**Can the integration of artificial intelligence memory programs alongside traditional memory training methods help people with acquired brain injuries improve memory more effectively than relying solely on traditional methods? A systematic review.**

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## Background

### Rationale

After acquired brain injuries (ABI), people often experience memory problems and cognitive difficulties that affect daily functioning and independence (Fernandez Lopez and Antoli 2020; Jamieson et al. 2023). Traditional cognitive rehabilitation plays a role in helping recovery from ABI (Fetta, Starkweather and Gill 2017; Gopi, Wilding & Madan, 2022), however results vary depending on disability severity, specific deficits, and individual responses (Fernandez Lopez and Antoli 2020). Traditional cognitive rehabilitation, focusing on memory, includes several approaches (Gopi, Wilding & Madan, 2022 & Nejati, 2023). These include the restorative approach, which involves exercises aimed at retraining memory abilities to restore memory function (Gopi, Wilding & Madan, 2022 & Nejati, 2023). Another method is specific knowledge acquisition, focusing on learning information directly relevant to daily life to improve daily activities (Gopi, Wilding & Madan, 2022 & Nejati, 2023). The compensatory approach uses internal and external memory aids, such as mnemonics and tools, to compensate for memory deficits (Gopi, Wilding & Madan, 2022 & Nejati, 2023). A newer approach, the holistic approach, considers memory, emotional, and social factors alongside cognitive consequences of ABIs, combining compensatory aids and therapy to address a wider range of challenges (Gopi, Wilding & Madan, 2022). These approaches serve cognitive rehabilitation needs, concentrating on memory and overall function (Gopi, Wilding & Madan, 2022). The choice depends on individual requirements and the nature of the impairment, with the goal of enhancing daily life and overall quality (Gopi, Wilding & Madan, 2022 & Nejati, 2023).

Limited literature explores artificial intelligence (AI) based memory rehabilitation for individuals with ABIs. Few comparative studies involving AI and traditional methods exist due to the emerging clinical applications of AI, raising concerns about safety. The limited research on the safety and efficacy of AI interventions in this context further emphasise clinicians' caution in preferring traditional methods, which have an extensive well-established history of traditional cognitive rehabilitation for ABI patients (Gopi, Wilding & Madan, 2022 & Nejati, 2023). Clinicians rely on evidence-based practices and established interventions to prioritise the safety and effectiveness of interventions, especially in cognitive rehabilitation for individuals with ABIs. As a result, clinicians may be cautious about making

AI-based memory rehabilitation their primary approach, particularly when working with vulnerable individuals like those with ABIs, where rigorous testing and evaluation are essential to ensure safety and effectiveness. A previous systematic review (Fernandez Lopez and Antoli 2020) looked at a wider field that encompassed both children and memory rehabilitation, though memory rehabilitation was not its primary focus. The updated review focuses specifically on recent adult-focused memory rehabilitation studies that reflect advances in AI technology. This systematic review addresses an important research gap and provides an overview of AI memory programs' potential to enhance ABI memory rehabilitation compared to traditional methods alone, advancing the understanding of cognitive rehabilitation in this population.

## Objectives

This systematic review aims to evaluate the efficacy of AI memory program for adults with ABI, as a complementary intervention, alongside traditional therapy to improve memory outcomes.

## Methods

### Search strategy

To identify meaningful peer reviewed studies that have been published up to October 2023, a thorough search strategy has been used in this review. Relevant articles and keyword phrases have emerged from the first search on MEDLINE, enabling a comprehensive strategy to be developed. This strategy was tailored for multiple databases, including Medline, Emcare, Embase, PsycINFO, Scopus, and OTseeker (see Appendices A-F). Only studies involving humans were searched and published in the English language. To ensure the focus of the review, studies which do not fall within these criteria such as those unrelated to human intervention or published in languages other than English have been excluded.

### Eligibility criteria

Table 1 outlines the inclusion and exclusion criteria for this review. It includes studies of adults with ABIs, regardless of origin or severity, with a primary focus on Randomised Controlled Trials (RCTs). The review specifically concentrates on the integration of AI memory programs alongside traditional memory training, comparing them with traditional methods alone. The primary outcome is memory improvement. Included are quantitative studies from peer-reviewed English journal articles. Excluded are qualitative research, conference abstracts, editorials, book chapters, and non-English publications.

