



Home-based physiotherapy programmes for individuals with neurological diseases: systematic review

Programas de fisioterapia Home-based para indivíduos com doenças neurológicas: revisão sistemática

Programas de fisioterapia Home-based para individuos con enfermedades neurológicas: revisión sistemática

Paulo Roberto Fonseca Junior ^[a,b], Paola Pinto Souza ^[a], Kelly Kuguio Maurino dos Reis ^[a],
Eduardo Filoni ^[c]*

^[a] Universidade Guarulhos (UnG), Guarulhos, SP, Brazil

^[b] Faculdade de Ciências Médicas Santa Casa de São Paulo (FCMSCSP), São Paulo, SP, Brazil

^[c] Universidade Mogi das Cruzes (UMC), Mogi das Cruzes, SP, Brazil

Abstract

Introduction: Home-based programmes have received increasing attention in rehabilitation, providing an opportunity to continue aspects of therapy, benefiting the retention of established intervention effects.

Objective: To describe the available home-based physiotherapy programmes in neurorehabilitation for people with neurological diseases. **Method:** MEDLINE, EMBASE, Cochrane Library, OTseeker and PEDro were searched, no restrictions regarding the date of publication or language restrictions for randomized controlled clinical trial. The quality of the selected studies using the PEDro scale and the Cochrane Collaboration's tool

* PRFJ: MS, e-mail: paulofonseca28@gmail.com
PPS: BS, e-mail: paola.psousa2014@gmail.com
KKMR: BS, e-mail: kelly_kuguio@yahoo.com.br
EF: PhD, e-mail: edufiloni@hotmail.com

for assessing the risk of bias. **Results:** Fifteen articles met the eligibility criteria and quality assessment and were selected for the present systematic review. The findings supports the positive impact of home-based intervention, finding evidence in the changes in activity level, improvement in the control and muscle strength, balance and walking in patients with neurological conditions who perform rehabilitation program at home, with a good adherence of participants in total. **Conclusion:** Models of rehabilitative such as home-based programmes can be an alternative efficient method to deliver rehabilitation, showing to be beneficial in improving different aspects of activities, and participation.

Keywords: Nervous System Diseases. Neurology. Home Care Services. Rehabilitation. Physical Therapy Specialty.

Resumo

Introdução: Programas home-based têm recebido atenção crescente na reabilitação, proporcionando uma oportunidade para continuar os aspectos da terapia, beneficiando a retenção de efeitos de intervenção estabelecidos. **Objetivo:** Descrever os programas de fisioterapia home-based disponíveis na neuroreabilitação para pessoas com doenças neurológicas. **Método:** MEDLINE, EMBASE, Biblioteca Cochrane, OTseeker e PEDro foram pesquisados, sem restrições quanto à data de publicação ou restrições de idioma para ensaios clínicos randomizados controlados. A qualidade dos estudos selecionados usando a escala PEDro e a ferramenta Cochrane Collaboration para avaliar o risco de viés. **Resultados:** Quinze artigos preencheram os critérios de elegibilidade e avaliação de qualidade e foram selecionados para a presente revisão sistemática. Evidências foram encontradas sobre mudanças no nível de atividade, melhora no controle e força muscular, equilíbrio e deambulação em pacientes com condições neurológicas que realizam um programa de reabilitação home-based, com boa adesão dos participantes no total. **Conclusão:** Os modelos de reabilitação, como os programas home-based, podem ser um método eficiente alternativo para promover a reabilitação, mostrando-se benéficos na melhoria dos diferentes aspectos das atividades e na participação.

Palavras-chave: Doenças do Sistema Nervoso. Neurologia. Serviços de Assistência Domiciliar. Reabilitação. Fisioterapia.

