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ORIGINAL ARTICLE

Efficacy of the cognitive orientation to daily occupational performance with Brazilian children with developmental coordination disorder

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ABSTRACT

Background: Children with Developmental Coordination Disorder (DCD) have difficulties performing daily activities which reflects negatively on participation, impacting their lives.
Objectives: To examine the effects of the cognitive orientation to daily occupational performance Approach (CO-OP Approach) protocol on occupational performance and satisfaction of Brazilian children who have DCD; to examine whether children could transfer strategies and skills learned during CO-OP to untrained goals.
Methods: A pre-post group comparison design with eight boys aged 6–10 years old. Children participated in 12 CO-OP sessions with their parents twice a week, with an extra session added to the protocol for parents´ orientation. The Canadian Occupational Performance Measure and the Performance Quality Rating Scale were used as outcome measures. The study was registered by the United States Institutes of Health at ClinicalTrials.gov (NCT03112746).
Results: Intervention resulted in higher, clinically and statistically significant, occupational performance measures according to parents, children's, and external evaluators' perspectives. All children improved occupational performance on their selected goals and five children could transfer the ability to use cognitive strategies to tasks not addressed in therapy.
Conclusions: This study provides initial directions for future research to investigate the applicability and to implement CO-OP approach on pediatric settings in Brazil.

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KEYWORDS
Child; goal; intervention; motor skills disorder; occupational therapy; cognitive therapy

Introduction

Children with developmental coordination disorder (DCD) have difficulties performing activities that require motor skills [1]. Diagnostic criteria for DCD include motor skill performance below age expectation, given the opportunity to develop motor skills, and the coordination problems interfere with academic achievement or the performance of daily activities [2].

The prevalence of DCD is 5–6% [3] however, this estimate varies depending on culture and the cutoff criteria used for the motor test [2,4]. In Brazil, there is an estimate of 4.3% among children aged 7 and 8 years old [5]. The prevalence of DCD is higher in children born prematurely [6] and the disorder affects more boys than girls, regardless of socioeconomic or educational status [3].

Motor difficulties may be associated with social and emotional problems, and co-occurrence with other disorders influence the prognosis [7]. Children with DCD and co-occurring psychosocial problems, such as anxiety and depression, perceive themselves less competent than their peers [8,9]. Children with DCD show lower self-efficacy when performing leisure and school activities and lower preferences to participate in recreational, physical, social, skill-based and self-improvement activities [10], they also feel less competent to practice physical activities and active play [11].

Although the term DCD is becoming increasingly used in Brazil, these children often receive no formal diagnosis and no specialized care [12], therefore, there is great need for valid assessment tools and cost-effective interventions. Although pediatric occupational therapists traditionally use process approaches (i.e. sensory integration, perceptual-motor training), evidence strongly suggests higher effectiveness for task-oriented interventions [13]. Among these, two specific intervention approaches showed strong treatment effects: neuromotor task training (NTT) and the

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Table 1. Summary of intruments.

Instrument	It was used at …	It was used …
Developmental Coordination Disorder Questionnaire - Brazilian version (DCDQ-Brazil)	Pretest	To identify children with DCD; To assesses the impact of motor difficulties on daily living tasks.
Brazilian Version of the Swanson, Nolan, and Pelham IV Scale (SNAP-IV)	Pretest	To identify signs of innatention and/or hiperactivity/impulsivity.
The Child Behavior Checklist (CBCL)	Pretest	To screen for emotional, behavioral, and social problems.
Wechsler Intelligence Scale for Children-Third Edition (WISC-III)	Pretest	To assess cognitive ability.
Perceived Efficacy and Goal Setting System (PEGS)	Pretest	To help children select goals
Movement Assessment Battery for Children Second Edition (MABC-2)	Pretest and posttest	To identify children with DCD; To compare motor performance.
The Canadian Occupational Performance Measure (COPM) scoring system	Pretest and posttest	To capture children's and parent's perceptions of performance and satisfaction with occupational performance.
Performance Quality Rating Scale (PQRS) - generic rating system	Pretest and posttest	To assess occupational performance of children on their goals.

cognitive orientation to daily occupational performance (CO-OP Approach) [13].

