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Feasibility and effectiveness of home-based therapy programmes for children with cerebral palsy: a systematic review

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ABSTRACT

Objective To assess the feasibility and effectiveness of home-based occupational therapy and physiotherapy programmes in children with cerebral palsy (CP), focusing on the upper extremity and reporting on child-related and/or parent-related outcomes.

Design Systematic review.

Data sources Electronic searches were performed in MEDLINE, EMBASE, CINAHL, PsycINFO, OTseeker and PEDro, and in ICTRP and CENTRAL trial registers, from inception to 6 June 2019.

Eligible criteria The review included all types of original studies concerning feasibility or effectiveness of home-based therapy in children aged <18 years with any type of CP. No language, publication status or publication date restrictions were applied.

Data extraction and synthesis Study and intervention characteristics and the demographics of participating children and their parents were extracted. Feasibility was assessed by outcomes related to acceptability, demand, implementation, practicality, adaptation, expansion or integration. Regarding effectiveness, child-related outcome measures related to any level of the International Classification of Functioning, Disability and Health, or parent-related outcomes were investigated. Two authors independently extracted the data. Risk of bias was assessed using the Downs and Black checklist and the Joanna Briggs Institute Critical Appraisal Checklist.

Results The search resulted in a total of 92 records: 61 studies and 31 conference abstracts. Feasibility studies reported mainly on acceptability and implementation. Overall compliance to home-based training programmes (implementation) was moderate to high, ranging from 56% to 99%. In the effectiveness studies, >40 different child-related outcome measures were found. Overall, an improvement in arm-hand performance within group across time was shown. Only two studies reported on a parent-related outcome measure. No increase in parental stress was found during the intervention.

Conclusions Based on the results of the included studies, home-based training programmes seem to be feasible. However, conclusions about the effectiveness of home programmes cannot be made due to the large variability in the study, patient and intervention characteristics, comparators, and outcome measures used in the included studies.

PROSPERO registration number CRD42016043743.

Strengths and limitations of this study

- ► This is the first review to be systematic as well as specifically focused on the feasibility and effectiveness of home-based occupational therapy and physiotherapy programmes in children with cerebral palsy.
- ► Besides child-related outcomes, this review also included parent-related outcomes.
- ► We were unable to perform a meta-analysis due to the large variability in study characteristics.

INTRODUCTION

Over the last years, despite an increased survival rate of low birthweight infants, the overall prevalence of cerebral palsy (CP) has remained constant at 1.96 per 1000 live births.[1] CP is the largest diagnostic group treated in paediatric rehabilitation. Social participation, independence and self-efficacy are restricted in children with CP as they experience limitations in the execution of daily activities.[2] About 60% of children between 4 and 16 years have problems with effective use of the arm and hand during reach, grasp, release and manipulation of objects, resulting in limitations in performance of daily activities.[3 4] Most currently applied upper extremity interventions aim at improving functionality and abilities towards independence. Studies examining these interventions have shown that the key ingredients for effective treatment constitute a high training intensity combined with meaningful goal-directed and task-specific training.[5] Relevant context for children to learn new daily activities is usually the home environment, and interventions provided in this context are called home-based programmes.[6 7] Home-based programmes are defined as 'therapeutic activities that the child performs with parental assistance in the home environment with the goal to achieve desired health outcomes'.[7]

Home-based programmes are thought to be a useful addition or even replacement of centre-based therapy in the rehabilitation of children with CP.[5] Home-based programmes provide a unique opportunity to train continuously, and specific tasks are trained in a relevant context. Furthermore, these programmes enable parents to incorporate training into their daily routine with the child, so no separate training moments are necessary, generalisation is fostered, and intensity and repetition of trained tasks can be high, which all enhance effective motor learning.[8] In addition, increased amount of training may facilitate retention of established intervention effects. Furthermore, it may also increase parental involvement and empowerment, in turn contributing to reciprocal partnerships between parents and health professionals.[9]

Despite consensus on the importance of home-based programmes for children with CP, there is scarce information regarding programme characteristics that may influence family participation.[10] For example, parents can be either a therapy provider in collaboration with a health professional (partnership home programme) or supervised by a health professional (therapist-directed home programme).[11] When parents become therapy providers, the relationship between parents and the health professional changes: the health professional becomes the coach of the parents. Depending on the role of parents and their specific needs, the way and amount of coaching can vary from limited instruction only at the beginning of the programme, to extensive demonstration, feedback and coaching throughout the entire programme. Mode of coaching can vary from home visits by the therapist to remote coaching by email or telephone consultation.

Parents are of great importance in home-based programmes. Although a survey among parents has shown that they do not have an unfavourable opinion concerning home programmes, these programmes may induce or enhance stress in parents.[11] Parents may experience pressure to comply, especially when the programme is demanding. Furthermore, the altered parent–child interaction during training may cause additional tension.[12] As the role of parents changes to that of a therapy provider, this may cause a conflict between their parenting style and their approach as a therapy provider. Consequently, loss of motivation by parents and/or child to complete training activities may affect compliance and probably effectiveness of the intervention. Because of the aforementioned factors, home-based interventions need to be carefully developed and implemented.

Feasibility is an important aspect that needs to be considered when implementing home-based programmes. Feasibility studies are used to determine whether an intervention is relevant, sustainable and appropriate for further testing.[13] Several studies have investigated the feasibility of home-based programmes for children with CP and indicated that the programmes were feasible in terms of compliance and adherence.[14 15] However, up until now no systematic overview is available of relevant feasibility components, such as satisfaction, acceptability or practicality, and even when these treatments appear feasible they are not necessarily effective. So far, effectiveness of home-based programmes in children with CP has been reviewed by Novak and Berry.[7] They concluded that home-based programmes using goal-directed training are effective in improving motor and functional outcomes.[7] Another review by Sakzewski *et al*[5] on non-surgical upper extremity therapies in children with unilateral CP concluded that home-based programmes are an effective supplement next to centre-based interventions.

Supplementary to these two reviews, this systematic review aims to provide a clear summary on both feasibility and effectiveness of currently available home-based programmes in children with CP (aged <18 years), specifically focusing on the upper extremity. Effectiveness will be investigated on both child-related and parent-related outcomes, as parent involvement has received little research attention.

The following two objectives will be addressed:

- To assess the feasibility of home-based occupational therapy and physiotherapy programmes in children with CP.
- To assess the effectiveness of home-based occupational therapy and physiotherapy programmes that focus on the upper extremity in children with CP in child-related and parent-related outcomes.

METHODS

The objectives and methods of this review were prespecified and registered in the International Prospective Register of Systematic Reviews (PROSPERO), as well as published in a protocol.[16]

Eligibility criteria

- Types of studies: all types of original studies concerning feasibility or effectiveness of home-based therapy in children with CP. An intervention was considered to be home-based if treatment was performed in the home setting without a healthcare provider being physically present. Studies that only included therapy provided at a healthcare facility, (pre)school or day care were excluded. In case the intervention took place in different settings, studies were only included if treatment in the home setting was a fundamental, prespecified element of the intervention. The studies included in this systematic review were categorised using the scale published by the American Academy for Cerebral Palsy and Developmental Medicine to hierarchise studies based on research design types of either intervention (group) studies or single-subject design studies.[17]
- Types of participants: children aged <18 years with any type of CP. In case of a more heterogeneous study population, results of the target population must have been reported separately.
- Types of intervention: home-based occupational therapy or physiotherapy intervention performed

in the home setting without (continuous) physical presence of a healthcare provider. To investigate *effectiveness*, only upper extremity interventions were included.

- Types of comparators: concerning *feasibility*, studies comprising all types of comparators or no control intervention were considered. In order to determine *effectiveness*, no therapy, care as usual, centre-based occupational therapy or physiotherapy, pharmacological intervention, and surgical procedure were considered. If a study comprised multiple distinct home-based programmes, the one of main interest was included as the experimental intervention and the other home-based programme(s) as comparator(s).
- Types of outcome measures: to review *feasibility*, studies reporting on key areas as proposed by Bowen *et al*[13] were considered: acceptability, demand, implementation, practicality, adaptation, expansion or integration. Regarding *effectiveness*, child-related outcome measures related to any level of the International Classification of Functioning, Disability and Health (ICF), or parent-related outcomes within the psychological and social domain including parenting, were investigated.[18]
- Report criteria: no restrictions regarding language, publication status or publication date were applied. Conference abstracts that provided insufficient information to decide on selection were excluded, as well as records of which the full text could not be retrieved.

Information sources

Records were identified using electronic databases MEDLINE (Ovid interface; 1946–present), EMBASE (Ovid interface; 1974–present), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (EBSCO interface; 1981–present), PsycINFO (EBSCO interface), OTseeker and PEDro. Trial protocols were also identified through International Clinical Trial Registry Platform (ICTRP) and Cochrane Controlled Trials Register (CENTRAL). Moreover, reference lists of included papers, excluded reviews and meta-analyses were scanned. Finally, a bibliography of included records was sent to all corresponding and last authors of included studies. They were asked to provide any related study by either their own research group or associates.

Search

Search terms for population and intervention were combined for Medical Subject Headings (MESH) terms and text words in titles and abstracts (online supplementary appendix 1). Search strategies were created by LWMEB and revised after peer review by JK. A data search expert from Kleijnen Systematic Reviews conducted the search on 10 October 2016, and an update of this search was done on 6 June 2019.

Study selection

The software platform Covidence was used to complete eligibility assessment. LWMEB and MLAPS independently executed the screening of titles and abstracts as well as the unblinded evaluation of full-text publications in duplicate. Any disagreements between reviewers were resolved through consensus and arbitrated by YJMJ-P, when necessary. Inter-rater agreement and reliability were calculated using percentage of agreement and Cohen's kappa statistic to determine consistency between reviewers in assessing the eligibility of full-text publications.

Data collection process

LWMEB and MMEG collected data independently for each study. A data extraction form was developed a priori, pilot-tested on two records that were not eligible for this review, and refined accordingly. During data collection reviewers discussed any discrepancies and consulted YJMJ-P to mediate when necessary. Authors were contacted if essential information was missing from a study or if reports were inconsistent. Author names, intervention locations, intervention characteristics, sample sizes and outcomes were compared to identify duplicate publications. Multiple records reporting on different outcomes or time points of one study were combined. For records investigating the same outcomes and time points, only the record reporting the largest sample size was included.

Data items

General information was extracted from each included study: (1) study characteristics (author(s), publication year, study design, country, comparator, number of participants (in total and per study arm), outcomes, follow-up duration and measurement time points); (2) intervention characteristics (objective, therapy provider(s), coaching approach of parents, duration of programme, frequency and duration of sessions, treatment approach, and motor learning approach); (3) demographics of participating children (age, gender, diagnosis (type and topographical distribution of CP), Manual Ability Classification System (MACS) level, Gross Motor Function Classification System (GMFCS) level, Communication Function Classification System level); and (4) demographics of parents of participating children (age, gender and educational level).

Feasibility was assessed primarily by outcomes related to the feasibility area, whereas demand, implementation, practicality, adaptation, integration and expansion were of secondary interest. Definitions of these constructs are provided in the protocol.[16] Concerning the *effectiveness* objective, child-related upper extremity outcomes within the ICF level activity were primary. Outcomes assessing body functions and structures, participation, and parent-related outcomes were of secondary interest.

Home-based programmes are often complex interventions, formed by multiple interacting components. For that reason, if results were reported separately for particular components of the intervention, this was also recorded.

Risk of bias in individual studies

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Qualitative Research was used to determine risk of bias of qualitative studies.[19] Studies with primary focus on intervention effectiveness were assessed by the Checklist for Measuring Quality by Downs and Black.[20] Construct power was not included, since this item estimates precision rather than bias. Single items were summarised into overall scores, and each study was classified into excellent (24–28 points), good (19–23 points), fair (14–18 points) or poor (<14 points).[21] All assessments were done at study level. LWMEB and MMEG performed the unblinded assessment independently. In case reviewers could not come to an agreement, YJMJ-P interceded.

For effectiveness studies included in the review, the risk of selective reporting was determined by comparing records on study results with previously published study protocols or registrations. Any discrepancies were listed.

Patient and public involvement

Patients and the public were not involved in our research.

RESULTS

The search resulted in 3077 records. After deduplication, a total of 2054 titles and abstracts were screened, resulting in 1779 irrelevant records. The remaining 275 records were full texts assessed for eligibility, of which 183 records did not meet the eligibility criteria. The search resulted in 92 records, some reporting on the same study. The flow chart is depicted in figure 1.

There were 83 corresponding and last authors contacted to provide any related studies. Of these authors, 49 (59%) responded with either a suggestion or no additions at all, resulting in 22 additional records, which are already included in the 92 records.

Inter-rater agreement of full-text assessment was found to be 83.3%. Inter-rater reliability was substantial (Cohen's kappa 0.66).

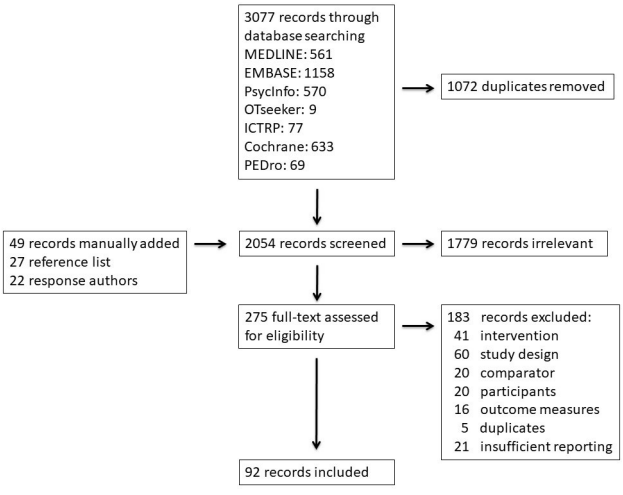

Figure 1 Flow chart. ICTRP, International Clinical Trial Registry Platform.

Of the 92 records, 31 records[22–52] were conference abstracts. Eight initial studies described in these abstracts[22–24 31–34 44] developed into a full-text article (25.8%). The remaining 61 studies[11 14 15 53–110] were included in this review, 30 feasibility studies[11 14 15 53–71 98 99 101 102 105–108] (49.2%), 10 effectiveness studies[87–96] (16.4%), and 21 studies[72–86 97 100 103 104 109 110] that reported on both feasibility and effectiveness (34.4%).

Study characteristics

Of the effectiveness studies, 2 studies[76 95] (6.5%) were large randomised controlled trials (RCTs), 24 studies[72–75 77–79 81–88 90 92 93 97 100 103 104 109 110] (77.4%) smaller RCTs, 4 studies[89 91 94 96] (12.9%) were single-subject designs, and 1 study[80] (3.2%) used a pretest–post-test cohort design, with the participants serving as their own controls (see table 1).

Methodological quality of studies with a primary focus on intervention effectiveness, assessed by the Downs and Black checklist, is depicted in online supplementary appendix 2. According to this scale, 5 studies[75–77 85 86] (16.1%) were rated as good, 15 studies[73 74 78 79 81–83 87 88 92 95 97 100 103 110] (48.4%) were fair and 11 studies[72 80 84 89–91 93 94 96 104 109] (35.5%) were poor. The 13 qualitative studies[11 55 57–59 61–64 67 70 72 101] found were scored with the JBI Critical Appraisal Checklist to determine risk of bias. A positive answer to the first five questions of this checklist is crucial for the assessment of risk of bias. Scores are given in online supplementary appendix 3. In only five qualitative studies[59 62–64 101] (38.5%), the first five questions of the JBI checklist could be answered. In other words, risk of bias in these five studies was clear, whereas in eight studies[11 55 57 58 61 67 70 72] (61.5%) this risk could not be estimated from the data provided. Records on study results were compared with previously published study protocols or registrations. Chiu *et al*[98] stated that therapy sessions lasted 20 min, while they stated in the trial registration that therapy sessions lasted 25 min. Several other studies showed a discrepancy in the amount of outcome measures reported. They reported either less or more outcome measures in the trial registration than in actual study results.

Participant characteristics

Most studies targeted children with unilateral spastic CP, but there was a large variation in other child characteristics such as age, MACS and GMFCS classification. The vast majority of studies did not report any parent characteristics. Only two studies[54 101] reported on age, gender and educational level of parents. Only 16% of the studies reported on gender characteristics, and only 7% reported on educational level. The number of study participants ranged from 1 to 147, with a maximum of 105 in an effectiveness study. All participant characteristics are shown in table 1.

Intervention characteristics

In table 2 intervention characteristics of the included studies are shown. One should note that all characteristics

Table 1 Study and participant characteristics

Authors	Study type	Study design	Study design specified	N	Age	Gender (male), n (%)	Disease-specific characteristics	Parents' characteristics
James *et al*[23] (CA)[59]	F		Generic qualitative research design (part of large RCT). Interview study.	10	M: 11 years 4 months (SD 2 years 6 months)	5 (50.0)	Spastic: 10 (100%)* Hemiplegia: 10 (100%) MACS: I: 3 (30.0%) II: 7 (70.0%)*	Gender: 1 male (10.0%)*
McBurney *et al*[61]	F		Qualitative study (embedded in an RCT).	11	M: 12 years 9 months (SD 2 years 10 months)	4 (36.4)*	Spastic: 11 (100%)* Diplegia: 11 (100%)* GMFCS: I: 2 (18.2%) II: 2 (18.2%) III: 7 (63.6%)*	Gender: 3 male (23.1%)*
Novak *et al*24 (CA),[11]	F		Qualitative study (embedded in an RCT).	8	Mdn: 6.5 years (range 5 years 5 months–12 years 8 months)*	5 (62.5)*	Spastic: 6 (75.0%) Ataxic: 1 (12.5%) Athetosis: 1 (12.5%)* Hemiplegia: 1 (12.5%) Bilateral: 5 (62.5%) Unknown: 2 (25.0%)*	Gender: 2 male (20.0%)*
Taylor *et al*[70]	F		Qualitative research design using indepth interviews, embedded in an RCT.	11	M: 12.7 years (SD 2.8 years)	4 (36.4)*	Spastic: 11 (100%)* Diplegia: 11 (100%)* GMFCS: I: 2 (18.2%) II: 2 (18.2%) III: 7 (63.6%)*	Gender: 3 male (23.1%)*
Law and King[15]	F		Feasibility study, embedded in a clinical trial.	72	Range 18 months–8 years		Spastic: 72 (100%)*	
Lorentzen *et al*[60]	F		Non-randomised controlled clinical study, including a feasibility component.	46	M: 11 years (SD 2.6 years)*	30 (65.2)*	Spastic: 42 (91.3%) Ataxic: 4 (8.7%)* Hemiplegia: 38 (82.6%) Bilateral: 4 (8.7%) Unknown: 4 (8.7%)* MACS: I: 28 (60.9%) II: 18 (39.1%)* GMFCS: I: 44 (95.7%) II: 2 (4.3%)*	
Psychouli and Kennedy[65]	F		Uncontrolled clinical trial, using an A1-B-C-A2 design, with a feasibility component.	9	M: 6 years 9 months (range 5 years 1 months–11 years)	6 (66.7)*	Spastic: 9 (100%)* Hemiplegia: 9 (100%)*	
Ahl *et al*[53]	F		Pilot study with feasibility component.	14	Mdn: 3 years 8 months (range 1 year 6 months–6 years)*	11 (78.6)*	Spastic: 14 (100%) Diplegia: 12 (85.7%) Quadriplegia: 2 (14.3%)* GMFCS: II: 1 (7.1%) III: 8 (57.1%) IV: 3 (21.4%) V: 2 (14.3%)*	
Novak *et al*[14]	F		Pilot study (single-group, pretest–post-test design) with a feasibility component.	20	M: 3.8 years (range 2–7 years)	16 (80)*	Spastic: 20 (100%)*	
Bilde *et al*[71]	F		Pilot study including feasibility components.	9	M: 10 years 3 months	5 (55.6)*	Spastic: 9 (100%)* MACS: I: 4 (44.4%) II: 5 (55.6%)* GMFCS: I: 8 (88.9%) II: 1 (11.1%)*	
Boyd *et al*[25] (CA)	F		Pre–post pilot study including a feasibility component.	9	Range 9–13 years		Spastic: 9 (100%)* Hemiplegia: 9 (100%)*	
McCoy *et al*[29] (CA)	F		Pilot project.	4	Range 9–14 years	3 (75)*	Spastic: 4 (100%)* Hemiplegia: 4 (100%)* MACS: I: 2 (50%) III: 2 (50%)*	
Farr *et al*[99]	F		Two-group, parallel feasibility trial.	30				
Shierk *et al*[108]	F		Evaluated through a trial.	65				
Liu *et al*[49] (CA)	F		Single-group, pre–post intervention trial.	15	M: 94.2 months (SD 27.5 months)		Hemiplegia: 15 (100%)*	
Ferre *et al*[22] (CA),[56]	F		Single-group design.	11	Mdn: 45 months (range 29–54 months)*	6 (54.5)	Spastic: 11 (100%) Hemiplegia: 11 (100%) MACS: I: 2 (18.2%) II: 5 (45.5%) III: 3 (27.3%) IV: 1 (9.1%)*	