**Table 1. PICOS Criteria**

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| **Population** | Adults (18+)<br><br>People who have a history of acquired brain injury (of any severity) | Children (0 – 18)<br><br>People who have NOT had an acquired brain injury |
| **Intervention** | The integration of artificial intelligence memory programs alongside traditional memory training methods | N/A |
| **Comparison** | Traditional memory training/therapy methods | N/A |
| **Outcomes** | Improvement in memory | N/A |
| **Studies** | Quantitative research designs<br><br>Randomised Controlled Trials (RCTs)<br><br>Peer reviewed journal articles<br><br>Published in English | Qualitative research designs<br><br>Conference abstracts, editorials, book chapters<br><br>Publications in all other languages |

## Literature selection

In EndNote 20 all the identified citations were sorted and uploaded into Covidence, prior to removal of duplicates. Titles and abstracts were then screened by one independent reviewer (A.K) for evaluation against the inclusion criteria for eligibility. Subsequently, a full review was carried out of the sources examined to assess their eligibility in detail. Search results and study inclusion are presented in a flowchart of the PRISMA extension of the systematic review (Page et al., 2021). The selected databases were chosen for their focus on and relevance to research of AI and memory rehabilitation for individuals with ABI, ensuring a comprehensive and thorough search.

## Methodological quality assessment

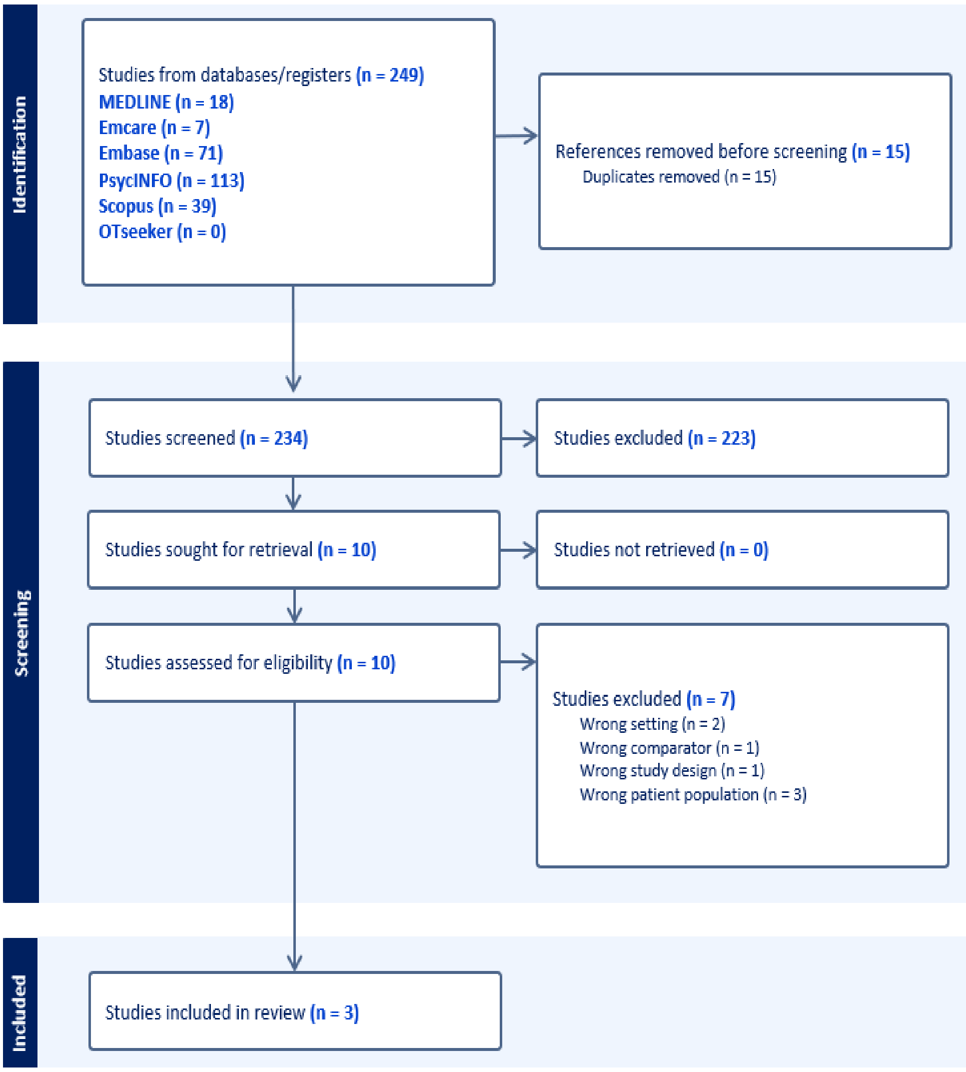
The methodological quality of the selected studies was independently assessed by one reviewer, AK. The evaluation used the Joanna Briggs Institute (JBI) critical appraisal tool for randomised control trials (RCT) (Barker et al., 2023), which consists of thirteen core components. This tool assessed methodological quality and assigned scores to individual components, indicated as '1' for 'yes' and '0' for 'no' or 'unclear'. Percentage points were calculated separately based on a table prepared for this review. In addition, study designs were classified into the National Health and Medical Research Council (NHMRC) hierarchical framework specifically for interventions and used to classify study designs into the hierarchy (Merlin et al., 2009).

## Results

### Study selection

As a result of that initial search, 249 studies were identified. Ten complete text studies were analysed after duplication was removed, and the titles and abstracts were checked. Seven studies were ruled out due to the wrong setup, comparators, study design, and patient population. Consequently, the inclusion criteria of that review were met by only three studies in Table 2. The results of the search and study inclusion process were described in Figure 1, PRISMA flow diagram.

