2023

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10.1016/j.jphys.2023.08.007
Weerakkody, A., White, J., Hill, C., Godecke, E., & Singer, B. (2023). Delivering constraint-induced movement therapy in stroke rehabilitation requires informed stakeholders, sufficient resources and organisational buy-in: A mixed-methods systematic review. Journal of Physiotherapy, 69(4), 249-259. https://doi.org/10.1016/j.jphys.2023.08.007

Journal of Physiotherapy 69 (2023) 249–259

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Research

Delivering constraint-induced movement therapy in stroke rehabilitation requires informed stakeholders, sufficient resources and organisational buy-in: a mixed-methods systematic review

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KEY WORDS

Neurological rehabilitation
Stroke rehabilitation
Qualitative research
Translational science
Physical therapy

ABSTRACT

Objective: To summarise and synthesise the qualitative literature relating to constraint-induced movement therapy (CIMT) among stroke survivors, carers, therapists and rehabilitation service managers. **Design**: Systematic review of qualitative studies. Quantitative studies using survey data were also included if they investigated perceptions and/or experiences related to CIMT. **Data sources**: Cochrane Library, Medline, JBI, Emcare, Embase, PsycInfo, CINAHL, PEDro, OT Seeker and NICE from inception to January 2022. **Data extraction and synthesis**: Two reviewers independently extracted data from the included studies and assessed comprehensiveness of reporting using established tools. Thematic synthesis was undertaken to synthesise findings for studies using focus groups and interviews. A summary of themes from quantitative studies using survey data was compiled to complement the qualitative synthesis. **Results**: Searches yielded 1,450 titles after removal of duplicates; 60 full-text articles were assessed for eligibility and 14 studies were included (1,570 total participants). Thematic synthesis identified nine descriptive themes from which four analytical themes were developed: CIMT is challenging but support at all levels helps; therapists need the know-how, resources and staffing; CIMT is different to other interventions, and there are positives and negatives to this; and functional outcomes do not always meet high expectations. Quantitative survey themes included: knowledge, skills and confidence in delivering CIMT programs; patient factors; and institutional factors. **Conclusions**: This review identified several determinants of implementation related to CIMT. Rehabilitation therapists need to develop their knowledge and skills to deliver CIMT, engage with organisational leaders, and develop CIMT protocols to fit the local clinical context in order to sustainably deliver CIMT in stroke rehabilitation services. Stroke survivors and carers require improved education to increase their engagement and participation. After addressing these determinants, future research should evaluate population-level outcomes and policy-level implementation in establishing CIMT as global standard rehabilitation practice. **Registration**: CRD42021237757. **[Weerakkody A, White J, Hill C, Godecke E, Singer B (2023) Delivering constraint-induced movement therapy in stroke rehabilitation requires informed stakeholders, sufficient resources and organisational buy-in: a mixed-methods systematic review. *Journal of Physiotherapy* 69:249–259]**

Introduction

Upper limb (UL) impairment after stroke reduces independence and contributes to greater disability.[1,2] Improving UL function is important to increase stroke survivors' ability to participate in valued roles and activities of daily living. Rehabilitation professionals must provide evidence-based interventions to improve UL function. Constraint-induced movement therapy (CIMT) is one such intervention with demonstrated efficacy in improving UL function in eligible patients at any time point after stroke.[3–6]

Constraint-induced movement therapy is based on the premise of facilitating neuroplasticity and overcoming learned non-use of the affected UL; it is recommended for stroke survivors demonstrating at least 10 deg of active wrist and finger extension.[7] 'Traditional' CIMT is a 2-week (10 weekdays) program and involves three main components: intensive practice of the affected UL for 6 hours per day (including repetitive task practice and graded active motor training known as 'shaping'); a suite of behaviour change strategies known as the 'Transfer Package'; and constraint of the less-affected UL for > 90% of waking hours.[8] Functional UL improvements have been

https://doi.org/10.1016/j.jphys.2023.08.007

demonstrated in clinical trials immediately following the program and persist for up to 2 years after its completion.[4–6,9–11]

Despite demonstrated efficacy, several barriers to providing CIMT to eligible stroke survivors have been reported.[12] The perceived demanding time commitment required of therapists and patients was seen as a major deterrent to provision.[13] Modified versions of CIMT (mCIMT) were developed to address these barriers[13] and several protocols have been described.[14–17] Well-conducted studies found no significant difference in outcomes between groups receiving CIMT or mCIMT, regardless of stroke chronicity.[5] Given the potential for greater compliance by patients and therapists with mCIMT,[12] this protocol has been pursued increasingly in the clinical setting.[14–16]

The research literature strongly supports the use of CIMT in clinical practice, including Clinical Practice Stroke Guideline recommendations from Australia,[18] Canada[19] and the UK.[20] However, despite strong evidence, CIMT is not routinely provided to stroke survivors.[21–23] Consequently, several studies have evaluated therapist perceived barriers and enablers to implementation,[22–25] while other studies have evaluated patient and carer perceptions and experiences.[13,25–27]

Like many stroke rehabilitation interventions,[28,29] CIMT is complex to administer, requiring engagement from multiple stakeholders for successful implementation by rehabilitation therapists and participation by patients and carers. Understanding the barriers and facilitators related to CIMT, and therefore the determinants of implementation, is a key tenet of translating research evidence into real-world clinical practice. This systematic review aimed to collate and synthesise the available literature to better understand the perceptions and experiences of all stakeholders about CIMT, and identify patterns in stakeholder responses, with the aim of identifying key determinants of implementation to support wide-ranging rehabilitation service implementation for this evidence-based intervention.

Therefore, the research questions for this systematic review were:

1. What are the perceptions, experiences, attitudes and beliefs related to CIMT among stroke survivors who received CIMT after stroke, carers of stroke survivors who undertook a CIMT program, rehabilitation therapists (physiotherapists, occupational therapists), and managers of rehabilitation services/centres?
2. Do interactions between stakeholder group views influence CIMT provision and implementation?