Continued

Table 1 Continued

Authors	Study type	Study design	Study design specified	N	Age	Gender (male), n (%)	Disease-specific characteristics	Parents' characteristics
Chiu *et al*[98]	F		Single-group, pre–post intervention group.	20	M: 8.7 years (SD 2.4 years)	11 (55)*	Hemiplegia: 8 (40%) Diplegia: 10 (50%) Quadriplegia: 2 (10%)* MACS: I and II: 17 (85%) III: 3 (15%)* GMFCS: I and II: 17 (85%) III: 3 (15%)*	
Visser *et al*[106]	F		Within-subjects, repeated-measures design.	10	Mdn: 14 years 3 months (range 6 years 2 months–16 years 6 months)*		Spastic: 9 (90%) Ataxic: 1 (10%)* Diplegia: 5 (50%) Triplegia: 3 (30%) Quadriplegia: 1 (10%) Unknown: 1 (10%)* MACS: I: 5 (50%) II: 4 (40%) III: 1 (10%)* GMFCS: II: 5 (50%) III: 5 (50%)* CFCS: I: 7 (70%) II: 1 (10%) III: 1 (10%) IV: 1 (10%)*	
Fehlings *et al*[27] (CA)	F		Prospective intervention study design (case series), including a feasibility component.	15	M: 8.8 years (SD 2.3 years)		Spastic: 15 (100%)* Hemiplegia: 15 (100%)*	
Kenyon *et al*[105]	F		Case series.	3	Mdn: 5 years 11 months (range 5 years 6 months–14 years 10 months)*	3 (100)	Spastic: 3 (100%)* Diplegia: 1 (33.3%) Triplegia: 1 (33.3%) Quadriplegia: 1 (33.3%)* MACS: I: 1 (33.3%) III: 1 (33.3%) IV: 1 (33.3%)* GMFCS: III: 1 (33.3%) IV: 2 (66.6%)* CFCS: I: 1 (33.3%) IV: 2 (66.6%)*	
Fergus *et al*[65]	F		Case report with feasibility component.	1	13 months	1 female	Spastic: 1 (100%)* Hemiplegia: 1 (100%)	Educational level: postgraduate
Reifenberg *et al*[107]	F		Case report.	1	5 years	1 (100)	Spastic: 1 (100%) Hemiplegia: 1 (100%)	Gender: 1 female
Hernandez Alvarado[102]	F		Prospective case study with a single experimental group.	5	M: 15 years	4 (80)*	MACS: I: 3 (60%) II: 2 (40%)* GMFCS: III: 5 (100%)*	
Jaber *et al*[47] (CA)	F		Mixed methods.	15	I: Mdn: 100 months*	11 (73.3)		
Basaran *et al*[54]	F		Adherence survey study (cross-sectional).	147	Range 2.5–18.0 years	83 (56.5)*	Spastic: 143 (97.3%) Unspecified: 4 (2.7%)* Hemiplegia: 39 (26.5%) Diplegia: 54 (36.7%) Quadriplegia: 50 (34%) Unspecified: 4 (2.7%)* GMFCS: I: 37 (25.2%) II: 21 (14.3%) III: 32 (21.8%) IV: 24 (16.3%) V: 33 (22.4%)*	Age: range 20–57 years Gender: 3 male (2.1%)* Educational level: Illiterate: 8 (5.4%) Literate: 3 (2.0%) Primary school: 68 (58.5%) Secondary school: 23 (15.6) High school: 23 (15.6%) University: 4 (2.7%)*
Halvarsson *et al*[57]	F		Qualitative study.	15	Range 3–19 years		GMFCS: II: 3 (30.0%) III: 3 (30.0%) IV: 4 (40.0%)	Gender: 5 male (33.3%)*
Hinojosa and Anderson[58]	F		Qualitative study.	9	Mdn: 3 years (range 2–5 years)*	5 (55.6)	Spastic: 8 (88.9%) Unspecified: 1 (11.1%) Hemiplegia: 1 (11.1%) Diplegia: 2 (22.2%) Quadriplegia: 5 (55.6%) Unspecified: 1 (11.1%)	Gender: 8 female
Peplow and Carpenter[62]	F		Qualitative research design (with constructivist approach).	4				Gender: 1 male (25%)*
Piggot *et al*[63]	F		Qualitative research project.	7	Range 2–10 years		Hemiplegia: 2 (28.6%) Quadriplegia: 5 (71.4%)*	Age: range mid-20s to late 30s Gender: 1 male (12.5%)*

Continued

Table 1 Continued

Authors	Study type	Study design	Study design specified	N	Age	Gender (male), n (%)	Disease-specific characteristics	Parents' characteristics
Piggot *et al*[64]	F		Grounded theory study.					
Ross and Thomson[66]	F		Questionnaire study.	23	M: 27.6 months	11 (47.8)*		
Sandlund *et al*[67]	F		Qualitative study.	15	M: 11 years (range 6–16 years)	8 (53.3)*		Gender: 6 male (31.6%)*
Gerhardy and Sandelance[28] (CA)	F		A needs analysis was undertaken using semistructured interviews.	17	Range 2–7 years			
Finet[101]	F		Qualitative, phenomenological methodological design.	9	Range 1–12 years			Age: range 32–53 years Gender: 1 male (11.1%)* Educational level: Some college: 1 (11.1%) High school: 2 (22.2%) Bachelor's degree: 5 (55.5%) Associate's degree: 1 (11.1%)*
Sel *et al*[50] (CA)	F		Questionnaire study.	118				
Sandlund *et al*[68]	F			14	M: 10 years 11 months (range 6–16 years)	8 (57.1)*	Spastic: 12 (85.7%) Dyskinetic: 1 (7.1%) Ataxic: 1 (7.1%)* Hemiplegia: 7 (50.0%) Bilateral: 5 (35.7%) Unknown: 2 (14.3%)* MACS: I: 7 (50.0%) II: 5 (35.7%) III: 1 (7.1%) IV: 1 (7.1%)* GMFCS: I: 10 (71.4%) II: 2 (14.3%) III: 2 (14.3%)*	
Sevick *et al*[69]	F			4	Mdn: 13.5 years (range 8–17 years)*	2 (50.0)*	Spastic: 4 (100%)* Hemiplegia: 4 (100%)* MACS: II: 4 (100%)* GMFCS: I: 4 (100%)*	
Dizmek *et al*[26] (CA)	F							
Pasquet *et al*[30] (CA)	F			28	M: 11.9 years (SD 2.7 years)		Spastic: 28 (100%)* Hemiplegia: 28 (100%)*	
Sisman Isik *et al*[51] (CA)	F			63		36 (57)*	GMFCS: I–III: 61.9% IV–V: 38.1%	
James *et al*[31] (CA), [32] (CA), [76]	BEF	Large RCT (with narrow CI level I).	Matched-pairs waitlist control RCT.	102	I: M: 11 years 8 months (SD 2 years 4 months)	51 (50.5)*	Spastic: 102 (100%) Hemiplegia: 102 (100%) MACS: I: 24 (23.8%) II: 76 (75.2%) III: 1 (1.0%)* GMFCS: I: 45 (44.6%) II: 56 (55.4%)*	
Hoare *et al*[75]	BEF	Smaller RCT (with wider CI level II).	Randomised, controlled, evaluator-blinded trial.	35	M: 35.8 months (SD 15.8 months)	20 (58.8)*	Spastic: 35 (100%) Hemiplegia: 35 (100%)	
Kirkpatrick *et al*[77]	BEF	Smaller RCT (with wider CI level II).	Single-centre, single-blinded (outcomes assessor), parallel-group RCT with 1:1 allocation.	70	M: 5.6 years (SD 2.1 years)	39 (55.7)*	Spastic: 70 (100%)* Hemiplegia: 70 (100%)	
Gordon *et al*[85]	BEF	Smaller RCT (with wider CI level II).	RCT including a feasibility component.	44	I: M: 6 years 3 months (SD 2 years 2 months)	20 (47.6)*	Spastic: 44 (100%)* Hemiplegia: 44 (100%) MACS: I: 5 (11.9%) II: 35 (83.3%) III: 2 (4.8%)*	
Wallen *et al* [33] (CA), [86]	BEF	Smaller RCT (with wider CI level II).	Pragmatic, randomised, assessor-blinded trial, including a feasibility component.	50	M: 48.6 months (SD 21.0 months)	27 (54.0)*	Spastic: 50 (100%)* Hemiplegia: 50 (100%) MACS: I: 2 (4%) II: 37 (77%) III: 8 (17%) IV: 1 (2%) GMFCS: I: 33 (67%) II: 15 (31%) III: 1 (2%)	
Al-Oraibi and Eliasson[72]	BEF	Smaller RCT (with wider CI level II).		20	I: M: 47 months (SD 19 months)	10 (71.4)*	Spastic: 14 (100%)* Hemiplegia: 14 (100%)	Educational level: Diploma: 3 (21.4%) Below high school: 3 (21.4%) High school: 7 (50.0%) Bachelor: 1 (7.1%)*

Continued

Table 1 Continued

Authors	Study type	Study design	Study design specified	N	Age	Gender (male), n (%)	Disease-specific characteristics	Parents' characteristics
Eugster-Buesch *et al*[73]	BEF	Smaller RCT (with wider CI level II).	Randomised, controlled, single-blinded pilot study including feasibility components.	23	I: M: 9.8 years (SD 3.5 years)	12 (52.2)*	Spastic: 23 (100%)* Hemiplegia: 23 (100%) GMFCS: I: 20 (87.0%) II: 3 (13.0%)*	
Hsin *et al*[74]	BEF	Smaller RCT (with wider CI level II).		12	I: M: 6.9 years (SD 0.6 years)	10 (45.5)*	Spastic: 23 (100%) Hemiplegia: 23 (100%)	
Klingels *et al*[78]	BEF	Smaller RCT (with wider CI level II).	Randomised, controlled and evaluator-blinded trial including a feasibility component.	51	M: 8 years 9 months (SD 2 years 2 months)	28 (54.9)*	Spastic: 51 (100%)* Hemiplegia: 51 (100%)* MACS: I: 4 (7.8%) II: 38 (74.5%) III: 9 (17.6%)*	
Lin *et al*[79]	BEF	Smaller RCT (with wider CI level II).	RCT with feasibility component.	22	I: M: 76.7 months (SD 26.2 months)	12 (57.1)*	Hemiplegia: 11 (52.4%) Quadriplegia: 10 (47.6%)*	
Novak *et al*[81]	BEF	Smaller RCT (with wider CI level II).	Double-blind RCT with a feasibility component.	36	M: 7.75 years (SD 2.02 years)	25 (69.4)*	Spastic: 30 (83.3%) Dyskinetic: 3 (8.3%) Ataxic: 1 (2.8%) Athetosis: 2 (5.6%)* Hemiplegia: 14 (38.9%) Diplegia: 14 (38.9%) Quadriplegia: 2 (5.6%) Unknown: 6 (16.7%)* MACS: I: 17 (47.2%) II: 9 (25.0%) III: 2 (5.6%) IV: 5 (13.9%) V: 3 (8.3%)* GMFCS: I: 17 (47.2%) II: 5 (13.9%) III: 6 (16.7%) IV: 2 (5.6%) V: 6 (16.7%)*	
Preston *et al*[82]	BEF	Smaller RCT (with wider CI level II).	Pilot, single-blind, multicentre RCT, with a feasibility component.	16	M: 9 years 2 months (SD 2 years 5 months)	9 (60.0)*	Hemiplegia: 14 (93.3%) Bilateral: 1 (6.7%)* MACS: II: 3 (20.0%) III: 5 (33.3%) IV: 7 (46.7%)*	
Sakzewski *et al*[83]	BEF	Smaller RCT (with wider CI level II).	Pragmatic, single-blind, matched-pairs RCT.	53	M: 7 years 10 months (SD 2 years 4 months)	32 (68.1)*	Spastic: 53 (100%)* Hemiplegia: 46 (97.9%) Unknown: 1 (2.1%)* MACS: I: 24 (51.1%) II: 23 (48.9%)* GMFCS: I: 34 (72.3%) II: 13 (27.7%)*	
Charles *et al*[84]	BEF	Smaller RCT (with wider CI level II).	Single-blinded RCT, including a feasibility component.	33	M: 6 years 8 months (SD 1 year 4 months)	14 (63.6)*	Spastic: 33 (100%)* Hemiplegia: 33 (100%)	
Chamudot *et al*[44] (CA), [97]	BEF	Smaller RCT (with wider CI level II).	RCT including a feasibility component.	36	M corrected age 11.1 months (SD 2.2 months)	19 (58)*	Spastic: 33 (100%)* Hemiplegia: 33 (100%)*	
Ferre *et al*[100 110]	BEF	Smaller RCT (with wider CI level II).	Randomised trial including a feasibility component.	40	I: M: 5.2 years (SD 2.7 years)	10 (41.7)*	Spastic: 24 (100%)* Hemiplegia: 24 (100%)* MACS: I: 5 (20.8%) II: 19 (79.2%)*	
Fischer *et al*[45] (CA)	BEF	Smaller RCT (with wider CI level II).	Multisite RCT using a factorial design, including a feasibility component.	55				
Hobbs *et al*[46] (CA)	BEF	Smaller RCT (with wider CI level II).	Pilot RCT.	18	M: 10 years 8 months (SD 3 years 4 months)	12 (66.7)*	Hemiplegia: 13 (72.2%) Diplegia: 5 (27.8%)* MACS: I: 2 (11.1%) II: 10 (55.6%) III: 3 (16.7%) IV: 3 (16.7%)*	
Hughes *et al*[103]	BEF	Smaller RCT (with wider CI level II).	Non-blinded, randomised intervention study.	28	Range 18–68 months	17 (60.7)*		Educational level: 12 years of schooling or less
Kassee *et al*[104]	BEF	Smaller RCT (with wider CI level II).	Pilot study employing pretest, post-test experimental design.	6	Mdn: 9 years (range 7–12 years)*	6 (100)*	Spastic: 6 (100%)* Hemiplegia: 6 (100%)* MACS: I: 2 (33.3%) II: 4 (66.7%)*	
Law *et al*[109]	BEF	Smaller RCT (with wider CI level II).	Two-by-two factorial design.	79		28 (39)*	Spastic: 72 (100%)* Hemiplegia: 28 (39%) Quadriplegia: 44 (61%)*	

Continued

Table 1 Continued

Authors	Study type	Study design	Study design specified	N	Age	Gender (male), n (%)	Disease-specific characteristics	Parents' characteristics
Liang *et al*[48] (CA)	BEF	Smaller RCT (with wider CI level II).	Randomised trial.	30				
Hobbs *et al*[52] (CA)	BEF	Smaller RCT (with wider CI level II).	RCT.	18	M: 10 years 8 months (SD 3 years 4 months)	12 (66.7)	Hemiplegia: 13 (72.2%) Diplegia: 5 (27.8%)* MACS: I: 2 (11.1%) II: 10 (55.6%) III: 3 (16.7%) IV: 3 (16.7%)*	
Lowes *et al*[80]	BEF		Pretest–post-test cohort design, with the participants serving as their own controls, including a feasibility component.	7	Mdn: 11.4 months (range 7.1–16.1 months)*	3 (42.9)*	Spastic: 7 (100%)* Hemiplegia: 7 (100%)*	
Facchin *et al*[95]	E	Large RCT (with narrow CI level I).	Multicentre, prospective, cluster-randomised controlled clinical trial.	105		53 (50.5)*	Spastic: 105 (100%)* Hemiplegia: 105 (100%)	
Chen *et al*[87]	E	Smaller RCT (with wider CI level II).	Single-blinded RCT.	48	I: M: 8.73 years (SD 1.9 years)	21 (46.7)*	Spastic: 45 (100%) Hemiplegia: 45 (100%)	
Chiu *et al*[34] (CA), [88]	E	Smaller RCT (with wider CI level II).	Prospective, single-blind, randomised trial.	62	I: M: 9.4 years (SD 1.9 years)	28 (45.2)*	Spastic: 62 (100%) Hemiplegia: 62 (100%) MACS: I–III: 42 (67.7%) IV–V: 20 (32.3%)* GMFCS: I–III: 52 (83.9%) IV–V: 10 (16.1%)*	
Kim *et al*[90]	E	Smaller RCT (with wider CI level II).		19	I: M: 9.1 years (SD 1.8 years)	10 (52.6)*	Hemiplegia: 10 (52.6%) Quadriplegia: 9 (47.4%)*	
Xu *et al*[92]	E	Smaller RCT (with wider CI level II).	Single-blinded RCT.	75	I: M: 56.8 months (SD 34.0 months)	E: 25 (36.8)*	Spastic: 75 (100%)* Hemiplegia: 75 (100%)* MACS: I: 10 (14.7%) II: 49 (72.1%) III: 9 (13.2%) GMFCS: I: 60 (88.2%) II: 8 (11.8%)	
Abd El-Kafy *et al*[93]	E	Smaller RCT (with wider CI level II).		30	I: M: 6.0 years (SD 1.7 years)	12 (44.4)*	Spastic: 30 (100%)* Hemiplegia: 30 (100%) MACS: II: 11 (40.7%) III: 9 (33.3%) IV: 7 (25.9%)*	
Bagley *et al*[35] (CA)	E	Smaller RCT (with wider CI level II).	Prospective RCT with patient preference.	38	Range 5–15 years		Spastic: 38 (100%)* Hemiplegia: 38 (100%)*	
Hoare *et al*[36 37] (CA)	E	Smaller RCT (with wider CI level II).	Randomised, controlled, assessor-blinded trial.	34	M: 3 years (SD 1 year 4 months)	20 (58.8)*	Spastic: 34 (100%)* Hemiplegia: 34 (100%)*	
Klingels *et al*[38] (CA)	E	Smaller RCT (with wider CI level II).		51	M: 8 years 9 months		Spastic: 51 (100%)* Hemiplegia: 51 (100%)*	
Koseotlu *et al*[39] (CA)	E	Smaller RCT (with wider CI level II).		32			Spastic: 32 (100%)* Hemiplegia: 32 (100%)*	
Novak *et al*[40 41] (CA)	E	Smaller RCT (with wider CI level II).	Double-blind RCT.	36				
Sakzewski *et al*[42 43] (CA)	E	Smaller RCT (with wider CI level II).	Single-blind, matched-pairs, randomised comparison trial.	48	M: 7.9 years (SD 2.3 years)	33 (68.8)*	Spastic: 48 (100%)* Hemiplegia: 48 (100%)* MACS: I: 25 (52.1%) II: 23 (47.9%)*	
Crocker *et al*[89]	E	Single-subject design study (level IV).	Single-subject, ABA experimental design.	2	2 years and 3 years	1 male and 1 female	Spastic: 2 (100%)* Hemiplegia: 2 (100%)	
Naylor and Bower[91]	E	Single-subject design study (level IV).	Single-case, A–B–A experimental design.	9	Mdn: 31 months (range 21–61 months)*	6 (66.7)*	Spastic: 9 (100%)* Hemiplegia: 9 (100%)*	
Coker *et al*[94]	E	Single-subject design study (level IV).	Single-subject ABAB design with a 6-month follow-up evaluation.	1	5 months	1 (100)	Spastic: 1 (100%)* Hemiplegia: 1 (100%)	
Gross *et al*[96]	E	Single-subject design study (level III).	Multiple-baseline, across-subjects design (A-B + follow up).	3	Mdn: 3 years 8 months (range 2 years 9 months–3 years 8 months)*	2 (66.7)	Spastic: 2 (66.7%) Mixed: 1 (33.0%)* Hemiplegia: 1 (33.3%) Quadriplegia: 1 (33.3%) Unspecified: 1 (33.3%)*	

*Numbers and percentages were calculated by the authors of this review.
BEF, both efficacy/effectiveness; CA, conference abstract; CFCS, Communication Function Classification System; E, efficacy/effectiveness study; F, feasibility study; GMFCS, Gross Motor Function Classification System; I, intervention group; M, mean; MACS, Manual Ability Classification System; Mdn, median; RCT, randomised controlled trial.