**Figure 1. PRISMA flow diagram**



## Methodological quality of findings

An overview of JBI's critical appraisal score as well as the level of evidence by NHMRC is given in Table 2. According to NHMRC levels of evidence, two studies were assessed as level II (RCT) (Amiri et al., 2023 & Taratino et al., 2021) and one study was classified as level III-1 (semi-RCT) (Cisneros et al., 2021). Amiri et al.'s study (2023) raises concerns about the reliability of outcome measurements due to insufficient reporting, which affects the internal validity of the study. Tarantino et al.'s study (2021) raises methodological issues in three areas: lack of blinding of providers, blinding of outcome assessors, and unclear reporting of reliability of outcome measures, all of which affect the study and the internal validity of the study. Cisneros et al.'s study (2021) presents various methodological concerns: the absence of true randomisation, unclear allocation concealment, lack of participant blinding, non-blinding of treatment deliverers, and an unclear status of outcome measurement reliability.

**Table 2. Levels of evidence and JBI critical appraisal checklist for methodological quality**

| Study | Study Design | NHMRC designation of levels of evidence | JBI Appraisal Checklist for Randomised Control Trials | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Total | % |
| Amiri et al. (2023) | RCT | II | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | ✓ | ✓ | ✓ | ✓ | 12/13 | 92.31 |
| Tarantino et al. (2021) | RCT | II | ✓ | ✓ | ✓ | ✓ | x | ✓ | x | ✓ | ? | ✓ | ✓ | ✓ | ✓ | 10/13 | 76.92 |
| Cisneros et al. (2021) | Semi- RCT | III-1 | x | x | ✓ | ? | ? | ✓ | ✓ | ✓ | ? | ✓ | ✓ | ✓ | ✓ | 8/13 | 61.54 |

## Summary of findings

Table 3 provides a summary of the study characteristics, while Table 4 summarises the results of the studies. In general, the studies described in this review showed that it can be more effective to improve memory for individuals with ABI when AI programs are integrated into traditional methods of training rather than using only traditional methods. This effectiveness is demonstrated by significant improvements in working memory and processing speed (Amiri et al., 2023), short-term memory (Tarantino et al., 2021), and substantial improvement in real-world memory functioning, particularly in daily life activities and social events (Cisneros et al., 2021). However, it's important to exercise caution when interpreting these results and considering the implementation of AI memory programs in clinical practice, as further research and a thoughtful transition into clinical settings are necessary for a comprehensive understanding of their long-term impact

**Table 3. Study characteristics** (Note: RCT = Randomised controlled trial; TBI= Traumatic Brain Injury; WM = Working memory; PS = Processing Speed; EF = Executive Function; MMSE = Mini-Mental State Examination; TIB = Italian version of the National Adult Reading Test; WAIS-III = Vocabulary sub-test; CEP = Cognitive Enrichment Program; MoCA = Montreal Cognitive Assessment;M = Mean; OT = Occupational Therapy; ST = Speech Therapy)

