







Physical therapy in children with cerebral palsy in Brazil: a scoping review

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ABBREVIATIONS

ICF	International Classification of Functioning, Disability and Health
LMIC	Low- and middle-income countries
NDT	Neurodevelopmental therapy
OCEBM	Oxford Centre for Evidence-Based Medicine

AIM To identify and assess published studies concerning physical therapy in Brazilian children and adolescents with cerebral palsy (CP) using the International Classification of Functioning, Disability and Health (ICF) framework.

METHOD Articles in English and Portuguese published until October 2020, with no date restrictions, were searched in several different databases. Study characteristics, journal metrics, sample characteristics, and ICF domains explored intervention components and outcomes were extracted. Studies were classified according to the Oxford Centre for Evidence-Based Medicine hierarchy levels to characterize the evidence.

RESULTS Ninety-four studies were included. Spastic CP with fewer limitations in gross motor abilities was the most reported; 67% of the studies had low levels of evidence and were published in journals without an impact factor. The three most frequent interventions were neurodevelopmental treatment, suit therapy, and transcranial direct current stimulation. Intervention components explored body functions and structures (73.4%), activity (59.6%), environment (2.1%). They did not explore participation (0%). The outcomes investigated addressed activity (79.8%), body functions and structures (67.0%), and participation (1.1%), but not environment (0%).

INTERPRETATION Studies of physical therapy for Brazilian children and adolescents with CP focused on reducing impairments and activity limitations. Studies with higher levels of evidence and an expanded focus on participation and environmental factors are necessary.

Cerebral palsy (CP) is defined as a group of developmental disorders of movement and posture attributed to a non-progressive injury occurring in the immature brain.^{1,2} It is one of the most common causes of physical disability in childhood, with a prevalence of 2.1 cases per 1000 live births in high-income countries. In low- and middle-income countries (LMIC), CP prevalence may be even higher.^{3–5} Additionally, LMIC may have a higher percentage of individuals with more severe limitations.^{6–8}

At the beginning of the 21st century, with the creation of the International Classification of Functioning, Disability and Health (ICF)^{9–11} framework, the World Health Organization proposed significant changes (expansions) to the rationale and language of health and disability. Thereafter, physical therapists and other professionals started to apply the ICF framework in health promotion, prevention, intervention strategies, and to develop the direction of relevant studies. The framework highlighted the importance of focusing on the activity, participation, and contextual

aspects of people's lives, beyond just offering therapies aimed at 'fixing' impairments in body functions and structures.^{10,12–14}

Historically, physical therapy interventions in children and adolescents with CP mainly focused on repairing impairments (at the ICF level of body functions and structures).¹⁵ After implementation of the ICF and research advances in the past decade, several therapy interventions, such as goal-directed training, treadmill training, home programs, constraint-induced movement therapy, environmental enrichment, and task-specific training have been investigated.^{13,16} These modalities have been shown to be effective primarily on motor outcomes and are mostly related to the activity domain.¹⁶ To date, little is known about the effectiveness of physical therapy on participation.^{17,18}

Most of the available literature supporting interventions for children and adolescents with CP originates from research in high-income countries (e.g. USA, UK, Canada,

and Australia).¹⁹ Due to the lack of financial resources and other public health issues, the contribution of LMIC (e.g. African countries, India, and Brazil) to the body of evidence regarding CP is much lower.^{5,19} Furthermore, a high proportion of children with CP from LMIC (e.g. Bangladesh, Nepal, Indonesia, and Ghana) have no access to any form of intervention before the age of 3 years.^{20,21} Although elements of the ICF model are often addressed in research on CP in high-income countries (such as participation and environmental factors),^{22,23} the extent to which this model has been implemented in LMIC research and practice is still uncertain.⁵

Some studies have investigated the scope of the LMIC literature on physical therapy for CP. In India and some African countries, the body of research does not follow the current worldwide state of evidence.^{5,19} Interventional studies in these LMIC are mainly concerned with body functions and structures, with much less attention paid to activity and participation.^{5,19} In addition, a significant percentage of these studies were published in low-quality journals.¹⁹ To date, there is no information addressing the scope of the literature regarding CP in other LMIC, such as Brazil.

Brazil is the fifth largest country in the world, with >200 000 physiotherapists.^{24,25} Brazil is also considered one of the top 25 most productive countries in CP research and one of the most productive LMIC in this list.²⁶ In Brazil, several physical therapists work with individuals with CP. Child and adolescent neurofunctional physiotherapy is a well-established specialization in the country and the number of research programs in the rehabilitation field has been increasing in the past years.^{27,28} In this context, understanding the nature of the Brazilian research literature may help Brazilian researchers to improve their approach and how they deliver updated information on physical therapy to the pediatric community. The aim of this scoping review was to identify published studies that addressed physical therapy in Brazilian children and adolescents with CP as mediated by the ICF framework.

METHOD

This scoping review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews. It was conducted using the following steps: (1) identify the purpose of the review; (2) identify and select potential studies; (3) extract and plot data; and (4) order, synthesize, and report the results.²⁹ The review protocol was registered in the Open Science Framework Register (<https://doi.org/10.17605/OSF.IO/7QFHG>).

Identifying the purpose of the review

This scoping review aimed to (1) review the characteristics of the literature on physical therapy in Brazilian children and adolescents (up to 20y) with CP, including the Oxford Centre for Evidence-Based Medicine (OCEBM)³⁰ levels of

What this paper adds

- Studies focused on reducing impairments and activity limitations.
- Participation and environmental factors were addressed only minimally.
- Many physical therapy studies presented low levels of evidence.
- Most studies were published in journals without an impact factor.

evidence and (2) categorize the components of the interventions and outcomes according to the ICF framework.

Search strategy and search terms

Searches for eligible studies were conducted in Medline/PubMed, Embase, Cochrane, Scopus, CINAHL, Web of Science, PEDro, and Lilacs. Gray literature was searched using Google and Google Scholar. The descriptors used were ‘cerebral palsy’, ‘rehabilitation’, ‘physical therapy’, ‘physical therapists’, ‘children’, ‘adolescent’, ‘Brazil’, and ‘clinical trials’ in both English and Portuguese (in Latin American databases). A detailed list of descriptors and search strategy for each database is provided in Table S1 (online supporting information). We manually searched all identified studies for possible additional eligible studies. The search strategy (without date restrictions) was conducted in October 2020 and researchers were assisted by a librarian.

Study selection

This scoping review included *n*-of-1 trials, randomized trials, non-randomized control trials, case studies, case series/case reports, single-subject designs, and historically controlled studies that investigated physical therapy in Brazilian children and adolescents with CP. Full-text articles published in English, Portuguese, or both were included. As an eligibility criterion, studies were included when they reported interventions related to the scope of physical therapy. The definition of physical therapy followed the normative laws of the Conselho Federal de Fisioterapia e Terapia Ocupacional (Brazilian Council of Physical and Occupational Therapy).³¹ As per the regulations of the Brazilian Council of Physical and Occupational Therapy, intervention studies that were not exclusive to physical therapists (e.g. hand–arm bimanual therapy, constraint-induced movement therapy, sensory integration, hippotherapy, and educational programs) were included if they were led by physical therapists. Interventions exclusively related to the scope of other areas (e.g. botulinum neurotoxin A and orthopedic surgery) were not included, except when combined with physical therapy. Studies that did not clearly report outcomes were also excluded.

Screening

A screening process was conducted independently by two reviewers (MASF and ISC), first identifying titles and abstracts, and then evaluating potential full-text articles using our eligibility criteria. Discrepancies were resolved by a third reviewer (HRL). To ensure reliability and consistency during the screening process, eligibility criteria were tested by examiners in the first 10 titles and abstracts in the databases.

Data extraction

The research team developed a data extraction form and tested it in the first five studies to determine its consistency with the purpose of the study. Data extraction included: (1) study characteristics (i.e. authors, year of publication, title, language of publication, study type, study aims, OCEBM levels of evidence, proponent institution, Brazilian regions, and access links); (2) journal metrics (i.e. journal title, impact factor, and indexing location); (3) sample characteristics (i.e. sample size, age, clinical CP type, Gross Motor Function Classification System [GMFCS] levels); and (4) intervention and outcomes (i.e. main intervention – characteristics, frequency, and intensity – and ICF domain [s] explored; outcomes – ICF domains assessed and tools/scales). All data extraction was performed by the first author (MASF) and reviewed by the second author (KMAA). Study design was classified by the second author (KMAA) and verified by the fifth author (ACRC). To identify the institution the study originated from, we considered the information in the study's ethics approval register or the affiliation of the first and/or last author of the study.