Resumen

Introducción: Los programas home-based han recibido una atención creciente en la rehabilitación, proporcionando una oportunidad para continuar los aspectos de la terapia, beneficiando la retención de efectos de intervención establecidos. **Objetivo:** Describir los programas de fisioterapia Home-Based disponibles en la neurorehabilitación para personas con enfermedades neurológicas. **Método:** MEDLINE, EMBASE, Biblioteca Cochrane, OTseeker y PEDro fueron investigados, sin restricciones en cuanto a la fecha de publicación o restricciones de idioma para ensayos clínicos randomizados controlados. La calidad de los estudios seleccionados mediante la escala PEDRO y la herramienta Cochrane Collaboration para evaluar el riesgo de sesgo. **Resultados:** Quince artículos cumplieron los criterios de elegibilidad y evaluación de calidad y fueron seleccionados para la presente revisión sistemática. Se encontraron evidencias sobre cambios en el nivel de actividad, mejora en el control y fuerza muscular, equilibrio y deambulación en pacientes con condiciones neurológicas que realizan un programa de rehabilitación Home-Based, con buena adhesión de los participantes en el total. **Conclusión:** Los modelos de rehabilitación, como los programas Home-Based, pueden ser un método eficiente alternativo para promover la rehabilitación, mostrándose beneficiosos en la mejora de los diferentes aspectos de las actividades y en la participación.

Palabras clave: Enfermedades del Sistema Nervioso. Neurología. Servicios de Atención Domiciliar. Rehabilitación. Fisioterapia.

Introduction

Neurorehabilitation research has progressed substantially over recent decades. Physical therapy (PT) for neurological patients is a comprehensive process that intends to teach, guide, and promote brain plasticity, thus preserving brain, muscle, and neuromuscular function, being critical to health and quality of life [1-3]. Adherence with treatment is an important factor which can influence the outcome of that treatment. Adherent patients may have better treatment outcomes than nonadherent patients. Poor adherence to treatment has been identified across many healthcare disciplines including physiotherapy, having implications on treatment cost and effectiveness. Within physiotherapy, the concept of adherence is multi-dimensional and could relate to attendance at appointments, following advice, undertaking prescribed exercises, frequency of undertaking prescribed exercise, correct performance of exercises or doing more or less than advised [4-6].

In recent years, home-based programmes have received increasing attention in rehabilitation. These programmes are a useful addition to physiotherapy for a number of reasons. Home-based programmes provide a unique opportunity to continue aspects of therapy, either in between centre-based sessions or after centre-based therapy has ended, benefiting the retention of established intervention effects [7, 8]. They also increase parental or caregivers involvement and empowerment, contributing to parents and health professionals to learn from each other and share each other's perspectives on the rehabilitation. The home-based programmes is considered cost-effective and may be the preferred or even the only feasible option in specific contexts, for example, in cases where long distances need to be travelled from the patient's home to the institution [9-11].

The information and communication technology (ICT), such as telerehabilitation (TR), which is transmitted by phone or video, represent an alternative method to deliver therapy in a setting convenient to the patient, such as their home, by minimizing the barriers of distance, time, cost and health care system load [12-14]. However, In the aspect of rehabilitation method, the overall rehabilitation scheme does not integrated TR devices (such as audiovideo conference, use of

the internet) and concrete rehabilitation exercises (for example, electrostimulation) together [15-17]. Moreover, in some reviews, the effects of TR were of low level of evidence [12, 15-19]. The lack of convenience is an important barrier to consumer use of interactive health ICT. Patients are less likely to use systems requiring access to equipment or technology that did not fit seamlessly into their normal daily routines. Technical issues often prevented consistent use of health ICT systems, especially among studies conducted on early system prototypes [19, 20].

The major aim of this review is to describe the currently available home-based physiotherapy programmes in neurorehabilitation for people with neurological diseases and to introduce the main rehabilitation approaches, their effects and adherence.

Methods

Protocol and registration

The PRISMA indication (preferential report items for Systematic Analyzes and Meta-analyzes) for conducting reviews of intervention studies was followed [21, 22]. This systematic review of the literature was also recorded in the PROSPERO database (CRD42018093687).

Sources of data and search strategy

We searched the following databases: MEDLINE (by PubMed), EMBASE, Cochrane Library, OTseeker and PEDro. The articles were searched using the terminology registered in the Medical Subject Headings of the U.S. National Library of Medicine (Mesh). The following terms were used for the literature search: 'Nervous System Diseases', 'Home Care Services', 'Physical Therapy Modalities'. Specifically, papers that were included in this review were required to have the term ('Nervous System Diseases' OR 'neurological disorder' OR 'neurological pathology' OR 'stroke' OR 'CNS infection' OR 'Parkinson's disease' OR 'essential tremor' OR 'epilepsy' OR 'head injury' OR 'multiple sclerosis' OR 'primary brain tumors' OR 'traumatic brain injury' OR 'Huntington's disease' OR 'cerebellar ataxia' OR 'spina bifida' OR 'cerebral palsy' OR 'muscular dystrophies' OR 'dystonia,')

AND ('Home Care Services' OR 'Home' OR 'in-home' OR 'home-based' OR 'self care' OR 'residence' OR 'domiciliary') AND ('Physical Therapy Modalities' OR 'exercise' OR 'therapy' OR 'therapies' OR 'program' OR 'train' OR 'physiotherapy') located within the title and/or abstract. In addition to the systematic electronic database search, a targeted search of the bibliographies of relevant articles was also performed to identify any additional studies for inclusion.