| Author & Country | Study design | Study objective | Participant characteristics | | Outcome measures | Intervention | |
|---|---|---|---|---|---|---|---|
| | | | Experimental | Control | | Experimental | Control |
| Amiri et al. (2023) Iran | RCT | Investigate the effect of RehaCom cognitive rehabilitation software on WM and PS in participants with chronic ischemic stroke. | n=25<br>Female = 10<br>Male = 15<br>M age = 54.4<br>Education<br>No diploma n =15<br>Diploma degree n = 6<br>Associate degree n = 1<br>Bachelor's degree n = 1<br>Master's degree n = 1<br>Ph.D. degree n = 1 | n=25<br>Female = 10<br>Male = 15<br>M age = 53.08<br>Education<br>No diploma n = 8<br>Diploma degree n = 9<br>Associate degree n = 4<br>Bachelor's degree n = 1<br>Master's degree n = 2<br>Ph.D. degree n = 1 | N-Back test<br>Paced Auditory Serial Addition Test (PASAT)<br>Symbol Digit Modalities Test (SDMT) | RehaCom cognitive rehabilitation software (ten x 45-min sessions across five weeks, two sessions per week). | Engaged in routine physiotherapy rehabilitation sessions. |
| Tarantino al. (2021) Venice | Single-blind RCT | Evaluate a computerised training program for potentiating EFs in patients with stroke. | n=18<br>Female = 6<br>Male = 12<br>M age = 64.6<br>Education (years) = 9.4<br>MMSE = 25.1<br>TIB = 106.1<br>Time since event (months) = 3.1<br>Etiology<br>Ischemia = 13<br>Hemorrhage = 6 | n=19<br>Female = 5<br>Male = 14<br>M age = 64.9<br>Education (years) = 9.3<br>MMSE = 24.6<br>TIB = 101.1<br>Time since event = 4.2<br>Etiology<br>Ischemia = 12<br>Hemorrhage = 6 | Neuropsychological test battery<br>Functional scales (Barthel Index, Functional Independence Measure). | Rehabilitation program plus EF training (10 sessions, approx. one hour each, distributed over a mean of 15.7 days ± 2.3 SD)<br><br>Rehabilitation program<br>ST= 5<br>Motor therapy = 18<br>OT = 8<br>Neuropsychological rehab = 12 | Received inpatient rehabilitation program based on needs.<br><br>Rehabilitation program<br>ST = 9<br>Motor therapy = 18<br>OT = 8<br>Neuropsychological rehab = 17 |
| Cisneros et al. (2021) Canada | Semi-RCT | Evaluate the impact of a 12-week CEP on episodic memory in older adults with TBI compared to an active control group receiving usual care | n= 20<br>Female = 6 ;Male = 14<br>M age = 64.90<br>Education (M years) = 12.30<br>Married = 13<br>Civil union = 5<br>Separated = 1<br>Widower = 0<br>Single = 1<br>TBI severity<br>Mild = 6<br>Complicated mild = 8<br>Moderate = 3<br>Severe = 3<br>Time since TBI (M days) = 595.75<br>MoCA = 25.90<br>Vocabulary (M scaled score) = 10.2<br># of vascular risk factors (M) = 1.93 | n= 12<br>Female = 7;Male = 5<br>M age = 63.75<br>Education = 11.83<br>Married = 5<br>Civil union = 0<br>Separated = 0<br>Widower = 2<br>Single = 5<br>TBI severity<br>Mild = 2<br>Complicated mild = 5<br>Moderate = 3<br>Severe = 2<br>Time since TBI = 859.33<br>MoCA = 24.83<br>Vocabulary = 9.25<br># of vascular risk factors = 2.88 | Neuropsychological memory tests:<br>Face-name association<br>Word list recall<br>Text memory<br>Self-Evaluation Memory Questionnaire Control measures: Forward and Backward Digit spans<br>Coding subtests<br>MoCA<br>WAIS-III | Usual care plus the CEP intervention.<br>*Usual care did not include formal cognitive rehabilitation* | Received only usual care.<br>Usual care was defined as individual interventions, if needed, within a holistic interdisciplinary rehabilitation program. Interventions could include physiotherapy or physical training, OT, ST, and neuropsychology. |

**Table 4. Summary of study findings**

| Study | Outcomes | | |
|---|---|---|---|
| | Memory | | |
| | Measurement tool | Results | Key findings |
| Amiri et al. (2023) | N-Back test | Repeated-measure ANOVA demonstrated a significant RehaCom treatment effect on WM and PS scales between time points ($F_{1,48} = 8.15$, $P < .01$).<br><br>Time-treatment interactions revealed a significant greater improvement in these scales for the experimental group compared to the control group over time ($F_{1,48} = 64.63$, $P < .001$).<br><br>Between-subjects analysis showed a significant difference between the two groups in these scales ($F_{1,48} = 4.86$, $P < .05$). | RehaCom treatment had a significant impact on WM and PS ↑<br>The experimental group showed significant improvements in these cognitive domains, highlighting the treatment's capacity to enhance cognitive functions, especially in the N-Back test context. |
| Tarantino et al. (2021) | Digit span forward<br><br>Digit span backward<br><br>Corsi block-tapping test | In the experimental group, there was a significant improvement from T0 to T1 (p = 0.050), with a moderate effect size (d) of 0.56. The control group also showed improvement, but it was not statistically significant (p = 0.331).<br><br>Neither the training group nor the control group showed significant changes in Digit Span Backward scores.<br><br>Both the training and control groups showed slight improvements, but the changes were not statistically significant. | The experimental group demonstrated a ↑ in short-term memory as assessed by Digit Span Forward.<br><br>The intervention didn't result in significant changes in Digit Span Backward scores for either group. |
| Cisneros et al. (2021) | Face-name association<br><br>Word list recall<br><br>Text memory<br><br>SEMQ | Significant improvement (p=0.001).<br><br>No significant improvement for immediate recall (p=0.448) and delayed recall (p=0.994).<br><br>No significant improvement.<br><br>Improved real world memory functioning in conversations, slips of attention, and political and social events (p = 0.027, p = 0.003, p = 0.006). | Improved abilities. Effect not maintained at 6 month follow up.<br><br>Word list recall: No significant improvement.<br><br>Text memory: No significant improvement.<br><br>↑a daily life memory. |

*Note:*

M = Mean score

SD = Standard deviation

↑ = Significant improvement

SEMQ = Self-Evaluation Memory Questionnaire

## Discussion

This review assessed the impact of AI memory programs alongside traditional rehabilitation in improving memory outcomes for ABI patients. The study included three studies: a high-quality RCT by Amiri et al. (2023), Tarantino et al. moderately rated RCT. (2021) and a low-quality semi-RCT, Cisneros et al. (2021) with weaker evidence. From these three studies, there was some evidence to suggest that AI memory programs can be effective in improving memory when incorporated alongside traditional rehabilitation.