Categorization

Journal metrics

Details about the journal impact factor for the studies selected were extracted by manual search of the Journal Citation Reports (Web of Science) website as an indicator of quality.^{32,33} For journals without an impact factor, no value was reported.

Level of evidence

All studies selected were classified according to the OCEBM levels of evidence for intervention studies.³⁰ The OCEBM hierarchy consists of five levels of evidence, ranging from level 1 (strongest) to level 5 (weakest), as follows: level 1, systematic reviews/meta-analyses that critically summarize several studies, and *n*-of-1 trials; level 2, randomized controlled trials; level 3, studies such as non-randomized studies that do not have strong control of bias; level 4, studies where a relatively low level of evidence is present, primarily including descriptive studies, such as case series/case reports; and level 5, studies based on mechanistic reasoning, whereby evidence-based decisions are founded on logical connections, including a pathophysiological rationale. The criteria used for the study design definition are reported in Table S2 (online supporting information).^{34,35}

Intervention characteristics

The main intervention components (i.e. experimental group) were categorized with regard to their principles, active components, and mechanisms (as extracted from the study) into: (1) body function and structure interventions (i.e. interventions that primarily manipulate body functions or body structures, such as strength training, stretching, or

mobility/stability of joint interventions); (2) activity interventions (i.e. interventions promoting task training aspects, such as task-specific training or gait training); (3) participation interventions (i.e. interventions promoting frequency and involvement in real-life contexts, such as community-based treatments); or (4) environmental factor interventions (i.e. interventions that provide modifications of environmental aspects, such as context-focused therapy and conductive education for parents).¹¹ Since the ICF framework makes no clear distinctions between activity and participation domains, the principles of participation-based interventions (i.e. goal-oriented, family-centered, collaborative, strength-based, ecological, and self-determined)¹⁸ were considered. Additionally, to better categorize interventions as 'environmental factors', the principles of contextual therapies (e.g. with a focus on identifying the constraints and facilitators related to task and environment)³⁶ were also considered.

All outcome measures investigated were classified into ICF domains and followed the definitions set out in the ICF, according to the standardized instruments used. Activity outcome measures were categorized using the qualifier capacity (i.e. what a person can do in a standardized environment) and performance (i.e. what a person actually does in their usual environment).¹¹ Outcome measures were categorized as a 'participation' domain if they covered its constructs, with instruments assessing attendance or involvement in life situations.¹⁷ Studies reporting non-ICF outcome domains were extracted and reported (e.g. quality of life). For those studies that examined the additional effect of physical therapy on other intervention modalities (e.g. botulinum neurotoxin A), we only categorized the physical therapy intervention (e.g. physical therapy treatment after botulinum neurotoxin A). All these categorizations were performed by the first author (MASF) and verified by the second (KMAA), with conflicts resolved by consensus between authors.

RESULTS

The database searches identified 6677 studies; after screening the title and abstract, 689 full-text studies were evaluated under our eligibility criteria. After review, 595 studies were excluded because they did not meet the inclusion criteria. Thus, 94 studies were retained for data extraction (Fig. S1, online supporting information).

Table 1 reports the main characteristics of the studies included in this scoping review (see also Table S3, online supporting information). Between 1996 and 2020, the 94 studies^{37–130} were published in 46 different journals, 67% of them without an impact factor and 33% with an impact factor from 1.0 to 4.4. The studies included a total of 1138 children and adolescents with CP, aged from 1 to 18 years, with bilateral (51.3%) or unilateral (31.9%) spastic, dyskinetic (4.4%), and ataxic (2.7%) CP subtypes, classified in GMFCS levels I (21.5%), II (26.0%), III (18.1%), IV

Table 1: Main characteristics of the studies included in this scoping review

Characteristic	n (%)
Publication decade	
1996–2000	1 (1.1)
2001–2010	22 (23.4)
2011–2020	71 (75.5)
Brazilian regions	
North	0 (0)
North-west	7 (7.4)
Midwest	4 (4.3)
South-east	58 (61.7)
South	25 (26.6)
Main proponent institution	
Public universities	47 (50.0)
Private universities	46 (48.9)
Rehabilitation centers	1 (1.1)
Language	
English	39 (41.5)
Brazilian Portuguese	49 (52.1)
Both	6 (6.4)
OCEMB level of evidence	
Level 1	0 (0)
Level 2	19 (20.21)
Level 3	10 (10.6)
Level 4	65 (69.1)
Level 5	0 (0)
Indexed databases	
PubMed	36 (32.4)
Lilacs	22 (19.8)
Scielo	17 (15.3)
Google, Google Scholar, Web of Science, Embase, Cochrane, Scopus, manually searched, PEDro	36 (32.5)

OCEMB, Oxford Centre for Evidence-Based Medicine.

(9.0%), and V (7.9%). Several studies did not report the CP subtype and GMFCS level (9.7% and 17.5% respectively).

The levels of evidence of the selected studies varied from 2 (20.21%) to 4 (69.1%) (Table 1). In total, 24 different interventions were investigated in the studies. Table 2 shows the 10 most frequently investigated interventions and the corresponding OCEBM levels of evidence. The other 14 interventions investigated were: task-specific training; fitness training; stretching; vegetable oil; Kinesio Taping; motor imagery training; constraint-induced movement therapy; hand–arm bimanual intensive therapy; proprioceptive neuromuscular facilitation; conductive education for parents; respiratory physical therapy; riding simulator; goal-directed training; and conventional physiotherapy.

Table 3 shows the ICF domains explored across interventions and outcomes measures. The body function and structure domains were the most explored in the interventions (73.4%). The most explored outcome measures focused on the activity domain (79.8%) and the most widely used instrument was the Gross Motor Function Measure, which assesses the capacity for activity. Two studies explored environmental factors in their interventions and only one study explored the participation domain as an outcome (Table S3). Additionally, three studies investigated quality of life as an outcome.

Table 2: Interventions investigated most frequently and corresponding OCEMB levels of evidence

Intervention ^a	Number of studies	n (%) of studies in each OCEMB level		
		Level 2	Level 3	Level 4
Suit therapy	12	0 (0)	0 (0)	12 (100)
NDT	10	0 (0)	0 (0)	10 (100)
TDCS	10	8 (80)	0 (0)	2 (20)
Hydrotherapy	9	2 (22.2)	1 (11.1)	6 (66.7)
Virtual reality	8	1 (12.5)	0 (0)	7 (87.5)
Treadmill training	7	2 (28.6)	0 (0)	5 (71.4)
Strength training	7	0 (0)	0 (0)	7 (100)
Electrical stimulation	7	0 (0)	1 (14.3)	6 (85.7)
Assistive technology ^b	6	3 (50)	1 (16.7)	2 (33.3)
Hippotherapy	5	0 (0)	2 (40)	3 (60)

^aOnly therapies cited more than four times in the studies included in the scoping review are described in this table. ^bIncludes orthoses, walker, and insole. OCEMB, Oxford Centre for Evidence-Based Medicine; NDT, neurodevelopmental treatment; TDCS, transcranial direct current stimulation.

Table 3: Domains of the ICF explored across the intervention and outcome measure components in the studies included in this scoping review

ICF domain	Intervention n=94, n (%)	Outcome measure n=94, n (%)
Body functions and structures	69 (73.4)	63 (67.0)
Activity	56 (59.6)	75 (79.8)
Capacity	–	72 (76.6)
Performance	–	12 (12.8)
Participation	0 (0)	1 (1.1)
Environmental factors	2 (2.1)	0 (0)
Non-ICF domain		
Quality of life	–	3 (3.2)

ICF, International Classification of Functioning, Disability and Health; –, not applicable.

DISCUSSION

Using the ICF framework, this study aimed to identify several aspects of the literature addressing physical therapy available to Brazilian children and adolescents with CP. The amount of research produced in Brazil has increased exponentially in the last decade; however, most studies have been published in poor-quality journals and have low levels of evidence. The focus of the reported intervention studies was to modify impairments in children with spastic CP, aiming for fewer limitations in gross motor abilities.