Study selection

An initial analysis was performed based on the title and abstract. Titles and abstracts were displayed and selected by two independent researchers to identify the relevant studies. When the title and abstract were unclear, the full text was read. The full texts of articles considered possibly relevant were analyzed to determine whether the articles met the eligibility criteria. In cases of divergence of opinion or doubts about the relevance of article, a third researcher analyzed the texts in question to reach a consensus.

Eligibility criteria

The following were the inclusion criteria: randomized controlled clinical trial, no restrictions regarding the date of publication or language restrictions, involving subjects diagnosed with any neurological disease, intervention with home-base physiotherapy program based on a motor recovery program. The exclusion criteria was: Pilot study; protocol study; cross-over study; subjects without neurological diseases; clinical trials that do not have a control group; studies based only on cognitive function interventions; interventions based on the use of telerehabilitation.

Quality assessment

The pre-selected articles were evaluated and scored for methodological quality using the PEDro scale [23]. The classification of the selected studies was performed by two independent researchers blinded to the objectives of the present review. In cases of a divergence of opinion, a third researcher made the decision regarding the score. For inclusion

in the present review, all articles needed to achieve a score of 6 points or higher on the PEDro scale.

We conducted a sensitivity analysis through the Cochrane Collaboration tool for bias risk assessment of randomized clinical trials [24], to investigate the robustness of the results to each of the 'Risk of bias' components by including only studies that were at low risk of bias for the most part. We used this information to guide our judgements on the quality of the evidence together with the PEDro quality assessment.

Results

Seven hundred and ninety-eight articles were retrieved from the databases searched. After the analysis of the titles, abstract and complete texts and the quality assessment using the PEDro scale (Table 1), only fifteen articles met the eligibility criteria and achieved a quality score of 6 points or higher. Figure 1 displays the flowchart of the selection process.

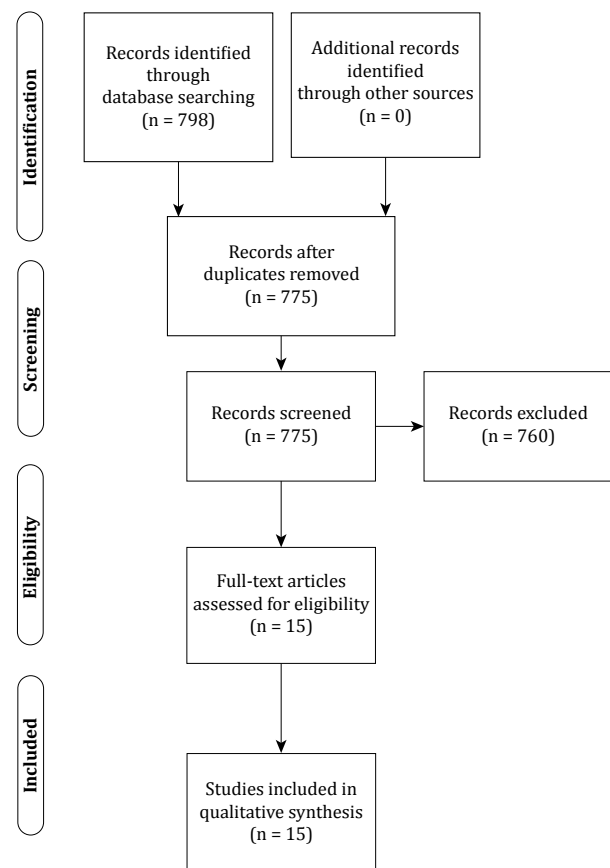


Figure 1 – Overview of article selection process.