CO-OP is one of the most well documented approaches for the treatment of performance problems of children with DCD [14–17]. CO-OP is a top-down approach specifically developed to enhance functional performance in everyday life. It is an individualized intervention where occupational therapists cooperate with their clients by using the dynamic performance analysis and guided discovery to enable them to identify cognitive strategies to achieve their goals and improve performance [18].

Since CO-OP is a short-term program, that can be implemented in different settings (e.g. clinics, home and school), and is supported by evidence of efficacy either with individual and group approach [13,17,19], it is important to investigate its use in Brazil, where limited economic resources require exploring feasible and cost-effective approaches to childrenś treatment. In a previous case study, Araújo et al. [16] explored the use of the CO-OP Approach with three children aged 9-10 years old and identified the need to adjust in the intervention protocol - the creation of informational materials and the addition of one more session to provide extra support for parents. These adjustments were recommended because parents needed support to understand the use of the global strategy Goal-Plan-Do-Check and to collaborate on the process of guided discovery with their children at home [16].

Building over this previous experience, the aim of this study was to investigate whether Brazilian children could use global and specific strategies acquired in CO-OP Approach to improve occupational performance and satisfaction and to transfer the ability to use the global and specific strategies to other activities.

Methods

Research design

A pretest-posttest design was used to examine the effects of an adapted CO-OP Approach protocol on occupational performance and satisfaction of children with DCD.

Instruments

We used instruments by which to measure participants' motor performance and its impact on daily living skills; cognitive performance; psychosocial and behavior characteristics. Children set therapy goals and we assessed perceived occupational performance and satisfaction; external assessment of performance were also included. Instruments are described below and summarized on Table 1.

The Developmental Coordination Disorder Questionnaire-Brazilian version (DCDQ-Brazil) is a parent-report questionnaire that helps to identify DCD and assesses the impact of motor difficulties on daily living tasks. It has adequate psychometric properties, with sensitivity of 0.73, test-retest reliability of 0.97 (intraclass correlation coefficient) and internal consistency of 0.92 (Cronbach's alpha) [20].

The Brazilian Version of the Swanson, Nolan, and Pelham IV Scale (SNAP-IV) is a public domain questionnaire developed based on the fourth edition of the DSM to screen for attention-deficit/hyperactivity disorder (ADHD) [21]. Its 18 statements comprehend nine symptoms of inattention, six of hyperactivity and three of impulsivity. The last two categories are part of a single domain (hyperactivity/impulsivity) and may be answered by parents and/or teachers. It uses a four-level scale of severity (0 = 'not at all' to 3 = 'a lot like').

The Child Behavior Checklist (CBCL) is a parent report questionnaire to screen for emotional, behavioral, and social problems [22]. The CBCL's questions are associated with problems on a syndrome scale in eight different categories: anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior. The CBCL are also scored on competence scales for activities, social relations, school and total competence. It does not represent a diagnose, but on each scale, the child can be classified into three groups: clinical, borderline or non-clinical [22]. The CBCL has a Portuguese version that was used in this study before intervention to characterize the sample [23].

The Perceived Efficacy and Goal Setting System (PEGS) [24] is an interview procedure that uses picture cards to help children over six years of age identify tasks that they experience difficulties with and choose 3–4 goals to improve performance in intervention. It has good psychometric properties (internal consistency was $\alpha = 0.795$, test-retest reliability Pearson's $r = .77$) [25] and it has been translated to Brazilian Portuguese [26].

We used the Canadian Occupational Performance Measure (COPM) [27] scoring system to capture the client's self-perception of performance in everyday living and the satisfaction with occupational performance. In this study, we used COPM scoring system with both children and parents. The COPM has good psychometric properties (test-retest reliability ranging 0.81–0.89 for performance and 0.76–0.88 for satisfaction) [27]. Additionally, it is a valid measure of occupational performance that is very responsive to change [28] and has been used with children [29]. We adapted the 1–10 scoring system to make it easier for children (i.e. performance = ladder with steps numbered 1 to 10 and satisfaction = Graduated faces from sad to happy). A score change of two or more points is clinically significant [27].