### AI memory programs

The recent AI growth in healthcare, driven by advances in deep learning, highlights its potential in replicating cognitive functions like human learning and problem-solving (Ongsulee, P 2017; Panch et al., 2018). This systematic review specifically focuses on AI memory programs.

Amiri et al. (2023) demonstrated improvements in working memory and processing speed using RehaCom cognitive rehabilitation software. RehaCom is a cognitive rehabilitation program that uses computerised training to address cognitive deficits, focusing on psychoeducation, motivation enhancement, and the training of compensatory and adaptive skills (Pawlukowska et al., 2020). It offers 20 modules in multiple languages, adjusts difficulty based on individual abilities, and allows for online progress tracking (Naeeni Davarani et al., 2020; Veisi-Pirkoohi et al., 2019). In Amiri et al.'s (2023) study, the experimental group received ten 45-minute sessions over five weeks.

Tarantino et al. (2021) implemented a computer-based training program targeting Working Memory (WM), Interference Control and Inhibition (ICI), Task-Switching (TS), and Monitoring (M). Stimuli were presented as "cards" on a laptop screen, with variable content. Tasks followed a hierarchical logic, lasted around 10 minutes, and used the spacebar for responses. A junior neuropsychologist ensured a consistent testing environment, with patients unaware of task manipulations. The training group underwent ten one-hour EF training sessions over about 15.7 days.

Cisneros et al. (2021) introduced the CEP with three intervention modules (introduction and self-awareness, attention and memory, and executive functions) delivered over 12 weeks. The program consists of 24 sessions lasting 90 minutes each and are delivered in small groups of 5 or 6 participants twice weekly. The memory-focused module incorporates strategies from Belleville et al.'s MEMO program, emphasizing the learning of new strategies for enhanced encoding and recall. Homework assignments focus on self-initiated strategies like face-name associations. The CEP is administered by an experienced clinical neuropsychologist who received MEMO training.

These studies included AI cognitive training along with traditional rehabilitation. These findings highlight the promise of AI memory programs in diverse populations, reflecting broader interest in AI and its implications for healthcare (Panch et al., 2018). Further research should investigate long-term effects and develop applications of AI reminders for memory-related conditions.

### Generalisability

Assessing Amiri et al. (2023), Tarantino et al. (2021), and Cisneros et al. (2021) reveals specific participant characteristics: chronic stroke, ischemic or haemorrhagic strokes, and older individuals (aged 57-90) with traumatic brain injuries. These differences suggest a limited degree of generalisability beyond these specific groups and settings, which calls for caution in broader healthcare settings. The need to further research and personalised training, in line with the concerns which have been identified during an earlier systematic review of Fernando Garca Lopez and Antoli 2020, is highlighted by this review. It reiterates calls for higher quality trials, long period measures and real life impact assessments to address the need on lasting effects. As suggested by Man et al. 2006, studies examining combinations such as compensatory strategies and learning techniques using computer based cognitive training show promise for enhancing interventions.

### Outcome measures

Across the three included studies, diverse outcome measures were used to explore various aspects of memory. The heterogeneity in these measures underscores the importance of conducting a careful assessment of their validity and reliability to ensure the overall quality of evidence. In the study by Amiri et al. (2023), the n-back test was used. Tarantino et al. (2021) utilised tests such as digit span forward, digit span backward, and the corsi block-tapping test. Cisneros et al. (2021) used a range of assessments, including face-name association, word list recall, text memory, and SEMQ. To collate the results of different studies, this variability in outcome measures highlights the need for a rigorous and standardised approach to assessing memory within these research areas.

### Memory improvement

These studies collectively highlight the potential of cognitive rehabilitation programs to improve memory aspects, including working memory, short-term memory, and real-world memory function. Although short-term memory improvement is observed, its long-term sustainability varies, as shown by Cisneros et al. (2021), highlighting the need for ongoing, personalised memory rehabilitation. Integrating AI cognitive programs with traditional methods, as seen in the studies by Amiri et al. (2023), Tarantino et al. (2021), and Cisneros et al. (2021), offers a multifaceted approach to memory improvement, potentially improving patient outcomes. It is necessary to consider memory therapy as an ongoing process that requires a periodic re-evaluation and adjustment. These findings support a wider literature of brain rehabilitation, which emphasises the use of tailored interventions to improve memory (Gopi, Wilding & Madan, 2022). The results are consistent with the growing interest in AI’s potential to transform healthcare, as demonstrated by Panch et al. 2018, which highlighted the need for further research concerning lasting effects and development of AI memory tools.