Table 2 Intervention characteristics

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
James *et al*[23] (CA), 59	F		Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents and therapists					
McBurney *et al*[61]	F	Strength training (resistance).	Duration of programme: 6 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 20–45 min.	No	Parents and therapists					
Novak *et al*[24] (CA), 11	F	Partnership home programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents and therapists					
Taylor *et al*[70]	F	Strength training (resistance).	Duration of programme: 6 weeks. Frequency of sessions: 3 days/week. Duration of sessions: ns.	No	Parents and therapists					
Law and King[15]	F	Intensive neurodevelopmental therapy and upper-extremity inhibitive casting.	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: ns.	ns	Parents					
Lorentzen *et al*[60]	F	Computer-based rehabilitation and virtual reality.	Duration of programme: 20 weeks. Frequency of sessions: daily. Duration of sessions: 30 min.	No	Parents and therapists		No therapy (n=12).			
Psychouli and Kennedy[65]	F	Modified CIMT.	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 2 hours + 20 min.	No	Parents					
Ahl *et al*[63]	F	Goal-directed training/ functional training.	Duration of programme: 5 months. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents and therapists					
Novak *et al*[14]	F		Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents and therapists					
Bilde *et al*[71]	F	Virtual reality.	Duration of programme: 20 weeks. Frequency of sessions: daily. Duration of sessions: 30 min.	No	Parents					
Boyd *et al*[25] (CA)	F	Computer-based rehabilitation.	Duration of programme: 20 weeks. Frequency of sessions: daily. Duration of sessions: 30 min.	No	ns					
McCoy *et al*[29] (CA)	F	Task-specific practice.	Duration of programme: 4 weeks. Frequency of sessions: ns. Duration of sessions: ns.	ns	ns	Neuroplasticity and motor learning principles.				
Farr *et al*[99]	F	Virtual reality (n=15).	Duration of programme: 12 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 30 min.	No	Parents		Other home-based training programme (n=15).			
Shierk *et al*[108]	F	Strengthening exercises and functional activities.	Duration of programme: ns. Frequency of sessions: 5 days/week. Duration of sessions: 15 min.	No	Parents					
Liu *et al*[49] (CA)	F	Bimanual training.	Duration of programme: 8 weeks. Frequency of sessions: 2 days/week. Duration of sessions: 2–2.5 hours.	No	ns					
Ferre *et al* [22] (CA), [56]	F	Bimanual training.	Duration of programme: 9 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 2 hours.	No	Parents	Motor-learning-based training.				
Chiu *et al*[98]	F	Virtual reality.	Duration of programme: 8 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 20 min.	No	Parents and therapists					

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Table 2 Continued

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
Visser *et al*[106]	F	Treadmill training.	Duration of programme: 12 weeks. Frequency of sessions: 3–4 days/week. Duration of sessions: maximal 20 min.	No	Parents					
Fehlings *et al*[27] (CA)	F	Virtual reality.	Duration of programme: 2 months. Frequency of sessions: daily. Duration of sessions: at least 30 min.	ns	ns					
Kenyon *et al*[105]	F	Treadmill training.	Duration of programme: 12 weeks. Frequency of sessions: 2–3 days/week. Duration of sessions: 15–20 min.	No	Parents					
Fergus *et al*[55]	F	Modified CIMT.	Duration of programme: ns. Frequency of sessions: daily. Duration of sessions: variable.	No	Parents	Guidelines for shaping the behaviours.				
Reifenberg *et al*[107]	F	Virtual reality.	Duration of programme: 8 weeks. Duration of sessions: 7 hours/week.	No	Parents					
Alvarado[102]	F	Virtual reality.	Duration of programme: 8 weeks. Frequency of sessions: minimal 3 days/week. Duration of sessions: 30–40 min.	No	Parents and therapists					
Jaber *et al*[47] (CA)	F	Virtual reality (n=9).	Duration of programme: 12 weeks. Frequency of sessions: ns. Duration of sessions: ns.	No	ns		Other home-based training programme (n=6).			
Basaran *et al*[54]	F	Daily home programme.	Duration of programme: ns. Frequency of sessions: daily. Duration of sessions: ns.	No	Parents					
Halvarsson *et al*[57]	F	Stretching.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents					
Hinojosa and Anderson[58]	F		Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents					
Peplow and Carpenter[62]	F	Prescribed exercise programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents					
Piggot *et al*[63]	F	Home programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	Parents					
Piggot *et al*[64]	F		Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	ns					
Ross and Thomson[66]	F	Home-based intervention programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	ns					
Sandlund *et al*[67]	F	Virtual reality.	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: at least 20 min.	No	Parents					
Gerhardy and Sandelance[28] (CA)	F	ns.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	ns	ns					
Finet[101]	F	Occupational therapy home programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	No	ns					

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Table 2 Continued

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
Sel *et al*[50] (CA)	F	ns.	ns.	No	ns					
Sandlund *et al*[68]	F	Virtual reality.	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: at least 20 min.	No	Parents					
Sevick *et al*[69]	F	Virtual reality.	Duration of programme: 9 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 1 hour.	No	Parents					
Dizmek *et al*[26] (CA)	F	ns.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	ns	ns					
Pasquet *et al*[30] (CA)	F	Mirror therapy.	Duration of programme: 4 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 15 min.	ns	ns					
Sisman *et al*[51] (CA)	F	ns.	ns.	No	ns					
James *et al*[31] (CA), 32 (CA), 76	BEF	Computer-based rehabilitation and virtual reality (n=51).	Duration of programme: 20 weeks. Frequency of sessions: 6 days/week. Duration of sessions: 20–30 min.	No	Parents	Principles of motor learning.	Care as usual (n=51).	Duration of programme: 20 weeks. Frequency of sessions: ns. Duration of sessions: ns.		
Hoare *et al*[75]	BEF	Modified CIMT (n=17).	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 3 hours (including therapy time).	3 months	Parents	Principles of motor learning theory.	Other home-based training programme (n=18).	Duration of programme: 8 weeks. Frequency of sessions: ns. Duration of sessions: ns.		
Kirkpatrick *et al*[77]	BEF	Play-based action observation with repeated practice (n=35).	Duration of programme: 3 months. Frequency of sessions: 5 days/week. Duration of sessions: 15 min.	3 months	Parents	Repeated movement practice.	Other home-based training programme (n=35).	Duration of programme: 3 months. Frequency of sessions: 5 days/week. Duration of sessions: 15 min.		
Gordon *et al*[85]	BEF	Modified CIMT (n=22).	Duration of programme: 6 months + 15 days. Frequency of sessions: daily. Duration of sessions: 1 hour.	No	Parents and therapists	Intensive progressive task practice based on motor learning approaches.	Other home-based training programme (n=22).	Duration of programme: 6 months + 15 days. Frequency of sessions: daily. Duration of sessions: 1 hour.		
Wallen *et al*[33] (CA), 86	BEF	Modified CIMT (n=25).	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 2 hours.	3.5 months*	Parents and therapists	Motor learning principles.	Other home-based training programme (n=25).	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 20 min.		
Al-Oraibi and Eliasson[72]	BEF	Modified CIMT (n=7).	Duration of programme: 8 weeks. Frequency of sessions: 6 days/week. Duration of sessions: 2 hours.	No	Parents	Principles of motor learning.	NDT (n=7).	Duration of programme: 8 weeks. Frequency of sessions: ns. Duration of sessions: 1–2 hours.		
Eugster-Buesch *et al*[73]	BEF	Forced use therapy (n=12).	Duration of programme: 2 weeks. Frequency of sessions: daily. Duration of sessions: 6 hours.	12 months	Parents	Task-orientated practice.	Care as usual (n=11).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.		
Hsin *et al*[74]	BEF	Modified CIMT (n=11).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: ns.	3 months	Parents and therapists	The principles of shaping and repetitive task practice.	Other home-based training programme (n=12).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: ns.		

Continued

Table 2 Continued

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
Klingels *et al*[78]	BEF	Modified CIMT (n=25).	Duration of programme: 10 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 1 hour.	10 weeks	Parents and therapists	Motor learning principles, included task analysis, repetitive whole-task practice, practice specificity, feedback, environmental adaptation and grading of difficulty level.	Other home-based training programme (n=26).	Duration of programme: 10 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 1 hour.		
Lin *et al*[79]	BEF	Modified CIMT (n=11).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: 3.5–4 hours.	6 months	Parents and therapists	Principles of shaping and repetitive task practice.	Other home-based training programme (n=11).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: 3.5–4 hours.		
Novak *et al*[81]	BEF	OTHP (n=12).	Duration of programme: 8 weeks. Frequency of sessions: variable. Duration of sessions: variable.	No	Parents		No therapy (n=12).		Other home-based training programme (n=12).	Duration of programme: 4 weeks. Frequency of sessions: variable. Duration of sessions: variable.
Preston *et al*[82]	BEF	Computer-assisted arm rehabilitation gaming technology (n=9).	Duration of programme: 6 weeks. Frequency of sessions: daily. Duration of sessions: 30 min.	6 weeks	Parents		Botulinum toxin treatment to reduce arm spasticity + usual follow-up rehabilitation (n=7).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.		
Sakzewski *et al*[83]	BEF	Goal-directed training/ functional training (n=25).	Duration of programme: 12 weeks. Frequency of sessions: 6 days/week. Duration of sessions: 30 min.	ns	Parents and therapists	Principles of motor learning.	Centre-based occupational therapy or physiotherapy intervention (n=28).	Duration of programme: 10 days. Frequency of sessions: daily. Duration of sessions: 6 hours.		
Charles *et al*[84]	BEF	Modified CIMT (n=19).	Duration of programme: 6 months + 12 days. Frequency of sessions: daily. Duration of sessions: variable.	No	Parents and therapists	Shaping and repetitive task practice.	Care as usual (n=14).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	Control after treatment (n=10).	
Chamudot *et al*[44] (CA), [97]	BEF	Modified CIMT (n=18).	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 1 hour.	No	Parents	Motor learning principles	Other home-based training programme (n=18).	Duration of programme: 8 weeks. Frequency of sessions: daily. Duration of sessions: 1 hour.		
Ferre *et al*[100 110]	BEF	Bimanual training (n=20).	Duration of programme: 9 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 2 hours.	6 months	Parents	Motor learning principles.	Other home-based training programme (n=20).	Duration of programme: 9 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 2 hours.		
Fischer *et al*[45] (CA)	BEF	Modified CIMT.	Duration of programme: 4 weeks. Total duration of sessions: 60 hours.	6 months	Parents	ns.	Other home-based training programmes: 2 dosage levels.	Duration of programme: 4 weeks. Total duration of sessions: 30 hours.	Other home-based training programmes: 2 types of constraint (part-time splint vs full-time cast).	Duration of programme: 4 weeks. Total duration of sessions: 30 or 60 hours.
Hobbs *et al*[46] (CA)	BEF	Computer-based rehabilitation (n=10).	Duration of programme: 6 weeks. Frequency of sessions: ns. Duration of sessions: ns.	4 weeks	Parents		Other home-based training programme (n=8).	Duration of programme: 6 weeks. Frequency of sessions: ns. Duration of sessions: ns.		

Continued

Table 2 Continued

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
Hughes *et al*[103]	BEF	NDT + ADL activities.	Duration of programme: 3 months. Frequency of sessions: daily three times. Duration of sessions: ns.	No	Parents	ns.	Other home-based training programme.	Duration of programme: 3 months. Frequency of sessions: daily three times. Duration of sessions: ns.		
Kassee *et al*[104]	BEF	Virtual reality (n=3).	Duration of programme: 6 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 40 min.	4 weeks	Parents	ns.	Other home-based training programme (n=3).	Duration of programme: 6 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 36–48 min.		
Law *et al*[109]	BEF	Intensive NDT plus cast (n=19).	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: 30 min.	3 months	Parents	ns.	Other home-based training programmes: regular NDT plus cast (n=17), regular NDT (n=18).	Duration of programme: 6 months. Frequency of sessions: 3 days/week. Duration of sessions: 15 min.	Other home-based training programme: intensive NDT (n=18).	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: 30 min.
Liang *et al*[48] (CA)	BEF	Modified CIMT.	Duration of programme: ns. Frequency of sessions: ns. Total duration of sessions: 36 hours.	No	ns		Other home-based training programme.	Duration of programme: ns. Frequency of sessions: ns. Total duration of sessions: 36 hours.		
Hobbs *et al*[52] (CA)	BEF	Computer-based rehabilitation (n=10).	Duration of programme: 6 weeks. Frequency of sessions: ns. Duration of sessions: ns.	4 weeks	Parents		Other home-based training programme (n=8).	Duration of programme: 6 weeks. Frequency of sessions: ns. Duration of sessions: ns.		
Lowes *et al*[80]	BEF	Modified CIMT (n=7).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: 1 hour.	1 month	Parents and therapists	Repeated movement and motor patterns according to motor learning and shaping procedures.	Traditional occupational therapy services in an outpatient clinic (n=7).	Duration of programme: 4 weeks Frequency of sessions: daily. Duration of sessions: 1 hour.		
Facchin *et al*[35]	E	Modified CIMT (n=39).	Duration of programme: 10 weeks. Frequency of sessions: 4 days/week. Duration of sessions: 3 hours.	No	Parents and therapists		Other home-based training programme (n=33).	Duration of programme: 10 weeks. Frequency of sessions: 4 days/week. Duration of sessions: 3 hours.	Care as usual (n=33).	Duration of programme: 10 weeks Frequency of sessions: variable. Duration of sessions: variable.
Chen *et al*[87]	E	Modified CIMT (n=24).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: ns.	6 months	Parents and therapists	Principles of shaping and used repetitive task practice.	Other home-based training programme (n=24).	Duration of programme: 4 weeks. Frequency of sessions: daily. Duration of sessions: ns.		
Chiu *et al*[34] (CA), [88]	E	Virtual reality (n=32).	Duration of programme: 6 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 40 min.	6 weeks	Parents and therapists		Care as usual (n=30).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.		
Kim *et al*[90]	E	Strength training (resistance) (n=9).	Duration of programme: 10 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 1 hour.	No	Parents		Centre-based occupational therapy or physiotherapy intervention (n=10).	Duration of programme: 10 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 1 hour.		
Xu *et al*[92]	E	Constraint therapy plus electrical stimulation (n=25).	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: 1 hour, extended to 2 hours.	No	Parents and therapists		Other home-based training programme (n=24).	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: 1 hour, extended to 2 hours.	Other home-based training programme (n=26).	Duration of programme: 6 months. Frequency of sessions: daily. Duration of sessions: 1 hour, extended to 2 hours.

Continued

Table 2 Continued

Authors	Study type	Intervention	Intensity of programme	Follow-up	Therapy providers	Motor learning	Comparator (1)	Intensity of programme	Comparator (2)	Intensity of programme
Abd El-Kafy *et al*[93]	E	Modified CIMT (n=15).	Duration of programme: 4 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 2 hours.	3 months	Parents and therapists	Shaping and repetitive task practice.	Other home-based training programme (n=15).	Duration of programme: 4 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 2 hours.		
Bagley *et al*[35] (CA)	E	Home therapy programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	ns	ns		Surgical intervention.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.	Drug intervention.	Duration of programme: 6 months. Frequency of sessions: ns. Duration of sessions: ns.
Hoare *et al*[36 37] (CA)	E	Modified CIMT.	Duration of programme: 6 months. Frequency of sessions: ns. Duration of sessions: ns.	ns	Parents and therapists		Other home-based programme (n=17).	Duration of programme: 6 months. Frequency of sessions: ns. Duration of sessions: ns.		
Klingels *et al*[38] (CA)	E	Modified CIMT.	Duration of programme: 10 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 1 hour.	10 weeks	ns		Other home-based programme.	Duration of programme: 10 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 1 hour.		
Koseotlu *et al*[39] (CA)	E	Modified CIMT + bimanual training.	Duration of programme: 6 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 3 hours.	ns	Parents		Modified CIMT.	Duration of programme: 6 weeks. Frequency of sessions: 3 days/week. Duration of sessions: 3 hours.		
Novak *et al*[40 41] (CA)	E	Home programme intervention (n=12).	Duration of programme: 8 weeks. Frequency of sessions: ns. Duration of sessions: ns.				Other home-based programme (n=12).	Duration of programme: 4 weeks. Frequency of sessions: ns. Duration of sessions: ns.	Control group, who did not receive a home-based programme (n=12).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.
Sakzewski *et al*[42 43] (CA)	E	Distributed standard individualised therapy (n=4).	Duration of programme: 12 weeks. Frequency of sessions: 6 days/week. Duration of sessions: 30 min.	ns	ns		Centre-based occupational therapy or physiotherapy intervention (n=24).	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.		
Crocker *et al*[89]	E	Forced use therapy.	Duration of programme: 3 weeks. Frequency of sessions: daily. Duration of sessions: 8 hours minimal.	17 weeks*	Parents		Care as usual.	Duration of programme: 7 weeks. Frequency of sessions: ns. Duration of sessions: ns.		
Naylor and Bower[91]	E	Modified CIMT.	Duration of programme: 4 weeks. Frequency of sessions: 5 days/week. Duration of sessions: 1 hour.	4 weeks	Parents and therapists		No therapy.			
Coker *et al*[94]	E	Modified CIMT.	Duration of programme: 30 days. Frequency of sessions: 3 days/week. Duration of sessions: 1 hour.	6 months	Parents and therapists		Other home-based training programme.	Duration of programme: ns. Frequency of sessions: ns. Duration of sessions: ns.		
Gross *et al*[96]	E	Target joint movements.	Duration of programme: ns. Frequency of sessions: daily. Duration of sessions: 10 min.	4 weeks	Parents		Centre-based occupational therapy or physiotherapy intervention.	Duration of programme: ns. Frequency of sessions: 3 days/week. Duration of sessions: 20 min.		

ADL, activities of daily life; BEF, both efficacy/effectiveness and feasibility study; CA, conference abstract; CIMT, Constraint-Induced Movement Therapy; E, efficacy/effectiveness study; F, feasibility study; NDT, neurodevelopmental treatment; ns, not specified; OTHP, Occupational Therapy Home Program.

described in the tables and the results apply to the parent-delivered part of the intervention only. A more detailed description of the intervention is provided in online supplementary appendix 4.

The treatment approach used in the studies was predominantly (modified) Constraint-Induced Movement Therapy (CIMT) (32.8%),[55 65 72–75 78–80 84–87 89 91–95 97] and several studies[60 67–69 71 76 82 88 98 99 102 104 107] also used computer-based rehabilitation (eg, virtual reality, 22.9%). Very few studies used goal-directed (n=2)[53 83] or bimanual (n=3)[56 100 110] training. Comparators used were none (feasibility studies), other home-based programmes, care as usual, centre-based occupational therapy or physiotherapy interventions. The objectives of the intervention were mostly unspecified, but when specified the focus was mainly on ICF activity level. The use of motor learning principles was often not mentioned; only 20 studies[55 56 72–80 83–87 93 97 100 110] (32.8%) reported that their intervention was based on motor learning principles. Training duration of home-based programmes varied from 2 weeks to 6 months (all parent-delivered), and intensity ranged from 70 min to 56 hours a week (all parent-delivered). Therapy was mostly provided by parents (55.7%), but there were also programmes combining parent-delivered and therapist-delivered sessions (41%). In the latter, the main part of sessions were delivered by parents. Coaching of parents was often unspecified (49.2%). Some studies mentioned different modes that were used by therapists to coach parents, such as course/training, manual or other form of written instructions, DVD, reviewing of logbooks, email, telephone or Skype calls, home visits, computer feedback, and mutual discussion of goals and therapeutic activities.

Outcomes

Feasibility studies mainly reported on the key areas of acceptability and implementation, and some on demand and practicality. None of the studies reported on the areas of adaptation, integration or expansion. Overall compliance to home-based programmes (implementation) was moderate to high, ranging from 56% to 99%.[14 54 56 60 61 70 71 98 99 106 108] Majority of studies reported that parents found it easy to carry out the programme and enjoyed seeing their children improve (acceptability). Some studies reported on the demand and mainly on the recruitment rate, which ranged between 45% and 83%.[98 106] One study reported on the safety (practicality) of the programme. During the programme no serious injuries occurred; children only experienced muscle soreness and were more fatigued.[98]

In the effectiveness studies, more than 40 different child-related outcome measures were found. Child-related outcome measures on ICF activity level were considered to be primary outcome measures in this review. There were 15 different primary outcome measures found, that is, Quality of Upper Extremity Skills Test (17×), Assisting Hand Assessment (15×), Canadian Occupational Performance Measure (10×), Melbourne Assessment of Unilateral Upper Limb Function (7×), Goal Attainment Scaling (4×), Pediatric Motor Activity Log (4×), ABILHAND-Kids (4×), video observation (3×), Shriners Hospital for Children Upper Extremity Evaluation (1×), Assessment of Motor and Process Skills (1×), Functional Inventory (1×), Box and Blocks Test (1×), Jebsen-Taylor Hand Function Test (1×), test of sensation (1×) and Children's Hand-use Experience Questionnaire (1×). The vast majority of these outcome measures showed an improvement in arm-hand performance within group, across time, that is, before and after intervention. However, in case of effectiveness, this improvement (within group) was not always sufficient to identify a difference between the interventions investigated (between groups).

Except for Hsin *et al*[74] and Novak *et al*,[81] who reported on the results of Cerebral Palsy-Specific Quality of Life (parent-proxy version) and Children's Assessment of Participation and Enjoyment, respectively, none of the studies included outcome measures on ICF participation level. Both studies reported gains in health-related quality of life. All other outcome measures were on ICF function level. Again, majority of studies showed a positive change in hand function, within group, before and after intervention, but a difference in effectiveness between interventions could not always be confirmed.

In contrast to the large amount of child-related outcome measures, only two studies[56 79] reported on a parent-related outcome measure, that is, Parenting Stress Index-Short Form. Lin *et al*[79] and Ferre *et al*[56] found no increase in parental stress during the intervention.

A detailed description of the results of feasibility studies, effectiveness studies and studies that reported on both feasibility and effectiveness is given in tables 3–5. Furthermore, the completed data extraction form can be obtained from the authors.