The Performance Quality Rating Scale (PQRS) [18], an observational measure rated after actual occupational performance on a scale (1-10), was used at pre- and post-CO-OP intervention. The scale has moderate to high interrater reliability (0.71–0.77) for the generic rating system, or PQRS-G, that was like the procedures adopted in our study. Evidence has shown that a change score between pre-and post-intervention of at least three points signalizes a clinically significant change [30].

The Movement Assessment Battery for Children Second Edition (MABC-2) [31] is based on direct observations of motor skills of individuals aged 3–16 years old in eight tasks of three areas: manual dexterity, ball skills, and static and dynamic balance. The higher the total score, the better the overall motor skills. The MABC-2 showed good psychometric properties (interrater reliability 0.86–0.99; test-retest 0.68–0.85; $\alpha = 0.78$ for internal consistency) and it is a valid measure of motor skills of Brazilian children [32]. Children were assessed with the MABC-2 at pre- and post-intervention. Green and colleagues [15] considered that a difference of four points between total scores at pre-and post-intervention is clinically significant [15].

The Wechsler Intelligence Scale for Children-Third Edition (WISC-III) [33] is an individually administered test of intelligence for assessing children aged 6 through 16 years and 11 months. The child's performance on its subtests measures is summarized in three composite scores, Verbal, Performance, and a Total Scale intelligence quotient (IQ). For this study, children with Total IQ equal or above 85 could be included.

Participants

We recruited children aged 6–12 years old, who fulfilled the following inclusion criteria: (1) score on MABC-2 below the 15th percentile; (2) score on DCDQ-Brazil below age expectation; (3) attending regular education with no evidence of marked school delay (over a year); (4) cognitive development within the expected age range according to the WISC-III; (5) no diagnosis or signs of neurological or neuromuscular diseases. The study was approved by the Federal University of Minas Gerais/Brazil Ethics Committee (registered COEP/UFMG ETIC N° 103/2009). The study was registered by the United States Institutes of Health at ClinicalTrials.gov (NCT03112746).

Procedures

After parents gave written consent, two trained clinicians collaborating with our research, assessed children who scored as possible DCD on the DCDQ-Brazil [20] using the MABC-2 [31]; video recording was done to ensure reliability. Children were also tested on the WISC-III [33] by a psychologist. Among 22 recruited children, 14 were excluded for the following reasons: MABC-2 percentile >15 ($n = 7$), total index of cognitive ability on WISC-III at or below two standard deviations from the mean (total IQ ≤ 70) ($n = 3$), neurological disease ($n = 2$), moving to another city ($n = 1$), refused to begin therapy ($n = 1$).

When appropriate, excluded children were referred to other health care services.

Parents completed the Brazilian version of the Swanson, Nolan, and Pelham IV Scale (SNAP-IV) [21] to identify signs of Attention Deficit Hyperactivity Disorder (ADHD) and the Child Behavior Checklist (CBCL) [22,23] to screen for psychosocial or other behavioral problems.

The researcher and CO-OP therapist interviewed children to set at least three main goals with PEGS and rated their performance and satisfaction on the established goals with COPM's 10-point scale. Parents participated on goal setting by helping their child to decide about their goals, especially if the child asked to. Parents also rated each child's goals using the COPM scale. Children were encouraged to set an extra goal that would not be addressed during the CO-OP Approach to check for transfer of learning at post treatment.

Assistant clinicians videotaped children performing their goals for PQRS analysis. Two external examiners, both occupational therapists with a minimum of four years of clinical experience with children with DCD, scored PQRS through the analyzes of video clips, presented randomly, containing three repetitions of each goal. The examiners were oriented to the scoring procedures, they were blind to the study and sequence of events. Their scores were averaged for each measure to improve reliability.