## Limitations

This review mainly focuses on specific patient groups, potentially limiting generalisability to a broader range of ABI clients and age groups, while representing an important but limited resource due to small sample sizes and varying quality studies. It is also difficult to draw comprehensive conclusions due to the different outcome measures, as well as differing assessment validity and reliability. The need for additional research is reinforced by the relevance of a long term effect on memory improvement, as has been demonstrated in one study. Finally, to fully understand AI memory programs for memory rehabilitation, these limitations need to be addressed through further research, despite the promise of these findings.

## Conclusion

## Implications for clinical practice

Evidence suggests that adults with ABI might benefit from the possibility of using an artificial intelligence to improve their memory, in addition to traditional rehabilitation. However, in view of its recent developments and a small number of studies that are included in the present review as well as their differing methodological characteristics, there is little support for this. Therefore, when implementing AI programs into clinical practice with ABI patients, healthcare professionals should demonstrate caution.

Disclaimer: This report was prepared by a graduate-entry student as part of assignment purposes

## References

Amiri, S Hassani-Abharian, P Vaseghi, S Kazemi, R & Nasehi, M 2023, 'Effect of RehaCom cognitive rehabilitation software on working memory and processing speed in chronic ischemic stroke patients', *Assistive Technology*, vo. 35, no. 1, pp. 41-47.

Barker TH, Stone JC, Sears K, Klugar M, Tufanaru C, Leonardi-Bee J, Aromataris E, Munn Z 2023, 'The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials', *JBI Evidence Synthesis*, vol. 21, no. 3, pp. 494-506.

Cisneros, E, de Guise, E, Belleville, S & McKerral, M 2021, 'A controlled clinical efficacy trial of multimodal cognitive rehabilitation on episodic memory functioning in older adults with traumatic brain injury', *Annals of Physical and Rehabilitation Medicine*, vol. 64, no. 5, pp. 101563–101563.

Fernandez Lopez, R & Antoli, A 2020, 'Computer-based cognitive interventions in acquired brain injury: A systematic review and meta-analysis of randomized controlled trials', *PloS One*, vol. 15, no. 7, pp. e0235510–e0235510.

Fetta, J, Starkweather, A & Gill, JM 2017, 'Computer-Based Cognitive Rehabilitation Interventions for Traumatic Brain Injury: A Critical Review of the Literature', *The Journal of Neuroscience Nursing*, vol. 49, no. 4, pp. 235–240.

Gopi, Y, Wilding, E & Madan, CR 2022, 'Memory rehabilitation: restorative, specific knowledge acquisition, compensatory, and holistic approaches', *Cognitive Processing*, vol. 23, no. 4, pp. 537–557.

Jamieson, M, McClelland, H, Goudie, N, McFarlane, J, Cullen, B, Lennon, M, Brewster, St Stanley, B McConnachie, A & Evans, J 2023, 'AppReminders - a pilot feasibility randomized controlled trial of a memory aid app for people with acquired brain injury', *Neuropsychological Rehabilitation*, DOI: 10.1080/09602011.2023.2220969.

Man, DWK, Soong, WYL, Tam, SF & Hui-Chan, CWY 2006, 'A randomized clinical trial study on the effectiveness of a tele-analogy-based problem-solving programme for people with acquired brain injury (ABI)', *NeuroRehabilitation (Reading, Mass.)*, vol. 21, no. 3, pp. 205–217.

Merlin, T, Weston, A, Tooher, R, Middleton, P, Salisbury, S & Cloeman, K 2009, *NHMRC levels of evidence and grades for recommendations for developers of guidelines*. Canberra: National Health and Medical Research Council.

Ongsulee, P 2017, 'Artificial intelligence, machine learning and deep learning', in *2017 15th International Conference on ICT and Knowledge Engineering (ICT&KE)*, IEEE, pp. 1–6.

Page, MJ, Moher, D, Bossuyt, PM, Boutron, I, Hoffmann, TC, Mulrow, CD, … McKenzie, JE 2021, 'PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews', *BMJ*, vol. 372, pp. n160–n160.

Panch, T, Szolovits, P & Atun, R 2018, 'Artificial intelligence, machine learning and health systems', *Journal of Global Health*, vol. 8, no. 2, pp. 020303–020303.

Tarantino, V, Burgio, F, Toffano, R, Rigon, E, Meneghello, F, Weis, L & Vallesi, A 2021, 'Efficacy of a Training on Executive Functions in Potentiating Rehabilitation Effects in Stroke Patients', *Brain Sciences*, vol. 11, no. 8, pp. 1002.

Nejati, V 2023, ‘Primary principles of cognitive rehabilitation’ in V. Nejati (eds), *Principles of Cognitive Rehabilitation*, Academic Press, pp. 59-137.

Pawlukowska, W, Dobrowolska, N, Szylinska, A, Koziarska, D, Meller, A, Rotter, I & Nowacki, P 2020, ‘Influence of rehacom therapy on the improvement of manual skills in multiple sclerosis subjects’, *Annals of Rehabilitation Medicine*, vol. 44, no. 2, pp. 142–150.