Table 1 – Methodological quality and reporting of eligible studies (n = 15)

Study	PEDro Scale Items ^a										Risk of bias							
	1	2	3	4	5	6	7	8	9	10	Score	Random allocation	Allocation	Blinding of patients, personnel assessors	Blinding of outcomes assessors	Incomplete outcome data	Selective outcome reporter	Other
Lin et al. [25]	Y	N	Y	N	N	Y	Y	N	Y	Y	06/10	Low	High	Low	Low	Low	Low	Low
Ashburn et al. [26]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Baskett et al. [27]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Chaiyawat et al. [28]	Y	Y	N	N	N	N	Y	Y	Y	Y	06/10	Low	Low	High	Low	Low	Low	Low
Adie et al. [29]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Barzel et al. [30]	Y	N	Y	N	N	Y	Y	Y	Y	Y	07/10	Low	High	Low	Low	Low	Low	Low
Chan et al. [31]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Chen et al. [32]	Y	N	Y	N	N	Y	Y	N	Y	Y	06/10	Low	High	Low	Low	Low	Low	Low
Hasset et al. [33]	Y	N	Y	N	N	N	Y	Y	Y	Y	06/10	Low	High	High	Low	Low	Low	Low
Hui-Chan et al. [34]	Y	N	Y	N	N	Y	N	Y	Y	Y	06/10	Low	High	Low	Low	Low	Low	Low
Hoang et al. [35]	Y	Y	Y	N	N	Y	Y	N	Y	Y	07/10	Low	Low	Low	Low	High	Low	Low
Ortiz-Rubio et al. [36]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Standen et al. [37]	Y	Y	Y	N	N	Y	Y	N	Y	Y	07/10	Low	Low	High	Low	High	Low	Low
Wang et al. [38]	Y	Y	Y	N	N	Y	Y	Y	Y	Y	08/10	Low	Low	Low	Low	Low	Low	Low
Yang et al. [39]	Y	N	Y	N	N	Y	Y	Y	Y	Y	07/10	Low	High	Low	Low	Low	Low	Low

Note: ^a 1: random allocation; 2: concealed allocation; 3: baseline comparability; 4: blinded participants; 5: blinded therapists; 6: blind assessors; 7: adequate follow-up; 8: intention-to-treat analysis; 9: between-group comparisons; 10: point estimates and variability. Y: yes; N: no.

Methodological quality

All fifteen studies included were randomized controlled trials [25-39] and were randomized in a blinded manner. Following the appraisal of methodological quality PEDro and Cochrane Collaboration tool, all studies performed well in terms of internal validity (randomization) as well as the results and quality of reporting (e.g., incomplete outcomes, selective outcome reporting and other biases). Although the controlled and randomized trials included in this review are of good methodological quality (mean PEDro score was 7.0) and are currently considered the gold standard in evidence-based medicine, the subjects and therapists were not blinded in any included study. The blinding of subjects and therapists is difficult in studies that involve interventional or surgical procedures [40].

Home-based intervention characteristics

Detailed information about the home-based interventions evaluated in the included studies is presented in Table 2. The interventions used in the included studies varied and generally consisted of the use of a low-cost home rehabilitation program based on functional tasks or rehabilitation exercises that required balance and resistance exercises. All studies were conducted in patients' homes, and the patients receive information and instruction about the programme of exercises and activities to be carried out at home.

In the included studies, the monitoring of activities was carried out through of daily logs [25], parental supervision [25, 32] home visits [26-28, 30, 31, 37],

telephone calls [29, 35, 38], or closely monitored by the physiotherapist-in-charge [33, 36, 39]. Only one study did not carry out monitoring of adherence during the intervention phase [33]. Three studies used the Constraint-Induced Movement Therapy (CIMT) to improve unilateral and bilateral motor performance and daily functions in individuals with Cerebral Palsy (CP) [25, 32] and Stroke [30]. Four included studies used exercise programmes based on conventional rehabilitation, involving strength training, cardiorespiratory fitness training, balance and walking training [26-28, 33, 36]. One of these studies provided the exercises through DVDs [28]. The neurological population that performed these conventional rehabilitation programs varied among individuals with Stroke [27, 28], Parkinson's Disease [26] and Traumatic Brain Injury [33].

