics^a

Author/s	Mean age and male N(%)	In- or outpatient	Inclusion/Exclusion criteria	Etiology/Diagnostic criteria	Time after onset	Severity ABI	Baseline function and awareness (at start of treatment)
Chandrashekar and Benshoff ⁴⁵	E: 59% 20-40 y 41% 40-60 y (65%) C: 47% 20-40 y 53% 40-60 y (63%)	Outpatient	Incl: patients with TBI in Southern Illinois and Missouri area	TBI	Chronic phase E: 47% 1-4 y 53% 5 y or more C: 21% 1-4 y 79% 5 y or more	Not specified	Not specified
Cheng and Man ²⁵	E: 54.9 (64%) C: 58.1 (60%)	Inpatient	Incl: Appropriate communication abilities, stable and alert (GCS = 15/15). SADI score of >0	TBI	Rehabilitation phase: mean hospital phase 5.2 wk (E + C). Average rehabilitation stay E: 7.5; C: 10 wk	GCS E: 10 C: 12.6	FIM: E: 67; C: 75 Lawton IADL: E: 4.4; C: 4.6 SADI: E 5.5; C: 5.1
Goverover et al ³⁸	E: 39.5 (20%) C: 39.2 (20%)	Outpatient	Incl: Some evidence of self-awareness impairment identified by treating therapist Excl: Aphasia and/or severe visual problems or primary psychiatric or substance abuse diagnosis	ABI	E: 12.9 mo C: 8.6 mo	GCS E: 4.6/15 C: 3.6/15	Independent in basic ADL AAD: E: 14.6; C: 16.5 SRSI: E: 44.2; C: 44.1 AQ-Discrepancy: E: 11.6; C: 13.3
Ownsworth et al ³⁹	No. 1: male, 36	Outpatient	Incl: Severe awareness deficit	TBI	48 mo	GCS: 3/15 (severe). PTA: at least 6 mo	Volunteer work. Global cognitive decline. SADI: 6 AQ-Discrepancy: 18
Rebmann and Hannon ⁴⁰	No. 1: 20, male No. 2: 21, male No. 3: 25, male	Outpatient	Incl: Underestimation memory deficit as defined by the inability to accurately predict performance on the memory tasks used.	No. 1: AVM rupture No. 2: TBI No. 3: TBI	No. 1: 15 mo No. 2: 26 mo No. 3: 36 mo	Coma No. 1: none No. 2: 12 wk No. 3: 7 wk	Enrolled in a special class for adults with brain injury at a community college. Awareness: see inclusion (continues)

TABLE 2 Patient characteristics^a (Continued)

Author/s	Mean age and male N(%)	In- or outpatient	Inclusion/Exclusion criteria	Etiology/Diagnostic criteria	Time after onset	Severity ABI	Baseline function and awareness (at start of treatment)
Tham et al ⁴¹	No. 1: 64, female No. 2: 73, female No. 3: 76, female No. 4: 58, female	Outpatient	Incl: Right CVA of no more than 10 wk ago, severe unilateral neglect and physical, psychological, and intellectual capacities that allowed active participation in assessment and training	Right hemisphere stroke	<10 wk	Not specified	MMSE No. 1: 22 No. 2: 26 No. 3: 24 No. 4: 27 Severe sensory loss. Moderate to severe hemiparesis, visual field deficits. Awareness level unknown
Toglia et al ⁴⁴	No. 1: 29, female No. 2: 27, male No. 3: 47, male No. 4: 50, female	Outpatient	Incl: > 6 mo after injury; independence in basic level skills (FIM); minimum assist in communication; ability to attend to task for least 30 min; competence to provide informed consent; difficulty in managing multistep instrumental ADL	TBI	No. 1: 67 mo No. 2: 37 mo No. 3: 42 mo No. 4: 49 mo	Not specified	Moderate level of disability (Disability Rating Scale). Basic self-care skills (FIM) AQ-Discrepancy: unknown SRS: No. 1: 10; No. 2: 10; No. 3: 8; No. 4: 6
Toglia et al ⁴²	No. 1: 29, female	Outpatient	Incl: >6 mo post-TBI, independence in self-care activities, difficulty in managing multistep instrumental ADL; competence to provide informed consent Excl: Report of intervention of substance abuse or hospitalization for psychiatric disorder.	TBI	66 mo	Not specified	Moderate level of disability (disability rating scale), living in apartment with 24-h aid and specialized day program. Denial of functional or cognitive difficulties, except for walking and speaking clearly