In the last decade, the number of studies addressing individuals with CP has grown exponentially.²⁶ According to current evidence, the therapy components with the greatest potential to promote benefits in individuals with CP include goal-directed practice of real-life tasks, child self-initiated active movements, high-intensity therapy, participation, and family engagement in therapeutic planning.^{131,132} In contrast, this scoping review showed that in Brazil, the most studied interventions, such as suit therapy,

neurodevelopmental therapy (NDT), and transcranial direct current stimulation do not necessarily address all these components.^{133,134}

NDT is the best known and implemented intervention in several countries, including Brazil,¹³⁵ where it is widely taught in training courses. Despite its name, identifying the original approach is no longer possible.¹³⁶ Primarily, NDT focuses on reducing neuromotor impairments, with techniques aimed at modifying body functions and structures (e.g. to normalize tone or inhibit reflex). Indeed, all studies that reported NDT as identified in this scoping review pointed out these original passive characteristics but also described other elements related to the activity domain, such as mobility and self-care training. Despite the changes in NDT observed over time, it is difficult to say if this approach has shifted from looking solely at 'fixing' neuromotor impairments to addressing the ICF activity domain consistently. Furthermore, the NDT studies included in this scoping review did not present participation as an investigated outcome.

Suit therapy interventions are relatively new and have gained popularity in Brazil, possibly due to good financial returns. In the suit therapy studies included in this scoping review, the intervention elements and outcomes explored both body functions and structures (e.g. strengthening) and activity (e.g. mobility tasks). The high frequency identified in this scoping review is in line with the most common therapy delivery by pediatric physiotherapists in Brazil.^{137,138} These interventions created great expectations for child improvement and a significant family commitment to obtaining resources to allow children access to this type of intervention; this generated concern from Brazilian physical therapy associations.^{139–141} Despite the popularity of suit therapy in Brazil, the main ICF intervention element and outcome target of this therapy are not well established in the literature.^{133,134}

Transcranial direct current stimulation is a new and more expensive approach to therapy and was the third most frequent intervention identified in this scoping review. Its mechanism of action is based on electrical stimulation of the brain, through the cranium, and is aimed at improving neuromusculoskeletal body functions and structures, as well as activity (such as capacity and performance); all interventions and outcomes extracted from the studies are included in this scoping review. However, no information as to whether transcranial direct current stimulation results might be transferred to participation outcomes was identified.¹⁴² All transcranial direct current stimulation studies included in this scoping review were carried out by the same research group, leading to potential publication bias and thus decreasing the strength of the evidence.¹⁴³ Therefore, the results of this scoping review indicate the need to expand research on this therapy to improve the quality of the evidence and support any decisions on its use in clinical practice.¹⁴³

Among the remaining 10 most frequent interventions extracted from the studies, we observed a focus on body

functions and structures (hydrotherapy, strength training, electrical stimulation, and assistive technology [e.g. orthoses]), and an activity component targeting mainly mobility training (virtual reality, treadmill training, and hippotherapy). These approaches are well known to Brazilian physical therapists; traditionally, they are carried out in clinics or rehabilitation centers, without modifying the environment where the child is living. Furthermore, these studies did not assess the carryover benefits of these interventions on participation outcomes.^{133,144}

Overall, the interventions extracted from the studies included in this scoping review primarily showed a focus on 'body functions and structures', followed by 'activity'. Less attention was paid to 'participation' and 'environmental factors'. Our results are in accordance with other studies carried out in other LMIC.^{5–7} Studies investigating rehabilitation approaches in children with CP in India and Africa showed a substantial focus on interventions that reduce impairments, with minimal attention paid to 'activities and participation' and 'environmental' and 'personal factors'.^{13,15–17} Despite studies conducted in Western countries focusing more on 'activity and participation' and 'contextual factors', their translation to clinical practice is a challenge.¹³ Considering this scenario, it is important to highlight that interventions aimed at remediating 'body functions and structures' would not automatically translate into improved activity or participation without addressing these specific domains and the real-life contexts of families.^{13–15} Nowadays, interventions that consider activity (e.g. active goals set by the child or caregiver and task-specific practice in real-life situations), participation (e.g. mutually agreed upon family and professional goals for home and community participation), and contextual factors (e.g. emphasis on changing the task and environment rather than the child) are deemed key elements for functioning in individuals with CP, which is consistent with current approaches and evidence.^{13–15,145} Assuming that the most investigated interventions are popular in Brazil's clinical practice, these results reinforce the need to expand the main focus of therapists to follow the current state-of-the-art physical therapy interventions for children and adolescents with CP.^{5,13,19}

Regarding participant characteristics in the studies included in this scoping review, children with spastic CP in GMFCS levels I to III were recruited most frequently. These children could walk independently or with the aid of gait devices in most environments.¹⁴⁶ Given the lack of robust epidemiological studies on CP in Brazil, it is not possible to assume that this clinical type and functional level are the most prevalent in this country. The higher frequency of the recruited subgroup of children with CP may be due to the lack of well-established protocols and evidence of physical therapy interventions in individuals with more limited motor functions (GMFCS levels IV and V).^{8,14} An ongoing national multi-center study, the Participa Brazil Research Project, will determine the most frequent clinical types and functional levels of Brazilian

individuals with CP, which may guide future interventional studies to target the country's most prevalent CP profile.¹⁴⁷

Most of the studies included in this scoping review were classified at level 4 in the OCEBM system, which ranges from levels 1 to 5 (strongest to weakest).³⁰ The OCEBM levels of evidence used in this scoping review represent the expected rigor in study design and control of bias, thereby indicating a certain level of confidence that may be placed in their findings.¹⁴⁸ Studies at the top represent stronger evidence; those at the bottom represent weak evidence. Studies at the top, such as randomized controlled studies, are the criterion standard and provide the most reliable evidence on the effectiveness of interventions because of the processes used when conducting these studies (e.g. eligibility criteria, individuals randomly allocated to groups, concealed allocation, and blinding).¹⁴⁹ Furthermore, a significant number of Brazilian studies (67%) were published in journals without an impact factor (based on the Journal Citation Reports resource). An impact factor is an indicator of quality control and selectivity (e.g. journals are monitored and excluded from the Journal Citation Reports when they demonstrate predatory behavior).^{32,33} Results of studies from journals without an impact factor and showing weak levels of evidence are not trustworthy for clinical decision-making; their findings need to be interpreted with caution.^{33,150} Thus, well-designed Brazilian interventional studies might facilitate evidence-based practice and reduce the gap between the research and clinical fields.

Furthermore, interventional studies on CP published in Brazil are mostly conducted in universities, with 88.3% in the two most economically developed regions (south and south-west). The northern region of Brazil, the area with the lowest income concentration, was not represented in any of the studies, meaning that there is no evidence of interventions aimed at children with specific environmental characteristics in this region. Lack of research funding and the small number of higher education programs and research groups can be challenging for research projects in the north, north-east, and midwest regions of Brazil.^{151–153} Considering the inequality between Brazilian regions, future efforts are needed to support and promote high-quality research in less-developed regions. Supporting clinical/rehabilitation settings in partnership with universities for high-quality research (especially on the participation domain and environmental factors) is very important since they usually have the adequate infrastructure to recruit a large number of participants who can count on free public transportation and are generally close to the research facilities.¹⁵⁴ Furthermore, Brazil has recently faced a significant reduction in its science budget,^{155,156} thereby supporting the need to stop the scarce resources available in low-quality research that addresses interventions shown to have limited effects.

Considering the country's significant social discrepancies, and that over 80% of its population depends on its public health service, it is important that Brazilian researchers invest their efforts in inexpensive and easy-to-

reproduce interventions in Brazilian clinical practice. Interventions such as home programs, environmental enrichment, and task-specific training are inexpensive, equipment-independent, directed to family goals, and carried out in the child's natural environment; this corresponds to the current trend of interventions aimed at improving performance and no longer aiming at only correcting impairments.^{157,158} Future studies should investigate the effects of these high-level, inexpensive, evidence-informed interventions in the Brazilian context. Due to the COVID-19 pandemic, new opportunities to deliver low-cost rehabilitation services in natural environments have become a reality.^{159,160}

This scoping review has some limitations. First, articles from databases including Brazilian journals or those published in other languages may have been missed. Second, although we did not engage in a detailed critical appraisal of all methodological aspects, challenges such as non-standardized therapy terms, lack of description of the intervention component, and study design not clearly reported might have led to a misleading outcome and components of the classification of the intervention. Third, terms related to the environment were missing from the search strategy, which may have influenced the low number of studies included. Fourth, with the aim of providing relevant aspects for Brazilian physical therapy clinical practice, studies investigating interventions common to other professionals (e.g. constraint-induced movement therapy) but not led by a physical therapist were excluded from this review. We recognize that it is still important to shed light on these interventions through the ICF framework. Fifth, our inclusion criteria did not exclude papers published before the inception of the ICF framework.¹¹ Despite this, only one article included in the present scoping review was published before 2001; this lessened our limitation when reporting study interventions and outcomes in light of the ICF framework. Sixth, we used the OCEBM system to classify levels of evidence. The OCEBM levels of evidence were used to find the likely best evidence but are not intended to provide a definitive judgment about its quality and recommendations.³⁰ Despite these limitations, the purpose of rating studies using this system in this scoping review was to provide clinicians and researchers with a general view of the best evidence, which could be used to (1) inform clinicians as to how trustworthy studies including Brazilian children and adolescents with CP are and (2) provide a rapid comprehensive resource that could be used by researchers to help prioritize efforts and funding in the future to improve the methodological quality of studies. Bearing in mind that a definitive recommendation is not possible from our scoping review, further studies aimed at better investigating this topic are needed.