Others three studies used virtual reality rehabilitation programme to improve arm function [29, 37] and balance [39]. One study utilized a step training mat, connected wirelessly to the television by a console, to improve balance, stepping, cognition and functional performance in people with Multiple Sclerosis [35]. Transcutaneous electrical nerve stimulation (TENS) was used in combination with task-related training in two included studies [31, 34], with the aim of treatment on spasticity [31] and muscle strength [34] in Stroke patients. One study used a home-based program of music therapy associate with resistance exercise to investigate the effect of additional patterned sensory enhancement on gross motor capacity, functional strength, daily mobility and self-care functions, and walking speed in children with CP [38].

Table 2 – Characteristics of studies included in systematic review (n = 15)

Study/year	Population (n)	Home-based intervention	Time	Results	Adherence (drop outs)
Lin et al. 2011 [25]	Hemiplegic or quadriplegic Cerebral Palsy (CP) n = 22	Constraint-induced therapy (CIT)	3.5–4 h a day, twice a week for 4 weeks	Significant increase on manual grip control, unilateral / bilateral motor efficacy and unilateral hand function immediately after treatment and after 6 months follow-up. Decreased in the dysfunctional parent-child interaction immediately after CIT.	One child failed to adhere to the requirement of restraint of the less affected hand and dropped out.
Ashburn et al. 2007 [26]	Parkinson's disease n = 70	Exercise programme with six levels of exercise progression: muscle-strengthening, range of movement, balance training, walking and strategies for falls prevention.	1h a day, daily for 6 weeks	There was a lower rate on falls after 8 weeks and 6 months and lower rates of injurious falls needing medical attention at 6 months. There was a positive effect of exercises at 6 months on Functional Reach and quality of life.	3 subjects were lost to follow-up at 8 weeks and a further 3 were lost to follow-up at 6 months. 64 of the 70 participants randomised to exercises had six treatment sessions, 5 had seven sessions and 1 had two sessions.
Baskett et al. 1999 [27]	Stroke n = 50	Exercises programme and activities with functional approach that incorporate established goals for restoration, or improvement, of normal activities within the home and rehabilitation exercises requiring coordination, balance and a bilateral approach.	Several times a day, during 3 months period.	No statistical differences between the hospital therapy group and supervised home-based group in characteristics, or in any outcomes measured, except that the contact time period.	In the six-week assessment, three subjects could not attend because of illness, one missed the appointment and four withdrew. At the final assessment, three months after discharge, 44 were assessed, with four withdrawn and two too ill to attend. Those who withdrew did so from personal choice, or because they had moved away from the study catchment area.
Chaiyawat et al. 2012 [28]	Stroke n = 30	Rehabilitation programme involved standard materials on a DVD of rehabilitation procedures for passive exercise, active exercise, resistance exercise, and activities of daily living (ADL).	6 months	Over 2 years, the functional capacity and incidence of depression were significantly improved.	There were no serious adverse events. Compliance with the intervention, based on daily records, was 92–95%.
Adie et al. 2016 [29]	Stroke n = 235	Wii™ sports games vs tailored arm exercises	45 minutes per day, for 6 weeks.	No significant difference of affected arm function at six weeks follow-up and no significant difference in the occupational performance, quality of life or arm function at six months, between the two groups.	Nine patients in the control group and six patients in the Wii group discontinued participation during treatment. Six patients in each group were lost to follow-up.
Barzel et al. 2015 [30]	Stroke n = 85	Home Constraint-Induced Movement Therapy (CIMT)	2 h each weekday, for 20 days. (Total of 40 h)	Home CIMT group improved movement quality more the standard therapy group. Both groups improved in motor function performance time.	82 (96%) patients in the home CIMT group completed treatment and were assessed at 4 weeks. Nine adverse events (of which six were serious) were reported in the home CIMT group. However, none was deemed related to the study intervention.
Chan et al. 2015 [31]	Stroke n = 37	Transcutaneous Electrical Nerve Stimulation (TENS) + Task Related Trunk Training (TRTT) vs placebo-TENS + TRTT	5 sessions per week, for 6 weeks (total of 30 sessions)	Both groups had significantly greater improvements in isometric peak trunk flexion torque and extension torque, lateral seated reaching distance to affected and unaffected side, and improve in trunk motor control after 3 weeks of training. The TENS + TRTT group had significantly greater and earlier improvement in its mean of trunk motor control.	There were no serious adverse events. All the subjects completed at least 85% of the treatment protocol (≥ 26 hours of the training).