(continues)

TABLE 2 Patient characteristics^a (Continued)

Author/s	Mean age and male N(%)	In- or outpatient	Inclusion/Exclusion criteria	Etiology/Diagnostic criteria	Time after onset	Severity ABI	Baseline function and awareness (at start of treatment)
Zhou et al ⁴³	No. 1: 30, male No. 2: 32, male No. 3: 31, male	Inpatient	Incl: Residents of the rehabilitation program and recommended for awareness instruction by clinical treatment team	No. 1: anoxic No. 2 and No. 3: TBI	No. 1: 24 mo No. 2: 18 mo No. 3: 120 mo	Not specified	Physical and verbal aggressive behavior. CRS difference: No. 1: 32; No. 2: 44; No. 3: 17 Knowledge of ABI residuals % correct responses: see Table 1.

Abbreviations: ABI, acquired brain injury; AVM, arteriovenous malformation; C, control group; E, experimental group; GCS, Glasgow Coma Scale; PTA, posttraumatic amnesia; TBI, traumatic brain injury.

^aExplanation of abbreviations and interpretation of outcome measures can be found in Supplemental Digital Content 2, available at <http://links.lww.com/JHTR/A88>.

noted in 9 of the 16 studies.^{6,46,48,50,51,55,57–59} The majority of participants had a severe brain injury. Mean time postonset varied from 8 weeks to 8 years. In 10 studies, patients were in the chronic phase after injury^{6,46,47,48,50–52,55,57,60}; in 3 studies, patients were in the postacute phase and in 1 study, chronicity was mixed⁵³; in 2 studies, time since injury was not specified.^{54,59}

Intervention characteristics

High-quality studies

The detailed characteristics of the interventions from high-quality studies are described in Table 3. All interventions consisted of more than 1 component. The majority used some form of psychoeducation about deficits, often in combination with feedback on performance. Education was given by presenting declarative knowledge about deficits,^{25,39,43} experiential functional exercises guided by therapists,^{25,41,42,45} or by using a board game with a question-answer-reward format.⁴³ Feedback was given verbally,^{25,40} visually,⁴⁰ or audiovisually,^{39,41} by positive reinforcement,^{38,40,43,42,44} by nonconfrontational discussion between patient and researcher about task performance,^{38,39,41,42} or by self-evaluation.^{42,44}

Occupational therapy was the major discipline involved in the studied interventions.^{38,39,41,42,44} In 1 study, a psychologist was involved.⁴³ In 3 studies, the discipline was not stated.^{25,40,45}

Treatment duration and intensity varied across the 9 studies, ranging from 3 to 12 weeks and the total number of sessions ranging from 6 to 40 (45 minutes–2 hours).

The treatment programs were effective in improving awareness in 5^{25,38,40,41,43} of the 9 high-quality studies. Therefore, they are described more thoroughly.

Goverover et al³⁸ investigated an occupation-based training protocol. Twenty patients with some evidence of self-awareness performed IADL tasks. The patients in the experimental group had to predict their performance before a task, then estimate and evaluate their performance afterward. They were stimulated to think of a strategy to improve their task performance. Participants had learned to improve IADL activities and showed better self-regulation. The improvement in self-regulation was significant (Hedge's $g = 1.0$). *Self-regulation* was defined as having awareness, the readiness to change and formulating strategy behaviors.⁶³ The patients in the control group completed the IADL tasks without the awareness intervention. On specific awareness measures, no significant treatment effect was observed.

Tham et al⁴¹ investigated awareness in 4 women with mild to moderate cognitive disabilities and severe sensory loss. Patients were fewer than 10 weeks poststroke and had intellectual awareness at baseline. The 4-week intervention phase consisted of training purposeful and