CONCLUSION

This review showed that the amount of research on children and adolescents with CP in Brazil is constantly increasing. The most studied interventions presented low-quality evidence,

which means that the evidence reported is not trustworthy for clinical decision-making. The focus of the studies was on reducing impairments and activity limitations, with minimal attention paid to participation and environmental factors and the evaluated outcomes. Brazilian researchers must expand their focus on therapeutics to include contextual and participation factors, thus promoting a more comprehensive view of individuals with CP. Well-designed Brazilian intervention studies might facilitate evidence-based practice and reduce the gap between the research and clinical fields. Many strategies could be considered, such as partnerships between junior and senior researchers and research centers, financial investment, and support by university librarians who can educate professionals about predatory journals and the writing process.

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DATA AVAILABILITY STATEMENT

Data sharing not applicable – no new data generated.

SUPPORTING INFORMATION

The following additional material may be found online:

Figure S1: PRISMA extension for scoping reviews study selection flow diagram.

Table S1: Search strategy conducted in October 2020

Table S2: Description of the types of study

Table S3: Details of the studies and ICF domains extracted from the interventions and outcomes

REFERENCES

- Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl* 2007; **109**: 8–14.
- Richards CL, Malouin F. Cerebral palsy: definition, assessment and rehabilitation. In: Dulac O, Lassonde M, Sarnat HB, editors. *Handbook of clinical neurology*, 1st ed. Burlington, MA: Elsevier; 2013: p. 183–95.
- Brandenburg JE, Fogarty MJ, Sieck GC. A critical evaluation of current concepts in cerebral palsy. *Physiology (Bethesda)* 2019; **34**: 216–29.
- Oskoui M, Coutinho F, Dykeman J, Jetté N, Pringsheim T. An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. *Dev Med Child Neurol* 2013; **55**: 509–19.
- Malek SA, Rosenbaum P, Gorter JW. Perspectives on cerebral palsy in Africa: exploring the literature through the lens of the International Classification of Functioning, Disability and Health. *Child Care Heal Dev* 2020; **46**: 175–86.
- Das SP, Ganesh GS. Evidence-based approach to physical therapy in cerebral palsy. *Indian J Orthop* 2019; **53**: 20–34.
- Khandaker G, Smithers-Sheedy H, Islam J, Alam M, Jung J, Novak I, et al. Bangladesh Cerebral Palsy Register (BCPR): a pilot study to develop a national cerebral palsy (CP) register with surveillance of children for CP. *BMC Neurol* 2015; **15**: 173 (study protocol).
- Verschuren O, Peterson MD, Balemans ACJ, Hurvitz EA. Exercise and physical activity recommendations for people with cerebral palsy. *Dev Med Child Neurol* 2016; **58**: 798–808.
- Leite HR, Chagas PSC, Rosenbaum P. Childhood disability: can people implement the F-words in low and middle-income countries – and how? *Braz J Phys Ther* 2021; **25**: 1–3.
- Paschoal LN, Souza PN, Buchalla CM, Brito CMM, Battistella LR. Identification of relevant categories for inpatient physical therapy care using the International Classification of Functioning, Disability and Health: a Brazilian survey. *Braz J Phys Ther* 2019; **23**: 212–20.
- World Health Organization. ICF: international classification of functioning, disability and health. Geneva: WHO; 2001.
- Moreau NG, Bodkin AW, Bjornson K, Hobbs A, Soileau M, Lahasky K. Effectiveness of rehabilitation interventions to improve gait speed in children with cerebral palsy: systematic review and meta-analysis. *Phys Ther* 2016; **96**: 1938–54.
- Anaby D, Korner-Bitensky N, Steven E, Tremblay S, Snider L, Avery L, et al. Current rehabilitation practices for children with cerebral palsy: focus and gaps. *Phys Occup Ther Pediatr* 2017; **37**: 1–15.
- Novak I, Morgan C, Fahey M, Finch-Edmondson M, Galea C, Hines A, et al. State of the Evidence traffic lights 2019: systematic review of interventions for preventing and treating children with cerebral palsy. *Curr Neurol Neurosci Rep* 2020; **20**: 3 (review).
- Law M, Darrah J. Emerging therapy approaches: an emphasis on function. *J Child Neurol* 2014; **29**: 1101–7.
- Ko EJ, Sung IY, Moon HJ, Yuk JS, Kim H-S, Lee NH. Effect of group-task-oriented training on gross and fine motor function, and activities of daily living in children with spastic cerebral palsy. *Phys Occup Ther Pediatr* 2020; **40**: 18–30.
- Adair B, Ullenhag A, Rosenbaum P, Granlund M, Keen D, Imms C. Measures used to quantify participation in childhood disability and their alignment with the family of participation-related constructs: a systematic review. *Dev Med Child Neurol* 2018; **60**: 1101–16.
- Palisano RJ, Chiarello LA, King GA, Novak I, Stoner T, Fiss A. Participation-based therapy for children with physical disabilities. *Disabil Rehabil* 2012; **34**: 1041–52.
- Jindal P, Macdermid JC, Rosenbaum P, Direzze B, Narayan A, Nayak SL. Treatment and re/habilitation of children with cerebral palsy in India: a scoping review. *Dev Med Child Neurol* 2019; **61**: 1050–60.
- Jahan I, Al Imam MH, Karim T, Muhit M, Hardianto D, Das MC, et al. Epidemiology of cerebral palsy in Sumba Island, Indonesia. *Dev Med Child Neurol* 2020; **62**: 1414–22.
- Jahan I, Muhit M, Hardianto D, Laryea F, Chhetri AB, Smithers-Sheedy H, et al. Epidemiology of cerebral palsy in low- and middle-income countries: preliminary findings from an international multi-centre cerebral palsy register. *Dev Med Child Neurol* 2021; **63**: 1327–36.
- Anaby D, Hand C, Bradley L, DiRezze B, Forhan M, DiGiacomo A, et al. The effect of the environment on participation of children and youth with disabilities: a scoping review. *Disabil Rehabil* 2013; **35**: 1589–98.
- Imms C. Children with cerebral palsy participate: a review of the literature. *Disabil Rehabil* 2008; **30**: 1867–84.
- Kobal AB, Filho MT, Cabral ACA. Burocracia Brasileira: um comparativo com os países do BRIC. *APGS* 2012; **4**: 246–68.
- Matsumura ESS, Júnior ASS, Guedes JA, Teixeira RC, Kietzer KS, Castro LSF. Distribuição territorial dos profissionais fisioterapeutas no Brasil. *Fisioter Pesqui* 2018; **25**: 309–14.
- Danis A, Kutluk MG. The evolution of cerebral palsy publications and global productivity: a bibliometric analysis between 1980 and 2019. *Acta Neurol Belg* 2020. <https://doi.org/10.1007/s13760-020-01549-2> (Online ahead of print).
- Associação Brasileira de Pesquisa e Pós-Graduação em Fisioterapia. Programas de Pós-graduação. <https://abrapg-ft.org.br/portal/>. Accessed 14 Sept 2021.
- Conselho Federal de Fisioterapia e Terapia Ocupacional. Resolução No. 189 de 9 de Dezembro de 1998,