Methods

This mixed-methods systematic review has been reported following the ENTREQ checklist[30] and was prospectively registered. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach has been applied to reporting of this review.

Identification and selection of studies

A library information specialist (CH) conducted a systematic and exhaustive search of the following databases: Cochrane Library, Medline, JBI, Emcare, Embase, PsycInfo, CINAHL, PEDro, OTSeeker and NICE. All databases were searched from inception to 20 January 2022, to maximise identification of eligible studies. Unpublished or grey literature was searched using Google Scholar and other specialty search engines. The reference lists for all identified eligible reports and papers were hand-searched for additional citations.

Inclusion criteria

The Sample, Phenomena of Interest, Design, Evaluation and Research type (SPIDER) tool[31] was used to guide the eligibility criteria and develop the search strategy. The search terms for OVID databases, and full inclusion/exclusion criteria have been included in Appendix 1 on the eAddenda. Studies were eligible if they were published in English and met the criteria listed in Box 1.

Box 1. Inclusion criteria.

Design
- Qualitative research studies
- Surveys or questionnaires

Participants
- Stroke survivors who received UL CIMT and aged > 18 years
- Carers of stroke survivors who received CIMT
- Physiotherapists and/or occupational therapists (rehabilitation therapists)
- Allied health/rehabilitation service managers

Intervention
- CIMT

Outcomes measures
- Investigated experiences, perceptions, attitudes or beliefs about CIMT

CIMT = constraint-induced movement therapy, UL = upper limb

Study screening and selection

Search results from each database were uploaded into commercial reference management software[a]. Duplicates were removed through Endnote and underwent further de-duplication using Research Screener,[32] which is a cloud-hosted, web-based machine learning tool that uses seed articles, known by the researcher as suitable for the review, and natural language processing algorithms to present titles and abstracts in order of likely relevance.[32] Validation studies using Research Screener suggest that by screening 50% of the total pool of articles, researchers are highly likely to have identified 100% of eligible papers.[32] This suggestion is consistent with findings from a recent systematic review evaluating performance of several machine learning tools that are currently used in systematic review screening automation.[33]

Two reviewers (AW and JW) independently screened titles and abstracts using Research Screener, and then met to discuss conflicts and determine studies for full-text review. Independent assessment of full-text articles for inclusion was performed by both reviewers with disagreements resolved through discussion. A third reviewer (BS) was available to resolve disagreements for inclusion but was not required. Decisions for inclusion and exclusion were recorded using a research log using commercial spreadsheet software[b].

Assessment of study quality

Studies selected for inclusion were assessed for quality, rigour and appropriateness of methodology using the consolidated criteria for reporting qualitative research (COREQ).[34] The COREQ is a 32-item checklist that covers the domains: research team and reflexivity, study design, and analysis and findings.[34] While the COREQ does not explicitly state a rating score around reporting quality, Al-Moghrabi and colleagues applied a binary Yes/No to each of the COREQ items in rating reporting quality in dental qualitative research,[35] which was replicated in a nursing qualitative methodology study.[36] This review used the same rating system for appraising methodological reporting. Reporting rating was scored as: good ($\geq$ 25), moderate (17 to 24), poor (9 to 16) and very poor ($\leq$ 8).

Several studies included in this review used surveys as the data collection tool and were not appropriate to appraise using the COREQ. For these studies, the AXIS tool was used in the critical appraisal process. The AXIS tool was developed to assess the quality of reporting in cross-sectional studies and can be used across several disciplines.[37] Critical appraisal was conducted by two reviewers (AW and JW) independently for all included studies. Disagreements in study quality were resolved through discussion. The methodological quality of included studies was noted when interpreting findings.

Data extraction and synthesis

Study characteristics and relevant information from included studies were extracted into a table in commercial spreadsheet

software[b] and included: general study information (eg, authors, journal, year of publication, country, clinical setting and type of study); data collection methods and tools; participant characteristics; intervention description if applicable (ie, duration of CIMT program, hours of therapy); and main findings.

The thematic synthesis approach as described by Thomas and Harden was used for data synthesis.[38] This approach guides data analysis with three stages: coding of text line by line, development of descriptive themes and generation of analytical themes.[38] All text from results and discussion sections, including participant quotes and author interpretations, were extracted from included studies and uploaded to commercial qualitative data analysis software[c], which was used throughout the analysis and synthesis process. Coding line by line and development of descriptive themes were conducted by AW and JW independently prior to meeting to establish consensus on these inductive themes. Both authors then inductively generated analytical themes in collaboration.

The primary focus of this review was to synthesise the qualitative data related to CIMT from a range of stakeholder perspectives. A summary of the key findings from the quantitative survey data was compiled to complement the thematic synthesis of the qualitative data.

Results

Flow of studies through the review

Following removal of duplicates, the search identified 1,450 papers for title and abstract screening. Research Screener was used to screen 967 titles and abstracts (67% of total papers). Full texts were retrieved for 60 papers and 13 papers (14 studies) were included in this review (Figure 1). Two studies were reported in separate chapters of a single PhD thesis,[39] for which Chapter 5 has been assigned Jarvis (a), and Chapter 6 Jarvis (b). Several potentially relevant conference abstracts were identified in the search[40–49] and authors were contacted by email for further information. These communications yielded no further studies to be included.