DISCUSSION

This systematic review aimed to assess both the feasibility and effectiveness of home-based occupational therapy and physiotherapy programmes in children with CP, specially focusing on upper extremity. The objective was to investigate all relevant feasibility components according to Bowen *et al*,[13] not only whether home programmes were feasible in terms of compliance and adherence, as is most commonly reported. However, only a few studies mentioned the feasibility outcomes demand and practicality. None of the included studies reported on the other aspects. Based on the implementation and acceptability results of the included studies, home-based programmes seem to be feasible. Overall compliance to home-based programmes was moderate to high, ranging from 56% to 99%. Farr *et al*[99] and Lorentzen *et al*,[60] who found the lowest compliance (56% and 62%, respectively), reported that technical problems and the fact that children were sometimes too tired or upset to complete the virtual reality training were the main reasons for the difference between the actual amount and intended amount of training. The high compliance

Table 3 Results of feasibility studies

Authors	Feasibility outcome	Measurements	Measurement time points	Results
James *et al* [23] (CA), [59]	A	Engagement of children participating in Mitii from the perspectives of children and their caregivers.	One interview.	Child/family characteristics. Enhancers: initial novelty of Mitii, technology-based, individual needs can be targeted, strong family support, children's increasing confidence. Barriers: novelty wears off, too broad for some children, lack of family support.
McBurney *et al*[61]	I	Exercise logbook to record the weights used and the number of sets and repetitions completed at each exercise session.	During intervention period.	Participants adhered to their prescribed programme, completing a mean of 16.9 (SD 2.3) of the 18 scheduled training sessions. The logbooks also showed that the training load increased over the 6 weeks, with the average load added for each exercise more than doubling in that time. Each exercise session took between 20 and 45 min.
	A	Indepth semistructured interviews with the participating children and their parent(s).	3 months after the end of the training programme.	The young people and their parents unanimously reported that participation in the strength training programme had been beneficial. There was no negative outcome in terms of impairments of body function and structure, limitations of activities, or restrictions of participation reported by the young people or their parents. There were a few minor negative comments about contextual factors, such as equipment and the need for parental involvement. Parents perceived that their involvement in the programme in terms of time management and assistance was very important to its success.
	A	Rating overall how worthwhile the strength training programme was on a 10 cm horizontal Visual Analogue Scale.	Not specified.	Responses to the Visual Analogue Scale were all towards the 'extremely worthwhile' end of the scale, with parents giving a mean rating of 8.9 (range 7.1–10, SD 1.0) and young people a mean rating of 7.9 (range 5.5–10, SD 1.7) out of 10.
Novak *et al*[24] (CA), [11]	A	Semistructured parental interviews to describe the experiences and views of parents who participated in the randomised controlled trial on partnership home programmes.	One interview after the clinical trial was completed, and follow-up interviews.	Implementation of the partnership home programme provided both parents and the child with perceived advantages over therapist-directed 'rigidly prescribed' home programmes. Factors and processes characterising the partnership home programme implementation experience and comparisons with therapist-directed home programmes (benefits) are support that sustains, realistic expectations, flexibility, goals that are motivating, translates to real life, reminder to practise, progress updates and role identity—parent not a therapist.
Taylor *et al*[70]	I	Adherence by a logbook.	During intervention period.	Participants were adherent to their prescribed programme, completing an average of 16.9 (SD 2.3) of the scheduled 18 training sessions. The logbooks also showed that training load progressed, with the average load added for each exercise more than doubling in that time.
	A	Each participant's evaluation of the benefits of the programme was recorded on a 10 cm Visual Analogue Scale with the anchors 'not worthwhile' and 'extremely worthwhile'.	3 months after completing a strength training programme.	Responses were all towards the 'extremely worthwhile' end of the scale, with parents giving a mean rating of 8.9 (range 7.1–10.0, SD 1.0) and young people a mean rating of 7.9 (range 5.5–10.0, SD 1.7) out of 10.
	A	The factors that affected the ability to participate in a strength training programme were explored by indepth interviews with the participating young persons and their parents.		The role of physiotherapist as coach was a factor that promoted adherence to the strength training programme. This role included progressing exercise dosage and monitoring exercise technique, as well as providing emotional support and encouragement. Other important factors for adherence were facilitating and maintaining the young person's motivation throughout the duration of the programme, autonomy about whether to participate in the programme, encouraging and facilitating parental support, and providing appropriate exercise equipment suitable for use in the home environment.
Law and King[15]	I	Parental self-rating of compliance with the home programme with a short questionnaire.	During intervention period and at the end of the intervention.	All subjects: mean 15.7, SD 2.3, range 10–20 (n=59). Regular: mean 15.6, SD 2.2, range 11–20 (n=27). Intensive: mean 15.8, SD 2.5, range 10–19 (n=32).
	I	Therapist's rating of parental compliance with the home programme with a short questionnaire.		All subjects: mean 13.4, SD 3.4, range 5–20 (n=57). Regular: mean 14.1, SD 2.9, range 9–20 (n=29). Intensive: mean 12.7, SD 3.8, range 5–20 (n=28).
	I	The number of therapy attendances by the child collected from therapist records.		All subjects: mean 20.0, SD 11.6, range 3–45 (n=54). Regular: mean 10.2, SD 5.1, range 3–22 (n=25). Intensive: mean 28.4, SD 8.7, range 10–45 (n=29).
	I	The mean time of cast-wear per day reported by the parent in a logbook.		All subjects: mean 3.1, SD 1.3, range 0.4–7.3 (n=30). Regular: mean 3.3, SD 1.4, range 1.4–7.3 (n=14). Intensive: mean 2.9, SD 1.2, range 0.4–3.9 (n=16).
	I	The number of days the parent completed the logbook.		All subjects: mean 100.7, SD 46.5, range 6–174 (n=51). Regular: mean 100.4, SD 48.6, range 9–174 (n=23). Intensive: mean 101.0, SD 45.6, range 6–173 (n=28).
Lorentzen *et al*[60]	I	Training duration.	During intervention period.	The 34 children in the training group on average completed the daily 30 min training programme on 78.0±36.3 days (range: 17–134 days) out of the scheduled 140 days. This corresponds to an average of 56% in the 20-week period. However, on 128.0±12.8 days (range: 91–140 days), the training was started, but not completed. This corresponds to 91% of possible days of training. On average the children thus trained 17 min per day for the 20-week period. This corresponds to 40 hours of total training time. Among the main reasons for the difference between the actual amount of training and the aim of 140 full days were technical problems and in some cases that the child was to too tired or upset, which made it difficult for the children to complete the training of the day. We found no relation between the number of days of training and the extent of improvement in any of the functional tests.

Continued

Table 3 Continued

Authors	Feasibility outcome	Measurements	Measurement time points	Results
	A	Subjective reports.	During intervention period.	All reports from the children and their families about their experiences were very positive. Despite some concerns during the training period about how to maintain the energy required to train intensively for 30 min every day, all families reported that they found this way of training very positive and appealing. Some exercises were reported to be boring by some children and not by other children. Also some exercises were reported too easy or too difficult. All families reported that the child showed several signs of improved activity in daily life. Most families reported that the child increased participation in daily activities at school and during leisure time. Also most families reported that the child showed signs of increased self-confidence and self-esteem. All families reported that specific skills such as bicycling, eating and attention skills were improved during the training. Several also reported increased muscle strength and increased endurance.
Psychouli and Kennedy[65]	I	Parents recorded on a daily log the total amount of time the splint was worn and the activities in which the children participated.	During phase B (splint + functional activities) and phase C (splint + functional activities + PC game).	Analysis of the daily logs revealed that the splint was worn for 39 hours and 32 min on average over phase B, whereas during phase C the time increased slightly to reach 40 hours and 28 min. Only one child wore the splint for all 30 days during either phase. The other eight children wore the splint over a range of 8–29 days. In both phases B and C, the activities performed most commonly were brushing teeth/hair, eating finger food, getting dressed, and playing with toys or computer games. The game was played in phase C by 8 of the 9 children, the exception being child 5 who did not have access to a computer. During phase C, all the children gradually increased their scores on the PC game except for child 4, who used the game on only 9 days, fewer than any other participant.
Ahl *et al*[63]	A	Measure of Processes of Care.	Preintervention and postintervention (5 months).	Mothers indicated a lower level of satisfaction with the intervention than fathers. In the domain of enabling and partnership, coordinated and comprehensive care, and respectful and supportive care, the fathers rated a higher grade of satisfaction with the services after the intervention than the mothers.
	A	Additional questionnaire.	Preintervention and postintervention (5 months).	After the intervention mothers' and fathers' scores indicated a significant change in the knowledge they had acquired and how clear the goals were.
	I	Training diary.	First month, third month, fifth month.	Frequency of training varied considerably. Variation was related to type of goal and how frequently the task occurred in daily life.
Novak *et al*[14]	I	Home programme participation: log in which parents estimate the total amount of time per day (in minutes) that they spent on home programme activities and to record their perceived total time per day on the log.	During intervention period.	The mean frequency of home programme participation was 0.90 times per day (range 0.63–1.00, SD 0.11)—that is, less than once a day, but approximately 27 times per month. The mean intensity of home programme daily session participation was 14.22 min (range 5.00–43.33, SD 8.53, skew 2.19). One family had high participation: the intensity of 43.33 min per session was more than 3 SD above the sample mean. With this outlier removed, the mean intensity of home programme daily session participation was 13.39 min (range 5.00–24.0, SD 5.06, skew 0.22).
Bilde *et al*[71]	I	Training duration.	During intervention period.	On average the nine children trained on 119±8.9 days (range: 111–138 days) out of the scheduled 140 days (corresponding to an average of 85% (range: 79.3%–98.5%)). The children on average trained 36.6±3.8 min per day, reaching a total average of 73.6±8.0 hours (range: 62–82 hours). This is a little above the 70 hours of training, which was the aim of the project (at least 30 min every day in the 140-day period=70 hours). Six of the children managed to train more than this. In total the children trained more than 30 min on 783 days out of the total 1260 training days, corresponding to 62%.
	A	Subjective reports.	Not specified.	All children and their families reported great satisfaction with the training system, although the children found it very hard—and at times boring—to do the requested 30 min of training every day for all 20 weeks. All families experienced difficulties persuading the children to do the training in periods. On the other hand many families also experienced that their child showed great enthusiasm for the training and many of them invited friends to be present while training. The families reported that they found that the most motivating factor was the contact with the therapists through email, which made them feel that they were not left alone with the training, but that each child had a 'virtual coach'. The game-like design of the training system was reported to be one of the initial motivating factors for most of the children, but following weeks of training this subsided. Instead, as the children experienced that the training system improved their functional abilities, a desire to improve their abilities became the dominant motivating factor. All families reported that the trained child showed signs of improved mobility in daily life, increased muscle strength, increased endurance and improvement in a number of skills in daily life. All families indicated that the single most important effect of the training system, as they experienced it, was that the child had gained much more self-confidence and dared to take on much more challenges than before.
Boyd *et al*[25] (CA)	I	Compliance.	During intervention period and at the end of the intervention.	Children completed Mitii with an average duration of 119 (8.9) days and intensity of 36.6 (3.8) min/day over 20 weeks.
	A			All participants reported high satisfaction, maintaining engagement through the trainer's motivation in addition to the game-like design and incremental challenges.
	I			Children performed around 135 reaching movements per session, meaning Mitii offers a model of training of sufficient intensity and duration with incremental challenges that may drive neuroplastic changes.

Continued

Table 3 Continued

Authors	Feasibility outcome	Measurements	Measurement time points	Results
McCoy *et al*[29] (CA)	A	Not specified.	Not specified.	All children reported enjoyment with the therapy.
	I	Compliance.	During intervention period.	Adherence with movement practice was high; practice intensity was 3–7 days per week for 30 min sessions.
Farr *et al*[99]	I	Adherence.	During intervention period.	The intervention group completed a mean number of 19 out of 36 sessions (56% adherence), while the control group completed 24 out of 36 (66%). Overall adherence was high; the mean total minutes spent for the intervention group was 75% of what was suggested (mean 819 min, compared with the recommended 1080), whereas the control group carried out 96% of the suggested activity time.
	A	Recruitment and dropout.		10 of the children in the intervention group (67%) and 11 in the control group (73%) completed the trial. There were a variety of reasons for participant dropout, showing that this population group lead complex lives and are susceptible to a range of problems. Children who completed the study experienced tiredness (three children) as a factor causing dropout, which also caused reported 'time off' from using the Wii Fit during the trial. Other factors were school, homework, surgery, difficulties with the technology, no time or autism.
	A	Project survey.		40% of comments were positive towards the programme. Activities were perceived as generally getting easier over time. There was variation in attitude towards difficulty of the games and in achieving better game scores; some children were frustrated, whereas others enjoyed the challenge. Families found the equipment set-up amenable, but the balance board was unable to detect weight of younger children especially those with hemiplegia.
	D	Health economics.		Therapists' logs for the intervention group showed a total of 54 calls (of the maximum of 78). Of these 29 (54%) involved a conversation with a parent. The remainder of calls were not answered or went to voicemail, or in two cases parents stated they were too busy to speak. The mean time spent on phone calls, including those with no response, was 35 min, ranging from 5 to 55 min. For the control group: 74 calls (of the expected 90). Of these 40 (54.1%) were answered. The mean duration of calls per child was 12.6 min, ranging from 2 to 20 min. In addition, the researcher sought advice from the supervising physiotherapist for three children whose parents raised particular issues about the use of the Wii. Total therapist time on these three enquiries was 45 min (5, 10 and 30 min, respectively).
Shierk *et al*[108]	I	Paper diary.	At each trial visit.	Two-thirds of families opted to complete the prescribed exercises five times per week, and one-third of families opted to complete the prescribed exercises once daily (ie, seven times per week). All but 2 of the 65 (97%) families maintained the frequency of the HETP throughout their participation in the trial.
	D	Score chart.		Thus far, all families agreed to follow the HETP (as evidenced by 100% agreement in the parent/caregiver commitment forms). Overall, 61 children (94%) began the HETP immediately following injection of abobotulinumtoxinA and two families began with a delay of a week and two others after a delay of 1–4 months (unknown reasons).
Liu *et al*[49] (CA)	A	Satisfactory Questionnaire.	At the end of the intervention.	Caregivers of participants also showed high satisfaction towards the BIT programme.
Ferre *et al*[22] (CA), [56]	I	Compliance using online daily logs.	During intervention period.	10 families completed the entire 9 weeks of intervention without any report of adverse events. On average, caregivers demonstrated high compliance, completing 86.5 hours of H-HABIT with their children. The most common type of activity performed included manipulative games/tasks (39% of all logged activities) and functional daily living tasks (22% of all logged activities). On average, families performed about 7.5 activities per day that lasted about 18.2 min per activity. Home observations by the supervisor and monitoring of daily logs confirmed that treatment protocols were adhered to.
	A	Caregiver perception of difficulty in completing the activities.		Responses to the daily questionnaires were consistent across the sample, with the majority of logs indicating that 80% of the time caregivers found it either very easy or easy to fit the training into their daily schedule, 86% the child was very attentive or attentive during the activities, 88% of the time the child tolerated the training either very well or well, and that 79% of the time it was very easy or easy to carry out the training.
	A	Caregiver stress levels were monitored with the PSI-SF.	Two baseline measurements, midway and two post-test measurements.	Parenting stress as measured by the PSI-SF showed no significant differences across the five assessments for either the total score or the three subscales of parental distress, parent–child dysfunctional interaction and difficult child. That is, there was no increase in parental stress during the intervention. All caregivers scored within 1 SD of the normative range for this measure.
Chiu *et al*[98]	A	Acceptability of the intervention was determined from a survey in which four statements about the training were rated on a 5-point Likert scale from strongly disagree (0) to strongly agree (4).	At the end of the intervention (8 weeks).	In terms of acceptability, 20 (100%) parents rated: ▶ Understanding the purpose of using the Wii Fit as 4.0 out of 5.0 (SD 0). ▶ Using the Wii Fit did not interfere with daily life as 3.8 (SD 0.5). ▶ The challenge of the training as 3.9 (SD 0.3). ▶ Whether they would recommend the training to others having children with CP as 3.9 (SD 0.3). 20 (100%) participants rated: ▶ Walking becomes easier after using the Wii Fit as 2.8 out of 5.0 (SD 1.0). ▶ Enjoying using the Wii Fit as 3.6 (SD 0.8). ▶ The challenge of the training as 3.6 (SD 0.7). ▶ Whether they would like to keep using the Wii Fit after the completion of training as 3.4 (SD 0.8).

Continued

Table 3 Continued

Authors	Feasibility outcome	Measurements	Measurement time points	Results
	I	Adherence.		477 of the 480 sessions were completed; the overall adherence was 99%.
	P	Safety was measured by recording events such as muscle soreness, fatigue, non-injurious falls and injurious falls.		Two (10%) participants reported muscle soreness most sessions and nine (45%) reported it occasionally. Three (15%) participants reported fatigue most sessions and seven (35%) reported it occasionally. Three (15%) participants reported non-injurious falls most sessions and five (25%) reported falling occasionally. However, none of these events were serious enough to stop participants from training. Five (25%) participants needed to use hand support on the back of a chair for some games.
	D	Recruitment.		44 children were screened over 1 year. 24 were eligible, giving an eligibility fraction of 55%. 20 were enrolled, giving a recruitment fraction of 45%. There were no dropouts.
Visser *et al*[106]	I	Parent report and intervention logs.	During intervention period.	The mean number of BWSTT sessions per week for the group was 3.03, and the mean total walking time per BWSTT session for the group at the completion of the intervention programme was 15.19 min. 6 of the 10 (60%) participants achieved the mean recommended frequency of 3–4 times per week for the 12-week duration. Six of the 10 (60%) participants achieved a mean total walking time of 20 min per session by the end of the 12-week intervention period.
	D	Parent report.		Only 10 of the desired 12 participants were recruited for the study. The amount of family involvement and the time commitment required of both families and participants may have discouraged some families.
	A	Parent report.		The fact that the families could perform the programme around their schedules at times that worked best for both the family and the child may have lessened the potential effect of fatigue as a personal barrier to physical activity. One family reported this as a major benefit as their child had previously attempted to participate in physical activities available in the community but was often too tired to participate at the scheduled times.
Fehlings *et al*[27] (CA)	I	Compliance.	During intervention period and at the end of the intervention.	15 children completed the study with an average daily usage of 0.16 hours/day, SD=0.11.
	A	Qualitative questionnaire on child/parent experience assessed usability of the VRT system.		Parents reported that their child enjoyed playing on the VRT with their hemiplegic hand. Usability issues included game stoppage independent of button compression by the child.
Kenyon *et al*[105]	I	Adherence.	During intervention period.	Participant 1: 12 weeks of intervention, 20 sessions completed, 9.9 min per session. Participant 2: 8 weeks of intervention, 26 sessions completed, 14.0 min per session. Participant 3: 8 weeks of intervention, 24 sessions completed, 12.9 min per session.
Fergus *et al*[55]	I	Caregivers' logs including the duration of constraint.	After the first and second phases of CIMT and 18 months after the initiation of intervention.	The constraint was worn and facilitation was performed as suggested except for a few days when the child was sick.
	A	Semistructured interviews with the caregivers, focusing on the impressions of the ease and barriers associated with the CIMT protocol, and the perceived efficacy of the treatment.		The protocol was implemented easily and all various phases of CIMT contributed to the child's performance, but the challenge was to find enough hours in the day. The less intense HEP can be implemented more easily when compared with the more intense protocol. Using the constraint outside the home was difficult at the beginning of the programme because of the reactions of others. The caregivers felt that that the HEP was preventing the reoccurrence of learnt non-use.
Reifenberg *et al*[107]	I	Adherence.	At the end of the intervention.	In total, more than 56 hours, as prescribed in the protocol, were completed.
	A	Informal questionnaires, parent and child interviews, and session notes.		The mother reported that he was highly motivated to play Timocco games, which was evident during weekly consultations; he eagerly described his efforts to 'beat' games or progress to harder levels. The PSS-14 results indicated that the stress level of the mother decreased during the course of the intervention. There were no adverse events.
Hernandez Alvarado[102]	I	Adherence by log file.	During intervention period.	Participants played 174.4 min per week on average (SD 45.4), in line with the prescribed amount of a minimum of 90 min per week. An encouraging result was that our participants played more minutes during the last week than the first, indicating high engagement with the game. At the end of the study, on average, participants had accumulated 1395.1 min of playing.
	A	Custom Likert scale questionnaire gathering the participants' feedback and experience + a personal interview with each participant collecting information about their experience.	At the end of the intervention.	We also found that all the minigames, except the game Biri Brawl, were highly enjoyed. The game goal, game style and gaming preferences of the players can affect the enjoyment of the games. A useful strategy to achieve games that are enjoyable is the involvement of the target population in the design process of the games. We did this for three of our minigames. Two of them were found fun by all the participants and the third was found fun by four out of five participants while the fifth was neutral. As a bonus finding we also saw that our game Liberi in general has promise as an effective way of motivating youth with CP to perform moderately vigorous exercise.
Jaber *et al*[47] (CA)	I	Adherence.	One measurement.	No differences between groups on patterns of VR therapy adherence: consistently completing all (n=6); sporadic (n=5); decline and incomplete adherence (n=4). Children not actively engaged/interested in physical activity showed poorer adherence and enjoyment.

Continued

Table 3 Continued

Authors	Feasibility outcome	Measurements	Measurement time points	Results
Basaran *et al*[54]	I	Adherence (by survey).	One cross-sectional measurement.	The good adherence ratio (daily) was 65.3% (n=96). The adherence did not differ among caregivers (mothers/fathers). The severity of the functional limitation of children with CP seems to enhance the adherence of caregivers to HEPs. When caregivers have difficulty in overcoming stress and experience exhaustion, they fail to show adherence to treatment. 39.2% (n=20) of poorly adherent caregivers expressed "I think that attending a state-funded regional children's rehabilitation centre is sufficient."
Halvarsson *et al*[57]	A	Parents' experiences of carrying out stretching as a home programme.	Cross-sectional study (one interview).	The parents described a gradual development of their own role in the home stretching programme, from that of an authority, when the child was young, to that of a coach when the child grew older. With this gradual development came an increased level of participation from the child. According to the parents, stretching could not be carried out without the child's active participation. Along with the process, the parents perceived increasing stress through added pressure and demands. Mobility, time, coping strategies for stress and support from professionals, in particular physiotherapists, were important prerequisites for parents to help their child best with stretching exercises.
Hinojosa and Anderson[58]	A	Mothers' experiences with and reactions to home treatment programmes.	One interview.	The mothers' descriptions suggest that they selected activities that were doable and that they could integrate into their daily routines and interactions. Some important characteristics of these activities were that they were enjoyable for the child and not stressful for the child, the mother or the family.
Peplow and Carpenter[62]	A	Individual, face-to-face, semistructured interviews to explore how parents perceived the relevance of exercise programmes.	One interview.	Participants expressed a willingness to assume the responsibility for encouraging their children to adhere to the recommended exercise programmes and identified aspects of the physical therapy services that supported them in that role. They also emphasised the need for a collaborative planning and decision-making process that resulted in an exercise programme that was relevant and meaningful within the unique context of their child's life.
	I	Individual, face-to-face, semistructured interviews to explore parents' adherence to exercise programmes.		A number of factors were identified that constrained their ability to support their child's adherence to and motivation for engagement in exercise. Exercise programmes, to be implemented by families at home and support workers in school, are often characterised as prescriptive and focused on the child's impairment, and need to be integrated into a more holistic approach that considers family and child preferences in the home and school environment. Despite the strong evidence supporting the model of FCC and the importance attributed to the principles of FCC by parents, it has not been consistently implemented in practice by physical therapists providing paediatric services. If this is to be achieved, parents' perspectives must play a legitimate part in planning and evaluating the effectiveness of practice.
Piggot *et al*[63]	A	Unstructured indepth interviews to seek both therapists' and parents' perspectives of the key issues and concerns with regard to home programmes and their experience of being involved with them.	Each participant was interviewed one to four times.	The findings of this study focus primarily on the experience of parents as they face the compelling challenge of being the best parents they can and doing all that they can for their child with CP. Parents' ability to continue with therapeutic activities at home with their child altered according to their level of adjustment to their child's disability. The early experience of coming to grips with their situation has highlighted a gap between the parents' level of involvement in activities at home and the therapist's perception of this. Parents described their capacity to participate in their child's therapy as having two distinct phases: ► In the first phase, when parents were coming to grips with their child's disability, they were absorbed in coping with their grief. Overwhelmed by strong emotions, they were unable carry out the tasks prescribed within the home programme. Despite the parents reporting liking and respecting their therapist, at this stage, they were unable to openly communicate to them how they were feeling and what they were doing in terms of activities at home. ► Once parents had broken through to the second phase, and were no longer immobilised by their grief or concerns regarding the well-being of their child, they were more able to take part in therapy activities. They saw enough progress in their child to believe that participating in the therapy programme was worthwhile, and recognised the importance of their input. They were now also able to work in partnership with their therapist.
Piggot *et al*[64]	A	Indepth interviews with therapists and parents.	Each participant was interviewed one to four times.	The core variable that emerged primarily from the parents' data is the compelling challenge that describes a process comprising two phases: coming to grips and striving to maximise. During the first phase, coming to grips, parents did not see their child make gains in response to their efforts and were so absorbed in surviving that they were unable to do the tasks designed to enhance their child's development. However, when they had broken through into the second phase of striving to maximise, they were more able to take part in programmes that could maximise their child's progress. During this second phase, the circumstantial support from those around them and their own personal strengths played a critical role in parents' ability to persevere with the programme.
Ross and Thomson[66]	A	Parents' response to carrying out the home programme themselves by a questionnaire which consisted of a mixture of closed and open questions.	One questionnaire.	The more help given by the rest of the family, (1) the more the home programme is carried out within the daily routine of the family, and (2) the more confident the parents are in carrying out the programme in the absence of a physiotherapist. It is also implied that the more the parents desire to be involved, the less anxious they feel about carrying out the exercises.