TABLE 3 *Intervention characteristics*

Author/s	Aim of intervention	Intervention (E/C)	Disciplines involved	Duration/Intensity
Chandrashekar and Benshoff ⁴⁵	To determine if persons with TBI who participate in 6 weeks of the Quality of Life and Awareness Training differ significantly from those who do not participate in the way that (1) they perceive quality of life and (2) they are aware of their deficits.	E: 6 wk Quality of Life and Awareness Training (QLAT). Training goals and activities were established on the basis of the Wisconsin HSS Quality-of-Life Inventory. Awareness training goals and activities were based on Ownsworth et al's ⁶¹ workbook on group activities for persons with TBI. C: no QLAT, playing board games and cards in a group.	Not specified	E: 6 sessions in 6 wk. Each session was 1 h and 30 min in length with 10-min break. C: 6 sessions of 1½ h during 6 wk
Cheng and Man ²³	Management of impaired self-awareness	E: Awareness Intervention Program: education to enhance objective knowledge about deficits; experiential, functional exercises to enhance patients' awareness of changes in their ability; practice of self-performed prediction and goal-setting during experiential functional exercise; concrete and extensive feedback. Individual. C: Conventional rehabilitation program: included physical, functional, and cognitive aspects of occupational therapy. In groups, participants were trained in activities of daily living, training in motor function prerequisites for functional tasks, cognitive training (unstructured orientation and memory group), and a predischarge arrangement group.	Not specified	4 wk, 5 d a week, 2 sessions per day.

(continues)

TABLE 3 *Intervention characteristics (Continued)*

Author/s	Aim of intervention	Intervention (E/C)	Disciplines involved	Duration/Intensity
Goverover et al ³⁸	Alleviate difficulties related to self-awareness and self-regulation and to address functional performance outcomes	Performance of one instrumental activity of daily living. E: Prior to task, participant defined task goals; predicted performance; anticipated and preplanned for errors or obstacles; chose a strategy to avoid errors; assessed amount of assistance needed. After task completion, participant estimated and evaluated own performance, followed by a discussion with the researcher. Afterwards the participant wrote experiences in a journal C: conventional practice, including direct corrective feedback from therapist.	Occupational therapy	6 individual sessions (45 min) over 3 wk
Ownsworth et al ³⁹	To target error awareness and self-correction in 2 real-life settings: (1) cooking at home and (2) volunteer work	Prior to baseline assessment subject practices cooking a meal with his mother's support. Treatment: Feedback about the subject's postinjury changes. Education for family, feedback on prompting during the specific performances on cooking and work tasks. Prompting according to the principles of "Pause, Prompt and Praise." ⁶² Role reversal technique (observing mother cook en give her feedback). External reminder (electronic timer) for checking recipe, precooking discussion, and postcooking feedback discussion. Video feedback. Similar techniques were used in the volunteer task.	Occupational therapist	Cooking: 16 wk: 4 wk baseline, 8 wk treatment, and 4 wk maintenance and generalization Work: 16 wk: 12 wk baseline, 4 wk treatment.
Rebmann and Hannon ⁴⁰	To test an intervention for reducing unawareness of memory deficits using a behavioral approach	Baseline condition: no feedback during performance treatment: (1) visual and verbal feedback: problem solving approach, encouraging subjects to find out why their predictions did not match their performance and (2) positive reinforcement: verbal praise and lottery tickets.	Not specified	No. 1: 8 treatment sessions No. 2: 6 treatment sessions No. 3: 6 treatment sessions Duration and intensity: 2 sessions a week for 5-6 wk. (continues)

TABLE 3 *Intervention characteristics (Continued)*

Author/s	Aim of intervention	Intervention (E/C)	Disciplines involved	Duration/intensity
Tham et al ⁴¹	Improving awareness of disabilities in client with unilateral neglect	A phase: occupational therapy; 5 days a week focused on training in self-care activities by using the participants available abilities and by adapting tasks demands and contexts. Patients participated in other rehabilitation services as well. B phase: Focus of occupational therapy on training awareness of abilities. Therapists support the patients to choose motivating training tasks; discuss and evaluate performance (including learning compensatory techniques); use the home environment (eg, confrontation); video feedback; using therapeutic narratives	Occupational therapy	ABA: A1 phase: baseline observations during 4 sessions over 2-wk period. 1-2 h a day. Intervention phase B: 4 data collection sessions over 4 wk, 1 h to 2 h a day, 5 days a week. A2 FU phase: 2 times data collection after 5 and 9 wk
Toglia et al ⁴⁴	To improve proximal outcomes (cognitive strategies and self-regulation), distal outcomes (general awareness and everyday function), and maintenance of gains 4 wk FU	Guided anticipation of challenges, guided strategy generation, error discovery phase, strategy training/mediation phase, reinforcement of strategy use, session self-evaluation, structured journal	Occupational therapy	75-min sessions, twice per week over ~5 wk
Toglia et al ⁴²	To improve learning and transfer of strategy use, self-monitoring skills, performance in functional tasks postintervention, and awareness	See Toglia et al ⁴⁴	Occupational therapy	75-min sessions, twice per week over ~5 wks

(continues)

TABLE 3 Intervention characteristics (Continued)

