Review Article

Play therapy strategies in motor rehabilitation of children with cerebral palsy: an integrative review

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ABSTRACT

The objective of this study was to identify and analyze play therapy strategies used in the rehabilitation of motor disorders in children with cerebral palsy. This is an integrative review of the literature, conducted by two independent reviewers, in the following databases: LILACS, Embase, Web of Science, CINAHL and PubMed databases. The searches covered the period from 2006 to 2017 and the Portuguese, English and Spanish languages. The search strategy included several keywords, using the PICO approach. Twenty articles were included that achieved satisfactory results for the use of ludic strategies, focusing on the fine motor skills, gross motor skills, balance and gait of children with cerebral palsy. Video games and computer games were the most commonly used strategies. It is concluded that the incorporation of ludic activities in the treatment of children with cerebral palsy, when properly used, is important in fostering the improvement of motor skills and favoring the therapist/patient relationship, making treatment more dynamic and effective.

Descriptors: Review; Cerebral Palsy; Child; Rehabilitation; Play Therapy; Pediatric Nursing.

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INTRODUCTION

Cerebral palsy (CP), also known as chronic non-progressive childhood encephalopathy (CNPCE), is the most common physical disability in childhood. It refers to motor development disorders resulting from permanent and changeable primary brain damage that causes secondary musculoskeletal changes and limitations of children's daily activities [(1)]. Patients with CP show problems such as muscle tone abnormalities, impaired balance and coordination, decreased strength, and loss of control in selectivity of movement[(2)].

Because of these musculoskeletal changes, the goals to be achieved by the therapies used with this population include promoting the performance of functional activities[(3)] and minimizing the development of secondary problems such as deformities[(4)]. Among these therapies rehabilitation should be emphasized; it should consider individuals based on physical, mental, emotional, communicative and relational aspects, in addition to their family, social and environmental context[(5)].

A variety of intervention methodologies are adopted in the rehabilitation of children with CP. Some literature reviews have evaluated the effect of isolated interventions commonly used for CP motor disorders, such as virtual reality, interactive games, and video games[(6-8)]. However, there are no reviews that integrate these different approaches and identify play therapies that may help health professionals in selecting the best treatment strategy for the rehabilitation of these children.

Playing is a natural activity in childhood, and potentially generates many opportunities for children with CP to improve their motor ability[(9-10)]. Considering ludic strategies in the rehabilitation of motor disorders may have a potentiating effect on the development of children with CP, when sensory, motor, cognitive, affective and social components of playing are taken in consideration[(11)].

Using ludic activities as a strategy make it possible to expand the level of activity and participation children, in addition to promoting a patient-centered approach. Therefore, the question posed in this integrative review was: "What are the play therapies used in rehabilitation to improve motor capacity of children with CP?" The objective was to identify and analyze the ludic strategies used in the rehabilitation of motor disorders in children with CP.

METHOD

An integrative literature review was carried out that included the following stages: problem identification, literature search, data analysis and evaluation, and synthesis to report the results[(12)]. The PICO approach (Population, Intervention, Comparison and Outcome)[(13)] was used to develop the review question, the scope of the review, and the inclusion criteria, which are shown in Table 1.

Table 1: Descriptors of subject used to search articles. Ribeirão Preto/SP, 2017.

PICO acronym	
P	Children younger than 12 years with a diagnosis of CP
I	Play therapies
C	Not applicable
O	Rehabilitation (motor)

The review included original studies, published as full texts in scientific journals and in annals of events, with children younger than 12 years of age who were diagnosed with CP, provided that they evaluated play therapies for the children. No comparison groups were reported, and the studies needed to address children's motor function (e.g., fine motor skills, gross motor skills, balance and gait). All study designs were considered, both quantitative and qualitative approaches, in order to cover the diversity of ludic strategies already used with children with CP. The following types of studies were excluded: those with adolescents (over 12 years of age) that did not separately present the results related to children; those that included different diagnoses, not presenting the results related to CP separately; and those that used any alternative intervention in the comparison group. Also excluded were gray literature, such as books, book chapters, abstracts published in annals of events, theses and dissertations.

The search was conducted by two independent reviewers in the following databases: LILACS, Embase, Web of Science, CINAHL and PubMed. The search strategy contemplated a wide range of keywords related to children, CP, rehabilitation, games, toys and play therapy. The search terms and the strategy used in PubMed are presented in Table 2 and were similar in the other databases, adapted to the specificities of each. The search was also limited to articles published in the period from 2006 to 2017, in the Portuguese, English and Spanish languages, and involving research with human subjects. The lists of references of the articles included were also checked.

Table 2: Search terms used in PubMed.