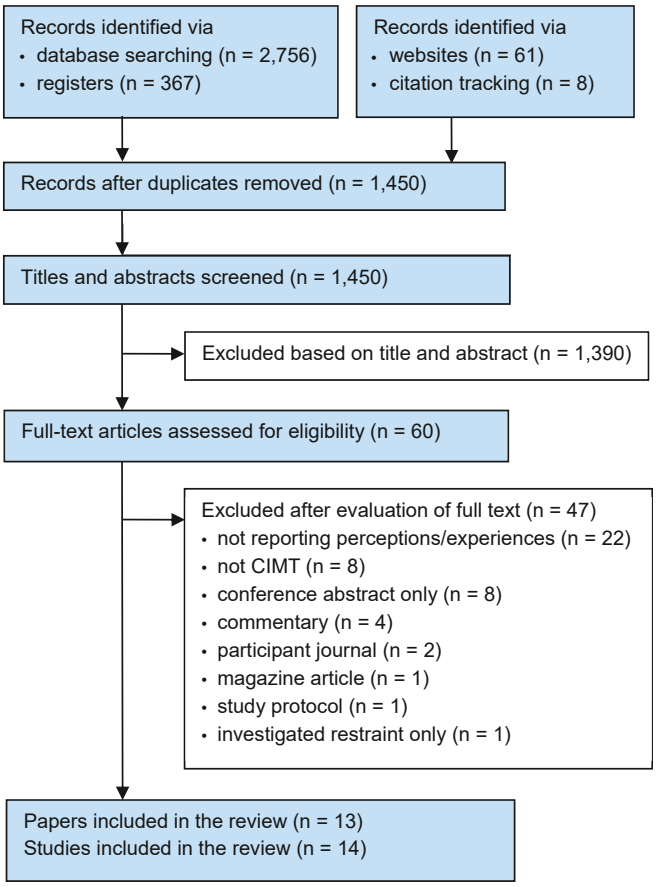

Figure 1. Flow of trials through the review.

Study characteristics

Of the 14 studies included for this review, eight used focus groups or interviews as the data collection tool,[27,39,50–53] and six studies used a survey and presented the findings quantitatively.[13,21–23,25,26] The study characteristics are presented in Tables 1 and 2.

Methodological quality

The quality of reporting against the 32-item COREQ checklist of the included qualitative studies ranged from very poor (7) to good (27), with recent publications demonstrating greater compliance with the reporting methodology (Table 3). The AXIS tool checklist has been included in Appendix 2 on the eAddenda.

Thematic synthesis

Thematic synthesis was conducted for the eight studies that used data from focus groups or interviews. Nine descriptive themes were identified, with subthemes related to five of these descriptive themes. Four analytical themes were derived and have been described below. Figure 2 maps the derivation of analytical themes from descriptive themes.

Theme 1: Constraint-induced movement therapy is challenging, but support at all levels helps

Diverse challenges were attributed to CIMT participation and delivery in several studies across stroke survivor, carer and therapist groups. Challenges specific to stroke survivors included fatigue, pain, frustration and competing interests that made it hard to prioritise CIMT programs.

Fatigue was commonly reported, with stroke survivors describing CIMT as physically and mentally exhausting.[50] 'Relief' was reported upon completion of CIMT, and this was attributed to the intensive nature of the program.[39,50] Fatigue was further compounded by competing interests for those undertaking employment or other household duties.[27]

> *I had worked… and then always having to work two additional hours in the evening [for the HOMECIMT-specific exercises] and then having to wear the glove… well, that was… pretty tough over the twenty days* (stroke survivor)[27]

The physical demands of CIMT programs on the stroke-affected arm were associated with the development of pain in some cases, most commonly in the shoulder.[27,39,50] Stroke survivors reported that task difficulty combined with the repetitive nature of practice with short breaks was the reason why their shoulder pain had developed. Stroke survivor perspectives of this pain were mixed and continuation of therapy was variable. Some stroke survivors reported pain impacting on sleep or resulting in a tendon pathology of the shoulder, leading to cessation of the program.[50] For others, pain was not reported as a barrier and was managed with simple analgesia,[39] some *gritted their teeth harder and continued*[50] or continued despite the pain in the hope that their arm would continue to improve.[27] However, there were also reports that pre-existing pain had improved during CIMT and that the intervention did not cause additional pain.[39]

Frustration was reported among stroke survivors and carers during CIMT programs. Stroke survivors reported frustration at completing activities of daily living using only their stroke-affected arm. This made tasks *slow, clumsy, unattractive*, *exhausting* or *simply difficult*, particularly if the non-dominant hand was affected and was therefore required to perform these tasks.[27]

Table 1
Characteristics of the included qualitative (n = 7) and mixed methods (n = 1) studies.