Intervention

The CO-OP protocol originally developed by Mandich and Polatajko [18] comprises 12 sessions – with two sessions reserved for pre-and-post assessments. In CO-OP Approach parents should be encouraged to participate in collaborative goal setting with the child and to participate in at least three sessions [18]. In our study, parents' participation began in collaborative goal setting and they attended between three to all sessions provided. Parents could watch their children and learn how they could use guided discovery to help them to use cognitive strategies at home.

We also included one exclusive session to discuss with parents how to improve on the process of guided discovery and how to use cognitive strategies to support the child when doing her/his homework. According to Mandich and Polatajko [18], it is important to enable parents or significant others to play an active role in helping their children succeed in other contexts to ensure that '*the approach is implemented beyond the treatment arena*' [18]. Therefore, children engaged in 12 therapy sessions, 60 minutes each, twice a week, and parents had an extra meeting with the therapist.

In CO-OP Approach, the therapist initially teaches the child a global cognitive strategy: GOAL - What I want to do; PLAN - How will I do; DO - execute the plan; CHECK - check if the plan worked [18]. In the following sessions, therapist, child and parents use the global strategy and cooperate to learn specific strategies to solve each task performance breakdown identified through Dynamic Performance Analyses (DPA). DPA is an interactive process of analyzing performance through direct observation of the child's chosen goals.

The therapist used DPA at pre-intervention and throughout the sessions and techniques to guide the child to use the global strategy to discover specific strategies to solve performance problems [18]. Learning techniques include reinforcement, providing stimulus to the child as a sort of feedback, modeling or demonstration of a skill, shaping, prompting, fading and chaining (to give cues to facilitate discovery of strategies that can lead the child to succeed and its removal once the child has accomplished the better plan) [18].

It is important to notice that despite parents' engagement, each child must be the center of the intervention. In this study, the occupational therapist guided the child to identify occupational performance breakdowns and to create her/his own solutions, i.e. domain specific strategies. Parents could watch this process very closely to execute at home to support transfer of learning.

The therapist conducted home and school visits on parents' and teachers' demands. We also prepared informative booklets on DCD and CO-OP Approach for parents, explaining how to integrate cognitive strategies into everyday life. The booklet was filled with examples of different activities that matched the goals of the children (jump rope, using scissors, playing ball games). It was designed in a way to be used by children and parents together; it was attractive for the child as well – colorful, with pictures of children and parents playing and talking to each other about the global strategy Goal-Plan-Do-Check. Additionally, we planned homework together with the family to stimulate the use of cognitive strategies to improve occupational performance in other contexts.

Data analysis

Statistical analyzes were conducted using IBM SPSS Statistics version 18 [34]. Pre-test scores were

Table 2. Children's characteristics and their goals.

Child	Goals	Age	DCDQ	MABC-2	WISC III	CBCL
C. 1[a,b]	Handwriting; kick balls; computer use; cutlery use[a]	6	20	52/5%	94	28-C
C. 2	Catch balls; bike riding; handwriting; kick balls[a]	7	40	61/9%	134	25-C
C. 3[b]	Bowling; basketball; kick balls; catch balls[a]	7	27	48/2%	136	31-C
C. 4[b]	Jump rope; catch balls; kick balls; running[a]	7	35	50/5%	123	25-C
C. 5[a,b]	kickballs; dodgeball; handwriting	8	43	40/1%	108	30-C
C. 6	Jump rope; basketball; handwriting; fasten zipper[a]	8	33	38/1%	116	28-C
C. 7	Catch balls; handwriting; use of scissors; painting[a]	8	18	58/9%	115	25-C
C. 8[a,b]	kickballs; handwriting	10	40	48/2%	94	28-C
Mean	–	7.63	32.0	49.37/4%	125.25	–
SD	–	±1.18	±9.44	±7.90	±16.02	–

C: child; a: inattention signs; b: hyperactivity signs on SNAP-IV: Swanson, Nolan and Pelham IV Scale; DCDQ: Developmental Coordination Disorder Questionnaire – Brazilian version; MABC-2: Movement Assessment Battery for Children 2nd Edition; WISC III: Wechsler Intelligence Scale for Children 3rd Edition; CBCL: Child Behavior Checklist; B: borderline; C: clinical.
[a]Extra goals not attended during therapy sessions.

compared to the post-test scores for each participant via non-parametric related samples Wilcoxon Signed Rank Tests. The main outcomes were children and parents' self-perception of performance and satisfaction as measured by COPM scoring system; occupational performance assessed by external evaluators with PQRS generic rating system. As secondary outcome, we examined changes in motor performance as measured by MABC-2. Significance level was set at 0.05.