Group	Descriptors ad keywords
1	"Cerebral Palsy"[Mesh] OR CP (Cerebral Palsy) OR (Cerebral Palsy, Dystonic-Rigid) OR (Cerebral Palsies, Dystonic-Rigid) OR (Cerebral Palsy, Dystonic Rigid) OR (Dystonic-Rigid Cerebral Palsies) OR (Dystonic-Rigid Cerebral Palsy) OR (Cerebral Palsy, Mixed) OR (Mixed Cerebral Palsies) OR (Mixed Cerebral Palsy) OR (Cerebral Palsy, Monoplegic, Infantile) OR (Monoplegic Infantile Cerebral Palsy) OR (Infantile Cerebral Palsy, Monoplegic) OR (Cerebral Palsy, Quadriplegic, Infantile) OR (Quadriplegic Infantile Cerebral Palsy) OR (Infantile Cerebral Palsy, Quadriplegic) OR (Cerebral Palsy, Rolandic Type) OR (Rolandic Type Cerebral Palsy) OR (Cerebral Palsy, Congenital) OR (Congenital Cerebral Palsy) OR (Little Disease) OR (Little's Disease) OR (Spastic Diplegia) OR (Diplegias, Spastic) OR (Spastic Diplegias) OR (Diplegia, Spastic) OR (Monoplegic Cerebral Palsy) OR (Cerebral Palsies, Monoplegic) OR (Cerebral Palsy, Monoplegic) OR (Monoplegic Cerebral Palsies) OR (Cerebral Palsy, Athetoid) OR (Athetoid Cerebral Palsy) OR (Cerebral Palsies, Athetoid) OR (Cerebral Palsy, Dyskinetic) OR (Cerebral Palsies, Dyskinetic) OR (Dyskinetic Cerebral Palsy) OR (Cerebral Palsy, Atonic) OR (Atonic Cerebral Palsy) OR (Cerebral Palsy, Hypotonic) OR (Hypotonic Cerebral Palsies) OR (Hypotonic Cerebral Palsy) OR (Cerebral Palsy, Diplegic, Infantile) OR (Diplegic Infantile Cerebral Palsy) OR (Infantile Cerebral Palsy, Diplegic) OR (Cerebral Palsy, Spastic) OR (Spastic Cerebral Palsies) OR (Spastic Cerebral Palsy)
2	"Child"[Mesh] OR (children)
3	1 AND 2
4	"Video Games"[Mesh] OR (Game, Video) OR (Games, Video) OR (Video Game) OR (Computer Games) OR (Computer Game) OR (Game, Computer) OR (Games, Computer) OR "Play and Playthings"[Mesh] OR (Playthings and Play) OR (Toys) OR (Toy) OR (Puppets) OR (Puppet) OR (Play) OR (Plays) OR (Playthings) OR (Plaything) OR "Play Therapy"[Mesh] OR (Play Therapies) OR (Therapies, Play) OR (Therapy, Play) OR (Sandplay Therapy) OR (Sandplay Therapies) OR (Therapies, Sandplay) OR (Therapy, Sandplay) OR (Sandplay) OR (Sandplays)
5	"Rehabilitation"[Mesh] OR (habilitation) OR (motor rehabilitation)
6	3 AND 4 AND 5

The references were exported to EndNote® for organization and verification of duplication. The titles and abstracts of articles were read by two independent researchers, based on the eligibility criteria for the review. The Kappa test was used to check interobserver agreement, which showed almost perfect agreement, with a value of 0.88[14]. Subsequently, two researchers independently read the articles considered relevant for inclusion.

Disagreements were resolved by consensus, with the help of a third reviewer. The PRISMA flowchart was used to illustrate the results, screening and selection process of the search to identify the studies included in the review[15].

Data extraction was conducted by two reviewers independently and guided by a data collection form developed by the researchers. Disagreements among reviewers regarding extracted data were discussed with the original publication as a reference. The following information was extracted: identification, study method, characteristics of the children studied, type of intervention and format, scenario, results related to motor development, measures used, limitations and conclusions presented.

It was not possible to perform a meta-analysis, due to the heterogeneity of the studies, and a narrative synthesis was created. The results of the review were structured in relation to the following aspects: description of the studies, types of intervention, measures used and impacts of the interventions, also exploring the relationship between the studies and their results.

RESULTS

A total of 425 studies was identified, 423 through searches in the databases, and two through verification of the references of the included articles. Of these, 50 were excluded because they were duplicated, followed by reading the titles and abstracts of 375 articles. Based on the eligibility criteria, 294 articles were excluded, which resulted in the sample analysis of 81 studies for full reading. After this reading, 20 articles were included in this review. The literature search process, based on PRISMA recommendations[15], is shown in Figure 1.

Table 3 illustrates the characteristics of the included studies[16-35]. They were carried out between 2007 and 2017; most interventions were developed in Europe (n = 7)[18-19,23,25-27,30], including the Netherlands (n = 4)[18-19,23,26], Spain (n = 1)[25], Denmark (n = 1)[27] and the United Kingdom (n = 1)[30]. North America[17,20-21,24,29,33] and Asia[16,22,28,31-32,34-35] presented six studies each, with the United States[17,20,24,33] being highlighted regarding the development of four interventions.

The methodologies used included experiments (n = 8)[16,18,20,23,26,31,34-35], quasi-experiments (n = 2)[19,29], preliminary studies (n = 1)[25,32], a single group study (n=2)[17,33], an exploratory study (n=1)[21], a randomized clinical study (n = 1)[22], a case study (n = 1)[24], a case report (n = 1)[28], a controlled study (n = 1)[27] and a crossover study(n = 1)[30]. Although only one study used a qualitative approach[28], four quantitative studies analyzed interventions through subjective assessment of the children's[29], parents[20], perceptions of health professionals[33], and perceptions of children and their teachers[30].

Interventions occurred in different settings, such as laboratories (n = 7)[16,18-19,22-24], outpatient facilities[21,29,31,34-35] (n = 4), playgrounds[33], a school (n = 2)[25,30] and a home (n = 1)[28]. In four studies[17,20,27,32], the authors did not report the sites of the interventions.