Author/s	Aim of intervention	Intervention (E/C)	Disciplines involved	Duration/Intensity
Zhou et al ⁴³	A game format to teach information about ABI to persons experiencing the effects of such injuries.	Six categories were targeted: behavior, emotion, cognition, communication, physical, and sensory. Each category consists of 18 questions concerning terminology, effect of residuals on a person's life and potential compensatory strategies. Question written on one side of the card, answer on the other side. Scores on a modified Trivial Pursuit board. Per game 3 x 6 = 18 questions + percentage of correct response. 3 phases (1: behavior and emotion, 2: cognition and communication, 3: physical and sensory). When 70% correct, then go to next phase. Monetary award for participation, success, and winning.	Psychology; advanced graduate students, master's degree in behavior analysis and therapy.	1 h 3 times a week. Duration 31 sessions (5 baseline sessions, 26 treatment sessions, 2 FU sessions). FU sessions 2-4 wk after final game.

Abbreviations: C, control group; E, experimental group; TBI, traumatic brain injury.

meaningful daily tasks at both the rehabilitation center and the home environment. Strategy behaviors were encouraged, followed by self-evaluation and visual and verbal feedback. Awareness of abilities improved in these 4 patients (clinically meaningful change). The PND of 100% indicates that the treatment was highly effective. The improvements were maintained at follow-up in 2 of 3 patients.

Cheng and Man²⁵ conducted an RCT with 22 patients with moderate ABI in the postacute phase with intellectual awareness at baseline. The experimental group received a 4-week Awareness Intervention Program that included enhancing objective knowledge about deficits, experiential functional exercises, practice of self-performed prediction and goal setting, and concrete and extensive feedback. The control group followed a conventional rehabilitation group program including training in activities of daily living, training in motor function, and cognitive training. The result was an improvement in the level of awareness and in functional activities of daily living and IADL activities for the experimental group, but not the control group (Hedge's $g = 0.5$ – 1.7).

The behavioral approach of Rebmann and Hannon⁴⁰ was based on positive verbal (praise) and materialistic (lottery tickets) reinforcement for more accurate predictions of performance. Task-specific awareness improved in all 3 participants; however, the effect of the treatment was questionable as indicated by a PND of 56%.

Zhou⁴³ investigated a modified Trivial Pursuit game format intervention over a period of 11 weeks using positive feedback in 3 aggressive men with severe TBI who had poor awareness of deficits in the chronic phase recovery. Participants engaged in 1-hour group sessions 3 times a week (32 sessions). The topics included "behavior and emotion," "cognition and communication," and "physical and sensory." For each topic, the questions concerned terminology, the effects that limitations might have on a person's life, and potential compensatory strategies. Feedback was positive when answers were correct and informative (ie, corrective) when answers were incorrect. All 3 patients showed improvement in general knowledge of the consequences of ABI (PND 80%–81%). However, a general understanding of the impact of ABI may not reflect patients' awareness of their own deficits. There was no change observed in the discrepancy between ratings given by patients and clinicians on a competency rating scale, indicating that patients' knowledge of their own deficits did not improve (PND 50%).

The remaining 4 studies in the high-quality group did not show improvement in awareness of deficits. However, the 2 studies of Toglia et al^{42,44} are worth describing briefly because of the theoretical background of the intervention.

Toglia et al^{42,44} outlined the importance of generalizing strategy use from trained to untrained tasks. Therefore, they used a multicontext approach that included systematically varying treatment activities and context and gradually increasing transfer distance. In 9 sessions, improvements were observed in monitoring skills and strategy use (PND 100%), and these improvements persisted in 3 of 4 patients at follow-up in one study,⁴⁴ but not in the other.⁴² General awareness of deficits, however, remained unchanged. Toglia et al⁴⁴ and Ownsworth et al⁶⁴ suggested that persons who lack understanding of their general deficits still are able to learn to use and monitor a strategy across situations. The underlying mechanisms may include automatic learning and habit formation and active and deliberate self-monitoring mechanisms.

Moderate-quality studies

The types of interventions in the moderate-quality studies are similar to those of the high-quality studies. They were diverse as well and consisted of multiple components, such as the therapeutic relationship ($N = 3$),^{55,57,58} education and feedback ($N = 9$),^{6,46,47,51,54,56–58,60} coping and problem-solving ($N = 2$),^{47,53} and social skills training ($N = 1$).⁵⁰ The interventions of the moderate-quality studies were mostly carried out by a multidisciplinary team ($N = 5$).^{6,47,48,52,60} Other disciplines involved were psychology ($N = 3$),^{46,50,53} occupational therapy ($N = 3$),^{57–59} and neurology ($N = 1$).⁵¹ In 4 studies, the type of therapy was not clearly specified.^{49,54–56} The intensity of the interventions varied between studies from 1 session to 56 sessions, with an average duration of 14 weeks and an average of 4 days a week therapy. Three interventions used group therapy.^{6,47,50} The other interventions consisted of individual training.