(To be continued)

(Conclusion)

Study/year	Population (n)	Home-based intervention	Time	Results	Adherence (drop outs)
Chen et al. 2014 [32]	Unilateral spastic CP n = 45	Home Constraint-induced therapy (hCIT) vs traditional rehabilitation (TR) therapy	3.5-4 hours/day, twice weekly, for 4 weeks	The hCIT group showed a shorter reaction time and normalized movement time, smaller maximum grip aperture, and fewer normalized movement unit in the reach-to-grasp movements, and improved more in the main functional outcome measures at post-treatment and follow-up than the TR group.	One child was unable to complete the follow-up, and two were excluded from the analysis because their motor ability was insufficient to complete the standardized study procedure. None drop-out was deemed related to the study intervention.
Hasset et al. 2011 [33]	Adults with traumatic brain injury n = 30	Home exercise program which is in line with usual care.	1-hour sessions per week for 12 weeks	Greater injury severity, older age and a pre-injury exercise history of walking or jogging positively influenced exercise adherence. As a combined set the three predictor variables accurately classified 82% of participants as adherent or nonadherent and were able to explain 49% of the variance.	The participants' adherence to the study was 82%. None drop-out was related.
Hui-Chan et al. 2009 [34]	Stroke n = 109	TENS vs TENS + Task-related training (TRT)	60 minutes or 2hour/day, 5days a week, for 4 week	TENS with TRT was superior to the other interventions for improving motor functions, gait velocity, increase in ankle plantarflexion torque and distance covered during the 6-minute walk test and decrease in the Timed Up and Go score.	92.7% of patients completed the treatment and were assessed at 2 and 4 weeks. 8 (7.3 %) subjects dropped out from the study.
Hoang et al. 2015 [35]	Multiple Sclerosis (MS) n = 28	Step training intervention	At least two 30-minute training sessions per week, for 12 weeks.	Significant increase on choice stepping reaction time, stiroop stepping test time, tests of sway with eyes open, single and dual task gait speed, Multiple Sclerosis Functional Composite and reduced of Nine Hole Peg Test (9-HPT) times.	Five participants (18%) withdrew due to either family matters or a relapse of MS.
Ortiz-Rubio et al. 2016 [36]	Multiple Sclerosis (MS) n = 37	Upper limb training program.	Two 60-minute sessions per week for 8 consecutive weeks	Significant improvement was found on motor function of the arm, manual dexterity, handgrip strength and finger prehension force.	All the patients completed the treatment. No adverse effects were reported by any patient
Standen et al. 2017 [37]	Stroke N = 17	Virtual reality system	8 weeks.	Significantly greater on grip strength and improvement of motor activity of the arm.	Four participants withdrew due to health problems or going on holiday.
Wang et al. 2013 [38]	Cerebral Palsy N = 36	Patterned sensory enhancement (PSE) music with resistance exercise vs resistance exercise with no music	3 times per week, for 6 weeks.	PSE group improved significantly greater than the no-music group in the Gross Motor Function Measure (GMFM) dimensions D and Goal dimensions, persisted for at least 6 or 12 weeks.	Three children did not complete the program. One because the parents were unable to supervise exercise the exercise, the second child due to participation in another rehabilitation program, and the third child discontinued due to severe fever.
Yang et al. 2016 [39]	Parkinson's diseases N = 23	Virtual reality balance training vs Conventional balance training	50 minutes per session, 12 sessions, for 6 weeks.	Both groups performed better in the Berg Balance Scale, Dynamic Gait Index, timed Up-and-Go test, and Parkinson's Disease Questionnaire at posttest and follow-up than at pretest.	Three participants dropped out during the intervention period. One participant in the experimental group stopped because she preferred conventional balance training. One participant in the control group stopped because of personal reasons. The reason of withdrawal of the third participant was not reported.

Effects of home-based interventions

Pooling of data from included studies was confounded by heterogeneity amongst the trials mentioned above and all included studies were critiqued qualitatively rather than attempting a meta-analysis.