Author, year Location Service setting	Purpose/research question	Perspective and participant characteristics	Sampling method	Data collection tools	Methodology/data analysis
Borch et al[50], 2015 Norway Subacute stroke	To explore how patients experience CIMT and how the therapy influences their functioning and daily life	*Stroke survivors* n = 3 (all male) Age *(y)*: 60 to 70	Purposive[a], recruited from NORCIMT study	In-depth semi-structured interviews	Content analysis
Christie et al[51], 2021 International All neurological rehabilitation settings	To identify individual, organisational and social factors enabling implementation and sustained delivery of CIMT programs internationally	*Rehabilitation therapists* n = 11 (8 female, 3 male) 7 OTs, 4 PTs Clinical experience *(y)*: ≥ 6 All had delivered ≥ two CIMT programs with fidelity in the past 2 years	Purposive	Semi-structured interviews	Qualitative descriptive, deductively mapped to the Theoretical Domains Framework
Gillot et al[52], 2003 USA Community, chronic stroke	To explore perceptions and describe experiences of stroke survivors who participated in CIMT home programs.	*Stroke survivors* n = 2 Age *(y)*: 42 to 65 Time since stroke *(y)*: 0.5 to 6.5	Convenience	Semi-structured interviews	Phenomenological
Jarvis (a)[39], 2016 UK NHS trust	To explore therapists' perceptions regarding: which CIMT protocols could feasibly be provided within a NHS stroke service; the best time, location and population for CIMT; facilitators of and barriers to implementing CIMT	*Rehabilitation therapists* n = 8 (3 OTs, 5 PTs) Band classification: 5 to 8a Experience working with stroke survivors ranged from < 3 to > 16 years	Purposive	Focus group	Thematic content analysis
Jarvis (b)[39], 2016 UK Early supported discharge rehabilitation (home and outpatient), subacute	To explore subacute stroke survivors' initial perceptions of the barriers to and facilitators of receiving CIMT, and their experiences of and response to undertaking CIMT	*Stroke survivors* n = 3 (all female) Age *(y)*: 37 to 69 Stroke: 2 ischaemic, 1 haemorrhagic; 2 right, 1 left Time since stroke *(mo)*: 6 to 7	Purposive	Semi-structured interviews	Phenomenological
Stark et al[27], 2019 Germany Chronic stroke, home-based	To investigate the experiences of chronic stroke patients and non-professional coaches with home CIMT	*Stroke survivors* n = 13 (7 female, 6 male) Mean age *(y)*: 57 Mean time since stroke *(y)*: 6.5 *Caregivers (non-professional coaches)* n = 9 (6 female, 3 male) Mean age *(y)*: 58 8 spouses, 1 daughter	Purposive, recruited from home CIMT RCT	Semi-structured interviews	Hermeneutic phenomenological data analysis
Sweeney et al[53], 2020 Scotland Inpatient secondary care, community services and outpatient services	To determine: therapists' perceptions of benefits and barriers for patients regarding CIMT; barriers and enablers for services regarding implementation and sustainability of CIMT; barriers and enablers of CIMT; and the extent of CIMT use within NHS Scotland rehabilitation services	*Rehabilitation therapists* n = 96 62 OTs, 34 PTs 84% were specialist (band 6) or highly specialist/team lead (band 7) clinicians 29% had used CIMT with stroke patients before *Stroke survivors* n = 2 for CIMT	Snowball sampling for therapists Convenience sampling for patients	Online survey for therapists Semi-structured interview for patients	Survey responses reported as percentages Thematic analysis for open survey questions and interviews
Walker et al[54], 2016 Australia Chronic stroke	To present the lived experience of two individuals undertaking mCIMT; and to explore the relationship between valued and meaningful occupations and positive outcomes due to mCIMT	*Stroke survivors* n = 2 (1 female, 1 male) Age *(y)*: 55 to 69 Time since stroke *(y)*: 1 to 4 Stroke: 1 right, 1 left	Not stated	Semi-structured interviews pre, post and 4-weeks post CIMT program	Not stated

CIMT = constraint-induced movement therapy, home CIMT = home-based constraint-induced movement therapy, mCIMT = modified constraint-induced movement therapy, NHS = National Health Service, NORCIMT = Norwegian Constraint-Induced Movement Therapy Multisite trial, OTs = occupational therapists, PTs = physiotherapists, RCT = randomised controlled trial.

[a] Inferred from author's description.

Table 2
Characteristics of the included quantitative studies (n = 6).

Author, year Location Service setting	Purpose/research question	Perspective and participant characteristics	Sampling method	Data collection tools	Methodology/ data analysis
Andrabi et al[26], 2021 USA Chronic stroke	To determine: perceived difficulties of CIMT for stroke survivors given a description of the intervention, satisfaction with outcomes after treatment, and change in perception of difficulty after treatment	*Stroke survivors* n = 40 (22 female) Mean age *(y)*: 60 (range 29 to 94) 58% left UL more affected 42% dominant hand more affected	Secondary analysis of data from two RCTs	Patient opinion survey	Paired t-test to determine change in patient opinion survey
Christie et al[21], 2019 International All neurological rehabilitation settings	Investigate clinician knowledge and experience delivering CIMT	*Rehabilitation therapists* n = 169 (139 female, 30 male) 109 OTs, 58 PTs 88% had > 5 years of clinical experience 99% had ≥ 1 year experience working in neurology 95% had some experience with CIMT	Passive snowball	Online open survey	Descriptive statistics
Daniel et al[25], 2012 USA Inpatient and outpatient therapy settings	To determine the opinions of therapists about CIMT	*Rehabilitation therapists* n = 92 (76 female, 16 male) 50 PTs, 31 OTs 69% had > 5 years of clinical experience 9% worked exclusively in neurological practice	Convenience	Survey	Descriptive statistics
Fleet et al[22], 2014 Canada All settings, therapists working in adult neurological rehabilitation	To explore usage patterns of CIMT among OT and PTs in adult neurological rehab in terms of frequency, treatment parameters and barriers to use.	*Rehabilitation therapists* n = 338 229 PTs, 135 OTs 88% had > 5 years of clinical experience 43% had used CIMT in past 2 years 88% unable to name all 3 components of CIMT	Email to relevant professional associations	Survey	Binary logistic regression
Page et al[13], 2002 USA Rehabilitation hospitals and outpatient clinics	To determine the opinions of patients and therapists about CIMT	*Stroke survivors* n = 208 (54 male, 43 female, 111 not stated) Mean age *(y)*: 64 Mean time since stroke *(mo)*: 26.5 (range 1 to 240) 97% had received upper limb rehabilitation post-stroke *Rehabilitation therapists* n = 85 59 PTs, 26 OTs Mean time as a therapist *(mo)*: 129 60% usually worked with orthopaedic patients	Convenience	Written questionnaire with support of telephone interview 5 point Likert scales to both patients and therapists	Descriptive statistics
Pedlow et al[23], 2014 UK Neurological rehabilitation (ABI)	To investigate current knowledge and application of CIMT by PTs and OTs	*Rehabilitation therapists* n = 489 320 PTs, 169 OTs 48% were currently working in stroke or TBI units 91% had ≥ 1 year of experience working in ABI 63% had not used CIMT before	Email to relevant professional associations	Online survey	Descriptive statistics

ABI = acquired brain injury, CIMT = constraint-induced movement therapy, home CIMT = home-based constraint-induced movement therapy, mCIMT = modified constraint-induced movement therapy, NHS = National Health Service, NORCIMT= Norwegian Constraint-Induced therapy Multisite trial, OTs = occupational therapists, PTs = physiotherapists, RCT = randomised controlled trial, TBI = traumatic brain injury.