Naeeni Davarani, M, Arian Darestani, A, Hassani-Abharian, P, Vaseghi, S, Zarrindast, M-R & Nasehi, M 2022, ‘RehaCom rehabilitation training improves a wide-range of cognitive functions in multiple sclerosis patients’, *Applied Neuropsychology. Adult*, vol. 29, no. 2, pp. 262–272.

Veisi-Pirkoohi, S, Hassani-Abharian, P, Kazemi, R, Vaseghi, S, Zarrindast, M-R & Nasehi, M 2020, ‘Efficacy of RehaCom cognitive rehabilitation software in activities of daily living, attention and response control in chronic stroke patients’, *Journal of Clinical Neuroscience*, vol. 71, pp. 101–107.

Belleville, S, Hudon, C, Bier, N, Brodeur, C, Gilbert, B, Grenier, S, … Gauthier, S 2018, ‘MEMO+: Efficacy, Durability and Effect of Cognitive Training and Psychosocial Intervention in Individuals with Mild Cognitive Impairment’, *Journal of the American Geriatrics Society (JAGS)*, vol. 66, no. 4, pp. 655–663.

# Appendices

**Appendix A.** MEDLINE Syntax

Ovid MEDLINE(R) ALL <1946 to October 06, 2023>

1 brain injuries/ or cerebrovascular disorders/ or hypoxia, brain/ 110168

2 ("Acquired brain injury" or "traumatic brain injury" or "ABI" or "TBI" or "stroke").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 436294

3 1 or 2 505782

4 artificial intelligence/ or neural networks, computer/ or Machine Learning/ 113046

5 ("Artificial Intelligence" or "AI memory*" or "AI" or "Artificial intelligence memory*" or "Computer-based intervention" or "Computer based intervention" or "Cognitive assistive technolog*" or "computer-based" or "computer-based cognitive retraining" or "computer based cognitive rehab*" or "cognitive assistive technology" or "non-invasive brain stimulation" or "cognitive stimulation" or "cognitive remediation" or "cognitive rehabilitation" or "neuropsychological intervention" or "neurocognitive training").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 119854

6 neurological rehabilitation/ or cognitive training/ or stroke rehabilitation/ or occupational therapy/ or memory/ 105658

7 ("memory training" or "memory rehab*" or "memory therapy" or "cognitive therapy" or "cognitive intervention" or "Traditional memory*" or "memory improv*" or "non-technology based memory*" or "non technology based memory*" or "Memory-enhancing exercises" or "working memory*" or "brain training" or "brain games" or "mental training").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word] 47459

8 4 or 5 189345

9 6 or 7 147514

10 3 and 8 and 9 666

11 limit 10 to (english language and humans and yr="2020-current" and ("young adult (19 to 24 years)" or "adult (19 to 44 years)" or "young adult and adult (19-24 and 19-44)" or "middle age (45 to 64 years)" or "middle aged (45 plus years)" or "all aged (65 and over)" or "aged (80 and over)")) 81

12 limit 11 to randomized controlled trial 18

**Appendix B.** Emcare Syntax

Ovid Emcare <1995 to 2023 Week 40>

1 brain injuries/ or cerebrovascular disorders/ or hypoxia, brain/ 20188

2 ("Acquired brain injury" or "traumatic brain injury" or "ABI" or "TBI" or "stroke").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word] 175310

3 1 or 2 188843

4 artificial intelligence/ or neural networks, computer/ or Machine Learning/ 22066

5 ("Artificial Intelligence" or "AI memory*" or "AI" or "Artificial intelligence memory*" or "Computer-based intervention" or "Computer based intervention" or "Cognitive assistive technolog*" or "computer-based" or "computer-based cognitive retraining" or "computer based cognitive rehab*" or "cognitive assistive technology" or "non-invasive brain stimulation" or "cognitive stimulation" or "cognitive remediation" or "cognitive rehabilitation" or "neuropsychological intervention" or "neurocognitive training").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word] 37092

6 4 or 5 51900

7 neurological rehabilitation/ or cognitive training/ or stroke rehabilitation/ or occupational therapy/ or memory/ 51221

8 ("memory training" or "memory rehab*" or "memory therapy" or "cognitive therapy" or "cognitive intervention" or "Traditional memory*" or "memory improv*" or "non-technology based memory*" or "non technology based memory*" or "Memory-enhancing exercises" or "working memory*" or "brain training" or "brain games" or "mental training").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word] 35806

9 7 or 8 84293

10 3 and 6 and 9 326

11 limit 10 to (human and english language and yr="2020 -Current" and (adult <18 to 64 years> or aged <65+ years>)) 49

12 limit 11 to randomized controlled trial 7

**Appendix C.** Embase Syntax

Embase Classic+Embase <1947 to 2023 October 06>

1 brain injury/ or cerebrovascular accident/ 391653

2 ("acquired brain injur*" or "ABI" or "traumatic brain injur*" or "TBI" or "stroke").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] 688732