All studies reported changes in motor recovery level in the home-based physiotherapy programmes (n = 804 participants) (Table 2). Two studies reported no significant difference in the experimental group compared to the control group. However, both groups had interventions performed at home and obtained improvement was seen from baseline [27, 29]. Three studies showed a significant improvement in functional activity in the intervention group in the post-intervention evaluation, remaining after 6 months [25, 26] and 2 years of follow-up [28]. Five studies showed a significant improvement in the control and muscle strength of trunk [31] and upper limb [25, 32, 36, 37]. Others five studies [26, 33-35, 39] showed that a home-based physiotherapy programme improved the balance, walking, and falls prevention.

Only one study [29] reported data on cost-effectiveness, showing no difference in mean quality-adjusted life years between the two groups. However, the Wii™ used to virtual therapy rehabilitation was more expensive than arm exercises.

Adherence to home-based intervention

Table 2 summarizes the dropouts and barriers to treatment adherence for each included study. In three studies [25, 38, 39], lack of adherence was reported because of the treatment performed. In two of these three studies [38, 39], the child preferred to undertake another rehabilitation program. In the third study [25], a child failed to meet the least affected hand restriction requirement at the CIMT and drop out. Seven studies [27, 30, 32, 35, 37-39] had dropout due to adverse events, health problems or either family matters. However, none was deemed related to the study intervention. Three studies [26, 29, 32] showed loss of follow-up, with no specific reasons. One study [29] did not report the reason for loss of adherence to treatment. In four studies [28, 31, 33, 36], all the patients completed the treatment and no adverse effects were reported by any patient.

Despite the dropout reported in the studies, there was good adherence: of the 804 participants, 50 were lost, the majority were not due to the use of the home-based intervention. Of the 11 studies [25-27, 29, 30, 32, 34, 35, 37-39] that presented dropouts, seven [26, 27, 29, 30, 34, 38, 39] used intention-to-treat analysis.

Discussion

This systematic review applied a multipronged and broad approach to assimilate published literature to provide the wider picture of currently available evidence, by including randomized controlled clinical trials. Were summarised the results from 15 moderate to high quality studies. The home-based physiotherapy programmes evaluated in the included studies showed marked heterogeneity in terms of characteristics, type and mode of delivery of the interventions, treatment and control protocols and length of follow-up.

Moderate to high quality evidence supports the positive impact of home-based intervention for individuals with neurological conditions, such as CP [25, 32, 38], Parkinson's Diseases [26, 39], Stroke [27-31, 34, 37], Traumatic Brain Injury [33] and Multiple Sclerosis [35, 36]. This systematic review found evidence that changes in activity level, improvement in the control and muscle strength, balance and walking can be found in patients with neurological conditions who perform rehabilitation program at home. There was no evidence for the cost-effectiveness of these programmes and for the best type/mode/intensity (frequency and duration) of interventions or superiority of one intervention over another.

Poor caregiver support or activity and the child's preference for the type of treatment were the main reasons for barriers to treatment adherence of studies involving children [25, 32, 38]. In the most studies involving adults with neurological conditions, health problems, discontinuation for personal reasons, and low in-follow up adherence were barriers to treatment adherence [26-31, 33-37, 39].

Rehabilitation is a complex intervention, defined as "complex" where the active ingredient in the intervention is not easily identifiable. There are many challenges in in choosing the type of intervention. Firstly, individuals with neurological diseases can present with diverse clinical presentations and with varying levels of disability, requiring an individualized

approach. The perspectives of patients (and/or caregivers), is often neglected and needs to be incorporated in any treatment programmes including home-based intervention, especially in interventions performed on children. Despite the possible dropouts and withdrawals during the execution of a home-based programme, often the reason for giving up is not related to the intervention, but due to family or health problems, as found in our study.

Limitations in the methodology and the completeness of this review cannot be ruled out. For the reason that this systematic revision attempts to synthesize evidence of interventions that are incorporated in the course of the actual clinical practice, we chose not to analyze the use of therapies based on Information Technology and Communication (ICT), such as telerehabilitation, inserting only concrete rehabilitation programs, which are considered viable, requiring no knowledge or access to technology or equipment not known in outpatient therapy.

Conclusion

New models of rehabilitative care such as home-based programmes can be an alternative efficient method to deliver rehabilitation, showing to be beneficial in improving different aspects of activities, and participation. However, the findings from existing studies are inconclusive, and assimilation of data was difficult due to the diversity of contents of Home-based programmes. Future studies are needed for future research into optimal intensity, frequency and cost-effectiveness of thome-based intervention over short and long term.

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