Results

Eight boys aged 6–10 years old and their families were recruited using convenience sampling through an extensive search. The participants' characteristics are presented in Table 2. Of the eight boys, five showed signs of ADHD and scored within the clinical range on the CBCL indicating potential psychosocial problems like anxiety, attention and social problems. All children chose at least one ball activity and six children chose handwriting (Table 2).

Children, parents, and therapists reported statistically significant changes based on COPM and PQRS scores. Considering motor performance on the MABC-2, even though there were no statistically significant difference on the pre-post scores (Table 3), four children remained in the same motor impairment category (i.e. C.2, C.4, C.6, C.8), two children moved from the severe motor impairment category to moderate (i.e. C.1, C.5), one moved from severe to normal range (C.3) and one child moved from moderate to severe (C7). A total of four children presented clinically relevant gains on the MABC-2 total scores (C.1, C.3, C.5, C.8).

The small sample size gave us the chance to describe clinically relevant changes. Individual data showed improvements on occupational performance and satisfaction ratings, according to children, parents, and external evaluators (Table 4). Except for the two measures of change for C.2, on self-assessment of performance (1.3) and satisfaction by the parents (1.7); and, for the measure of satisfaction for C.6 (1), all other children achieved clinically significant changes on the COPM. Data on PQRS showed that all children achieved clinically significant changes on the PQRS-G, as rated by the external examiners.

Table 3. Group comparison before and after CO-OP considering the trained goals.

	Median (IQR)		Wilcoxon Test	
	Pre	Post	Z	*p*
MABC-2	49 (14.5)	57.5 (11.8)	−0.844	0.398
COPM P Ch.	5 (2.4)	8.43 (1.4)	−2.524	0.012
COPM P Par.	4.53 (3)	7.68 (1.6)	−2.521	0.012
COPM S Ch.	5.88 (3.8)	9.25 (2)	−2.524	0.012
COPM S Par.	4.75 (3.9)	8.5 (1.1)	−2.521	0.012
PQRS 1	3.08 (2)	7.36 (2)	−2.524	0.012
PQRS 2	5.9 (1.2)	8.71 (0.9)	−2.521	0.012

IQR: inter quartile range; MABC-2: Movement Assessment Battery for Children 2nd Edition; COPM P Ch.: Canadian Occupational Performance Measure: performance according to the children; COPM P Par.: COPM: performance according to parents; COPM S Ch.: COPM: satisfaction according to the children; COPM S Par.: COPM: satisfaction according to parents; PQRS 1: *Performance Quality Rating Scale* for external evaluator 1; PQRS 2: *Performance Quality Rating Scale* for external evaluator 2.

Transfer of learning

The analysis of outcomes in transfer of learning is presented individually for better comprehension. We used the means on performance and satisfaction COPM scoring system for both children and parents as well as for PQRS-G, to describe clinically relevant changes, as not all the children wanted to choose the extra goal. Six of the eight children chose an extra goal not addressed during therapy, so it was possible to analyze data on transfer of learning for these boys also individually.

C.1 and C.7 achieved clinically relevant changes for the extra goal regarding occupational performance in the perspectives of children, parents and external

Table 4. Measures of performance and satisfaction before and after CO-OP according to children, parents, and external evaluators for the trained goals.