Table 3
COREQ checklist criteria met by the included qualitative (n = 7) and mixed methods (n = 1) studies.

Author	Interviewer	Credentials	Occupation	Gender	Experience/training	Relationship established	Participant knowledge of interviewer	Interviewer characteristics	Methodological orientation and theory	Sampling	Method of approach	Sample size	Non-participation	Setting of data collection	Presence of non-participants	Description of sample	Interview guide	Repeat interviews	Audiovisual recording	Field notes	Duration	Data saturation	Transcripts returned	Number of coders	Description of coding tree	Derivation of themes	Software	Participant checking	Quotations presented	Data and findings consistent	Clarity of major themes	Clarity of minor themes	Score
Borch[50]	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	N	P	Y	Y	N	15
Christie[51]	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	P	N	Y	Y	N	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	27
Gillot[52]	N	N	N	N	N	N	N	N	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	N	Y	Y	Y	N	14
Jarvis (a)[39]	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	26
Jarvis (b)[39]	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	P	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	19
Stark[27]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	P	N	Y	N	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	23
Sweeney[53]	N	Y	N	N	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	N	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	13
Walker[54]	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	7

N = no, P = partially stated, Y = yes.

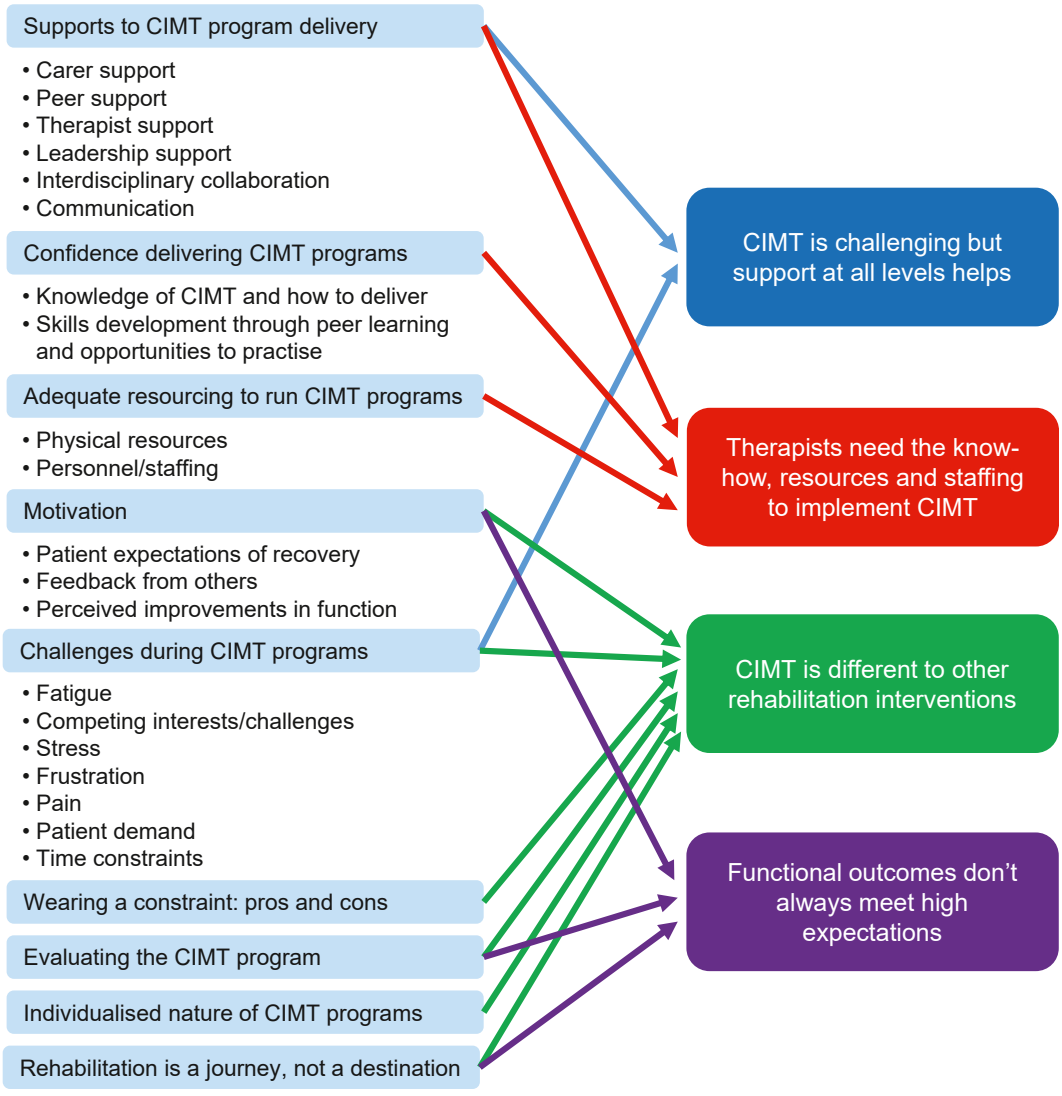

Figure 2. Mapping of descriptive and analytical themes. CIMT = constraint-induced movement therapy.

I've been feeling terribly temperamental with it and feeling like cheating and thinking I could do this so much quicker with the other hand. It's terribly frustrating and slow and it's just very hard when your hand doesn't do what you want it to do (stroke survivor)[54]

Carers expressed frustration when they felt that the patient was not trying as hard as they could, or they thought that functional improvements could be greater with more effort and motivation.