- alterado pela resolução no 226/2001, reconhece a especialidade de fisioterapia neuro funcional e dá outras providências. Brasília: COFFITO. <https://www.coffito.gov.br/nsite/?p=2947>. Accessed 14 Sept 2021.
29. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009; **26**: 91–108.
 30. Howick J, Chalmers I, Glasziou P, Greenhalgh T, Heneghan C, Liberati A, et al. Explanation of the 2011 Oxford Centre for Evidence-Based Medicine (OCEBM) levels of evidence (background document). Oxford: OCEBM; 2011. <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocem-levels-of-evidence>. Accessed 14 Sept 2021.
 31. Conselho Federal de Fisioterapia e Terapia Ocupacional. <https://www.coffito.gov.br/nsite/>. Accessed 14 Sept 2021.
 32. Journal citation reports. <https://clarivate.com/webofsciencelibrary/solutions/journal-citation-reports/>. Accessed 20 Jul 2020.
 33. Saha S, Saint S, Christakis DA. Impact factor: a valid measure of journal quality? *J Med Libr Assoc* 2003; **91**: 42–6.
 34. Portney LG. Foundations of clinical research: applications to evidence-based practice. 4th ed. Philadelphia, PA: F.A. Davis Company; 2020.
 35. Last JM. A dictionary of epidemiology. 4th ed. New York, NY: OUP; 2001.
 36. Darrah J, Law MC, Pollock N, Wilson B, Russell DJ, Walter SD, et al. Context therapy: a new intervention approach for children with cerebral palsy. *Dev Med Child Neurol* 2011; **53**: 615–20.
 37. Durigon OFS, Sá CS. Intervenção fisioterápica facilitatória em paciente com encefalopatia não progressiva crônica da infância. *Rev Fisioter Univ São Paulo* 1996; **3**: 54–64.
 38. Sá CSC, Santos FHS, Xavier GF. Mudanças motoras, sensoriais e cognitivas em crianças com paralisia cerebral espástica diparética submetidas a intervenção fisioterápica pelas abordagens Kabat ou Bobath. *Rev Fisioter Univ São Paulo* 2004; **11**: 56–65.
 39. Martinelli JL, Franco RC, Andrade DV, Peres JA, Corrêa JCF. O uso do biofeedback-EMG na reabilitação da postura e do padrão de marcha de uma criança portadora de paralisia cerebral do tipo diparética espástica. *Fisioter Bras* 2004; **5**: 399 (case report).
 40. Mota AP, Pereira JS. Influência da fisioterapia nas alterações motoras em crianças com paralisia cerebral. *Fisioter Bras* 2006; **7**: 209 (research article).
 41. Cury VCR, Mancini MC, Melo AP, Fonseca ST, Sampaio RF, Tirado MGA. Efeitos do uso de órtese na mobilidade funcional de crianças com paralisia cerebral. *Rev Bras Fisioter* 2006; **10**: 67–74.
 42. Coimbra SAL, Bonifácio TD, Sanches KC, Souza MF, Jorge DA. A influência da equoterapia no equilíbrio estático e dinâmico: apresentação de caso clínico de encefalopatia não progressiva crônica do tipo diparético espástico. *Fisioter Bras* 2006; **7**: 391–5.
 43. Assis RD, Massaro AR, Chamlian TR, Silva MF, Ota SM. Terapia de restrição para uma criança com paralisia cerebral com hemiparesia: estudo de caso. *Acta Fisiatr* 2007; **14**: 62–65. (case study).
 44. Bonomo LMM, Castro VC, Castro VC, Ferreira DM, Miyamoto ST. Hidroterapia na aquisição da funcionalidade de crianças com paralisia cerebral. *Rev Neurociênc* 2007; **15**: 125–30.
 45. Camargos ACR, Fontes PLB, Gontijo ÉG, Araújo FM, Cota K. Fisioterapia associada à toxina botulínica na diplegia espástica: um relato de caso. *Fisioter Mov* 2007; **20**: 17–24.
 46. Jerônimo BP, Silveira JA, Borges MBS, Dini PD, David AC. Spatio-temporal gait variables of children with cerebral palsy undergoing electrostimulation in the anterior tibial muscle. *Rev Bras Fisioter* 2007; **11**: 261–6.
 47. Palácio SG, Ferdinande AKS, Gnoatto FC. Análise do desempenho motor de uma criança com hemiparesia espástica pré e pós-tratamento fisioterápico: estudo de caso. *Ciênc Cuid Saúde* 2008; **7**: 127–31.
 48. Silva MS, Daltrário SMB. Paralisia cerebral: desempenho funcional após treinamento da marcha em esteira. *Fisioter Mov* 2008; **21**: 109–15.
 49. Nunes LCBG, Quevedo AAF, Magdalon EC. Effects of neuromuscular electrical stimulation on tibialis anterior muscle of spastic hemiparetic children. *Rev Bras Fisioter* 2008; **12**: 317–23.
 50. Vaz DV, Mancini MC, Fonseca ST, Arantes NF, Pinto TPS, de Araújo PA. Effects of strength training aided by electrical stimulation on wrist muscle characteristics and hand function of children with hemiplegic cerebral palsy. *Phys Occup Ther Pediatr* 2008; **28**: 309–25.
 51. Ferrari PP, Oliveira AR, Corrêa FI, Franco RC, Corrêa JCF. Alterações no comportamento da marcha após o uso da estimulação elétrica neuromuscular em pacientes com seqüela de paralisia cerebral do tipo hemiparesia espástica. *Fisioter Bras* 2008; **9**: 194–8.
 52. Vedoato RT, Pereira K, Conde AR. Influência da intervenção fisioterápica na função motora grossa de crianças com paralisia cerebral diparética: estudo de caso. *ConScientiae Saúde* 2008; **7**: 241–50.
 53. Barbosa AP, Vaz DV, Gontijo APB, Fonseca ST, Mancini MC. Therapeutic effects of electrical stimulation on manual function of children with cerebral palsy: evaluation of two cases. *Disabil Rehabil* 2008; **3**: 723–8.
 54. Brianeze ACGS, Cunha AB, Peviani SM, Miranda VCR, Tognetti VBL, Rocha NACF, et al. Efeito de um programa de fisioterapia funcional em crianças com paralisia cerebral associado a orientações aos cuidadores: estudo preliminar. *Fisioter Pesqui* 2009; **16**: 40–5.
 55. Furtado SRC, Vaz DV, Mancini MC, Rodrigues JD, Garboci M. Programa domiciliar de fortalecimento muscular em adolescentes com diplegia espástica: um relato de três casos. *Fisioter Mov* 2009; **22**: 315–22.
 56. Pastrello FHH, Garção DC, Pereira K. Método Watsu como recurso complementar no tratamento fisioterápico de uma criança com paralisia cerebral tetraparética espástica: estudo de caso. *Fisioter Mov* 2009; **22**: 95–102.
 57. Batista KG, Lopes PO, Serradilha SM, Souza GAF, Bella GP, Souza RCT. Benefícios do condicionamento cardiorrespiratório em crianças ou adolescentes com paralisia cerebral. *Fisioter Mov* 2010; **23**: 201–9.
 58. Bernardi BM, Motta AAP, Allegretti KMG, Monteiro VC, Borges HC, Chamlian TR, et al. Efeitos do treino funcional pós bloqueio químico em crianças com paralisia cerebral. *Rev Neurociênc* 2010; **18**: 166–71.
 59. Cabral AS, Narumia LC, Teixeira LA. Facilitação do planejamento e da aprendizagem por meio da prática mental na paralisia cerebral. *Rev Neurociênc* 2010; **18**: 150–5.
 60. Feroldi MM, Mira RB, Sasseron AB, Fregadolli P. Efeito de um protocolo fisioterápico na função respiratória de crianças com paralisia cerebral. *Rev Neurociênc* 2011; **19**: 109–14.
 61. Rizzetti DA, Fabbrin APA, Trevisan CM. Efeitos do fortalecimento muscular na marcha de adolescentes portadores de paralisia cerebral espástica diparética. *Arq Ciênc Saúde UNIPAR* 2011; **15**: 181–7.
 62. Borges MBS, Werneck MJS, Silva ML, Gandolfi L, Pratesi R. Therapeutic effects of a horse riding simulator in children with cerebral palsy. *Arq Neuropsiquiatr* 2011; **69**: 799–804.
 63. Garcia JM, Knabben RJ, Pereira ND, Ovando AC. Terapia por Contensão Induzida (TCI) em adolescentes com hemiparesia espástica: relato de caso. *Fisioter Mov* 2012; **25**: 895–906.
 64. Cândido E, Xavier-Filho L. Viabilidade do uso do óleo essencial da *Alpinia zerumbet*, Zingiberaceae, na otimização do tratamento fisioterápico em paralisia cerebral espástica. *Arq Bras Neurocir* 2012; **31**: 110–15.
 65. da Costa CS, Rodrigues FS, Leal FM, Rocha NA. Pilot study: investigating the effects of Kinesio Taping® on functional activities in children with cerebral palsy. *Dev Neurorehabil* 2013; **16**: 121–8.
 66. Grecco LAC, Zanon N, Sampaio LMM, Oliveira CS. A comparison of treadmill training and overground walking in ambulant children with cerebral palsy: randomized controlled clinical trial. *Clin Rehabil* 2013; **27**: 686–96.
 67. Botega R, Medola FO, Santos CBA, Silva AT, Lunes DH, Purquerio Bde M. A new walking aid with axillary support for children with cerebral palsy: electromyographic evaluation. *Disabil Rehabil Assist Technol* 2013; **8**: 507–10.
 68. Neves EB, Krueger E, Pol S, Oliveira MCN, Szinke AF, Rosário MO. Benefícios da terapia neuromotora intensiva (TNMI) para o controle do tronco de crianças com paralisia cerebral. *Rev Neurociênc* 2013; **21**: 549–55.
 69. Schewtschik AC, Oliveira ES, Moreira IV, Ribas CG, Loureiro APC. Construction of an artifact to the suitability of sitting posture in children with cerebral palsy and multiple disabilities. *Disabil Rehabil Assist Technol* 2013; **8**: 502–6.
 70. Grecco LAC, Tomita SM, Christovão TCL, Pasini H, Sampaio LMM, Oliveira CS. Effect of treadmill gait training on static and functional balance in children with cerebral palsy: a randomized controlled trial. *Braz J Phys Ther* 2013; **17**: 17–23.