Regarding the study populations, six articles identified the type of CP of the participants: hemiplegic (n = 2)[26,34], diparetic (n = 3)[23,31,35], hemiplegic and diparetic (n = 1)[25] and spastic quadriplegic (n = 1)[28]. The minimum number of participants was one and the maximum 48, and ages ranged from 21 months to 12 years. Fourteen studies considered boys and girls[16-18,21-22,25-31,33,34-35], five included only boys[19,23,24,28,32] and one had only girls as participants[20].

Figure 1: PRISMA Flow chart of the process of literature search.

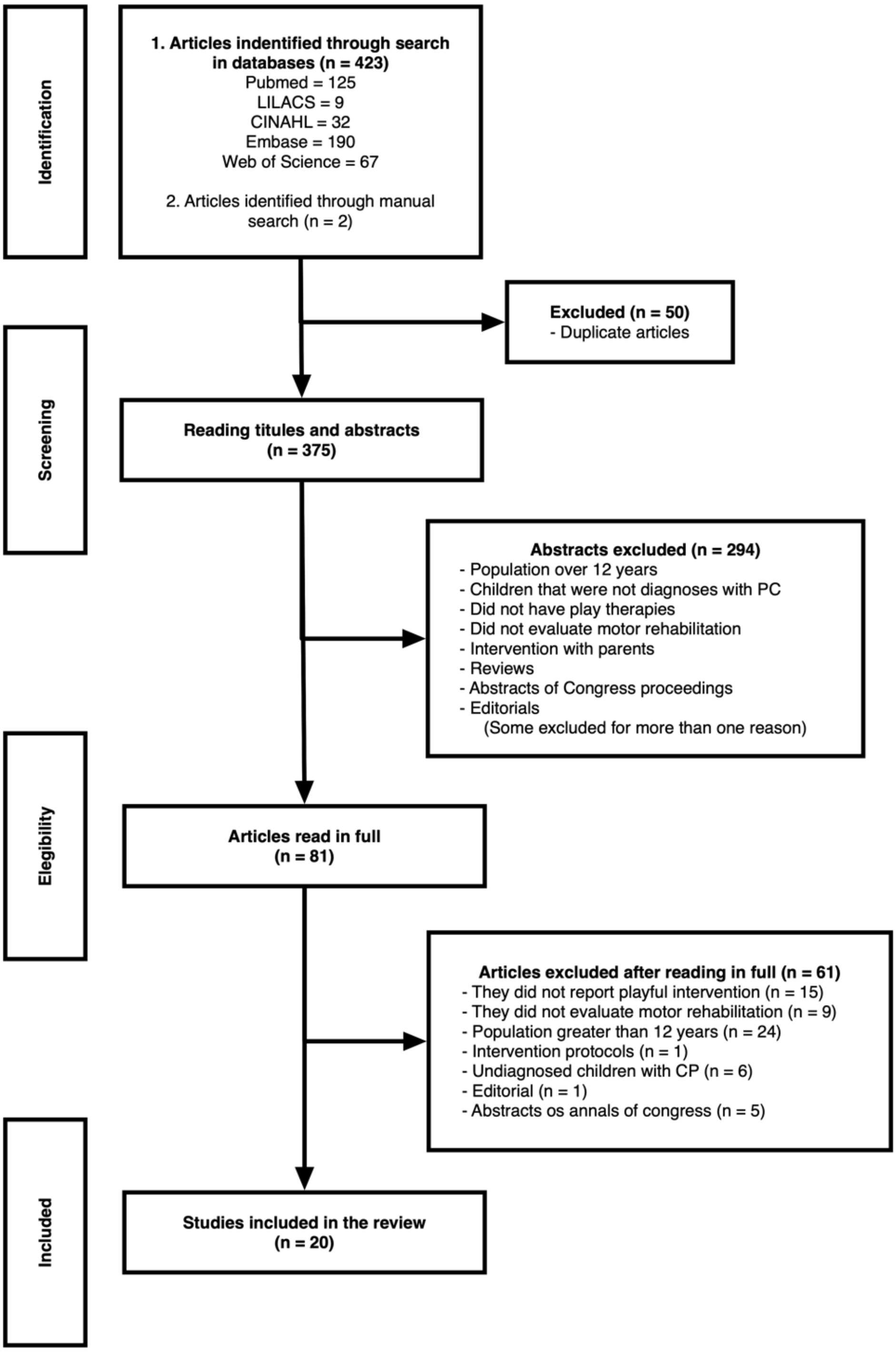

Table 4 illustrates the aspects addressed in the rehabilitation process of children with CP, using play activities for the purpose of motor stimulation. Most of the studies used video games and computer games (n = 9)[21-23,25-26,29-31,34]. Robots (n = 5)[16-17,24,30,32], animals (horse) (n = 1)[20], adapted toy cars (n = 1)[28], interactive equipment (n = 2)[19,28], games of reaching, grasping and fitting, according to the child's interest (n = 2)[19,35], and playground play (n=1)[33] were also used.

Table 3: Main characteristics of studies included.