	COPM Performance Pre/Post			COPM Satisfaction Pre/Post			PQRS – External evaluators		
	Child	Parents	Change Child/Parents	Child	Parents	Change Child/Parents	Pre	Post	Change
C.1	2.7/5.3	2.3/7.3	2.7/5	2/9.3	2/7.3	7.3/5.3	5.5	9,1	3.6
C.2	6/7.3	4.7/7.7	1.3/3	6.3/8.3	7/8.7	2/1.7	3.5	8.3	4.8
C.3	6/8.3	5.7/9	2.3/3.3	6/8.3	7.3/9.3	2.3/2	3.8	8	4.2
C.4	4/7.7	5.3/7.3	3.7/2	6.7/9	6/8.3	2.3/2.3	3.6	6.7	3.1
C.5	6/8.7	4.3/7.7	2.7/3.4	6.3/9.3	4/7.7	3/3.7	4.3	8.3	4
C.6	7.3/10	2/9	2.7/7	9/10	2/9	1/7	4.6	7.9	3.3
C.7	2.3/9.3	2.7/9	7/6.3	2.3/9.3	2.7/9	7/6.3	5.4	8.5	3.1
C.8	4.5/10	5.5/9.5	5.5/4	4/10	5.5/9.5	6/4	5.1	8.5	3.4

Two-point changes on COPM means of performance and satisfaction for child and/or parents are clinically significant; a three-point change on PQRS generic rating system indicate a smallest real difference (means for the three goals for both external evaluators).

evaluators, and they showed also improved satisfaction. C.6 exhibited clinically relevant changes for children and parents, but only approached clinical significance regarding PQRS (2.8 points of change). C.2 had clinically relevant changes on performance and satisfaction for the child, parents and external evaluators; the child's satisfaction improved. C.4 improved performance and satisfaction on the extra goal, though his parents did not perceive relevant changes. Only C.3 did not show any improvements which in part can be explained by his behavior compromising compliance to treatment specially regarding homework performance (Table 5).

Compliance to treatment

Children and parents participated in all session, except for the parents of child C.8, who remained present, but did not attend the sessions. Even though all children presented associated clinical problems, most of them collaborated with the therapist in all aspects of the intervention, except for child C.3. He presents signs of oppositional deviant disorder (ODD), refusing to collaborate with some assessments and therapy procedures and to do his homework, which possibly limited his opportunity to practice and to use the strategies at home.

Discussion

This study shows that Brazilian children, treated with an adapted CO-OP Approach, could use global and specific strategies acquired to improve occupational performance, satisfaction, and transfer learning on child's selected goals. Even with a small sample size, COPM scores on performance and satisfaction for children and parents reached statistical significance ($p = 0.012$). Performance measured by PQRS resulted in statistically significant gains ($p = 0.012$) according to external evaluators. Miller and colleagues [14] on the first pilot trial comparing CO-OP Approach to a contemporary treatment approach with DCD children with the same age range, reported improvements from pretest to posttest for COPM and PQRS scores in both groups, but a significant treatment by time interaction was found in favor of CO-OP [14].

More recently, two studies also investigated the effects of CO-OP Approach in a group format [19,35]. Thornton and colleagues (2015) found statistically significant improvements on COPM performance and satisfaction ratings for 8-10-year-old DCD boys. Although the researchers did not use PQRS as an outcome measure, they reported that improvements in Goal Attainment Scale scores were significantly higher than baseline scores [19]. Zwicker and colleagues [35] also reported statistically significant changes om COPM scores, but they did not use another measure of performance [35].

The choice of therapy goals signalizes cultural preferences: all of them chose goals that were challenging for children with DCD, but ball skills (i.e. to kick and to catch balls) possibly prevailed in Brazil, given the boys' interest in soccer, an activity they frequently perform at school with their peers. On the other hand, handwriting, another task chosen by several children, is a highly demanding task required for academic purposes, which children need to perform in the classroom.

The preference for ball tasks can also be associated with the sample composition, as Brazilian boys are expected to play soccer. The predominance of males was not intended, but since DCD is underdiagnosed in Brazil, it seems that, supporting Rivard et al. [36] findings, boys with clinical and/or behavioral problems are more referred for therapy and available for the study. This male predominance is also compatible with other studies and with data suggesting that DCD

Table 5. COPM Performance and satisfaction scores and external assessment before and after CO-OP for the extra goal.