Continued

Table 3 Continued

Authors	Feasibility outcome	Measurements	Measurement time points	Results
Sandlund *et al*[67]	A	Semistructured interviews carried out with parents to assess parents' perception of using motion interactive video games in home training.	One interview at the end of the intervention.	The parents in this study expressed confidence in the potential of motion interactive video games in the training of children with CP. The games were perceived as a training device that could facilitate a positive experience of physical training and promote independent physical training. The social aspects of gaming and the reduced coaching role of the parent were considered especially positive. The parents asked for games that could provide more control and individualisation of the required physical performance to better challenge the specific need of each child.
Gerhardy and Sandelance[28] (CA)	I	Semistructured interviews were conducted with a convenience sample of occupational therapists and families of children with CP.	Not specified.	Families identified time, the range and relevance of activity suggestions as key barriers to implementing an intensive programme. Staff identified time and easy access to home programme resources as particular barriers for them.
Finet[101]	A	Interviews, critical incident guides and the diaries.	Two interviews.	Findings indicated that caregivers experienced a range of negative emotions including guilt, being misunderstood and feeling criticised. The caregivers felt communication was key. It helped when the therapist was patient, compassionate and made the caregiver feel heard. It hindered learning when the therapist was defensive or said things which contributed to the caregiver having negative feelings. Caregivers wanted the therapist to explain why they were being asked to do certain activities within the home programme. They wanted information, resources and more time learning how to do what will help the child. Lastly, caregivers wanted the relationship with the therapist to be a partnership.
Sel *et al*[50] (CA)	I	Adherence: Parents of Children With Cerebral Palsy Compliance on Physiotherapy Home Program Questionnaire.	One questionnaire.	Increased confidence in physical therapists makes parents do home programme more regularly and frequently. Parents' compliance with exercise programme is linearly related to the importance given by physiotherapists to home programme. Results are directly related to physiotherapists' manner of home programme.
Sandlund *et al*[68]	I	Time spent on playing every day was recorded with a diary. The gaming diary also monitored who took the initiative to playing each day; if the child played alone or together with parents, siblings or friends; games played; or if the child did not play that particular day.	Every day during the 4 weeks of gaming.	According to the gaming diaries, the children played on average 5.5 (range 4–7) sessions every week and the mean time was 33 (range 22–52) min/day. The gaming intensity decreased over time from 6 sessions of 48 min each during the first week to 5 sessions of 26 min each in the last week of the intervention (difference in min/session). Over the 4 weeks children played on their own initiative in 59% of all gaming sessions while the parents took the initiative 32% of the time. The remaining 9% of sessions played were initiated by siblings, friends, relatives or this information was not reported. The proportion of parents' initiative for playing increased over time and approached the level of the children's during the last week. Playing together with others and especially games involving competition were most popular. The average time for sessions played together with someone was 37 min compared with 21 min when playing alone.
Sevick *et al*[69]	I	Recorded data from the Kinect and FAAST software, whether the entire 12-week intervention (3/week) could be completed by the participant in both the laboratory and the home.	During intervention period.	Four participants completed all 12 weeks of the intervention and demonstrated success in using equipment and software in their homes. Due to family preferences, participant 1 did not progress to the intervention fully taking place in the home. This participant continued coming to the laboratory two times per week and completed one session at home per week for the last 9 weeks of the intervention. The remaining participants progressed through the preset 12-week plan.
	I	Quantification of the number of repetitions that typically occurred during a single training session.		All participants obtained a high number of repetitions during training sessions. On average, participant 1 obtained about 500 repetitions per session. Participant 2 completed about 640 repetitions per session. Participant 3 completed an average of 850 repetitions per session. Participant 4 obtained an average of 1480 repetitions per session.
	A	The level of intrinsic motivation during training was monitored using the interest/enjoyment subscale of the IMI. From a qualitative perspective, all verbal comments relative to the training made by the participant during the intervention were recorded in a SOAP (subjective, objective, assessment and plan) note.	Biweekly during intervention period.	The participants expressed high intrinsic motivation throughout the intervention. This was demonstrated by their average rating of 46 out of 49 possible points on the IMI over the 12-week intervention. A high level of motivation was also noted in the comments made by the participants.
Dizmek *et al*[26] (CA)	I	Family compliance to home-based programme.	During intervention period and at the end of the intervention.	Results not described.
	I	Correlation between compliance and socioeconomic levels in families.		The correlations between monthly income, knowledge level about CP and home programme compliance were not significant. But the correlation between educational level of family and home programme compliance was significant.
Pasquet *et al*[30] (CA)	I	A diary was given to each child to note the daily time spent on the protocol and the number of series actually done for each exercise. Adherence was assessed by the number of series performed.	During intervention period.	This self-rehabilitation protocol by mirror therapy shows good feasibility and good compliance. Self-rehabilitation seems to be an interesting tool, easy to implement and well accepted by the children with CP.
	A	Difficulties and adverse events that occurred during this period were collected.		No event or significant adverse effects were detected during the protocol.
Sisman Isik *et al*[51] (CA)	A	Families' and physiotherapists' recordings.	During intervention period.	Families had difficulties in comprehension of home rehabilitation programme components other than strengthening and stretching exercises, and the physiotherapists considered the family's efforts in following these programmes inadequate.

A, acceptability; BIT, Bimanual Training; BWSTT, Body Weight Supported Treadmill Training; CA, conference abstract; CIMT, Constraint-Induced Movement Therapy; CP, cerebral palsy; D, demand; FAAST, Flexible Action and Articulated Skeleton Toolkit; FCC, family-centred care; HEP, home exercise programme; HETP, Home Exercises Therapy Program; H-HABIT, Home-based Hand-Arm Bimanual Intensive Therapy; I, implementation; IMI, Intrinsic Motivation Inventory; n, number of participants; p, practicality; PC, Personal Computer; PSI-SF, Parenting Stress Index-Short Form; PSS-14, Perceived Stress Scale-14; VRT, Virtual Reality Therapy; VR (therapy), Virtual Reality (therapy).

Table 4 Results of both effectiveness and feasibility studies

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
James *et al*[31] (CA), [32] (CA), [76]	Baseline and after intervention (20 weeks).		Computer rehabilitation and virtual reality.	Care as usual.					
		AMPS, P.	AMPS-M 0.32 (0.7) AMPS-P 0.34 (0.6)	AMPS-M −0.03 (0.7) AMPS-P −0.07 (0.8)		AMPS-M 0.28 (0.17 to 0.39; p≤0.001) AMPS-P 0.30 (0.19 to 0.41; p≤0.001)			
		AHA, P.	1.56 (22.6)	1.78 (22.5)		0.81 (−1.46 to 3.08; p=0.478)			
		JTHFT, P.	Impaired upper limb −28.47 (254.8) Dominant upper limb −4.81 (12.2)	Impaired upper limb −19.06 (253.7) Dominant upper limb 1.28 (28.2)		Impaired upper limb −22.03 (−44.78 to 0.72; p=0.058) Dominant upper limb −4.68 (−7.39 to −1.98; p<0.001)			
		MA, P.	−0.07 (25.4)	−0.81 (23.9)		1.48 (−4.11 to −1.15; p=0.265)			
		COPM, S.	COPM performance 2.11 (2.2) COPM satisfaction 2.08 (2.4)	COPM performance 0.76 (1.9) COPM satisfaction 0.58 (2.4)		COPM performance 1.29 (0.73 to 1.85; p≤0.001) COPM satisfaction 1.45 (0.44 to 0.83; p≤0.001)			
	During intervention period.						I	Compliance.	Participants in the intervention group completed an average of 32.4 hours of Mitii (range 3.7–74.7 hours).
Hoare *et al*[75]	At baseline (1–2 weeks before injection), and at 1 month, 3 months and 6 months after injection.		mCIMT.	Other home-based training programme.					
		AHA, P.	EMD (95% CI) 3 months–baseline 5.6 (3.3 to 7.9) 6 months–baseline 5.5 (3.1 to 7.8)	EMD (95% CI) 3 months–baseline 4.8 (2.5 to 7.1) 6 months–baseline 6.0 (3.7 to 8.4)		EMD (upper limit 95% CI) 3 months–baseline 0.8 (3.6; p=0.32) 6 months–baseline −0.6 (2.3; p=0.36)			
		QUEST, S.	EMD (95% CI) QUEST grasp 3 months–baseline 6.1 (0.0 to 12.3) 6 months–baseline 8.1 (3.2 to 13.1) QUEST dissociated movement 3 months–baseline 3.4 (4.3 to 11.0) 6 months–baseline 2.6 (9.1 to 3.8)	EMD (95% CI) QUEST grasp 3 months–baseline 5.1 (−1.0 to 11.3) 6 months–baseline 2.3 (2.6 to 7.3) QUEST dissociated movements 3 months–baseline 3.3 (4.3 to 11.0) 6 months–baseline 4.0 (2.4 to 10.4)		EMD (upper limit 95% CI) QUEST grasp 3 months–baseline 1.0 (8.3; p=0.41) 6 months–baseline 5.8 (11.6; p=0.05) QUEST dissociated movements 3 months–baseline 0.0 (9.1; p=0.50) 6 months–baseline −6.6 (0.9; p=0.07)			
		Self-care domain of PEDI, S.	PEDI functional skills 3 months–baseline 10.3 (7.4–13.2) 6 months–baseline 11.2 (7.6–14.7) PEDI caregiver assistance 3 months–baseline 9.6 (5.3–13.9) 6 months–baseline 10.4 (3.8–16.9)	PEDI functional skills 3 months–baseline 7.3 (4.4–10.2) 6 months–baseline 11.4 (7.8–15.0) PEDI caregiver assistance 3 months–baseline 9.0 (4.7–13.3) 6 months–baseline 12.1 (5.6–18.7)		PEDI functional skills 3 months–baseline 3.0 (6.6; p=0.08) 6 months–baseline −0.2 (4.1; p=0.47) PEDI caregiver assistance 3 months–baseline 0.6 (5.7; p=0.42) 6 months–baseline −1.8 (6.0; p=0.35)			

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		COPM, S.	COPM performance 3 months–baseline 3.3 (2.5–4.1) 6 months–baseline 3.2 (2.5–4.0) COPM satisfaction 3 months–baseline 3.3 (2.4–4.1) 6 months–baseline 3.3 (2.5–4.2)	COPM performance 3 months–baseline 3.0 (2.2–3.8) 6 months–baseline 3.2 (2.4–3.9) COPM satisfaction 3 months–baseline 3.0 (2.1–3.9) 6 months–baseline 3.2 (2.4–4.1)		COPM performance 3 months–baseline 0.3 (1.2; p=0.30) 6 months–baseline 0.1 (1.0; p=0.45) COPM satisfaction 3 months–baseline 0.3 (1.6; p=0.33) 6 months–baseline 0.1 (1.1; p=0.45)			
		GAS, S.	Cannot be calculated.			Not provided.			
	During intervention period.						I	The amount of home therapy undertaken.	There was a difference between groups in the intensity of home programme (mean hours: BoNT-A+mCIMT 98.5; BONT-A+BOT 31.6). Children in the BoNT-A+mCIMT group wore the restraint mitt (therapy sessions and home programme) for a mean of 98.5 (SD 32) hours of the expected 168 hours.
Kirkpatrick *et al*[77]	Baseline, 3 months and 6 months (3 months after intervention).		Play-based action observation with repeated practice.	Other home-based training programme.					
		AHA, P.	Mean (95% CI) 3 months–baseline 2.2 (1.3 to 3.1) 6 months–baseline 1.7 (0.2 to 3.3)	Mean (95% CI) 3 months–baseline 1.6 (0.6 to 2.6) 6 months–baseline 1.2 (0.4 to 2.7)		No effect size.			
		MA-2, S.	Mdn (95% CI) ROM 3 months–baseline 7.4 (4.4 to 10.7) 6 months–baseline 3.7 (0.0 to 14.8) ACC 3 months–baseline 4.8 (1.2 to 12.0) 6 months–baseline 4.7 (4.0 to 12.7) FLU 3 months–baseline 2.4 (0.6 to 9.5) 6 months–baseline 2.4 (1.4 to 14.3) DEX 3 months–baseline 8.8 (3.1 to 18.8) 6 months–baseline 10.1 (6.3 to 18.8)	Mdn (95% CI) ROM 3 months–baseline 7.4 (3.7 to 11.8) 6 months–baseline 3.7 (0.2 to 13.7) ACC 3 months–baseline 5.9 (5.0 to 16.1) 6 months–baseline 4.0 (0.0 to 14.7) FLU 3 months–baseline 4.8 (2.4 to 11.9) 6 months–baseline 9.5 (2.4 to 14.3) DEX 3 months–baseline 0.0 (0.0 to 12.5) 6 months–baseline 6.7 (3.1 to 15.6)		No effect size.			

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		ABILHAND-Kids, S.	Mdn (95% CI) 3 months–baseline 0.67 (0.2 to 1.7) 6 months–baseline 0.50 (0.9 to 1.7)	Mdn (95% CI) 3 months–baseline 0.67 (0.4 to 1.4) 6 months–baseline 0.74 (0.5 to 1.4)		No effect size.			
	During intervention period.						I	Compliance through therapy diaries.	42 therapy diaries were returned (22 from the AO+RP group). The mean number of play sessions was 48.2 (19.3) in the therapy group and 54.8 (23.1) in the control group. Compliance data showed that 62% of the children who returned therapy diaries achieved this dose, while 78% achieved or exceeded 1 hour per week of therapy.
Gordon *et al*[85]	Pretest and post-test, and 1-month and 6-month follow-up.		mCIMT.	Other home-based training programme.					
		AHA, P.	Post-test–pretest 0.42 1-month follow-up–pretest 0.52 6-month follow-up–pretest 0.67	Post-test–pretest 0.56 1-month follow-up–pretest 0.60 6-month follow-up–pretest 0.61		Not provided.			
		JTHFT, P.	Post-test–pretest −141.7 1-month follow-up–pretest −167.7 6-month follow-up pretest −153.8	Post-test–pretest −131.2 1-month follow-up–pretest −143.9 6-month follow-up pretest −158.1		Not provided.			
		QUEST, S.	Dissociated movement Post-test–pretest 5.1 1-month follow-up–pretest 6.1 6-month follow-up–pretest 3.9 Grasp Post-test–pretest 11.1 1-month follow-up–pretest 11.7 6-month follow-up–pretest 9.3	Dissociated movement Post-test–pretest 3.5 1-month follow-up – pretest 3.1 6-month follow-up–pretest 3.2 Grasp Post-test–pretest 10.8 1-month follow-up–pretest 11.3 6-month follow-up–pretest 7.6		Not provided.			
		GAS, S.	Cannot be calculated.			Not provided.			
		Activity monitor on the wrists, S.	Post-test–pretest 12.3 1-month follow-up–pretest 12.5 6-month follow-up–pretest 13.7	Post-test–pretest 15.2 1-month follow-up–pretest 13.3 6-month follow-up–pretest 14.7		Not provided.			

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
	During intervention period.						I	Compliance with home-based training.	Home logs indicated that children averaged 286 min of the requested 360 min/week engaging in home practice during the 6 months following the intervention.
Wallen *et al*[33] (CA),[86]	Baseline, 10 weeks and 6 months following randomisation.		mCIMT.	Other home-based training programme					
		COPM, P.	COPM performance 10-week–baseline 3.6 (2.5) 6-month–baseline 4.3 (2.1) COPM satisfaction 10-week–baseline 3.8 (2.8) 6-month–baseline 4.5 (2.5)	COPM performance 10-week–baseline 3.1 (2.0) 6-month–baseline 3.9 (1.9) COPM satisfaction 10-week–baseline 3.3 (3.2) 6-month–baseline 3.8 (3.0)		COPM performance 10-week–baseline 0.3 (–0.8 to 1.4; p=0.61) 6-month–baseline 0.2 (–0.7 to 1.2; p=0.65) COPM satisfaction 10-week– baseline 0.1 (–1.1 to 1.2; p=0.90) 6-month–baseline 0.3 (–0.7 to 1.4; p=0.50)			
		GAS, S.	10–week–baseline 2.5 (0.9) 6-month–baseline 2.9 (0.9)	10-week–baseline 2.5 (0.8) 6-month–baseline 2.8 (0.8)		10-week–baseline 0.0 (–0.5 to 0.5; p=0.88) 6-month–baseline 0.2 (–0.3 to 0.7; p=0.51)			
		AHA, S.	10 week–baseline 2.3 (41.8) 6-month–baseline 7.3 (39.7)	10-week–baseline 2.2 (42.2) 6-month–baseline 4.7 (40.9)		10-week–baseline 1.0 (–3.8 to 5.8; p=0.68) 6-month–baseline 4.3 (–1.3 to 9.8; p=0.13)			
		PMAL-R, S.	How often 10-week–baseline 10.4 (26.4) 6-month–baseline 14.4 (25.3) How well 10-week–baseline 17.2 (32.1) 6-month–baseline 19.7 (31.3)	How often 10-week–baseline 12.8 (23.4) 6-month–baseline 14.9 (22.6) How well 10-week–baseline 12.9 (26.2) 6-month–baseline 15.2 (23.2)		How often 10-week–baseline –0.2 (–8.7 to 8.2; p=0.95) 6-month–baseline 2.0 (–5.8 to 9.8; p=0.62) How well 10-week–baseline 5.2 (–3.8 to 14.2; p=0.25) 6-month–baseline 5.9 (–2.7 to 14.6; p=0.18)			
		(MAS), S.	MAS elbow flexors 10-week–baseline –0.1 (1.0) 6–month–baseline –0.2 (1.2) MAS pronators 10-week–baseline 0.2 (0.8) 6-month–baseline 0.1 (0.9) MAS wrist flexors 10-week–baseline –0.1 (0.8) 6-month–baseline 0.0 (0.9)	MAS elbow flexors 10-week–baseline 0.0 (1.1) 6-month–baseline 0.0 (0.9) MAS pronators 10-week–baseline 0.2 (1.0) 6-month–baseline 0.1 (0.9) MAS wrist flexors 10-week–baseline 0.0 (0.8) 6-month–baseline 0.0 (0.8)		Not provided.			

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		Modified Tardieu Scale, S.	Tardieu elbow flexors 10-week–baseline 4.6 (42.2) 6-month—baseline –0.5 (47.8) Tardieu pronators 10-week–baseline 1.9 (42.6) 6-month–baseline –8.1 (50.9) Tardieu wrist flexors 10-week–baseline 10.3 (29.1) 6-month–baseline 3.1 (35.2)	Tardieu elbow flexors 10-week–baseline –1.4 (46.0) 6-month–baseline 1.3 (48.9) Tardieu pronators 10-week–baseline 2.6 (50.3) 6-month–baseline –6.6 (49.8) Tardieu wrist flexors 10-week–baseline 0.4 (30.1) 6-month–baseline –6.9 (35.1)		Tardieu elbow flexors 10-week–baseline 8.7 (–6.8 to 24.1; p=0.26) 6-month– baseline 1.0 (–18.7 to 20.8; p=0.92) Tardieu pronators 10-week–baseline 2.6 (–14.8 to 20.1; p=0.76) 6-month–baseline 2.4 (–18.9 to 23.7; p=0.82) Tardieu wrist flexors 10-week–baseline 6.1 (–5.9 to 18.2; p=0.31) 6-month–baseline 6.6 (–9.5 to 22.7; p=0.41)			
	During intervention period.						I	Daily log of the amount of time the constraint was worn (mCIT group) and the nature of intervention and time spent completing therapy (both groups).	Most parents (75%) did not find it easy to carry out this intervention. The majority, however, reported that they felt mCIT was worthwhile (96%) and would consider implementing it again (76%). Time mitt worn as % of total time expected (112 hours) (n=22): mean (SD) 67.2 (27.7), range 21–113. Therapy completed during intervention, hours per day: mCIMT mean (SD) 1.3 (0.6), range 0.4–2.3; intensive occupational therapy mean (SD) 0.8 (0.6), range 0.3–2.6.
	Before the 10-week assessment.						A	Adverse events were monitored via a semistructured interview with each parent.	Number of children experiencing adverse events: mCIMT 5 of 25, intensive occupational therapy 1 of 25. Adverse events were minor, were related to participants' lack of acceptance of constraints of therapy, and manifested as frustration and refusal to cooperate.