71. Dos Santos AN, da Costa CSN, Golineleo MTB, Rocha NACF. Functional strength training in child with cerebral palsy GMFCS IV: case report. *Dev Neurorehabil* 2013; **16**: 308–14.
72. Maciel F, Mazzitelli C, Sá CSC. Posture and balance in children with cerebral palsy under different therapeutic approaches. *Rev Neurociênc* 2013; **21**: 14–21.
73. Grecco LAC, Freitas TB, Satie J, Bagne E, Oliveira CS, Souza DR. Treadmill training following orthopedic surgery in lower limbs of children with cerebral palsy. *Pediatr Phys Ther* 2013; **25**: 187–92.
74. Tavares CN, Carbonero FC, Finamore PS, Kós RS. Uso do Nintendo® Wii para reabilitação de crianças com paralisia cerebral: estudo de caso. *Rev Neurociênc* 2013; **21**: 286–93.
75. Grecco LAC, Duarte NAC, Zanon N, Galli M, Fregni F, Oliveira CS. Effect of a single session of transcranial direct-current stimulation on balance and spatiotemporal gait variables in children with cerebral palsy: a randomized sham-controlled study. *Braz J Phys Ther* 2014; **18**: 419–27.
76. Duarte NAC, Grecco LAC, Galli M, Fregni F, Oliveira CS. Effect of transcranial direct-current stimulation combined with treadmill training on balance and functional performance in children with cerebral palsy: a double-blind randomized controlled trial. *PLoS One* 2014; **9**: e105777 (research article).
77. Neto HP, Grecco LAC, Duarte NAC, Christovão TCL, Franco de Oliveira LV, Dumont AJL, et al. Immediate effect of postural insoles on gait performance of children with cerebral palsy: preliminary randomized controlled double-blind clinical trial. *J Phys Ther Sci* 2014; **26**: 1003–7.
78. Pavão SL, Arnoni JLB, Oliveira AKC, Rocha NACF. Impact of a virtual reality-based intervention on motor performance and balance of a child with cerebral palsy: a case study [Article in Portuguese]. *Rev Paul Pediatr* 2014; **32**: 389–94.
79. Gerzson LR, Almeida CS. Intervenção motora com a tarefa direcionada na paralisia cerebral: relato de caso. *ConScientiae Saúde* 2014; **13**: 619–24.
80. Grecco LAC, Duarte NAC, Mendonça ME, Cimolin V, Galli M, Fregni F, et al. Transcranial direct current stimulation during treadmill training in children with cerebral palsy: a randomized controlled double-blind clinical trial. *Res Dev Disabil* 2014; **35**: 2840–8.
81. Rezende FL, Duarte NAC, Grecco LAC, Oliveira CS. Treadmill training combined with transcranial direct current stimulation over the primary motor cortex in a child with cerebral palsy and hydrocephalus: a case report. *Man Ther Postural Rehabil J* 2014; **12**: 210 (case report).
82. Lazzari RD, Politti F, Santos CA, Dumont AJL, Rezende FL, Grecco LAC, et al. Effect of a single session of transcranial direct-current stimulation combined with virtual reality training on the balance of children with cerebral palsy: a randomized, controlled, double-blind trial. *J Phys Ther Sci* 2015; **27**: 763–8.
83. Christovão TCL, Pasini H, Grecco LAC, Ferreira LAB, Duarte NAC, Oliveira CS. Effect of postural insoles on static and functional balance in children with cerebral palsy: a randomized controlled study. *Braz J Phys Ther* 2015; **19**: 44–51.
84. Grecco LAC, Duarte NAC, Mendonça ME, Galli M, Fregni F, Oliveira CS. Effects of anodal transcranial direct current stimulation combined with virtual reality for improving gait in children with spastic diparetic cerebral palsy: a pilot, randomized, controlled, double-blind, clinical trial. *Clin Rehabil* 2015; **29**: 1212–23.
85. Martins LG, Rocha LPB, Veris TCRA, Souza JS, Prudente COM, Ribeiro MFM. Efeitos da reabilitação virtual, conceito Bobath e terapia aquática em crianças com paralisia cerebral. *Rev Neurociênc* 2015; **23**: 68–73.
86. Santos CG, Pagnussat AS, Simon AS, Py R, Pinho AS, Wagner MB. Humeral external rotation handling by using the Bobath concept approach affects trunk extensor muscles electromyography in children with cerebral palsy. *Res Dev Disabil* 2015; **36**: 134–41.
87. Oliveira LMM, Braga DM, Oliveira LC, Alves TL, Cyrillo FN, Kanashiro MS. Interferência da fisioterapia aquática no equilíbrio de crianças com paralisia cerebral. *Rev Pesqui Fisioter* 2015; **5**: 70–82.
88. Furtado SRC, Vaz DV, Moura LB, Pinto TPS, Mancini MC. Fortalecimento muscular em adolescentes com paralisia cerebral: avaliação de dois protocolos em desenho experimental de caso único. *Rev Bras Saúde Matern Infant* 2015; **15**: 67–80.
89. Yamaguchi B, Souza FCF, Villegas ILP, Gluszewicz IS, Israel VL. Efeito postural agudo da fisioterapia aquática na encefalopatia crônica não progressiva da infância. *Rev Neurociênc* 2015; **23**: 130–5.
90. Koch HGB, Peixoto GO, Labronici RHDD, Silva NCOV, Alfieri FM, Portes LA. Therapeutic climbing: a possibility of intervention for children with cerebral palsy. *Acta Fisiatr* 2015; **22**: 35–8.
91. Silva RR, Iwabe-Marchese C. Using virtual reality for motor rehabilitation in a child with ataxic cerebral palsy: case report. *Fisioter Pesqui* 2015; **22**: 97–102.
92. Antunes FN, Pinho AS, Kleiner AFR, Salazar AP, Eltz GD, de Oliveira Junior AA, et al. Different horse's paces during hippotherapy on spatio-temporal parameters of gait in children with bilateral spastic cerebral palsy: a feasibility study. *Res Dev Disabil* 2016; **59**: 65–72.
93. Cabral-Sequeira AS, Coelho DB, Teixeira LA. Motor imagery training promotes motor learning in adolescents with cerebral palsy: comparison between left and right hemiparesis. *Exp Brain Res* 2016; **234**: 1515–24.
94. Machado FRC, Antunes PP, Souza JM, Santos AC, Levandowski DC, Oliveira AA. Motor improvement using motion sensing game devices for cerebral palsy rehabilitation. *J Mot Behav* 2016; **49**: 273–80.
95. Santos AN, Serikawa SS, Rocha NACF. Pilates improves lower limbs strength and postural control during quiet standing in a child with hemiparetic cerebral palsy: a case report study. *Dev Neurorehabil* 2016; **19**: 226–30.
96. Grecco LAC, Oliveira CS, Galli M, Cosmo C, Duarte NAC, Zanon N, et al. Spared primary motor cortex and the presence of MEP in cerebral palsy dictate the responsiveness to tDCS during gait training. *Front Hum Neurosci* 2016; **10**: 361 (research article).
97. Grecco LAC, Oliveira CS, Duarte NAC, Lima VLCC, Zanon N, Fregni F. Cerebellar transcranial direct current stimulation in children with ataxic cerebral palsy: a sham-controlled, crossover, pilot study. *Dev Neurorehabil* 2017; **20**: 142–8.
98. Lazzari RD, Politti F, Belina SF, Collange Grecco LA, Santos CA, Dumont AJL, et al. Effect of transcranial direct current stimulation combined with virtual reality training on balance in children with cerebral palsy: a randomized, controlled, double-blind, clinical trial. *J Mot Behav* 2017; **49**: 329–36.
99. Moura RCF, Santos C, Grecco LC, Albertini G, Cimolin V, Galli M, et al. Effects of a single session of transcranial direct current stimulation on upper limb movements in children with cerebral palsy: a randomized, sham-controlled study. *Dev Neurorehabil* 2017; **20**: 368–75.
100. Da Silva EM, Da Silva TAS, Balk RS, Lopes RR, Santos CC, Lara S, et al. Avaliação do alinhamento postural e extensibilidade muscular pela escala SAROMM em crianças com paralisia cerebral após fisioterapia aquática. *Fisioter Bras* 2017; **18**: 719–26.
101. Horchuliki JA, Parisotto D, Chiarello C, Mélo T. Influência da terapia neuromotora intensiva na motricidade e na qualidade de vida de crianças com encefalopatia crônica não progressiva da infância. *Rev Bras Qual Vida* 2017; **9**: 17–29.
102. Mélo TR, Yamaguchi B, Chiarello CR, Costin ACS, Erthal V, Israel VL, et al. Intensive neuromotor therapy with suit improves motor gross function in cerebral palsy: a Brazilian study. *Motricidade* 2017; **13**: 54–61.
103. Neto HP, Grecco LAC, Ferreira LAB, Duarte NAC, Galli M, Oliveira CS. Postural insoles on gait in children with cerebral palsy: randomized controlled double-blind clinical trial. *J Bodyw Mov Ther* 2017; **21**: 890–5.
104. Oliveira LS, Golin MO. Técnica para redução do tônus e alongamento muscular passivo: efeitos na amplitude de movimento de crianças com paralisia cerebral espástica. *ABCS Health Sci* 2017; **42**: 27–33.
105. Melo GA, Lemos MT, Carvalho S, Germano CFM. A realidade virtual no treino do equilíbrio corporal na hemiparesia causada por paralisia cerebral. *Adolesc Saude* 2017; **14**: 176–82.
106. Saquetto MB, de Santana Bispo A, da Silva Barreto C, Gonçalves KA, Queiroz RS, da Silva CM et al. Addition of an educational programme for primary caregivers to rehabilitation improves self-care and mobility in children with cerebral palsy: a randomized controlled trial. *Clin Rehabil* 2018; **32**: 878–87.
107. Espindula AP, Júnior DEB, Ribeiro MF, Lage JB, de Mello EC, Raizel JBE, et al. Avaliação da flexibilidade de fisioterapêutica espástica após intervenção crianças com paralisia cerebral. *ConScientiae Saúde* 2018; **17**: 41–7.
108. Oliveira L, Santos MCC, Costin ACMS, Mélo TR. Effect of intensive neuromotor therapy on trunk control of children with quadripareia. *Rev Uniandrade* 2018; **19**: 77–83.
109. Oliveira LL, Nery LC, Gonçalves RV. Efetividade do método suit na função motora grossa de uma criança