…the spouse obviously wants progress to be made, wants one to do more for it and wants one to put more effort into it. Especially as the spouse believes that one is capable of doing more… That's when one as a stroke patient says: Man, I've been at this for an hour now, that's enough (stroke survivor)[27]

However, despite the reported challenges to undertaking a CIMT program, several supports were identified that enabled CIMT participation, delivery and sustained implementation within rehabilitation services. For therapists to sustainably provide CIMT programs, leadership and organisational support was identified as a key enabler. Managers helped clinicians initiate their first CIMT program, providing time to practise CIMT skills and supporting attendance at professional development courses.[51] Interdisciplinary collaboration was another important enabler for CIMT delivery, particular for services with limited resources. Therapists reported benefits to engaging the broader multidisciplinary team, allied health students and family members in supporting CIMT programs and reinforcing its principles.[51]

We had our management at the time, she was keen… she… supported me to do the training course. So at the time, definitely, I felt like the stroke team, the OT department, they were all supportive of it (rehabilitation therapist)[51]

Conversely, changes in leadership support or the focus of health service priorities, such as rapid hospital discharge planning, were reported as barriers to sustainable CIMT program delivery.

It's frustrating because we're therapists at the end of the day and are there to deliver therapy to help people get better… we had a change of consultants on the ward, a change in the organisation and I think priorities shifted (rehabilitation therapist)[51]

Stroke survivors reported the important role that therapists play in supporting CIMT programs. Therapist feedback was motivating,[50] and stroke survivors identified that the therapist's own motivation was itself motivating to them.[27] In a home-based CIMT program that was primarily driven by a non-professional coach, stroke survivors reported that their motivation would have been enhanced with greater therapist support.[27]

I'm the type of person who does things better when someone else is there and knows what he/she is doing, and tells me what to do. Then I'll do it (stroke survivor)[27]

Stroke survivors and carers reported positive experiences of completing a CIMT program together. They reported that it allowed them to spend more time with each other and gave stroke survivors a sense that they could rely on the support of their families during their rehabilitation journey. Carers reported that they enjoyed supporting the program. However, stroke survivors expressed disappointment when there was a mismatch between their expectations of carer involvement, and the actual support provided by carers.[27]

Patient 4 was somewhat disappointed as her family seemed to not understand the importance of the therapy and did not support her the way she had hoped[27]

Peer support was another motivating enabler identified, particularly in group-based CIMT programs,[39,51] increasing adherence to the program, allowing personal experiences for coping with reduced upper limb function to be shared,[51] and adding a social element to the program that is missing from individual programs.[39]

To be honest, I enjoyed it because I don't really go anywhere to socialise. We don't go out anywhere. So as I say, it was nice to come and, you know, have company and that, it was good (stroke survivor)[39]

Theme 2: Therapists need the know-how, resources and staffing to implement constraint-induced movement therapy

Therapist and organisational factors influenced the decision to implement and the ability to sustain delivery of CIMT programs across health services. For therapists, a lack of knowledge was the major barrier to providing CIMT. Therapists without experience in CIMT reported an openness to providing the therapy but acknowledged a need for formal training, including theoretical and practical training, and ongoing support to be confident in delivering programs.[39] Attending formal training was important, as it was reported that CIMT was not an intervention that could be learnt independently.[51]

It's just if we're gonna implement this… I would feel like I would need quite a bit of training. It's not a negative, it's just if I'm gonna implement this with patients and be very positive to improve compliance, I'd want a lot more… training (rehabilitation therapist)[39]

After attending formal training, therapists reported that they required opportunities to develop their skills in delivering CIMT programs to become more confident over time.[51] Therapists reported that a slightly reduced caseload could provide more opportunities to practise CIMT.[39] Once confident in their ability to deliver CIMT programs, experienced therapists then shared their knowledge with colleagues at their workplace. Several skill development strategies were reported, including training packages, in-services and buddying-up with less experienced therapists as a peer mentor.[39,51]

Adequate resources were required to run a CIMT program, including an appropriate physical space, easily accessible therapy resources and readily available documentation. These resources were often adapted from other services for local application.[51] Flexibility in CIMT program delivery was another enabler, as services with limited resources could deliver an effective program that was feasible in their setting, such as group-based CIMT.[51] Therapists also reported that leadership and organisational support, in the form of autonomy to provide CIMT, was an important factor in facilitating CIMT implementation.[51]

So… the biggest enabler of us setting up CIMT has been my ability to clinically say 'This is what we're going to do' and I've got freedom to act (rehabilitation therapist)[51]

Theme 3: Constraint-induced movement therapy is different to other interventions and there are positives and negatives to this

Stroke survivors and therapists acknowledged several differences in the delivery, their experiences and functional outcomes for CIMT compared with other stroke UL rehabilitation interventions. Therapists experienced in stroke rehabilitation reported outcomes with CIMT far exceeding their experience with other interventions, and this encouraged provision of CIMT to other patients. Further, seeing stroke survivors returning to meaningful activities due to improved arm use was particularly rewarding and motivated them to continue offering CIMT.[51]

I… worked with neuro patients for years and years but truly I had never seen change like I've seen with these patients (rehabilitation therapist)[51]

Stroke survivors provided perspectives on specific components of the CIMT program. The provision of 'shaping' and the fact that tasks

were timed was predominantly seen positively. This provided direct feedback on performance to stroke survivors, which built confidence and was motivating for continuing with the program.[27,50]

It was just a confidence booster to see you were getting quicker (stroke survivor)[53]

However, some stroke survivors also reported that the timed shaping tasks placed pressure on them to move faster, rather than focusing on the quality of the movement.[50]

My movements were not as they should be (stroke survivor)[50]