First author, year	Objective related to motor function	Type of study	Context of intervention	Population and sample	Age and gender
CHEN, 2007[16]	To investigate the effects of training with virtual reality on behavioral intervention in children with spastic CP.	Experimental	Physical therapy laboratory	CP diagnosis, type not reported N=4	4 to 8 years Boys and girls
FASOLI, 2008[17]	To examine the viability and effects of robotic therapy of the upper limbs for children with hemiplegic CP.	Single group	Not reported	CP diagnosis, type not reported N=12	5 to 12 years Boys and girls
CRAJÉ, 2010[18]	To investigate action plans in small children (3 to 6 years), with and without unilateral CP.	Exploratory experimental	University laboratory	CP diagnosis, type not reported N=24	3 to 6 years Boys and girls
AARTS, 2011[19]	To describe a protocol of modified constraint-induced movement therapy for children combined with goal-oriented, task-specific bimanual training.	Quasi-experimental	University laboratory	CP diagnosis, type not reported N=1	2.7 years Boy
FRANK, 2011[20]	To describe functional improvement in participation, measured by the perception of self-competence and social acceptance.	Experimental	Not reported	CP diagnosis, type not reported N=1	6 years Girl
GORDON, 2012[21]	To explore the possibility of using the Nintendo Wii ® as a rehabilitation tool for children with CP in a developing country and to determine the impact on gross motor function.	Clinical-exploratory	Outpatient facility	CP diagnosis, type not reported n=7	6 to 12 years Boys and girls
SHARAN, 2012[22]	To evaluate the effect of virtual reality training in terms of balance, manual skills, level of participation and satisfaction among post-operative children who have CP underwent rehabilitation.	Clinical-randomized	University laboratory	CP diagnosis, type not reported n=16 (N=8 in the experimental group and n=8 in the control group)	8 to 10 years Boys and girls
BARTON, 2013[23]	To examine changes in pelvic coupling in a computer game driven by pelvic rotation.	Experimental	University laboratory	CP children of diparetic type N=1	10 years Boy
BURDEA, 2013[24]	To investigate the viability of robotic treatment based on the ankle game in CP children.	Case study	University Laboratory	CP diagnostic, type not reported n= 3	7 to 12 years Boys
LUNA-OLIVA, 2013[25]	To evaluate the usefulness of a video game system based on non-immersive virtual reality technology (Xbox 360 Kinect ™) to support the conventional treatment by physical therapy of children with CP.	Preliminary study	School	Children with mild-moderate hemiplegic and diplegic CP N=11	4 to 12 years Boys and girls

First author, year	Objective related to motor function	Type of study	Context of intervention	Population and sample	Age and gender
PEPER, 2013[26]	Examine the potential effects of training on bimanual coordination on the performance of the affected arm.	Experimental	University laboratory	Children with hemiparetic CP N=6	7 to 12 years Boys and girls
CURTIS, 2014[27]	To study the effect of active stretching of the plantar flexors of the ankle using a dynamic stander in children with CP.	Controlled study	Not reported	Children with CP levels I to III N=6	4 to 11 years Boys and girls
HUANG, 2014[28]	To select a set of variables that quantify changes in independent mobility, socialization and self-care, qualitatively evaluated by the researchers.	Case report	Participant's home	Child with quadriplegic, spastic CP N=1	21 months Boy
NI, 2014[29]	To describe the design and evaluation of two computer games to verify the therapeutic relevance and gaming experience for rehabilitation of the lower and upper limbs in children with CP.	Quasi-experimental	Outpatient facility	Diagnosis of CP, type not reported N=8	10 years (SD=1.4 years) Boys and girls
PRESTON, 2014[30]	To present the feasibility of implementing a system of computer-assisted arm rehabilitation games for English schools with the aim of involving children with CP from 5 to 12 years of age in daily arm rehabilitation exercises during the school week.	Crossover design (AB–BA)	School	Diagnosis of CP, with upper limb impairment N=11	5 to 12 years Boys and girls
ALSAIF, 2015[31]	To investigate the effect of training with Nintendo Wii Fit games on motor performance of children with spastic CP.	Experimental	Outpatient facility	Children with diparetic CP N=40	6 to 10 years Boys and girls
TONG, 2015[32]	To present a preliminary study of the evaluation of the reachMAN modular handle to train upper limb function.	Preliminary study	Not reported	CP diagnosis, type not reported N=1	8 years Boy
PRATT, 2016[33]	To investigate the effect of playgrounds that comply with the Americans with Disabilities Act and those that don't comply on physical activities with children with CP.	Single group research	Playgrounds	Children with CP Level II n=5	6 to 10 years Boys and girls

Table 4: Identification of the study and details of the ludic intervention developed; variables/tools for measurement and main results.