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
Al-Oraibi and Eliasson[72]			mCIMT.	NDT.					
	Pretest and post-test (8 weeks).	AHA, P.	6.4 (17.2)	0.6 (26.5)		ES=1.5			
	During intervention period.						I	Compliance with training with diary notes.	Compliance varied, since some families found it difficult to engage the children in activities at home, while others found it easy. The children wore the restraint glove for a mean of 92.2 (SD 29.2) hours of the expected 96 hours. Children only received training for 56.6 (SD 25.7) hours of the expected 96 hours. The attendance varied between 5 and 8 sessions with a mean of 7.3 (SD 1.3) of the expected 8 hours.
	Not specified.						A	Open interviews: therapists' experiences performing the treatment and reactions of the families.	Several of the children needed some time to adjust to wearing the glove both at home and in the therapy sessions. Both therapists and parents found the parental involvement in the planning of training meaningful. Several mothers reported that they were motivated to continue the programme since they could see the difference in their children.
Eugster-Buesch *et al*[73]			Forced use therapy.	Care as usual.					
	Baseline (2 weeks prior to the intervention), pretest, post-test, and 2-week, 3-month and 12-month follow-up.	MA, P.	Post-test–baseline 1.93 (4.86)	Post-test–baseline −0.05 (3.74)		ES=0.46 (−1.94 to 5.90; p=0.304)			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
	At the end of the 3-month follow-up.						A	Structured 43-item questionnaire with parents about compliance and participation.	72% (8 of 11) of the participants reported having always or often reached the 6 hours/day specified splint wearing. 60% (6 of 10) of the parents indicated that wearing the splint had been a tedious matter. Refusal to wear the splint was observed in 54% (6 of 11) of children. Frustration in regard to accomplishing certain activities was observed rarely in 64% (7 of 11). Playtime occurred mainly within the family structure, whereby parents played a very important role, as 82% indicated having played always with their children. 73% (8 of 11) of parents indicated that daily routine and activities were successfully integrated into the daily forced use time span. 55% (6 of 11) of parents stated that the forced use period had been exhausting.
Hsin *et al*[74]			mCIMT.	Other home-based training programme.					
	Pretest and post-test at 3-month follow-up.	Subtest 8 of BOTMP, P.	Post-test–pretest 5.4 (2.1) 3-month follow-up–pretest 7.4 (2.1)	Post-test–pretest 4.4 (1.5) 3-month follow-up–pretest 5.7 (1.8)		Post-test–pretest ES=0.470 (p=0.001) 3-month follow-up–pretest ES=0.462 (p=0.001)			
		PMAL, S.	AOU Post-test–pretest 0.7 (0.4) Follow-up–pretest 1.1 (0.4) QOU Post-test–pretest 0.5 (0.4) Follow-up–pretest 1.1 (0.4)	AOU Post-test–pretest 0.5 (0.5) Follow-up–pretest 0.9 (0.5) QOU Post-test–pretest 0.4 (0.4) Follow-up–pretest 0.8 (0.4)		AOU Post-test–pretest ES=0.438 (p=0.001) 3-month follow-up–pretest ES=0.233 (p=0.027) QOU ES=0.415 (p=0.002) 3-month follow-up–pretest ES=0.237 (p=0.025)			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		Cerebral Palsy-Specific Quality of Life (parent-proxy version), S.	Social well-being and acceptance domain Post-test–pretest 9.4 (5.5) Follow-up–pretest 14.5 (5.0) Functioning domain Post-test–pretest 12.0 (14.0) Follow-up–pretest 13.8 (12.0) Participation and physical health domain Post-test–pretest 8.3 (18.6) Follow-up–pretest 11.7 (17.0) Emotional well-being and self-esteem domain Post-test–pretest 12.2 (15.4) Follow-up–pretest 14.8 (13.3) Pain and impact of disability domain Post-test–pretest 11.9 (23.7) Follow-up–pretest 19.4 (22.2) Access to service domain Post-test–pretest 9.5 (12.2) Follow-up–pretest 14.5 (13.6) Family health domain Post-test–pretest 10.8 (18.4) Follow-up–pretest 14.5 (15.3)	Social well-being and acceptance domain Post-test–pretest 6.3 (9.1) Follow-up–pretest 10.1 (7.4) Functioning domain Post-test–pretest 8.6 (8.8) Follow-up–pretest 11.6 (7.4) Participation and physical health domain Post-test–pretest 8.7 (10.0) Follow-up–pretest 12.1 (9.2) Emotional well-being and self-esteem domain Post-test–pretest 8.5 (7.7) Follow-up–pretest 12.5 (6.8) Pain and impact of disability domain Post-test–pretest 10.2 (22.6) Follow-up–pretest 14.4 (20.0) Access to service domain Post-test–pretest 8.9 (13.6) Follow-up–pretest 11.6 (12.6) Family health domain Post-test–pretest 9.9 (8.9) Follow-up–pretest 12.8 (7.2)		Social well-being and acceptance domain Post-test–pretest ES=0.147 (p=0.086) Follow-up–pretest ES=0.366 (p=0.004) Functioning domain Post-test–pretest ES=0.074 (p=0.234) Follow-up–pretest ES=0.236 (p=0.026) Participation and physical health domain Post-test–pretest ES=0.046 (p=0.350) Follow-up–pretest ES=0.180 (p=0.056) Emotional well-being and self-esteem domain Post-test–pretest ES=0.071 (p=0.244) Follow-up–pretest ES=0.326 (p=0.007) Pain and impact of disability domain Post-test–pretest ES=0.045 (p=0.356) Follow-up–pretest ES=0.323 (p=0.007) Access to service domain Post-test–pretest ES=0.000 (p=0.925) Follow-up–pretest ES=0.289 (p=0.012) Family health domain Post-test–pretest ES=0.042 (p=0.373) Follow-up–pretest ES=0.136 (p=0.100)			
	During intervention period.						I	The number of restraint hours outside therapy in daily logs.	The average constraint time in constraint-induced therapy group is 3.5 (SD 0.1) hours, ranging from 3.3 to 3.8 hours/day.
Klingels *et al*[78]			mCIMT.	Other home-based training programme.					
	Baseline, after intervention and after 10-week follow-up.	AHA, P.	Post-test–baseline 4.2 (20.6) Follow-up–baseline 3.7 (20.8)	Post-test–baseline 2.0 (21.0) Follow-up–baseline 1.9 (22.1)		No effect size.			
		MAS, S.	Post-test–baseline −0.7 (3.7) Follow-up–baseline −0.78 (4.0)	Post-test–baseline −1.81 (3.5) Follow-up–baseline −1.28 (3.3)		No effect size.			
		MMT, S.	Mdn Post-test–baseline 0.5 Follow-up–baseline 2.0	Mdn Post-test–baseline 2.0 Follow-up–baseline 1.2		No effect size.			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		Maximum contraction recorded with a Jamar dynamometer, S.	Post-test–baseline 0.05 (5.1) Follow-up–baseline 0.65 (5.3)	Post-test–baseline –0.12 (4.5) Follow-up–baseline 0.22 (3.8)		No effect size.			
		MA, S.	Mdn Post-test–baseline 5.7 Follow-up–baseline 6.5	Mdn Post-test–baseline 5.7 Follow-up–baseline 5.3		No effect size.			
		JTHFT, S.	Mdn Post-test–baseline –77 Follow-up–baseline –94	Mdn Post-test–baseline –92 Follow-up–baseline –97		No effect size.			
		ABILHAND-Kids, S.	Post-test–baseline 0.43 (1.9) Follow-up–baseline 0.39 (2.2)	Post-test–baseline 0.35 (2.0) Follow-up–baseline 0.21 (2.1)		No effect size.			
	During intervention period.						I	Compliance recorded with an activity log.	Mean time spent wearing the constraint was 39 hours 30 min (SD 12 hours) in the mCIMT group and 39 hours 15 min (SD 14 hours) in the mCIMT+IT group. In the mCIMT group, 15 out of 23 children wore the splint for more than 80% of the expected time (>40 hours). For the mCIMT+IT group, a compliance of more than 80% was reached in 17 out of 25 children. Children in the mCIMT+IT group received a mean therapy time of 20 hours 30 min (SD 3 hours). 22 out of 25 children received more than 80% of the expected therapy sessions (>18 hours).
Lin *et al*[79]			mCIMT.	Other home-based training programme.					
	Pretest and post-test, and 6-month follow-up.	PDMS-2 of the more-affected upper extremity, P.	PDMS-G, grasping subscale Post-test–pretest 3.4 (12.4) Follow-up–pretest 3.9 (12.2) PDMS-V, visual motor integration subscale Post-test–pretest 7.1 (38.6) Follow-up–pretest 11.1 (37.6)	PDMS-G, grasping subscale Post-test–pretest 0.72 (8.8) Follow-up–pretest 0.45 (8.7) PDMS-V, visual motor integration subscale Post-test–pretest 5.45 (33.3) Follow-up–pretest 6.09 (33.2)		PDMS-G, grasping subscale Post-test–pretest ES=0.252 (p=0.012) Follow-up–pretest ES=0.155 (p=0.043) PDMS-V, visual motor integration subscale Post-test–pretest ES=0.023 (p=0.254) Follow-up–pretest ES=0.051 (p=0.163)			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		BOTMP, P.	Subtest 8 Post-test–pretest 3.45 (12.0) Follow-up–pretest 1.85 SD (11.5) More affected upper extremity Post-test–pretest 4.05 (7.2) Follow-up–baseline 3.25 (7.1) Bilateral coordination Post-test–pretest 0.85 (4.1) Follow-up–pretest 0.05 (3.9)	Subtest 8 Post-test–pretest −0.23 (13.2) Follow-up–pretest −0.32 (13.8) More affected upper extremity Post-test–pretest 0.95 (8.6) Follow-up–baseline 0.77 (8.8) Bilateral coordination Post-test–pretest 0.09 (3.2) Follow-up–pretest 0.19 (3.5)		Subtest 8 Post-test–pretest ES=0.230 (p=0.033) Follow-up–pretest ES=0.045 (p=0.369) More affected upper extremity ES=0.378 (p=0.002) Follow-up– pretest ES=0.100 (p=0.088) Bilateral coordination ES=0.145 (p=0.049) Follow-up– pretest ES<0.001 (p=0.482)			
		PMAL, S.	Amount of use Post-test–pretest 1.1 (1.4) Follow-up–pretest 1.49 (1.3) Quality of use Post-test–pretest 0.67 (1.3) Follow-up–pretest 1.00 (1.2)	Amount of use Post-test–pretest 0.26 (1.2) Follow-up–pretest 0.43 (1.4) Quality of use Post-test–pretest 0.19 (1.0) Follow-up–pretest 0.13 (1.1)		Amount of use Post-test–pretest ES=0.354 (p=0.003) Follow-up–pretest ES=0.201 (p=0.024) Quality of use Post-test–pretest ES=0.184 (p=0.030) Follow-up–pretest ES=0.317 (p=0.005)			
		CFUS, S.	Amount of use Post-test–pretest 0.65 (1.4) Follow-up–pretest 1.19 (1.3) Quality of use Post-test–pretest 0.58 (1.5) Follow-up–pretest 0.81 (1.3)	Amount of use Post-test–pretest 0.44 (1.4) Follow-up–pretest 0.37 (1.3) Quality of use Post-test–pretest 0.25 (1.2) Follow-up–pretest 0.4 (1.1)		Amount of use Post-test–pretest ES=0.037 (p=0.210) Follow-up–pretest ES=0.308 (p=0.006) Quality of use Post-test–pretest ES=0.067 (p=0.128) Follow-up–pretest ES=0.181 (p=0.027)			
		PSI-SF (parent-related), S.	Parental distress Post-test–pretest −0.7 (9.5) Follow-up–pretest −1.3 (10.5) Parent–child dysfunctional interaction Post-test–pretest 3.9 (7.9) Follow-up–pretest −2.00 (7.6) Difficult child Post-test–pretest 1.55 (7.3) Follow-up–pretest −4.25 (10.9)	Parental distress Post-test–pretest −0.4 (9.6) Follow-up–pretest −1.77 (9.7) Parent–child dysfunctional interaction Post-test–pretest −2.82 (11.6) Follow-up–pretest −0.73 (12.6) Difficult child Post-test–pretest −3.64 (10.7) Follow-up–pretest −5.00 (10.2)		Parental distress Post-test–pretest ES<0.001 (p=0.996) Follow-up– pretest ES=0.013 (p=0.627) Parent–child dysfunctional interaction Post-test–pretest ES=0.235 (p=0.030) Follow-up– pretest ES=0.043 (p=0.378) Difficult child Post-test–pretest ES=0.057 (p=0.299) Follow-up– pretest ES=0.007 (p=0.724)			
	During intervention period.						I	Compliance with daily restraint, documented by parents in daily logs.	CIT: 31.69±14.05 hours; control group: 28.24±16.55 hours.

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
Novak *et al*[81]			OTHP.	No therapy.	Other home-based training programme.				
	Baseline, at 4 weeks and at 8 weeks.	COPM, P.	Cannot be calculated.			COPM performance 4 weeks–baseline ES=0.2 (0.1 to 0.3; p=0.01) 8 weeks–baseline ES=1.4 (0.6 to 2.2; p=0.01) COPM satisfaction 4 weeks–baseline ES=0.3 (0.1 to 0.6; p=0.15). 8 weeks–baseline ES=1.5 (0.3 to 2.6; p=0.01)			
		GAS, S.	Cannot be calculated.			4 weeks–baseline ES=13.3 (8.6 to 18.0; p=0.01). 8 weeks–baseline ES=17.9 (12.423.4; p=0.01)			
		QUEST, S.	Cannot be calculated.			4 weeks–baseline ES=3.9 (0.5 to 8.3; p=0.08) 8 weeks–baseline ES=4.6 (0.1 to 9.0; p=0.05)			
		CAPE, S.	Cannot be calculated.			No effect size.			
	During intervention period.						I	Self-report minutes of OTHP participation per day (a calendar by parents).	Both groups implemented the programme less than daily but 18 (4-week OTHP) or 17 (8-week OTHP) times per month. The mean session length was 15.66 min (range: 5–60 min) for the 4-week OTHP and 17.63 min (range: 4.28–40 min) for the 8-week OTHP. Most participants in the 4-week OTHP group did not discontinue the programme after 4 weeks, contrary to instruction, because parents reported that they perceived the programme as helpful and they considered it in the best interests of their child to continue. Only two participants in the 4-week OTHP group implemented the OTHP for 4 weeks as instructed.

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
Preston *et al*[82]			Computer-assisted arm rehabilitation gaming technology.	Botulinum toxin treatment to reduce arm spasticity + usual follow-up rehabilitation.					
	Before randomisation and at 6 and 12 weeks.	ABILHAND-Kids, P.	6 weeks–baseline −0.48 (range −2.378 to −0.684) 12 weeks–baseline −0.61 (range −2.166 to 0.684)	6 weeks–baseline −0.88 (range −2.341 to 0.611) 12 weeks–baseline −0.31 (range −2.341 to 1.42)		6 weeks–baseline −0.51 (p=0.919) 12 weeks–baseline 0.19 (p=0.919)			
		Performance scale of COPM, S.	Results only provided for all participants.			6 weeks–baseline 0.9 (p=0.221) 12 weeks–baseline 0.1 (p=0.862)			
	During intervention period.						I	Diary describing the rehabilitation exercises performed daily.	Mean number days the gaming technology was played on was 14 of the 40 days. Half of the children used the device for three or fewer of the 6 weeks, with one child using the gaming technology in the first week only. The mean total use per child was 99 min. The mean daily amount of time the gaming technology was played was 7 min, substantially less than the 30 min per day that was suggested to parents.
Sakzewski *et al*[83]			Goal-directed/functional training.	Centre-based occupational therapy or physiotherapy intervention.					
	Pretest, at 13 weeks (post-test) and at 26 weeks (follow-up).	MA, P.	Post-test–pretest 0.3 (25.5) Follow-up–pretest 0.1 (27.0)	Post-test–pretest −1.8 (26.0) Follow-up–pretest −0.8 (26.2)		Post-test–pretest −2.3 (−5.6 to 1.0; p=0.2) Follow-up–pretest −1.1 (−4.4 to 2.2; p=0.5)			
		AHA, P.	Post-test–pretest 3.3 (25.6) Follow-up–pretest 3.6 (27.6)	Post-test–pretest 1.6 (19.4) Follow-up–pretest −0.6 (20.7)		Post-test–pretest −0.3 (−3.3 to 2.6; p=0.8) Follow-up–pretest −3.1 (−6.0 to −0.2; p=0.04)			
		COPM, S.	Post-test–pretest Performance: 3.3 (2.5) Satisfaction: 3.8 (2.0) Follow-up–pretest Performance: 3.7 (2.1) Satisfaction: 4.1 (1.7)	Post-test–pretest Performance: 2.6 (1.9) Satisfaction: 2.6 (2.4) Follow-up–pretest Performance: 3.0 (1.9) Satisfaction: 3.0 (2.1)		Post-test–pretest Performance: −0.7 (−1.6 to 0.2; p=0.1) Satisfaction: −1.2 (−2.2 to 0.1; p=0.04) Follow-up–pretest Performance: −0.7 (−1.6 to 0.2; p=0.1) Satisfaction: −1.0 (−2.1 to 0.0; p=0.06)			
		JTHFT, S.	Post-test–pretest −29.7 (357.1) Follow-up–pretest −45.7 (358.2)	Post-test–pretest −30.9 (348.7) Follow-up–pretest −56.3 (335.4)		Post-test–pretest −5.0 (−49.9 to 40.0; p=0.8) Follow-up–pretest −14.4 (−59.4 to 30.5; p=0.5)			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		BBT, S.	Post-test–pretest 3.3 (15.6) Follow-up–pretest 3.8 (18.0)	Post-test–pretest 3.7 (16.5) Follow-up–pretest 3.3 (16.1)		Post-test–pretest −0.7 (−3.8 to 2.4; p=0.6) Follow-up–pretest 0.1 (−3.0 to 3.3; p=0.9)			
		CHEQ, S.	Independent activities Post-test–pretest 0.5 (6.9) Follow-up–pretest 1.0 (6.7)	Independent activities Post-test–pretest 0.9 (7.4) Follow-up–pretest 0.7 (7.6)		Independent activities Post-test–pretest 0.2 (−1.9 to 2.4; p=0.8) Follow-up–pretest −0.5 (−2.8 to 1.8; p=0.7)			
	During intervention period.						I	Dosage of therapy (home practice daily log for completion by parents).	13 (68%) children in standard care completed home practice therapy logs, with an average of 20.9 hours (SD 10.7) of home practice completed over 12 weeks (range 4.5–39.8 hours).
Charles *et al*[84]			mCIMT.	Care as usual.	Control after treatment.				
	Pretest and post-test and at 1-month and 6-month follow-up.	JTHFT, P.	Post-test–pretest −82.7 (316.4) 1-month follow-up–pretest −92.6 (314.4) 6-month follow-up–pretest −88.7 (313.3)	Post-test–pretest −13.2 (254.4) 1-month follow-up–pretest −53.9 (234.3) 6-month follow-up–pretest −17.2 (267.4)	Post-test–pretest −0.6 (291.3) 1-month follow-up–pretest 5.0 (291.4) 6-month follow-up–pretest 18.2 (308.7)	Post-test–pretest ES=0.315 (p<0.01)			
		Subtest 8 of BOTMP, S.	Post-test–pretest 2.4 (4.2) 1-month follow-up–pretest 2.8 (5.3) 6-month follow-up–pretest 2.1 (4.8)	Post-test–pretest 0.4 (5.6) 1-month follow-up–pretest 0.7 (5.5) 6-month follow-up–pretest 1.5 (6.3)	Post-test–pretest 1.2 (7.9) 1-month follow-up–pretest 0.7 (7.8) 6-month follow-up–pretest 1.4 (8.2)	Post-test–pretest ES=0.399 (p<0.005)			
		CFUS, S.	How frequently Post-test–pretest 0.4 (1.0) 1-month follow-up–pretest 0.7 (1.1) 6-month follow-up–pretest 0.7 (1.1) How well Post-test–pretest 0.5 (0.8) 1-month follow-up–pretest 1.0 (0.8) 6-month follow-up–pretest 0.9 (0.9)	How frequently Post-test–pretest −0.3 (0.8) 1-month follow-up – pretest −0.1 (0.7) 6-month follow-up–pretest 0.0 (0.8) How well Post-test–pretest 0.2 (0.6) 1-month follow-up–pretest 0.1 (0.6) 6-month follow-up–pretest 0.1 (0.7)	How frequently Post-test–pretest −0.1 (0.8) 1-month follow-up–pretest 0.2 (0.8) 6-month follow-up–pretest 0.1 (1.1) How well Post-test–pretest 0.1 (0.6) 1-month follow-up–pretest 0.2 (0.7) 6-month follow-up–pretest 0.3 (0.9)	How frequently Post-test–pretest ES=0.262 (p<0.001) How well Post-test–pretest ES=0.285 (p<0.01)			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		TPD, S.	Post-test–pretest −0.9 (4.8) 1-month follow-up–pretest −1.0 (4.5) 6-month follow-up–pretest 0.1 (5.1)	Post-test–pretest −1.3 (3.9) 1-month follow-up–pretest −1.1 (3.8) 6-month follow-up–pretest 0.0 (3.7)	Post-test– pretest −0.3 (3.3) 1-month follow-up–pretest 0.5 (4.4) 6-month follow-up–pretest −1.3 (2.6)	No effect size.			
		MAS, S.	Shoulder Post-test–pretest −0.4 (0.6) 1-month follow-up–pretest −0.1 (0.7) 6-month follow-up–pretest −0.3 (0.6) Elbow Post-test–pretest −0.2 (0.8) 1-month follow-up–pretest −0.1 (0.8) 6-month follow-up–pretest −0.2 (0.9) Wrist Post-test–pretest 0.0 (0.8) 1-month follow-up–pretest 0.1 (0.8) 6-month follow-up–pretest 0.0 (1.1)	Shoulder Post-test–pretest 0.0 (1.0) 1-month follow-up–pretest −0.2 (0.9) 6-month follow-up–pretest −0.1 (1.0) Elbow Post-test–pretest −0.2 (1.3) 1-month follow-up–pretest −0.2 (1.3) 6-month follow-up–pretest 0.1 (1.2) Wrist Post-test–pretest 0.4 (1.3) 1-month follow-up–pretest 0.3 (1.1) 6-month follow-up–pretest 0.5 (1.2)	Shoulder Post-test–pretest −0.6 (0.8) 1-month follow-up–pretest −0.4 (0.8) 6-month follow-up–pretest 0.0 (1.0) Elbow Post-test–pretest −0.3 (0.9) 1-month follow-up–pretest 0.0 (0.5) 6-month follow-up–pretest −0.1 (0.7) Wrist Post-test–pretest −0.3 (0.8) 1-month follow-up–pretest 0.2 (0.7) 6-month follow-up–pretest 0.4 (1.0)	No effect size.			
	During intervention period.						I	The time each child practised at home during the intervention.	The children used their involved upper extremity in home practice for an average of 5.7 hours per 10 days during the intervention and 7.3 hours per week for 6 months after the intervention.
Chamudot *et al*[44] (CA), [97]			mCIMT.	Other home-based training programme.					
	Pretest and post-test.	Mini-AHA, P.	14.5	18.7		No effect size.			
		FI, S.	FI gross motor skills 0.3 FI unilateral hand use 0.6 FI bilateral hand use 0.5	FI gross motor skills 0.3 FI unilateral hand use 0.7 FI bilateral hand use 0.5		No effect size.			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
	During intervention period.						I	The infant's compliance with the programme (recorded in a daily log by the parents).	The average treatment time for the whole group was 46.7 hours (9.9) out of a total of 60 hours (78%). In the intervention group, the average was 48.4 hours (9.5; 81%); in the control group, it was 45.0 hours (10.2; 75%).
Ferre *et al*[100 110]			Bimanual training.	Other home-based training programme.					
	Pretest, post-test and 6-month follow-up.	BBT, P.	Post-test–pretest 5.5 6-month follow-up–pretest 6.2	Post-test–pretest 1.3 6-month follow-up–pretest 3.8		No effect size.			
		AHA, P.	Post-test–pretest 1.4 6-month follow-up–pretest –0.8	Post-test–pretest 0.2 6-month follow-up–pretest 3.0		No effect size.			
		COPM, S.	COPM performance Post-test–pretest 3.9 6-month follow-up–pretest 3.5 COPM satisfaction Post-test–pretest 3.5 6-month follow-up–pretest 2.9	COPM performance Post-test–pretest 2.0 6-month follow-up–pretest 2.4 COPM satisfaction Post-test–pretest 2.6 6-month follow-up–pretest 3.1		No effect size.			
	During intervention period.						I	Adherence.	Participants in the intervention and control groups completed on average 82.9 hours (12.7) and 76.7 hours (7.29) of home training.
							I	Adherence.	On average, families performed seven activities per day, which lasted about 19 min per activity.
Fischer *et al*[45] (CA)			mCIMT.	Other home-based training programme.	Other home-based training programme.				
	Pretreatment and post-treatment, 6-month follow-up.	PSS, S.	Analysis of variance revealed no significant differences in PSS scores across therapy groups or between pretreatment and post-treatment.			Not provided.			