Perceptions and experiences of wearing a restraint during CIMT were mixed. Among therapists with little to no experience with CIMT, it was assumed that wearing a restraint for 90% of waking hours during the program was unfeasible.[39,53] However, this was not a barrier reported by therapists who had delivered CIMT programs.[51] Negative experiences for stroke survivors wearing a restraint included that it drew the attention of others to the fact that they had suffered a stroke, or that they felt insecure wearing a restraint. Respondents also reported *counting down the days* until the restraint came off,[50] indicating that they found wearing a restraint challenging. However, stroke survivors also reported that wearing a restraint pushed them to use their stroke-affected UL more and this had positive impacts on functional use of their arm.[27,39,53]

The glove naturally hindered me in doing what I would normally have done, automatically grabbing something with my left hand […] and, of course, it was an unusual feeling but it was also the good part (stroke survivor)[27]

Theme 4: Functional outcomes do not always meet high expectations

This theme focused on stroke survivor responses on the factors influencing their decision to participate in CIMT programs, what kept them motivated during the program, their reflections on the impact of CIMT on them, and whether CIMT changed their perspectives on their role in future rehabilitation. Stroke survivors expected[52] or hoped[27] for a large improvement in functional use of their stroke-affected UL and, in many cases, this drove their decision to participate in CIMT. Several factors influenced this motivation. Feeling frustrated with their current situation and a desire for this to improve was reported in some studies.[27,39,52] *Word of mouth* from prior CIMT participants who had positive outcomes potentially fuelled this expectation and translated to greater demand for CIMT in some services.[51]

I want people to say 'Wow'; I want the recovery to be substantial; I want to see big changes (stroke survivor)[52]

Specific aspects of the CIMT program maintained and facilitated further motivation. These included self-observations of functional improvements and noting the ability to perform tasks they could not previously perform, verbal feedback, and seeing their performances improve during shaping trials, leading to greater confidence in themselves to try new activities.[27,39,50,52]

I even put the scones in the oven yesterday, which I hadn't done before because I didn't have the strength in my wrist to hold the thing (stroke survivor)[39]

Several studies investigated stroke survivors' reflections of the changes achieved upon completion of the CIMT program. Most noted an increased awareness and functional use of their stroke-affected UL.[27,39,50,52] Participants attributed the functional improvements to the intensive nature of the program,[50] and noted that their gains decreased without the intensive training.[27]

I definitely do more things with the right hand, and it's just automatically grabbing glasses, a dish rag, a broom with the right hand…

I'm going to keep [CIMT] up; I think it's going to be evolving instead of ending (stroke survivor)[52]

Some stroke survivors reported that whilst they noted improvements, these did not meet their initial expectations. For these respondents, participation in CIMT highlighted to them that rehabilitation is an ongoing process rather than having a discrete endpoint.[27,39,52] As such, ongoing practice was required to increase the functional gains achieved during the program. This provided a sense of hope[27] and optimism for the future.[39]

I intend to every day try and do a bit more. Like, washing the dishes, I try and do it all the time with it [left UL]. It's the pans and things I can't deal with but, like, eventually I'll get there (stroke survivor)[39]

However, some participants expressed disappointment when perceived improvements in arm use did not meet their initial expectations:[27]

I'm not saying that I have been expecting a miracle, but I guess I sort of had [laughs]. I always thought: Man, now you're doing all these exercises, […] there must be some concrete results eventually (stroke survivor)[27]

Summary of key findings from quantitative survey data

Knowledge, skills and confidence delivering constraint-induced movement therapy programs

The knowledge, skills and confidence of rehabilitation therapists to deliver CIMT programs were important for CIMT provision.[22,23,25,51] Self-reported knowledge of CIMT predicted CIMT use.[22] Rehabilitation therapists reported that they attained knowledge about CIMT through reading research publications and clinical practice guidelines, peer discussion, workplace in-services or attending formal training.[21–23] Respondents who had attended a formal CIMT course were more likely to self-report greater knowledge and confidence using CIMT compared with those who had not, which was independent of their level of professional qualification. Support from senior clinicians experienced in CIMT facilitated sustained delivery of CIMT programs for those who had undertaken CIMT training.[21] For non-CIMT users, respondents identified a need for specialised training in order to deliver CIMT.[13]

Patient factors

Several patient-related factors were reported to potentially influence a therapist's decision to offer CIMT and a stroke survivor's ability to comply with the treatment regimen. The most commonly reported factors that contributed to CIMT eligibility were a stroke survivor's cognitive function[21–23] and safety concerns due to the impact of wearing a restrictive device, particularly for stroke survivors at risk of falling.[13,23,25] Therapists also reported concerns over a stroke survivor's ability to tolerate the intensive training of CIMT[13,25] or comply with home practice outside of sessions,[21] which could be further compounded by fatigue or lack of motivation.[13,21] However, availability of a supportive carer, and education to patients and/or family could improve engagement in CIMT participation.[21] Survey data investigating patient-perceived difficulty of CIMT before and after the program indicated that CIMT was not as difficult as initially perceived; these authors speculated that accurate descriptions of the intervention may improve patient perceptions.[26]

Institutional factors

Therapist respondents identified several institutional factors that influenced CIMT implementation and sustainability within health services. Differences in the data were identified between those who were experienced in providing CIMT compared with those who were not.[22] Among non-CIMT users, perceived barriers included: a lack of resources and a dedicated space,[13,22,23,25] insufficient staffing, the time taken for CIMT would impact other patients,[13] and funding constraints by managed healthcare insurers.[13,25] Among CIMT users,

organisational support was highlighted as an important facilitator for sustainable CIMT programs.[21] Allied health management support enabled reallocation of resources to run programs, allocation of sufficient staffing and flexibility in scheduling.[21]

Discussion

It is believed that this is the first systematic review to synthesise the published literature related to the perceptions and experiences of CIMT among a range of relevant stakeholders. CIMT is a complex and challenging intervention for patients to undertake, carers to support, therapists to deliver and health services to sustain. Investigating multiple stakeholder perceptions and experiences enables increased understanding of factors influencing participation and sustained implementation of complex interventions.[55–58] This review identified several determinants of implementation, which are relevant for many rehabilitation clinicians and services in planning delivery of CIMT programs. The findings of this review could guide future implementation research.