First author, year	Play intervention and its format	Duration, number and time of sessions	Evaluation variables and tools	Main results
CHEN, 2007[16]	Virtual reality game. The children were seated on a special chair with trunk support during the intervention. Virtual reality programs were selected based on children's motor skills and cognition.	4 weeks No. of sessions not reported 30 minutes each	Fine motor skills - Peabody Developmental Motor Scales–Second Edition (PDMS- 2) - Subtest	Four children were evaluated. In the subtest of fine motor skills evaluation (grabbing), two showed improvement: children 2 and 4 (both with 48 points in the evaluation and 51 points in the reevaluation). In the visual evaluation subtest, three children scored higher during the reevaluation: child 1 (95 points and 106 points), child 3 (114 points and 119 points) and child 4 (137 points and 140 points). In the laterality subtests, all of them improved: child 1 (141 and 153 points), child 2 (192 points and 193 points), child 3 (141 and 153 points) and child 4 (188 points and 191).
FASOLI, 2008[17]	Robotic prototype. 640 repetitive movements with the paretic arm during each session. The movements of the shoulder and elbow joints were mainly performed.	8 weeks 16 sessions 60 minutes each	- QUEST: Skills Tests - Fugl-Meyer: Subtest for upper limb evaluation	In the skills test, the evaluated participants showed significant improvement in movement dissociation (p <0.0005). In the evaluation of the upper limb subtest, the improvement was also significant (p< 0.0005).
CRAJÉ 2010[18]	The children remained in their own adjusted chairs, so that the feet were supported and they could rest the armpits on the table. A wooden sword was left on the table and had to be placed in a tight hole in a block of wood.	6 weeks of constraint-induced movement therapy, followed by 2 weeks of bimanual training. Number of sessions was not reported. 10 minutes each	Critical conditions and comfortable final postures	The children who underwent the interventions in comfortable fine postures obtained statistically significant results, with them being higher in the control group (p<0.001).
AARTS, 2011[19]	Games of reaching, grasping and fitting according to the interest of the child.	9 weeks of attendance, with follow up on the 17th day after the end of the session. Number and time of sessions were not reported.	ABILHAND-Kids - upper limb impairment Assisting Hand Assessment (AHA) - Functional assessment of upper limbs	In the functional evaluation of the upper limbs, the participant reached 44% of the total score on the evaluative scales; in the reevaluation, the value obtained was 59%. There was a 15% improvement in the assessment of the upper limbs after play intervention.

First author, year	Play intervention and its format	Duration, number and time of sessions	Evaluation variables and tools	Main results
FRANK, 2011[20]	Horse. Conventional sessions of hippotherapy.	8 weeks. Number of sessions not reported. Each session included 45 minutes of equine therapy, plus 10 minutes of terrestrial physical therapy, plus 5 minutes of parent guidance.	Gross motor evaluation - Gross Motor Function Measure (GMFM 66)	The baseline GMFM 66 assessment was 96.05. After the intervention, the participant scored 97.06, obtaining a non-significant improvement in the evaluation of gross motor function.
GORDON, 2012[21]	Nintendo Wii video game (games: boxing, tennis and baseball). The participants performed the game according to its commands. Children who depended on wheelchairs played seated, and those who could ambulate played standing.	6 weeks. 12 sessions 45 minutes each	Gross motor evaluation - GMFM	Based on the GMFM evaluation, the participants presented an average increase of 7% after the intervention, with the main modifications occurring in Item A (lying and rolling), with a 2% improvement and Item B (sitting), with a 12% improvement.
SHARAN, 2012[22]	Nintendo Wii video game (games: tennis, baseball, golf, bowling and boxing). The subjects were assigned to play the games according to the therapist's guidelines.	3 weeks 9 sessions Time of sessions not reported.	Upper limb function - Manual Ability Classification System (MACS) Balance – Pediatric Balance Scale (PBS).	There was a significant improvement in the evaluation of the experimental ($p < 0.001$) and control ($p < 0.001$) groups in the PBS index after the intervention. There was also a significant improvement in the manual ability after the intervention for both groups (experimental ($p < 0.05$), control ($p < 0.01$)).
BARTON, 2013[23]	Computer game. The goal was to blow up balloons in a cave. The virtual walking speed was controlled by the software of the game and also by the movement of the pelvis in the kneeling position.	6 weeks 13 sessions 30 minutes each	Trunk-pelvis coupling - convex hull in MATLAB	During all the sessions performed and biomechanically analyzed, the paired t-test showed that hip coupling during games with distant targets was higher than during games with close targets ($p = 0.007$).

First author, year	Play intervention and its format	Duration, number and time of sessions	Evaluation variables and tools	Main results
BURDEA, 2013[24]	Small prototype robot, consisting of a pneumatic platform, interconnected between the foot and the monitor. The participant piloted a virtual plane, crossing targets (hills and valleys). At the beginning of the exercise, the therapist chose airplane speed, air resistance, turbulence, scene visibility and exercise time.	12 weeks 36 sessions Time for each session not reported.	Gross motor function - GMFM	According to the GMFM evaluation, only participants 2 and 3 achieved improvement of 5.1% and 7.7%, respectively, in gross motor function.
LUNA-OLIVA, 2013[25]	Xbox 360 video game (football, volleyball, bowling, driving and adventure games at Disneyworld). The games had avatars of the children, from which they simulated the movements, obtaining return on each accomplished task.	2-month duration 2 days a week 20 minutes each	Motor skills - Assessment of Motor and Process Skills (AMPS). Balance - Pediatric Reach Test (PRT) Gait speed - 10-meter walk test Gross motor assessment – GMFM	The Friedman test showed significant differences during the reassessment of all tests: motor AMPS ($p = 0.001$), AMPS process ($p < 0.010$), PRT ($p = 0.005$), 10MW test ($p < 0.029$) and GMFM ($p < 0.001$).
PEPER, 2013[26]	Four computer games. Apparatus with two horizontal levers, a portable computer and a potentiometer that monitored the movements of the levers.	6 weeks 12 sessions 30 minutes each	Functional evaluation of upper limbs – Assisting Hand Assessment (AHA)	The children's scores using the AHA scale increased, on average, from 1 point (SD ± 1.08) to 5.8 points (SD ± 2.3) ($p < 0.005$).
CURTIS, 2014[27]	Dynamic and interactive stander (HAPPY REHAB, InnovaidApS, Aarhus, Denmark). The equipment had two rotating pedals, which allowed for plantar flexion and ankle dorsiflexion. The surface of the rotating pedals contained strength sensors. Ankle movements were used to control computer games.	10 weeks Sessions 5 days a week 30 minutes each	Gross motor function - GMFM - Number of steps and passive and active movements of the ankle – 10-meter walk test	During the initial GMFM evaluation, the total score of the participants was 66 points and, in the reassessment, 67 points ($p = 0.048$). During the evaluation of the 10-meter walk test, which assessed the number of steps, significance was found only during the movement of dorsiflexion with knee extension ($p = 0.026$).