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
	During intervention period.						A	Semistructured questionnaire.	In the P-CIMT groups, 74% reported pretreatment stress concerning the use of a constraint, which declined to 44% post-treatment. Additionally, 38% identified concerns related to therapy intensity before treatment, but only 3% reported that quantity of therapy received was too much, while 18% reported it was not enough. Therapy occurring in the home was not a significant stressor pretreatment or post-treatment. At 6 months post-treatment, 42% of parents reported stress conducting the recommended home activities, with child behaviour and time constraints being contributing factors.
Hobbs *et al*[46] (CA)			Computer-based rehabilitation.	Other home-based training programme.					
	On enrolment, immediately after the 6-week intervention and 4 weeks postintervention.	JTHFT, S.	Results not presented.			Not provided.			
	On enrolment and immediately after the 6-week intervention.	ABILHAND-Kids questionnaire.	10 recorded increased logit scores (average increase 0.72 (0.63)). 4 recorded decreased logit scores (average decrease −1.10 (0.79)), with no change for 2 participants.			Not provided.			
	During intervention period.						I	Adherence.	The average OrbIT system usage was 403 min (SD 322 min; range 117–1140 min) for the experimental group and 340 min (SD 134 min; range 136–526 min) for the control group. Overall, participants rated the system highly, scoring it 7.7 (SD 1.7) out of 10. Parents noted that the system increased sibling interaction and participation. From a utility perspective, the system was accessible, intuitive, robust and required minimal support.

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
Hughes *et al*[103]			NDT and ADL activities.	Other home-based training programme.	Control group.				
	Preassessment and postassessment.	QUEST, S.	Dissociated movements 11.91 (18.8) Grasps 7.39 (13.0) Weight-bearing 14.94 (25.0) Protective extension 5.41 (29.7) Total 11.9 (16.5)	Dissociated movements 8.78 (21.0) Grasps 4.63 (15.29) Weight-bearing 18.78 (28.7) Protective extension –2.92 (26.62) Total 7.09 (16.59)	Dissociated movements 9.15 (17.52) Grasps 0.35 (23.4) Weight-bearing 0.24 (25.8) Protective extension –2.7 (31.7) Total 1.7 (26.0)	Dissociated movements ES=0.46 (p=0.53) Grasps ES=0.34 (0.43) Weight-bearing ES=1.22 (p=0.40) Protective extension 0.45 (p=0.91) Total ES=0.82 (p=0.96)			
	Postassessment.						A	Questionnaire.	Most caregivers (18 of 19) reported that the home programme was easy to follow. All the caregivers of the child participants who were evaluated for the final assessment felt that there was some improvement in their child over the duration of the study, also reporting improvement in upper limb functioning in the child's ability to do everyday activities.
Kassee *et al*[104]			Virtual reality.		Other home-based training programme.				
	Pre, post and 4-week follow-up.	Melbourne Assessment of Unilateral Upper Limb Function-2 (Melbourne-2), S.	Not on group level.			Not provided.			
		ABILHAND-Kids questionnaire, S.	Not on group level.			Not provided.			
		Average maximal grip strength in the spastic and non-spastic hand, S.	Not on group level.			Not provided.			
	During intervention period.						I	Compliance using daily logs.	All participants in the Wii training group demonstrated a higher compliance rate than the most compliant resistance participant.

Continued

Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
							A	In addition, the daily logs for both the Wii and resistance training groups asked the participants to directly respond each day to the following questions: (1) How much did you use your affected arm today? (2) How hard did you exercise today? (3) Did you have fun exercising today? The children were asked to respond to these questions on a 6-point Likert scale.	Trend lines for both groups were variable, and the Wii training group had a greater response rate to the questions.
							A	Parent feedback questionnaire (four questions) was used to assess motivation and feasibility of the intervention, as perceived by parents.	Parents of participants in the Wii training group reported a more positive (higher) average response to all four questions asked. Parents of children in the Wii training group had a higher average positive response to all questions posed, regarding motivation and feasibility.
Law *et al*[109]			Intensive NDT and cast.	Other home-based training programmes: regular NDT plus cast; regular NDT.					
	After 6-month therapy and 3-month follow-up.	Peabody Fine Motor Scales, S.	Intensive NDT + cast 6 months–baseline 5.1 (19.2) 9 months–baseline 7.8 (18.0) Intensive NDT 6 months–baseline 3.1 (25.4) 9 months–baseline 2.8 (25.7)	Regular NDT + cast 6 months–baseline 3.1 (27.3) 9 months–baseline 2.2 (27.0) Regular NDT 6 months–baseline 3.5 (29.4) 9 months–baseline 5 (29.8)		Not provided.			

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
		QUEST, S.	Intensive NDT+ cast 6 months–baseline 4.9 (31.8) 9 months–baseline 7.3 (28.0) Intensive NDT 6 months–baseline 0.8 (37.6) 9 months–baseline 0.1 (37.3)	Regular NDT + cast 6 months–baseline 7.0 (36.3) 9 months–baseline 4.9 (37.1) Regular NDT 6 months–baseline 1.4 (41.4) 9 months–baseline 1.5 (41.4)		Not provided.			
		Range of motion at the wrist, S.	Results not presented.			Not provided.			
	During intervention period.						I	Adherence.	66% of the parents completed all or some of the home programme more than 75% of the time.
Liang *et al*[48] (CA)			mCIMT.	Other home-based training programme.					
	Before and immediately after the intervention.	Melbourne Assessment-2 (MA-2), S.	Results not presented.			Not provided.			
		BOT-2, S.	Results not presented.			Not provided.			
		BBT, S.	Results not presented.			Not provided.			
		PMAL-R.	Results not presented.			Not provided.			
		TOP, S.	Results not presented.			Not provided.			
							A	PSI-SF.	Results not presented.
							A	Satisfactory Questionnaire.	Caregivers of participants also showed high satisfaction towards the BIT programme.
Hobbs *et al*[52]			Computer-based rehabilitation.	Other home-based training programme.					
	On enrolment, immediately after the intervention and 4 weeks postintervention.	Tests of sensation (pressure sensitivity, texture discrimination, distal proprioception, and stereognosis), P.	Results not presented.			Not provided.			
		JTHFT, P.	Results not presented.			Not provided.			
	During intervention period.						I	Not specified.	OrbIT was rated highly by families (7.4±1.9 out of 10, median=8.0, n=17) and overall average system usage was 377±267 min.

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Table 4 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))	Feasibility outcome	Measurements	Results
Lowes *et al*[80]			mCIMT.	Traditional occupational therapy services in an outpatient clinic.					
	At baseline and after each phase.	BSID, S.	Cognitive pre to post usual care occupational therapy 4.8 (2.8) Pre to post CIMT 1 (1.4) Pre to post follow-up 1.4 (1.7) Fine motor score (more involved) Pre to post usual care occupational therapy 2.2 (1.8) Pre to post CIMT 4.2 (1.8) Pre to post follow-up −0.8 (2.2) Fine motor score (less involved) Pre to post usual care occupational therapy 1.6 (1.7) Pre to post CIMT 1.4 (1.9) Pre to post follow-up 1.6 (1.5) Gross motor score Pre to post usual care occupational therapy 1.0 (1.6) Pre to post CIMT 3.2 (1.9) Pre to post follow-up 3.0 (1.9)			No effect size.			
		IMAL, S.	Results not presented.			No effect size.			
	During intervention period.						I	Fidelity through a fidelity measure.	89% consistent with the treatment protocol. The infants demonstrated engaged and on-task behaviour 74% of the time and were not engaged in the treatment activities 26% of the time.
							I	Parent recordings of the amount of time spent involving the infant in targeted activities.	All parents recorded that they performed the home programme for an hour or more each day. They reported that the individualised activities were easy to incorporate into their daily routine and naturally occurring opportunities. Parents' comments and feedback regarding the programme were positive.

A, acceptability; ACC, accuracy; ADL, Activities of Daily Life; AHA, Assisting Hand Assessment; AMPS, Assessment of Motor and Process Skills; AO+RP, Action Observation + Repeated Practice; AOU, amount of hand use; BoNT-A, Botulinum Toxin A; BOT-2, Bruininks-Oseretsky Test of Motor Proficiency-2; BOT, Bimanual Occupational Therapy; BOTMP, Bruininks-Oseretsky Test of Motor Proficiency; BSID, Bayley Scales of Infant and Toddler Development-Third Edition; CA, conference abstract; CAPE, Children's Assessment of Participation and Enjoyment; CFUS, Caregiver Functional Use Survey; CHEQ, Children's Hand-use Experience Questionnaire; CIT, Constraint-Induced Therapy; COPM, Canadian Occupational Performance Measure; DEX, dexterity ; EMD, estimated mean difference; ES, effect size; FI, Functional Inventory; FLU, fluency; GAS, Goal Attainment Scale; I, implementation; IMAL, Infant Motor Activity Log; JTHFT, Jebsen-Taylor Hand Function Test; MA-2, Melbourne Assessment of Unilateral Upper Limb Function 2; MA, Melbourne Assessment of Unilateral Upper Limb Function; MAS, Modified Ashworth Scale; mCIMT, modified Constraint-Induced Movement Therapy; mCIT, modified Constraint-Induced Therapy; Mdn, median; Mini-AHA, Mini Assisting Hand Assessment; MMT, Manual Muscle Testing; NDT, neurodevelopmental treatment; OTHP, Occupational Therapy Home Program; PDMS-2, Peabody Developmental Motor Scales, Second Edition; PEDI, Pediatric Evaluation of Disability Inventory; PMAL, Pediatric Motor Activity Log; PMAL-R, Revised Pediatric Motor Activity Log; PSI-SF, Parenting Stress Index-Short Form; PSS, Perceived Stress Scale; QUEST, Quality of Upper Extremity Skills Test; QUO, quality of hand use; ROM, range of movement; TOP, Test of Playfulness; TPD, Two-Point Discrimination.

Table 5 Results of the effectiveness studies

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
Facchin *et al*[95]			mCIMT.	Other home-based training programme.	Care as usual.	
	Before and after the 10-week treatment.	QUEST, P.	QUEST Global score 7.2 Grasp 7.1 Dissociated movements 6.1 Protective extension 8.6 Weight-bearing 6.6 QUEST-affected limb Global score 8.2 Grasp 2.0 Dissociated movements 2.3 Protective extension 2.3 Weight-bearing 1.6 QUEST-non-affected limb Global score 0.9 Grasp −0.3 Dissociated movements 0.7 Protective extension 0.0 Weight-bearing 0.6	QUEST Global score 4.4 Grasp 3.6 Dissociated movements 3.1 Protective extension 2.3 Weight-bearing 8.9 QUEST-affected limb Global score 6.3 Grasp 0.7 Dissociated movements 0.8 Protective extension 2.3 Weight-bearing 2.3 QUEST-non-affected limb Global score 3.5 Grasp 0.5 Dissociated movements 0.7 Protective extension 1.0 Weight-bearing 1.3	QUEST Global score 1.3 Grasp 2.5 Dissociated movements 2.7 Protective extension −1.5 Weight-bearing 2.6 QUEST-affected limb Global score 3.1 Grasp −0.1 Dissociated movements 1.6 Protective extension 1.9 Weight-bearing −0.3 QUEST-non-affected limb Global score 2.0 Grasp −0.3 Dissociated movements 0.9 Protective extension −0.2 Weight-bearing 1.1	No effect size.
		Besta Scale, P.	Global score 0.23 Grasp 0.28 Bimanual spontaneous use 0.25 ADL (2–6 years) 0.21 ADL (7–8 years) −0.21	Global score 0.23 Grasp 0.08 Bimanual spontaneous use 0.29 ADL (2–6 years) 0.21 ADL (7–8 years) 0.0	Global score 0.06 Grasp 0.06 Bimanual spontaneous use 0.14 ADL (2–6 years) 0.05 ADL (7–8 years) 0.34	No effect size.
Chen *et al*[87]			mCIMT.	Other home-based training programme.		
	Baseline, 4 weeks (post-test), and 3-month and 6-month follow-up.	Subtest 8 of BOTMP, P.	Post-test–baseline 3.96 (2.6) 3 months–baseline 5.96 (2.5) 6 months–baseline 6.87 (2.5)	Post-test–baseline 3.22 (2.0) 3 months–baseline 4.63 (2.0) 6 months–baseline 5.5 (1.8)		Post-test–baseline ES=0.058 (p=0.116) 3 months–baseline ES=0.167 (p=0.006) 6-months–baseline ES=0.193 (p=0.003)
		Fine motor domain of PDMS-2, P.	Post-test–baseline 4.31 (4.0) 3 months–baseline 6.93 (4.0) 6 months–baseline 8.13 (4.1)	Post-test–baseline 2.54 (4.2) 3 months–baseline 3.86 (4.2) 6 months–baseline 4.82 (4.3)		Post-test–baseline ES=0.604 (p<0.001) 3 months–baseline ES=0.634 (p<0.001) 6 months–baseline ES=0.658 (p<0.001)
		WeeFIM, S.	Post-test–baseline 3.04 (8.9) 3 months–baseline 5.21 (8.5) 6 months–baseline 7.26 (8.2)	Post-test–baseline 2.32 (5.2) 3 months–baseline 4.36 (5.1) 6 months–baseline 6.00 (5.0)		Post-test–baseline ES=0.195 (p=0.003) 3 months–baseline ES=0.202 (p=0.002) 6 months–baseline ES=0.264 (p<0.001)
		Reach-to-grasp task (kinematic analysis), S.	Post-test–baseline RT (s) −0.07 (0.02) nMT (s/mm) −0.06 (0.07) nMU (times/mm) −0.03 (0.04) PV (mm/s) 0.74 (6.34) MGA (cm) −1.49 (1.27) PMGA (%) 11.36 (20.52) 3 months–baseline RT (s) −0.11 (0.03) nMT (s/mm) −0.12 (0.06) nMU (times/mm) −0.05 (0.05) PV (mm/s) 4.66 (6.42) MGA (cm) −1.58 (1.34) PMGA (%) 10.44 (24.54) 6 months–baseline RT (s) −0.14 (0.03) nMT (s/mm) −0.15 (0.06) nMU (times/mm) −0.07 (0.05) PV (mm/s) 6.14 (6.39) MGA (cm) −0.94 (1.44) PMGA (%) 4.9 (22.73)	Post-test–baseline RT (s) −0.04 (0.02) nMT (s/mm) −0.04 (0.04) nMU (times/mm) −0.03 (0.05) PV (mm/s) 2.34 (4.38) MGA (cm) −0.73 (1.29) PMGA (%) −5.28 (20.83) 3 months–baseline RT (s) −0.08 (0.03) nMT (s/mm) −0.07 (0.04) nMU (times/mm) −0.03 (0.04) PV (mm/s) 4.40 (4.00) MGA (cm) −0.99 (1.39) PMGA (%) −11.44 (19.93) 6 months–baseline RT (s) −0.11 (0.04) nMT (s/mm) −0.10 (0.04) nMU (times/mm) −0.05 (0.04) PV (mm/s) 5.80 (3.70) MGA (cm) −0.77 (1.29) PMGA (%) −6.72 (16.83)		Post-test–baseline RT (s) ES=0.133 (p=0.015) nMT (s/mm) ES=0.158 (p=008) nMU (times/mm) ES=0.027 (p=0.291) PV (mm/s) ES=0.004 (p=0.670) MGA (cm) ES=0.165 (p=0.006) PMGA (%) ES=0.055 (p=0.125) 3 months–baseline RT (s) ES=0.221 (p=0.001) nMT (s/mm) ES=0.494 (p<0.001) nMU (times/mm) ES=0.137 (p=0.049) PV (mm/s) ES=0.006 (p=0.608) MGA (cm) ES=0.084 (p=0.057) PMGA (%) ES=0.013 (p=0.454) 6 months–baseline RT (s) ES=0.137 (p=0.014) nMT (s/mm) ES=0.601 (p<0.001) nMU (times/mm) ES=0.136 (p=0.014) PV (mm/s) ES=0.013 (p=0.463) MGA (cm) ES=0.008 (p=0.564) PMGA (%) ES=0.005 (p=0.659)