3 1 or 2 842702

4 artificial intelligence/ or artificial intelligence software/ 64131

5 ("Artificial Intelligence" or "AI memory*" or "AI" or "Artificial intelligence memory*" or "Computer-based intervention" or "Computer based intervention" or "Cognitive assistive technolog*" or "computer-based" or "computer-based cognitive retraining" or "computer based cognitive rehab*" or "cognitive assistive technology" or "non-invasive brain stimulation" or "cognitive stimulation" or "cognitive remediation" or "cognitive rehabilitation" or "neuropsychological intervention" or "neurocognitive training").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] 157063

6 4 or 5 157063

7 neurological rehabilitation/ or cognitive training/ or stroke rehabilitation/ or occupational therapy/ or memory/ 212165

8 ("memory training" or "memory rehab*" or "memory therapy" or "cognitive therapy" or "cognitive intervention" or "Traditional memory*" or "non-technology based memory*" or "non technology based memory*" or "Memory-enhancing exercises" or "working memory*" or "brain training" or "brain games").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word] 114123

9 7 or 8 315772

10 3 and 6 and 9 1381

11 limit 10 to (human and english language and yr="2020-Current" and (adult <18 to 64 years> or aged <65+ years>)) 256

12 limit 11 to randomized controlled trial 71

**Appendix D.** PsycINFO

APA PsycInfo <1806 to October Week 1 2023>

1 cerebrovascular accident/ or brain injuries/ or cognitive impairment/ or traumatic brain injury/ or acquired brain injury/89325

2 (acquired brain injur* or ABI or traumatic brain injur* or TBI or stroke).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] 66451

3 1 or 2 109770

4 Artificial Intelligence/ or Machine Learning/ or Neural Networks, Computer/ 22321

5 ("Artificial Intelligence" or "AI memory*" or "AI" or "Artificial intelligence memory*" or "Computer-based intervention" or "Computer based intervention" or "Cognitive assistive technolog*" or "computer-based" or "computer-based cognitive retraining" or "computer based cognitive rehab*" or "cognitive assistive technology" or "non-invasive brain stimulation" or "cognitive stimulation" or "cognitive remediation" or "cognitive rehabilitation" or "neuropsychological intervention" or "neurocognitive training").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] 36674

6 4 or 5 47026

7 neurorehabilitation/ or cognitive training/ or stroke rehabilitation/ or occupational therapy/ or memory/ 84379

8 ("memory training" or "memory rehab*" or "memory therapy" or "cognitive therapy" or "cognitive intervention" or "Traditional memory*" or "memory improv*" or "non-technology based memory*" or "non technology based memory*" or "Memory-enhancing exercises" or "working memory*" or "brain training" or "brain games" or "mental training").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] 74399

9 7 or 8 152722

10 3 and 6 and 9 847

11 limit 10 to (human and english language and ("300 adulthood <age 18 yrs and older>" or 320 young adulthood <age 18 to 29 yrs> or 340 thirties <age 30 to 39 yrs> or 360 middle age <age 40 to 64 yrs> or "380 aged <age 65 yrs and older>" or "390 very old <age 85 yrs and older>") and yr="2020 - Current") 132

12 limit 11 to ("0300 clinical trial" or 1800 quantitative study) 113

**Appendix E.** Scopus Syntax

Scopus Syntax Results from 8th Oct 2023

1 ‘acquired brain injury’ OR ‘traumatic brain injury’ OR ‘cerebrovascular accident’ OR ‘brain injury’

2 ‘Artificial Neural Networks’ OR ‘Computational Modeling’ OR ‘Artificial Intelligence’ OR ‘Machine Learning’

3 ‘Neuropsychological Rehabilitation’ OR ‘Intervention’ OR ‘Cognitive Rehabilitation’ OR ‘Memory Training’ OR ‘Memory’

4 "clinical trials" OR "clinical trials as a topic" OR "randomized controlled trial" OR "Randomized Controlled Trials as Topic" OR "controlled clinical trial" OR "Controlled Clinical Trials as Topic" OR "random allocation" OR "randomly allocated" OR "allocated randomly" OR "Double-Blind Method" OR "Single-Blind Method" OR "Cross-Over Studies" OR "Placebos" OR "cross-over trial" OR "single blind" OR "double blind" OR "factorial design" OR "factorial trial"

5 1 and 2 and 3 and 4 71

**Appendix F.** OTseeker Syntax

| | OTseeker Syntax | Results from 8th Oct 2023 |
|---|---|---|
| 1 | ‘acquired brain injur*’ OR ‘abi’ OR ‘traumatic brain injur*’ OR ‘tbi’ OR ‘stroke’ OR ‘cerebrovascular accident’ OR ‘brain injury’ | |
| 2 | ‘Artificial intelligence’ OR Artificial Neural Networks’ OR ‘Machine Learning’ | |
| 3 | ‘Cognitive Rehabilitation’ OR ‘Memory Training’ OR ‘Memory’ | |
| 4 | 1 and 2 and 3 | 0 |