First author, year	**Play intervention and its format**	**Duration, number and time of sessions**	**Evaluation variables and tools**	**Main results**
HUANG, 2014[28]	Adapted toy car. The child's family, physiotherapist, and the researchers encouraged him daily to use the adapted toy car in different settings.	12 weeks Sessions 5 days per week Minimum duration of 20 minutes each	The intervention was recorded and the following items were evaluated: independent mobility, assisted mobility; caregiver mobility	Through qualitative analysis, which included the perspective of the researchers and parents, it was verified that the act of driving the family car required and motivated the increase in range of movement and / or active control.
NI, 2014[29]	Computer games. The child played three times, for 20 minutes, with pauses, under the supervision and guidance of the therapist. After each game, the child and the therapist completed a questionnaire about the experience with the game.	The duration of the study was not reported. Each session was held in 1 day, for 1 hour and 50 minutes	Questionnaire with the child – Physical Activity Enjoyment Scale (PACES) Questionnaire with the physiotherapists - System Usability Scale (SUS) Both assess the applicability of the game.	The children and therapists unanimously agreed on the therapeutic value of the games. The mean scores on the PACES were high (6.24 ± 0.95 on the 7-point scale). The SUS score reached 68 out of 100 points.
PRESTON, 2014[30]	Assisted robotic rehabilitation with individual and group games. Group A played the video game in pairs with school friends who did not have CP and Group B participants played alone.	Maximum of 4 weeks and minimum of 3. Sessions held every weekday for 30 minutes, not necessarily a single session	Manual skills of children with CP - ABILHAND-Kids Upper limb functionality - Canadian Occupational Performance Measure (COPM)	When comparing assessment and reassessment scores during the final measures, no significant values (ABILHAND-Kids p = 0.424 and COPM p = 0.484) were found for the 2 groups (A and B)
ALSAIF, 2015[31]	Nintendo Wii Fit games, with games focused on balance and jumping. Each child received a Nintendo Wii and games for use at home.	12-weeks No. and time of sessions were not reported.	Motor performance – Movement Assessment Battery for Children-2 (MABC-2 Coordination of upper limbs - subtest: (touching a ball while it swings) - Bruininks Motor Proficiency (BOTMP) General motor function- One-minute walk test	The values obtained on the MABC-2 increased significantly after the intervention. In addition, manual dexterity scores, including pointing and shooting, balance, the one-minute walk test, and the BOTMP all showed significant improvements.

First author, year	Play intervention and its format	Duration, number and time of sessions	Evaluation variables and tools	Main results
TONG, 2015[32]	Robot with interactive game. The child was seated in an upright position, with the forearm resting on a cushioned chair arm, holding the robot.	2-weeks, with 3 sessions in the first week and 2 sessions in the second. Each session took about 1 hour, with 2 minutes of rest between the training changes.	3 parameters were used to quantify the effects of game therapy: accuracy, mean time and smoothness of movements.	After the intervention, participants achieved a 52% increase in the accuracy score and a 19% decrease in reach time. The peak speed and average speed decreased by 50% and 30%, respectively.
PRATT, 2016[33]	Playground games. Two playgrounds were selected near the residences of the participants: One complied with the Americans with Disabilities Act (ADA) and another did not (non-ADA0..	Between June and November. 2 sessions 30 minutes, with a mean rest of 52 minutes	Steps - StepWatch™ activity monitor	In the ADA and non-ADA playground, the average number of steps was: participants 1 (non-ADA = 515, ADA = 526), 3 (non-ADA = 550, ADA = 589), 4 non-ADA = 561, ADA = 657) and 5 (non-ADA = 622, ADA = 727).
DO, 2016[34]	Nintendo Wii (golf, paddle, sword and cycling games). A monitor and a remote control were used that detected movements of the upper limbs. The remote control was handled with both hands by moving an avatar according to the commands that appeared on the screen.	Total of 20 sessions: 4 baseline sessions; 12 intervention sessions and 4 follow-up sessions. 2 sessions per week, 30 minutes each, with 15 minutes in each game	Motor function of upper limbs and hands - Wolf Motor Function Test (WMFT) Functionality of the affected upper limbs assessed by means of interviews with the Pediatric Motor Activity Log (PMAL) Assessment of bilateral hand coordination through activities (throwing a ball through a hoop and moving boxes)	The three study participants had higher scores in motor function assessment than baseline assessment (participant 1: baseline assessment = 23.9 points and reassessment = 23.9 points; participant 2: baseline assessment = 15.5 points and reassessment = 20 points; participant 3: baseline assessment = 24.4 points and reassessment = 26.6 points) Participant 1 scored 22 points in the baseline assessment of motor function and, in the reassessment, 23.9 points.
SENAPATI, 2017[35]	Board games and functional self-care activities. The children in Group A participated in board game activities, and the children in Group B participate in functional activities of self-care, adapted to their age	6 weeks 1 hour of intervention, 5 times a week	Fine motor skills - Peabody Developmental Motor Scales–Second Edition (PDMS-2)	Group A was shown to be significantly better than Group B, when the fine motor coefficient was analyzed (p= 0.002).