- com paralisia cerebral. *Rev Interdiscip Ciên Méd* 2018; **1**: 15–21.
110. Araujo LB, Silva TDC, Oliveira LC, Tomasetto LC, Kanashiro MS, Braga DM. Efeitos da fisioterapia aquática na função motora de indivíduos com paralisia cerebral: ensaio clínico randomizado. *Fisioter Bras* 2018; **19**: 613–23.
 111. Reitz GS, Chirrolli MJ, Assunção MN, Crippa PVS, Pereira SM, Roesler H. Influência do tratamento intensivo com suporte de peso corporal na função motora de crianças com paralisia cerebral. *Acta Fisiátr* 2018; **25**: 195–9.
 112. Reitz GS, Chirrolli MJ, Gantzel LC, Lunardelli BS, Pereira SM, Roesler H. Efeitos da prática do suporte de peso corporal em crianças com paralisia cerebral: uma série de casos. *Rev Pesqui Fisioter* 2018; **8**: 397–403.
 113. Moraes AG, Copetti F, Ângelo VR, Chiavoloni L, de David AC. Hippotherapy on postural balance in the sitting position of children with cerebral palsy – longitudinal study. *Physiother Theory Pract* 2018; **36**: 259–66.
 114. Possel EFRP, Erthal V, Chiarello CR, Costin ACMS, Mélo TR. Terapia neuromotora intensiva (TNMI) na função motora grossa de crianças com paralisia cerebral. *Rev Uniandrade* 2018; **19**: 53–60.
 115. de Oliveira MC, Mélo TR, de Pol S, Costin AC, de Oliveira FC, Neves EB, et al. Terapia neuromotora intensiva promove ganhos de habilidades motoras grossas e manutenção da composição corporal em crianças com paralisia cerebral. *Rev Bras Obesidade Nutr Emagrecimento* 2018; **12**: 598–606.
 116. de Oliveira MC, Mélo TR, de Pol S, Costin AC, de Oliveira FC, Neves EB. Intervenção fisioterapêutica em crianças com paralisia cerebral. *Rev Uniandrade* 2018; **18**: 122–30.
 117. Nascimento NF, Marques JS, Triqueiro LCL, Silva TCC, Lacerda MO, Lindquist ARR. Treino com realidade virtual no alcance manual de crianças com paralisia cerebral: estudo de três casos. *Fisioter Bras* 2018; **19**: 223–30.
 118. Ribeiro MF, Espindula AP, Lage JB, Bevilacqua Júnior DE, Diniz LH, Mello EC, et al. Analysis of the electromyographic activity of lower limb and motor function in hippotherapy practitioners with cerebral palsy. *J Bodyw Mov Ther* 2019; **23**: 39–47.
 119. Batista JPE, Souza DM, Ghattás V, Bernardino G, Fontenelle RS. Analysis of the physiotherapeutic treatment for cerebral palsy based on the Bobath neurodevelopmental treatment through the GMFM. *Int J Innov Educ Res* 2019; **7**: 1–11.
 120. Flores FM, Dagnese F, Copetti F. Do the type of walking surface and the horse speed during hippotherapy modify the dynamics of sitting postural control in children with cerebral palsy? *Clin Biomech* 2019; **70**: 46–51.
 121. Arnoni JLB, Pavão SL, Silva FPS, Rocha NACF. Effects of virtual reality in body oscillation and motor performance of children with cerebral palsy: a preliminary randomized controlled clinical trial. *Complement Ther Clin Pract* 2019; **35**: 189–94.
 122. Gonçalves RV, Fonseca ST, Araújo PA, Souza TR, Resende RA, Mancini MC. Functional task training combined with electrical stimulation improves motor capacity in children with unilateral cerebral palsy: a single-subject design. *Pediatr Phys Ther* 2019; **31**: 208–15.
 123. Freitas J, Mélo TR, Sabbag AA, Costin ACMS, Neves EB. Influência da terapia neuromotora intensiva no controle de cabeça de uma criança com paralisia cerebral do tipo quadriplegia espástica. *Cad Pós-Grad Distúrb Desenvol* 2019; **19**: 65–80.
 124. Menegassi DA, Sabbag AA, Costa ARC, Maltauro L, Mélo TR, Neves EB. Terapia neuromotora intensiva melhora a composição corporal na paralisia cerebral e amiotrofia. *Rev Bras Obesidade Nutr Emagrecimento* 2019; **13**: 275–83.
 125. Ramalho VM, Kakihata AM, Kanashiro MS, Oliveira LC, de Oliveira LM, Branco FR, et al. Protocolo de controle de tronco em ambiente aquático para crianças com paralisia cerebral: ensaio clínico randomizado. *Rev Bras Ciên Saúde* 2019; **23**: 23–32.
 126. Souto DO, Cruz TKF, Coutinho K, Julio-Costa A, Fontes PLB, Haase VG. Effect of motor imagery combined with physical practice on upper limb rehabilitation in children with hemiplegic cerebral palsy. *NeuroRehabilitation* 2020; **46**: 53–63.
 127. Figueiredo PRP, Mancini MC, Feitosa AM, Teixeira CMMF, Guerzoni VPD, Elvrum A-KG, et al. Hand-arm bimanual intensive therapy and daily functioning of children with bilateral cerebral palsy: a randomized controlled trial. *Dev Med Child Neurol* 2020; **62**: 1274–82.
 128. Silva F, Yamaguchi B, Almeida KC, Costin ACMS, Maltauro L, Neves EB, et al. Efeito imediato, agudo e crônico da Kinesio Taping® associada à terapia neuromotora intensiva na postura sentada de crianças com paralisia cerebral. *Arq Ciên Saúde UNIPAR* 2020; **24**: 47–52.
 129. Santos LM, Sabbag AA, Menegassi DA, Maltauro L, Costin AC, Neves EB, et al. Terapia neuromotora intensiva no controle de tronco e habilidades motoras grossas em criança com hemiparesia espástica: relato de caso. *Cad Pós- Grad Distúrb Desenvol* 2020; **20**: 67–84.
 130. Neri LLO, Silva DFS, Marques da Silva J, Nascimento GGA, Silva MFB, Paes MNS, et al. Uso de um protocolo do método pediasuit no tratamento de crianças com paralisia cerebral: relato de caso. In: Ciências da saúde: campo promissor em pesquisa. Ponta Grossa - PR: Atena Editora; 2020: p. 161–9.
 131. Willis C, Nyquist A, Jahnsen R, Elliott C, Ullenhag A. Enabling physical activity participation for children and youth with disabilities following a goal-directed, family-centred intervention. *Res Dev Disabil* 2018; **77**: 30–9.
 132. Reedman SE, Boyd RN, Elliott C, Sakzewski L. ParticiPate CP: a protocol of a randomised waitlist controlled trial of a motivational and behaviour change therapy intervention to increase physical activity through meaningful participation in children with cerebral palsy. *BMJ Open* 2017; **7**: e015918 (protocol).
 133. Almeida KM, Fonseca ST, Figueiredo PRP, Aquino AA, Mancini MC. Effects of interventions with therapeutic suits (clothing) on impairments and functional limitations of children with cerebral palsy: a systematic review. *Braz J Phys Ther* 2017; **21**: 307–20.
 134. Zanon MA, Pacheco RL, Latorraca COC, Martimbianco ALC, Pachito DV, Riera R. Neurodevelopmental treatment (Bobath) for children with cerebral palsy: a systematic review. *J Child Neurol* 2019; **34**: 679–86.
 135. Capelovitch S. Neurodevelopmental therapy – a popular approach. *Dev Med Child Neurol* 2014; **56**: 402 (letter to the editor).
 136. Damiano D. Pass the torch, please! *Dev Med Child Neurol* 2007; **49**: 723 (editorial).
 137. Campos TNC, Schiariti V, Gladstone M, Melo A, Tavares JS, Magalhães AG, et al. How congenital Zika virus impacted my child's functioning and disability: a Brazilian qualitative study guided by the ICF. *BMJ Open* 2020; **10**: e038228 (research article).
 138. Bailes AF, Greve K, Burch CK, Reder R, Lin L, Huth MM. The effect of suit wear during an intensive therapy program in children with cerebral palsy. *Pediatr Phys Ther* 2011; **23**: 136–42.
 139. Weisleder P. Unethical prescriptions: alternative therapies for children with cerebral palsy. *Clin Pediatr* 2010; **49**: 7–11.
 140. Moraes DS, Teixeira RS, Santos MS. Profile of the judicialization of the Therasuit Method and its direct cost in the scope of the state of Rio de Janeiro. *Rev Bras Epidemiol* 2019; **22**: e190006 (research article).
 141. Associação Brasileira de Fisioterapia Neurofuncional. Parecer técnico em resposta a demanda judicial ementa: parecer técnico-científico sobre o pediasuit. Rio de Janeiro, Brazil: ABRAFIN; 2017. https://abrafin.org.br/wp-content/uploads/2017/06/Parecer-Pediasuit-2017_crefito8_final.pdf. Accessed 14 Sept 2021.
 142. Fleming MK, Theologis T, Buckingham R, Johansen-Berg H. Transcranial direct current stimulation for promoting motor function in cerebral palsy: a review. *J Neuroeng Rehabil* 2018; **15**: 121 (review).
 143. Corsi C, Santos MM, Moreira RFC, dos Santos AN, de Campos AC, Galli M, et al. Effect of physical therapy interventions on spatiotemporal gait parameters in children with cerebral palsy: a systematic review. *Disabil Rehabil* 2021; **43**: 1507–16.
 144. Hsieh Y-L, Yang C-C, Sun S-H, Chan S-Y, Wang T-H, Luo H-J. Effects of hippotherapy on body functions, activities and participation in children with cerebral palsy based on ICF-CY assessments. *Disabil Rehabil* 2017; **39**: 1703–13.
 145. Novak I. Evidence-based diagnosis, health care, and rehabilitation for children. *J Child Neurol* 2014; **29**: 1141–56.
 146. Silva DBR, Pfeifer LI, Funayama CAR. Gross Motor Function Classification System Expanded & Revised (GMFCS E & R): reliability between therapists and parents in Brazil. *Braz J Phys Ther* 2013; **17**: 458–63.
 147. Chagas PSC, Drumond CM, Toledo AM, de Campos AC, Camargos ACR, Longo E, et al. Study protocol: functioning curves and trajectories for children and