Continued

Table 5 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
Chiu *et al*[34] (CA), [88]			Virtual reality.	Care as usual.		
	At baseline, at 6 weeks (after intervention) and at 12 weeks (6 weeks beyond the intervention).	Tracking task (elbow and index finger), S.	Week 6–baseline Elbow 0.03 (0.13) Finger 0.01 (0.07) Week 12–baseline Elbow 0.01 (0.14) Finger 0.02 (0.11)	Week 6–baseline Elbow −0.01 (0.13) Finger 0.02 (0.14) Week 12–baseline Elbow −0.04 (0.12) Finger 0.02 (0.11)		Week 6–baseline Elbow 0.04 (−0.03 to 0.11) Finger −0.01 (−0.07 to 0.05) Week 12–baseline Elbow 0.05 (−0.02 to 0.12) Finger 0.00 (−0.06 to 0.06)
		Power grip by PowerTrack IITM commander, S.	Week 6–baseline 4.9 (10.7) Week 12–baseline 7.1 (13.1)	Week 6–baseline 0.9 (7.5) Week 12–baseline 3.0 (9.5)		Week 6–baseline 4.0 (−0.8 to 8.8) Week 12–baseline 4.1 (−2.1 to 10.3)
		Nine-Hole Peg Test, S.	Week 6–baseline 0.0 (0.02) Week 12–baseline 0.01 (0.11)	Week 6–baseline 0.01 (0.03) Week 12–baseline 0.01 (0.03)		Week 6–baseline −0.01 (−0.02 to 0.00) Week 12–baseline 0.00 (−0.04 to 0.04)
		JTHFT, S.	Week 6–baseline 0.05 (0.06) Week 12–baseline 0.09 (0.07)	Week 6–baseline 0.05 (0.06) Week 12–baseline 0.10 (0.07)		Week 6–baseline 0.00 (−0.03 to 0.03) Week 12–baseline −0.01 (−0.05 to 0.03)
		CFUS, S.	Week 6–baseline Quantity 4.6 (9.9) Quality 3.9 (9.4) Week 12–baseline Quantity 8.1 (9.7) Quality 5.2 (10.3)	Week 6–baseline Quantity 0.1 (10.2) Quality 0.7 (7.8) Week 12–baseline Quantity 1.7 (12.3) Quality 1.7 (11.7)		Week 6–baseline Quantity 4.5 (−0.7 to 9.7) Quality 3.2 (−1.3 to 7.7) Week 12–baseline Quantity 6.4 (0.5 to 12.3) Quality 3.5 (−2.3 to 9.3)
Kim *et al*[90]			Strength training.	Centre-based occupational therapy or physiotherapy intervention.		
	Before and after the intervention (10 weeks).	Motion analysis: the left and right upper limbs were reached out five times with a convenient speed and fast speed, S.	Movement time (s) Comfortable speed: −0.4 (1.0) Fast speed: −0.1 (0.4) Mean velocity (cm/s) Comfortable speed: 7.4 (8.2) Fast speed: 14.1 (18.4) Normalised jerk score Comfortable speed: −11.8 (93.0) Fast speed: −53.2 (166.3) Shoulder mean angular velocity (cm/s) Comfortable speed: 18.0 (34.0) Fast speed: 17.8 (38.3) Elbow mean angular velocity (cm/s) Comfortable speed: 13.3 (36.9) Fast speed: 14.2 (38.0) Wrist mean angular velocity (cm/s) Comfortable speed: 5.1 (15.1) Fast speed: 14.6 (38.5) Shoulder normalised jerk score Comfortable speed: −50.8 (194.5) Fast speed: 16.0 (128.3) Elbow normalised jerk score Comfortable speed: −136.4 (596.9) Fast speed: −11.5 (375.8) Wrist normalised jerk score Comfortable speed: −552.3 (880.1) Fast speed: −206.8 (266.1)	Movement time (s) Comfortable speed: −1.1 (1.5) Fast speed: −0.6 (0.9) Mean velocity (cm/s) Comfortable speed: 21.5 (23.0) Fast speed: 33.1 (31.9) Normalised jerk score Comfortable speed: −168.3 (199.4) Fast speed: −199.4 (260.2) Shoulder mean angular velocity (cm/s) Comfortable speed: 42.7 (55.9) Fast speed: 64.5 (71.1) Elbow mean angular velocity (cm/s) Comfortable speed: 22.7 (24.8) Fast speed: 32.7 (31.9) Wrist mean angular velocity (cm/s) Comfortable speed: 21.8 (15.8) Fast speed: 38.8 (38.9) Shoulder normalised jerk score Comfortable speed: −107.3 (281.4) Fast speed: −127.8 (256.3) Elbow normalised jerk score Comfortable speed: −451.3 (472.3) Fast speed: −669.8 (994.6) Wrist normalised jerk score Comfortable speed: −633.3 (592.9) Fast speed: −630.0 (670.4)		No effect size.
Xu *et al*[92]			Constraint therapy and electrical stimulation.	Other home-based training programme.	Other home-based training programme.	
	At 2 weeks immediately after the hospital-based intervention, and at 3 and 6 months after the start of the home-based intervention.	Sphygmomanometry, S.	Results not described.			No effect size.

Continued

Table 5 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
		Upper extremity functional test, S.	Results not described.			No effect size.
		Global rating scale, S.	Results not described.			No effect size.
		Surface EMG (Flexcomp Infiniti surface EMG analysis system), S.	RMS of involved wrist extensors Week 2–baseline 12.8 (17.8) Month 3–baseline 21.9 (18.9) Month 6–baseline 31.3 (21.8) RMS of involved wrist flexors Week 2–baseline 6.7 (13.8) Month 3–baseline 17.3 (17.2) Month 6–baseline 27.1 (25.0) RMS of uninvolved wrist extensors Week 2–baseline −4.0 (9.0) Month 3–baseline −5.0 (9.5) Month 6–baseline −8.8 (8.6) RMS of uninvolved wrist flexors Week 2–baseline −3.8 (7.8) Month 3–baseline −5.6 (8.8) Month 6–baseline −8.4 (9.5) iEMG of involved wrist extensors Week 2–baseline 282.7 (335.3) Month 3–baseline 444.7 (392.6) Month 6–baseline 636.1 (416.1) iEMG of involved wrist flexors Week 2–baseline 200.6 (254.1) Month 3–baseline 308.5 (321.7) Month 6–baseline 428.4 (360.1) Cocontraction ratio Week 2–baseline −2.7 (4.2) Month 3–baseline −3.7 (4.6) Month 6–baseline −5.0 (5.4) iEMG of uninvolved wrist extensors Week 2–baseline 3.7 (62.2) Month 3–baseline −28.3 (92.5) Month 6–baseline −59.3 (92.3) iEMG of uninvolved wrist flexors Week 2–baseline 4.6 (36.4) Month 3–baseline −27.3 (77.4) Month 6–baseline −53.3 (106.0)	RMS of involved wrist extensors Week 2–baseline 9.1 (9.7) Month 3–baseline 16.8 (11.3) Month 6–baseline 24.9 (14.6) RMS of involved wrist flexors Week 2–baseline 6.6 (8.0) Month 3–baseline 15.1 (9.4) Month 6–baseline 24.2 (14.3) RMS of uninvolved wrist extensors Week 2–baseline −4.0 (4.0) Month 3–baseline −4.4 (4.0) Month 6–baseline −6.5 (5.3) RMS of uninvolved wrist flexors Week 2–baseline −3.9 (4.9) Month 3–baseline −4.6 (4.6) Month 6–baseline −6.9 (5.8) iEMG of involved wrist extensors Week 2–baseline 159.9 (180.7) Month 3–baseline 244.4 (199.9) Month 6–baseline 321.9 (256.1) iEMG of involved wrist flexors Week 2–baseline 155.0 (187.1) Month 3–baseline 232.7 (211.2) Month 6–baseline 301.7 (263.9) Cocontraction ratio Week 2–baseline −0.6 (1.2) Month 3–baseline −0.9 (1.2) Month 6–baseline −1.2 (1.3) iEMG of uninvolved wrist extensors Week 2–baseline 5.2 (28.9) Month 3–baseline −25.4 (42.9) Month 6–baseline −54.4 (56.5) iEMG of uninvolved wrist flexors Week 2–baseline 3.2 (26.5) Month 3–baseline −24.7 (43.0) Month 6–baseline −55.2 (52.6)	Results not described.	No effect size.
Abd El-Kafy *et al*[83]			mCIMT.	Other home-based training programme.		
	Pretreatment, immediately post-treatment (post 1: 4 weeks after the start of the intervention) and 3 months post-treatment (post 2).	PAFT, S.	Mean rank (n=14) Unilateral functional activities Post 1–baseline 1.21 Post 2–baseline 1.21 Bilateral functional activities Post 1–baseline 0.97 Post 2–baseline 0.33	Mean rank (n=13) Unilateral functional activities Post 1–baseline −1.31 Post 2–baseline −1.31 Bilateral functional activities Post 1–baseline −1.04 Post 2–baseline −0.35		No effect size.
		QUEST, S.	Mean rank (n=14) Post 1–baseline 6.14 Post 2–baseline 6.07	Mean rank (n=13) Post 1–baseline 3.38 Post 2–baseline 3.46		No effect size.
		Isokinetic muscular performances of the shoulder flexors, extensors and abductor muscles, S.	Shoulder flexor muscles Post 1–baseline 2.18 (2.6) Post 2–baseline 1.08 (2.3) Shoulder extensor muscles Post 1–baseline 2.32 (2.1) Post 2–baseline 1.93 (1.7) Shoulder abductor muscles Post 1–baseline 2.60 (2.0) Post 2–baseline 1.32 (2.0)	Shoulder flexor muscles Post 1–baseline 0.43 (2.1) Post 2–baseline 0.32 (1.7) Shoulder extensor muscles Post 1–baseline 0.26 (1.5) Post 2–baseline 0.18 (1.5) Shoulder abductor muscles Post 1–baseline 0.66 (2.2) Post 2–baseline 0.46 (2.1)		No effect size.

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Table 5 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
Bagley *et al*[35] (CA)			Home therapy programme.	Surgical intervention.	Drug intervention.	
	At entry into the study, at 6 months and at 12 months.	AHA, S.	12 months–baseline 2.5 (6.6)	12 months–baseline 1.2 (12.2)	12 months–baseline 1.6 (14.5)	No effect size.
		SHUEE, DPA and SFA.	SFA 12 months–baseline 3.8 (22.5) DPA 12 months–baseline –1.5 (19.9)	SFA 12 months–baseline 4.5 (26.7) DPA 12 months–baseline 21.2 (14.5)	SFA 12 months–baseline 4.3 (29.5) DPA 12 months–baseline 2.4 (20.0)	No effect size.
		Box and Blocks Test.	12 months–baseline 1.3 (12.3)	12 months–baseline 1.0 (10.0)	12 months–baseline –1.0 (12.6)	No effect size.
		Pinch and grip strength, S.	Results not described.			No effect size.
		Pediatric Outcomes Data Collection Instrument, S.	Results not described.			No effect size.
		COPM, S.	Results not described.			No effect size.
		CAPE, S.	Results not described.			No effect size.
Hoare *et al*[36 37] (CA)			mCIMT.	Other home-based training programme.		
	At baseline, 1, 3 and 6 months.	AHA, P.	Results not described.			1 month–baseline 0.62 (–1.47 to 0.22; p=0.14). 6 months–baseline 0.58 (–1.43 to 0.28; p=0.19)
		QUEST, S.	Results not described.			Dissociated movement ES=0.08 (p=0.47) Grasp domain ES=0.10 (p=0.38)
		PEDI, S.	Results not described.			Self-care functional skills ES=0.07 (p=0.51) Self-care caregiver assistance ES=0.02 (p=0.87)
		COPM, S.	Results not described.			COPM performance ES=0.03 (p=0.80) COPM satisfaction ES=0.03 (p=0.80)
		GAS.	Results not described.			Not provided.
Klingels *et al*[38] (CA)			mCIMT.	Other home-based training programme.		
	At baseline, after intervention and at 10 weeks follow-up.	AHA, P.	Results not described.			No effect size.
		Muscle tone, S.	Results not described.			No effect size.
		Strength, S.	Results not described.			No effect size.
		Melbourne Assessment, S.	Results not described.			No effect size.
		JTHFT, S.	Results not described.			No effect size.
		ABILHAND-Kids, S.	Results not described.			No effect size.
Koseotlu *et al*[39] (CA)			mCIMT and bimanual training.	mCIMT.		
	ns.	Unimanual capacity, P.	Results not described.			No effect size.
		Bimanual performance, P.	Results not described.			No effect size.
		Movement efficiency and speed of the affected hand, S.	Results not described.			No effect size.
		Active range of motion of the wrist and forearm, S.	Results not described.			No effect size.
		Level of independence in activities of daily living, S.	Results not described.			No effect size.

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Table 5 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
Novak *et al*[40] [41] (CA)			Home programme intervention.	Other home-based training programme.	Control group.	
	Baseline, at 4 weeks and at 8 weeks.	COPM, P.	Results not described.			4 weeks–baseline ES=2.4 (0.7 to 4.2) 8 weeks–baseline ES=1.4 (0.6 to 2.2)
		GAS, S.	Results not described.			Not provided.
		QUEST, S.	Results not described.			Not provided.
		CAPE, S.	Results not described.			Not provided.
Sakzewski *et al*[42] [43] (CA)			Distributed standard individualised therapy.	Centre-based occupational therapy or physiotherapy intervention.		
	Baseline, at 13 weeks and at 26 weeks.	Melbourne Assessment of Unilateral Upper Limb Function, S.	Results not described.			Not provided.
		JTHFT, S.	Results not described.			Not provided.
		AHA, S.	Results not described.			Not provided.
		COPM, S.	Results not described.			COPM performance 26 weeks–baseline EMD=4.7 (0.9 to 8.5; p=0.02) COPM satisfaction 13 weeks–baseline EMD=1.2 (0.01 to 2.3; p=0.03)
Crocker *et al*[89]			Forced use therapy.	Care as usual.		
	Three times during the presplinting and postsplinting phases, five times during the splinting phase, and once at the 6-month follow-up.	Videotaping, S.	Total frequency of use of the subject's right upper extremity for the behaviours recorded during the videotaped sessions averaged 20 observations between observers in the presplinting phase. In the splinting phase, the frequency increased by more than twofold to a mean of 48 observations per session, followed by a reduction during the postsplinting phase to a mean of 38 observations per session. At 6-month follow-up, a mean of 50 observations were recorded by two observers.			Not provided.
	Once during each phase.	Fine motor domain of PDMS-2, S.	The total score increased by 9 points from the presplinting to the splinting phase, increased by 17 points from the splinting to postsplinting phase, and decreased at 6-month follow-up to a score similar to that obtained in the splinting phase.			Not provided.
	During intervention period.	Daily log by the parents, S.	The subject did not use her more-involved extremity to bring finger foods to her mouth during the daily feeding task at any time during the study.			Not provided.
	During intervention period.	Qualitative observations by the parents, S.	The mother's observations corroborated the findings.			Not provided.

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Table 5 Continued

Authors	Measurement time points	Outcome measure, primary (P) or secondary (S)	Results: intervention group	Results: comparator group (1)	Results: comparator group (2)	Results between groups (difference or ES (95% CI; p value))
Naylor and Bower[91]			mCIMT.	No therapy.		
	At baseline, 4 weeks (start of experimental intervention), 8 weeks (end of experimental intervention), 12 weeks (follow-up).	QUEST, P.	Baseline observation period (A) (difference after and before) 1.226 (1.382) (95% CI 2.288 to 0.164) Treatment period (B) (difference after and before) 10.907 (4.649) (95% CI 14.480 to 7.333) Follow-up period (A) (difference after and before) 1.188 (1.246) (95% CI 2.146 to 0.230)			No effect size.
Coker *et al*[94]			mCIMT.	Other home-based training programme.		
	Initial evaluation, at the end of first baseline phase A (A1), the end of the first intervention phase B (B1), the end of the second baseline phase A (A2), the end of the second intervention phase B (B2), and at 6-month follow-up.	PDMS-2, S.	The child in this study improved his gross and fine motor movement patterns after participation in mCIMT and demonstrated motor skills average for his chronological age despite motor deficits resulting from a right-sided hemiparesis. These new motor movements were maintained during non-intervention phases of this study and after a 6-month follow-up evaluation when he was not receiving mCIMT. The child showed greater motor progress during mCIMT periods than when participating in traditional weekly therapy sessions. This was especially evident during the first mCIMT intervention phase (B1).			Not provided.
		GMFM-88, S.				Not provided.
	Repeated measures during phases A1, B1, A2 and B2.	Videotaping of unstructured play, S.				Not provided.
Gross *et al*[96]			Target joint movements.	Centre-based occupational therapy or physiotherapy intervention.		
	Baseline phase: 1–6 measurements; training phase: 1–6 measurements; follow-up: 1 measurement.	Target joint movements measured from videotapes using a goniometer, P.	Arm extension was stable during the baseline and follow-up phase, and a large increase was seen during the training period.			Not provided.

ADL, Activities of Daily Life; AHA, Assisting Hand Assessment; BOTMP, Bruininks-Oseretsky Test of Motor Proficiency; CA, conference abstract; CAPE, Children's Assessment of Participation and Enjoyment; CFUS, Caregiver Functional Use Survey; COPM, Canadian Occupational Performance Measure; DPA, dynamic positional analysis; EMD, estimated mean difference; EMG, electromyography; ES, effect size; GAS, Goal Attainment Scale; GMFM-88, Gross Motor Function Measure-88; JTHFT, Jebsen-Taylor Hand Function Test; mCIMT, modified Constraint-Induced Movement Therapy; MGA, Maximum Grip Aperture; nMT, normalized Movement Time; nMU, normalized Movement Unit; ns, not specified; PAFT, Pediatric Arm Function Test; PDMS-2, Peabody Developmental Motor Scales, Second Edition; PEDI, Pediatric Evaluation of Disability Inventory; PMGA, percent time where MGA occurs; PV, Peak Velocity; QUEST, Quality of Upper Extremity Skills Test; RMS, Root Mean Square; RT, Reaction Time; SFA, spontaneous functional analysis; SHUEE, Shriners Hospital for Children Upper Extremity Evaluation; WeeFIM, Functional Independence Measure.

(96.1%) reported by Ferre *et al*[56] may be due to the fact that they employed a strict selection of participants. Eleven parents and their children met the inclusion criteria and were willing to commit to the programme requirements. One family dropped out after 4 weeks because the programme was too demanding. Adjoining, they provided intensive coaching sessions to parents. Chiu *et al*[98] reported a compliance of 99%. This may be due to the fact that the therapy demand was low: only 20 min a session, three times per week, over 8 weeks. In addition, both parents and children were highly satisfied with the therapy. Overall, studies reported that parents were positive about their experiences with the programmes. They found it easy to carry out the programme and enjoyed seeing their children improve. However, there were also parents who found it difficult to incorporate the programme in their daily life routine. Parents indicated that it was difficult to find enough hours in a day to perform the programme next to their daily activities.[55] When the parent who delivered the programme got support and help from other family members, it was easier for them to implement the training in their daily routine.[66] Despite these difficulties reported, general parental stress did not increase during the intervention.[56 58]

Conclusions about the effectiveness of home programmes cannot be made due to the large variability in the study, patient and intervention characteristics, comparators, and outcome measures used in the included studies. Even within the same treatment approach, frequency and duration of the interventions varied. As training intensity is an important predictor for treatment success, improvement in arm-hand function and performance can therefore not be solely attributed to the intervention approach.

Many different treatment approaches were found in the included studies. Majority of studies reported on the effectiveness of (modified) CIMT, whereas only three studies[56 100 110] investigated the effect of bimanual training. Both treatment approaches have shown to be effective in clinical rehabilitation. However, most daily activities require bimanual use of hands. Therefore, an intervention focusing on the coordinated use of both hands in bimanual activities may have more impact on the child's daily life than a modified CIMT programme focusing on improving the capacity of the affected hand.

According to Sakzewski *et al*,[5] upper limb interventions in children with unilateral CP should be goal-directed, adequately dosed and based on motor learning approaches that use activity-based therapy. Most studies found in this review did not specify whether their intervention was based on motor learning principles. Some studies indicated that they used shaping and repetitive task practice, implying that the intervention was based on motor learning principles. The question which motor learning approach in the specific context of parent-delivered programmes is best suitable, remains, therefore, unanswered. Protocols from existing intramural programmes may not always be feasible in a home setting, where parents are supervising the training of the child. They need to instruct their children and prompt the use of the affected hand over and over again. Continuous prompting may pose an important stress factor on parents.[111] Studies on basic motor learning in children with movement disorders have shown that implicit motor learning has positive effects on motivation and compliance and may therefore be better suited for a home setting.[112–114] There is also evidence indicating that children with CP often have problems with working memory, making it difficult for them to learn in an instruction-driven way.[115] Moreover, implicit learning may lead to increased self-efficacy, which is important for motivation and compliance. Parents and clinicians rate motivation as the most influential personal characteristic, determining outcome and treatment adherence.[116] An implicit motor learning approach seems very promising and should be explored in future studies.

Coaching of parents is a key element of home-based programmes. When parents are effectively coached by therapists and guided throughout the training period, parents become more confident in carrying out the home-based programme and find it easier to implement the programme in their daily routine.[11 66] Surprisingly, information on how parents were coached to be therapy providers was lacking in a lot of the reported studies. Perhaps coaching received little attention during the interventions. Information on parent characteristics was also hardly given. Inferences about why some parents find it easy to carry out a home programme while others struggle with finding ways to do so cannot be made. The fact that only two studies[56 79] reported on a parent-related outcome measure is also surprising given the major role of parents in the execution of a home-based programme.

In conclusion, one can state that a detailed description of home-based training protocols in most intervention studies is lacking. An extensive description of interventions tested may take up many words, but provides crucial information that increases our understanding on the working mechanism of an intervention. We therefore plea in favour of writing protocol papers before publishing results.

Study limitations

Due to the large variability in study, participants and intervention characteristics, as well as child-related outcome measures found in the included studies, a meta-analysis on outcome measures was not possible. Although home-based training seems to be promising as most studies showed positive changes in child-related outcome measures, hard evidence on the effectiveness of these programmes cannot be given. This also means that guidelines to improve existing home-based programmes or to develop new home programmes are still awaited. As no synthesis of evidence was possible, the Grading of Recommendations Assessment, Development and Evaluation guidelines to judge the quality of evidence was not relevant and could not be used.[117] With this, the review deviates from the protocol published by Beckers *et al*.[16]

Recommendations for future research would be to develop a core set of outcome measures incorporating all ICF levels to investigate the effects of interventions. In addition, the outcome measures should be validated for the total population of children with CP, including all types of CP, and should have good usability. Furthermore, parent-related characteristics, intervention elements and outcome measures should be part of and described in detail in studies investigating home-based programmes. Finally, future studies should focus on the comparison of two different home-based programmes using a different motor learning approach while keeping aforementioned characteristics the same.

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