Regarding the formats of interventions, some emphasized motor stimulus of the upper limbs (n = 9)[16-19,22,26,30,34-35], others overall motor stimulus (n = 8)[20-21, 24-25,28-29,31-32], and trunk and hip stimulus (n = 1)[23], and the gait approach were also focused on (n = 2)[27,33]. The measurement tools used for upper limb motor assessment were the AHA (n = 2)[19,26], MACS (n = 1)[22], ABILHAND-Kids (n = 2)[19,30], PRT (n = 1)[25] and, for trunk and hip evaluation, convex hull in MATLAB (n = 1)[23]. In the evaluation of global motor function, the measurement tools included biomechanical analysis (n = 2)[17,28], the GMFM (n = 5)[20-21,24-25,27], PBS (N = 1)[22], observation (n = 2)[18,32], the MABC-2 (N = 1)[31], the PACES (n = 1)[29], SUS (n = 1)[29], the WMFT (n = 1)[34], the COM (n = 1)[30], the AMPS (n = 1)[25], the PMDS-2 (n=2)[16,35], QUEST (n=1)[17], and applying a functionality questionnaire to parents (n = 1)[34]. During gait, the evaluation tools used were the 10-meter walk test (n = 1)[33] and the StepWatch activity monitor(n=1)[27].

DISCUSSION

The results of the articles analyzed in this review highlight the importance of the use of play approaches as complementary therapy in physiotherapeutic rehabilitation, with a view to the motor and motivational improvement of children with CP.

Among the play approaches used in rehabilitation processes, computer games using virtual reality (VR)[16-17,22-23,25-26,29,31,34] was highlighted. This is a relatively recent approach, because studies carried out in the last 10 years have shown that the use of ludic activities in the rehabilitation process allows simulating functional tasks, in addition to conventional rehabilitation interventions. These systems, originally designed for recreation, have also been adapted by clinicians for therapeutic purposes. In addition, some interactive video games are being designed specifically for rehabilitation[36].

The use of the Nintendo Wii® predominated among VR-based games. The use of games aimed at strengthening, conditioning and yoga[21,23,25-26,29,31,34] allowed measurement of the effects of therapy on the functionality and postural control of patients with gross motor dysfunction. Motor rehabilitation using the Nintendo Wii® as a play intervention obtained favorable results in the postural control of the individuals analyzed, which can be attributed to the stimuli provided by the game in the systems responsible for postural control, working displacement, visual feedback, proprioceptive and auditory stimuli, which all have a direct role in the improvement of postural stability[37].

It is noteworthy that postural stability in children with CP has been identified as the main limitation on motor development. Maintaining postural control involves a complex process, which depends on the integration of sight, vestibular and peripheral sensation, central commands and neuromuscular responses; all of these affect gait phases and, consequently, children's functional activities[38].

Studies analyzing playgrounds[33] and interactive toys[19,27-28,35] showed favorable results in broad and fine motor improvement of children with CP. Although the playground was mentioned in a single study, it is a space where young children begin socialization, interact with one another, exchange experiences, and often exercise motor skills[39]. For the child with CP who was the focus of this study, it was important to play on the playground, although some adjustments were necessary for the use of toys, depending on the motor impairment presented.

Because playgrounds are places that are capable of greatly stimulating child development, they are considered an effective ludic approach that can complement motor rehabilitation.[40]

Interactive toys, according to the ludic purposes of rehabilitation, are also good opportunities for children with CP to develop and begin learning group and social rules[41].

The studies analyzed the use of the play approach with an emphasis on the evaluation of both fine motor skills and manual and upper limb abilities[16-17,19,22,26,30-31,34-35] in children with hemiparetic CP. Such studies[16-17,19,22,26,30-31,34-35] such are necessary, because execution of the games require a certain level of functional ability, with consequent improvement in bimanual ability. Rehabilitation in neurological patients has been focused on activities involving repetition and high intensity directed toward specific tasks, to enable the reacquisition of learned motor patterns[42].

The use of robots in the rehabilitation process was also favorable for motor improvement, specifically for the upper limbs of children with CP[16-17,24,30,32]. These positive results can be explained by the versatility of robotics, which allows the training and execution of functional tasks[43].

Only one of the studies reviewed used animals as a ludic strategy for children with CP. It was carried out with a single subject and showed improvement during the assessment of broad motor function[20]. Research suggests that these benefits arise from the stimulation resulting from the three-dimensional movement provided by the horse, because it requires constant adjustments by the rider, and the fact that this type of therapy is not performed in a clinical environment, which allows different stimuli and favors rehabilitation[44].

Regarding physiotherapy time, the sessions varied from one day to five months, with frequency of one to five times a week and duration of 10 to 60 minutes for each session. Some studies[21-22,31] did not report the number of sessions performed, but the literature recommends developing as many as are necessary for continuity of treatment, to achieve overall improvement in musculoskeletal dysfunctions[46]. Thus, the use of ludic activities favors compliance with pediatric physical therapy, because it establishes children's functionality in playing as one of the primary objectives of the treatment plan, which is one of the main desires of children and their parents[10].