Quality assessment

Although the CONSORT Statement is primarily intended to address RCTs, an effort was made by the authors to review non-RCT studies of higher quality as well as the validity and applicability of their results.

The quality of the 9 high-quality studies is presented in Table 4. In general, the quality of the report was moderate. No study scored more than 50% on the checklist. Positive aspects were accurate reporting in the abstract, introduction, and discussion. The method sections, however, were of lower quality. The description of intervention methods was mostly in global terms, without specific discussion of the similarities and differences between interventions. Furthermore, descriptions of the procedure for tailoring interventions to individual participants and details of how therapist

TABLE 4 Quality assessment of included studies using the CONSORT statement 2010

Author/s	Title, abstract (Max 2)	Introduction (Max 2)	Methods—design, etc ^a (Max 8)	Methods—interventions (Max 4)	Methods—randomization, etc ^b (Max 8)	Results (Max 11)	Discussion (Max 3)	Other information (Max 3)	Total (%) score (Max 41)
Chandrashekar and Benshoff ⁴⁵	0	2	0	0	3	2	3	0	24%
Cheng and Man ²⁵	1	2	3	2	2	3	2	0	37%
Goverover et al ³⁸	1	2	2	2	3	3	2	1	39%
Owensworth et al ³⁹	1	2	1	2	0	3	3	1	32%
Rebmann and Hannon ⁴⁰	1	2	5	1	0	0	2	1	29%
Tham et al ⁴¹	1	2	3	2	0	4	3	1	39%
Toglia et al ⁴⁴	1	2	3	2	1	2	3	1	37%
Toglia et al ⁴²	1	2	3	2	0	1	3	1	32%
Zhou et al ⁴³	0	2	2	1	0	3	0	0	20%

^aMethods—design, participants, outcome, sample size.^bMethods—randomization, blinding, statistics.

adherence to the protocol was assessed or enhanced were often not indicated.

DISCUSSION

This systematic literature search of the available treatment methods for unawareness of deficits in people with brain injury yielded 25 studies for inclusion. Nine studies with controlled or single case experimental designs were considered to be high quality and were investigated thoroughly. Interventions were performed mostly in people with traumatic brain damage who were in the chronic phase and had moderate to severe levels of injury.

Conceptual and methodological differences made it difficult to compare studies. As noted in previous reviews, researchers used different interventions to address impaired self-awareness.²⁷ The majority of the treatments included a combination of psychoeducation and feedback.

Three interventions (2 RCTs and 1 SCED) showed promising results with multimodal training and feedback.^{25,38,41} These studies utilized patients in the postacute phase of rehabilitation with intellectual awareness at baseline. It remains unclear which aspects of the treatment were effective, but the interventions in these studies shared some elements that might have led to improvements in awareness. These were training functional skills in real life settings, guided experience, multimodal feedback, and dialogue between therapist and patient, which could best be described as Socratic reasoning. The last of these comports with the view that motivational interviewing might be a useful technique to improve awareness of deficits.⁶⁵

Furthermore, 2 studies^{40,42} investigated awareness interventions in an artificial training situation. In patients with ABI exhibiting severe lack of awareness, a single task or game was practiced, and performance was rewarded on the basis of the principles of operant conditioning. These interventions led to task-specific improvements in awareness.

The studies that did show a positive effect of intervention on awareness included patients with at least some intellectual awareness. To date, there is no convincing evidence that people with unawareness in the chronic phase post-ABI may progress to some level of intellectual awareness. It remains unclear whether awareness of deficits can be improved in patients with very poor intellectual awareness who are in the chronic phase after injury when spontaneous recovery is unlikely. Moreover, a prerequisite for intellectual awareness is the basic cognitive ability of patients to remember and integrate past experiences to draw conclusions about the commonalities between their pre- and postinjury experiences. Thus, significant deficits in abstract reasoning or memory during

the chronic phase of recovery might underlie enduring limitations in intellectual awareness.¹⁵