The training intensity of CIMT has been proposed as a challenge for both stroke survivors and therapists. Respondents without experience of CIMT overwhelmingly felt that the intensity of the program was unfeasible, either to undertake or deliver, whereas the views were mixed among those with CIMT experience. Stroke survivors reflected on the challenges associated with the program intensity, such as mental and physical fatigue, but they also acknowledged that intensity was needed to induce change in arm function and reported satisfaction when they saw improvements. Therapists acknowledged resource and labour restraints that impacted the delivery of CIMT. However, they also identified strategies to address these, such as mCIMT, group-based CIMT and interdisciplinary collaboration. Positive patient outcomes drove the decision to continue providing CIMT despite the reported challenges, indicating that CIMT is worthwhile for therapists to deliver. Engaging carers in a home-based CIMT program was another strategy used to reduce the labour demands on therapists in a chronic stroke population, with positive outcomes.[15] However, only one study identified in this review involved carers,[27] highlighting a gap in knowledge about the experiences of this stakeholder group.

Rehabilitation therapists need specific training to learn how to deliver CIMT programs in their setting, and time to develop their skills and confidence through practice and peer mentoring. To sustain implementation, these educational structures require ongoing support and resource allocation.[56] Upper limb stroke rehabilitation interventions are inherently complex to deliver and therapist knowledge is a key determinant to implementation,[28,59] which is a perception reinforced by data in this review. An Australian-based CIMT implementation study reported that therapists spent 30 hours learning how to deliver CIMT,[60] highlighting the importance of knowledge development in CIMT provision. Carers also benefit from education in supporting CIMT programs,[61] with those who undertook online training on CIMT (CARE-CITE) reporting that it improved their ability to support a CIMT program in a chronic stroke population.[62]

Organisational and leadership support was identified as an enabler among clinicians providing CIMT programs and a barrier among non-CIMT users, reflecting a gap between perception and experience. These perceptions may have changed over time as the evidence for CIMT has grown and health leaders become more aware and supportive of compliance with evidence-based practice.[63] Engaging these organisational leaders is critical to overcome the evidence-to-practice gap when implementing CIMT. McCluskey and colleagues reported that 5 hours of meetings were required to obtain organisational support prior to implementing CIMT;[60] however, the strategies adopted to gain this support were not described.

Prior to conducting this review, the authors were aware of several studies investigating stakeholder opinions of CIMT using cross-sectional surveys. The inclusion of quantitative survey findings was to complement the data synthesised from focus groups and interviews. While this added complexity to the analysis, inclusion of these data provided greater insights into the perceptions and experiences of stakeholders related to CIMT across a larger range of settings. This expands the reach of this review by providing a single point of reference in linking current evidence to the practice gaps for CIMT and enhances the clinical applicability of the review's findings.

The conclusions that can be drawn from a systematic review partly depend on the quality of the studies included. The poor methodological reporting, small sample sizes and inclusion of non-neurological rehabilitation therapists in the selected studies (Table 2) may have influenced the validity of our findings. While quality assessment is contentious in qualitative research,[34] we have rated 'risk of bias' using valid tools, allowing the reader to make their own judgements about the findings of the included studies.

In conclusion, this review provides important insights into perceptions and experiences of CIMT from a range of stakeholder viewpoints. CIMT is the most researched and best supported UL stroke rehabilitation intervention, yet this intervention has struggled to achieve widespread uptake. Several determinants of implementation have been identified in this review. Rehabilitation therapists need to develop their knowledge and skills to deliver CIMT through education, mentoring support and opportunities to practise. Improved educational resources will lead to better engagement and participation of stroke survivors and carers. Engaging with organisational leaders and developing CIMT protocols and resources to fit the local clinical context are critical for CIMT programs to be sustained. Future research should be co-designed with healthcare providers and consumers targeting these determinants to understand local influences on sustainable CIMT programs; developing and evaluating educational resources specific to the learning needs for each of these groups; and documenting the processes undertaken to embed CIMT training and support structures into stroke rehabilitation services. After addressing these determinants, future research should evaluate population-level outcomes and policy-level implementation, through T3 and T4 research, to establish CIMT as global standard rehabilitation practice.[64]

What was already known on this topic: Constraint-induced movement therapy improves upper limb function in eligible patients after stroke. Despite the demonstrated efficacy, several barriers to providing the therapy have been reported and it is not routinely provided to eligible stroke survivors.
What this study adds: Constraint-induced movement therapy is challenging but support at all levels helps. Therapists need the know-how, resources and staffing to implement the therapy. It is different to other interventions, and there are positives and negatives to this. Functional outcomes do not always meet the high expectations.

Footnotes: [a] Endnote X9.3, Clarivate, Philadelphia, USA.
[b] Excel V.16.0, Microsoft, Redmond, USA.
[c] NVivo V.12, QSR International Pty Ltd, Melbourne, Australia.
eAddenda: Appendices 1 and 2 can be found online at https://doi.org/10.1016/j.jphys.2023.08.007

Ethics approval: Ethics approval was not required as this is a systematic review of published studies.
Competing interests: Nil.
Source(s) of support: JW received funding from the South Metropolitan Health Service Allied Health Building Research Capacity grant to provide backfill from clinical duties whilst conducting this review.
Acknowledgements: The authors would like to thank Cheryl Hamill and Bethwyn Allen from the South and East Metropolitan Health Service Libraries for their support in developing and carrying out the search; Leo Ng and Kevin Chai for supporting the researchers in using and understanding Research Screener; and Vinicius Cavalheri for reviewing the protocol.

Provenance: Not invited. Peer reviewed.

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