The articles included in this review aimed to contribute to the improvement of gross and fine motor function, balance, gait and body biomechanics in children diagnosed with CP. The efficacy of the described treatments was verified through the use of specific evaluative tools. The most widely used tool for gross motor function assessment was the GMFM scale[20-21,24-25,27]; for fine motor function, the AHA scale[17,19,24,26]; and for gait evaluation and body biomechanics, kinematic analyses and foot strike tests[27,33].

The tests applied to evaluate children with CP diagnoses have some advantages (they describe motor parameters) and disadvantages (they are subjective evaluations). Thus, examiners should choose those that are most appropriate for their objectives, for both research and clinical screening, and for checking the effectiveness of the proposed early interventions[46]. In addition, they should be aware of the psychometric properties of the instruments, since good reliability and validity scores are determinant in the efficacy of tests, especially when applied to individuals of certain age groups or with specific clinical conditions[47].

In the analyzed studies, evaluations and interventions with children occurred mainly in laboratories [16,18,23-24,26]) and outpatient facilities [21,29,31,34-35]; this may affect the results, because they are not part of children's immediate environment. Evidence suggests that motor responses through stimulation of children (typical and atypical) in development occur after progressively more complex processes and reciprocal interactions between people, objects and symbols in the immediate external environment (schools, social projects, and rehabilitation clinics, among others). Thus, this two-dimensional interaction influences motor evolution, especially among children with motor deficits from neurological injury. However, the advantages of use of these environments for evaluations and interventions are that they are easy to use and are seen as credible by children and their families, and that they make professionals and the appropriate equipment more easily accessible(48).

Although the articles showed favorable results for the rehabilitation of children with CP through play activities, some were obtained only by comparing participants' scores by evaluation and reassessment of motor parameters(16,19,21,24,29,32-34); they did not present intergroup statistical comparisons based on p-values, which describe the probability of groups differing only by chance. In addition, small numbers of individuals were often included in the studies, or they were even single-subject studies(16,19-20,23-24,28,32-34).

Due to these limitations, the conclusions of the studies analyzed, although important, reinforce the need for more research on the subject. Evaluating the impact of play activities with larger numbers of individuals, using robust methodologies such as randomized clinical trials, could show more accurately whether the use of a particular play approach in children with CP influences their motor improvement. However, increasing the numbers of participants with CP in the studies is a challenge, due to the specificities of each patient's impairment. This also hampers the development of randomized clinical trials(24), due to the lack of homogeneous groups that meet eligibility criteria; initially, the groups should be similar with regard to the most important prognostic indicators.

This difficulty is shown by the limited number of randomized clinical trials, and the small samples, in this review. This necessitates gathering the best available evidence on the use of play strategies in the rehabilitation of motor disorders in children with CP. The pertinence of this review lies in the desire to show the state of the art, in order not only to provide evidence about the impact of playing in motor rehabilitation among children with CP, but also to suggest areas for further research. It is understood that evidence-based practice for physiotherapy(49) and related areas should integrate the best evidence available for the provision of high-quality care. In this sense, randomized clinical trials are the gold standard of experimental design.

CONCLUSION

Considering the universe of articles that make up the present review, it can be stated that play therapy is used as a means to favor motor gains in children with CP and to contribute to the rehabilitation process, because it emphasizes the performance components necessary for the execution of these activities.

There is a considerable number of studies with homogeneous groups of children with CP, and children with different types of CP, which result in several developmental alterations. There is also substantial research on the interaction of children with play activities and on fine motor evaluation and abilities of the upper limbs in children with hemiparetic CP, because they present a high level of functionality.

This study describes the ludic strategies used with children with CP and their contributions to motor development, based on qualitative and quantitative investigation approaches. The most-used play activities with these children were video games, computer games, and interventions with robots or prototypes.

The results of this review should be considered in the context of its limitations and strengths. Although five major databases were independently consulted by two researchers for this review, there may be other studies published in journals not included in the databases. Evaluation of the methodological quality of the included studies was not the objective of this review, but the limitations noted, such as small samples, knowledge of the participants and the therapist who administered the intervention, lack of randomization, and the number and frequency of intervention sessions, should be considered for the interpretation of the results.

The results of quantitative studies, which used evaluation instruments, showed improvements in the participants' overall motor performance after ludic interventions. Only one study adopted a qualitative approach to investigate the perceptions of parents and health professionals about the intervention. However, some quantitative studies subjectively evaluated children, parents, teachers and health professionals about the interventions used. Thus, it is important to know the perceptions of the various people involved in the interventions; this allows for choosing the best strategy to be used and identifying the need for possible adjustments in future studies, depending on the context and the target population. Particularly in Brazil, there is little knowledge about ludic activities in children with physical disabilities, which is why most of the journals highlighted in this review are foreign.

The present review achieved its proposed objectives, because it allowed for envisioning the use of play activities in research with children with CP, particularly as a complementary strategy for rehabilitation. There, the following is recommended: a) research investigating the effects of play, contemplating the heterogeneity of CP types; and, b) research analyzing the effects of the use of virtual play to promote motor performance in children with CP in order to implement their use in clinical practice.

This review contributes important information that will support future investigations on rehabilitation, mainly physical therapy. This information will also contribute to other areas, such as nursing, psychology, speech therapy and pedagogy. It reinforces the values of the use of play activities with children with CP and the need for development of new research.

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