There are still many questions to be answered. To formulate general guidelines for the development of an awareness intervention, several points need further attention. First, many studies lack a theoretical perspective. Although some studies acknowledge and hypothesize 2 or 3 components underlying the concept of awareness, they do not specifically report at which component of awareness their intervention and outcome measures are aimed. Defining these factors is necessary to frame the results in a theoretical perspective to verify and refine the existing theories. Second, there are several good quality measurement instruments to assess awareness.⁶⁶ However, these measurements do not encompass all 3 components of awareness. This is important to consider when evaluating the impact of awareness interventions. Third, the concepts “learning” and “changing awareness” seem to be used interchangeably. It remains unclear whether a task-specific improvement is the result of increased awareness or simply learning a task. Only when an improvement can be generalized to other nontrained tasks or daily functioning, one can speak of an improvement in awareness.

Before reaching a consensus on how to treat unawareness of deficits, we should agree on an underlying theory and standardize measures of awareness to promote accurate determination of treatment effects. The next step is to take into account patients’ basic and higher-order cognitive deficits that may affect awareness and, thus, determine the patients’ current ability to be aware of their problems.¹⁵ Another conceptual issue to address is the fact that the reviewed studies did not distinguish between impaired self-awareness and denial of disability, that is, the psychological component of awareness. These concepts are not mutually exclusive, but likely require different treatment approaches.^{58,67}

In general, the quality of the study reports was moderate. Often, the description of the intervention was not clearly stated or was explained only in general terms. It was never reported how therapist adherence to the treatment protocol was assessed or enhanced. In addition, it was not always clear what the important outcome measures were and how they were used in the analysis. These results are in line with those of a previously published systematic review concerning the content of evidence-based cognitive rehabilitation, which emphasized the lack of information provided in studies about the actual content of treatment.⁶⁸

This review differs from previous reviews in that it used less stringent restrictions on included studies of methods to improve awareness of deficits, resulting in a broad spectrum of research. However, this approach has its limitations. The heterogeneity of the studied samples in terms of injury severity, brain injury etiology, time

since injury, and the small sample sizes of several studies limit the generalizability of the results and the practical applicability of the conclusions. Also, we utilized authors’ conclusions in interpreting the effects of studies that lack statistical test results, and these conclusions may be too optimistic or even erroneous. However, for some studies, the calculated PNDs, despite its limitations, provided a better basis for interpretation of the results.

Unawareness of deficits in patients with ABI is a well-known clinical problem that hinders the rehabilitation process. To tackle this problem, a practical and evidence-based protocol to improve awareness is necessary; however, such a protocol is not yet available. We advise clinicians to consider the improvement of awareness as a primary treatment goal and not as merely a byproduct of rehabilitation. In other words, if a patient undergoes cognitive rehabilitation but is unaware of his or her cognitive deficits, one main objective of cognitive rehabilitation should be to increase awareness of the patient’s problems. Furthermore, future studies should consider the use of the CONSORT Statement^{36,37} to improve methodological quality reporting.

On the basis of this review, we can propose some tentative guidelines regarding treatment of patients with impaired self-awareness. A general approach to improve awareness includes training functional skills in multiple, preferably real life, settings with feedback using guided experience in a Socratic dialogue. Furthermore, to choose which intervention is most appropriate for a specific patient, it is helpful to determine a cognitive profile of strengths and weaknesses, because cognition is an important component of awareness of deficits.¹³ It is also worthwhile to determine on which learning level the intervention should focus. For example, if the intervention is aimed at improving a specific task, the training could be based on procedural and explicit learning. If the goal is improving ability, the intervention is more complex. In this case, generalization across tasks is necessary, and it requires the meta-cognitive ability to reflect upon oneself, which is an important aspect of awareness.

Although we realize that the aforementioned considerations will be challenging in both research and clinical settings, they represent a necessary step to move forward to increase understanding and improve the efficacy of interventions aimed at awareness of deficits.

CONCLUSION

Our systematic review showed that impaired awareness after ABI could be improved in patients with some degree of intellectual awareness through a combination of education and multimodal feedback related to performance. However, there still is a need

for high-quality intervention studies with controlled designs (ie, SCED, RCT) based on a theoretic perspective with a detailed description of the content of the intervention and suitable outcome measures. Future research should focus on identifying the components that contribute to improved awareness in people with ABI,

preferably using a sound methodology and theoretical perspective. Instead of considering improved awareness as the residual byproduct of rehabilitation, clinicians should specifically focus on awareness and test their efforts to improve awareness with single-case experimental designs.

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