- adolescents with cerebral palsy in Brazil – ParticIPA Brazil. *BMC Pediatr* 2020; **20**: 393 (protocol).
148. Howick J, Chalmers I, Glasziou P, Greenhalgh T, Heneghan C, Liberati A, et al. The 2011 Oxford CEBM levels of evidence: (introductory document). Oxford: OCEBM; 2011. <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebml-levels-of-evidence>. Accessed 14 Sept 2021.
 149. Hariton E, Locascio JJ. Randomised controlled trials – the gold standard for effectiveness research: study design: randomised controlled trials. *BJOG* 2018; **125**: 1716 (research methods guides).
 150. Grzybowski A. The journal impact factor: how to interpret its true value and importance. *Med Sci Monit* 2009; **15**: SR1–4.
 151. de La-Roque Barros Warken G, Freitas JS, Domingues JS, Kietzer KS. The academic formation and the scientific production of physiotherapist researchers from Amazon region. *Rev Bras Pós-Grad* 2015; **12**: 743–68.
 152. Cruz FG, Cedro TAN, Camargo SB, Sá KN. Scientific profile of physiotherapists Brazilian scientists. *Fisioter Mov* 2018; **31**: e003123 (research article).
 153. Zanon MA, Araújo AKM, Neto EVC, Mendes LC, Pascoal DB, Trindade Filho EM, et al. Prevalence and characterization of the cerebral palsy in Maceió, a north-east city of Brazil. *World J Neurosci* 2018; **8**: 333–41.
 154. Dal-Ré R, Janiaud P, Ioannidis JPA. Real-world evidence: how pragmatic are randomized controlled trials labeled as pragmatic? *BMC Med* 2018; **16**: 49 (debate).
 155. de Oliveira Andrade R. Brazil's budget cuts threaten 80,000 science scholarships. *Nature* 2019; **572**: 575–6.
 156. Angelo C. Brazil freezes science spending. *Nature* 2019; **568**: 155–6.
 157. Ouyang R-G, Yang C-N, Qu Y-L, Koduri MP, Chien C-W. Effectiveness of hand-arm bimanual intensive training on upper extremity function in children with cerebral palsy: a systematic review. *Eur J Paediatr Neurol* 2020; **25**: 17–28.
 158. Morgan C, Novak I, Badawi N. Enriched environments and motor outcomes in cerebral palsy: systematic review and meta-analysis. *Pediatrics* 2013; **132**: e735–46.
 159. Longo E, de Campos AC, Schiariu V. COVID-19 pandemic: is this a good time for implementation of home programs for children's rehabilitation in low- and middle-income countries? *Phys Occup Ther Pediatr* 2020; **40**: 361–4.
 160. Rosenbaum PL, Silva M, Camden C. Let's not go back to 'normal'! Lessons from COVID-19 for professionals working in childhood disability. *Disabil Rehabil* 2021; **43**: 1022–8.

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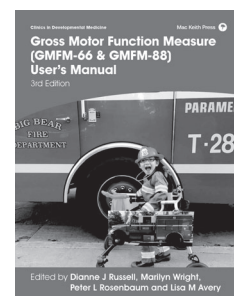


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3rd Edition

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