		COPM Performance Pre/Post			COPM Satisfaction Pre/Post			PQRS – External Evaluators		
Extra Goal		Child	Parents	Change Ch./Par.	Child	Parents	Change Ch./Par.	Pre	Post	Change
C.1	Cutlery use	5/10	5/8	5/3	3/8	3/8	5/5	5.0	8.5	3.50
C.2	Kick a ball	4/7	5/6	3/1	5/7	8/8	2/0	4.5	8.0	3.50
C.3	Catch a ball	5/5	7/4	0/-3	5/5	8/6	0/-2	5.9	1.5	−4.40
C.4	Running	5/10	6/7	5/1	6/10	7/9	4/2	4.5	6.0	1.5
C.6	Fastenzipper	4/9	1/9	5/8	4/10	1/9	6/8	1.8	5.9	4.10
C.7	Painting	1/7	1/8	6/7	1/7	1/8	6/7	5.2	8.0	2.80

Par.: parent.

affects more boys than girls [2,15]. Regarding the co-occurrence of DCD with other disorders, SNAP-IV and CBCL suggested co-occurrences with combined and inattentive ADHD in five children, as indicated in other studies [7].

Children and parents showed similarity in their COPM performance and satisfaction ratings, supporting the idea that children are accurate informants about their skills, and it is imperative to allow them to express their opinions, as recommended in client-centered practice. The overall PQRS scores indicates that external evaluations captured changes on performance as well as the children and their parents, a finding observed in a previous study, even with younger children [37].

As well as in the study of McEwen and colleagues [38], that used extra goals to evaluate transference of learning, we observed that improvements in performance and satisfaction on extra goals demonstrated the ability of some children to transfer cognitive strategies and acquired skills to other tasks. We felt that giving more support to parents and specific information (i.e. booklet) on how to support children through guided discovery to use global and specific strategies at home improved transfer of learning. Only one mother did not attend all sessions, but she received information about their children's' progress during therapy.

There are some risks on having parents during the sessions: at the beginning parents may not understand what guided discovery means, even when they are informed about it. Sometimes parents tend to answer many questions that were directed to their children or even do an action that was supposed to be done by the child. The presence of the parents is important exactly because the therapist can teach them on how to manage their behavior towards the child and how to ask appropriate questions to support cooperation in other contexts. This change of behavior can facilitate the use of cognitive strategies by the child guided by their parents. When you provide this learning environment to the family, the therapist can help to rise the child's voice on her/his own problem-solving strategies even with others involved.

Even though change in the group's motor performance scores (MABC-2 pre = 49; post = 57.5) was not statistically significant ($p = 0.398$), it is important to notice that four children presented clinically significant gains on the MABC-2 and three children moved to less severe motor impairment categories. In other study with CO-OP, Green and colleagues [15] using the MABC-2 as an outcome measure, also noted that some children changed category on the test [15]. On the other hand, Thornton and colleagues [19] did not find statistically significant differences on movement proficiency assessed with MABC-2 pre-post CO-OP group intervention; they do not report on clinically significant differences. Although the focus of CO-OP is not on changing motor impairment, it seems that for some children, the strategies learned might have helped them to improve performance on the MABC-2, a factor that should be investigated in further studies.

Limitations

Small sample size and the absence of a control group certainly limits the generalizability of the study, but the strong results, with gains for most of the children, supports further studies to explore the use of CO-OP with larger samples of Brazilian children and group approach to reduce costs. We also did not stablish inter-rater reliability for the external evaluators on scoring PQRS, but they were experienced clinicians and the averaged measures improved reliability.

Conclusion

Brazilian children with DCD often receive little attention, but they require fast and resolute intervention to minimize or avoid potential secondary problems. CO-OP is a brief, performance-focused, problem-solving based approach with substantial empirical support, that also showed efficacy with a group of Brazilian children.

Considering the need to systematically examine alternatives that are cost effective for intervention

with Brazilian children with DCD, this research aimed to contribute to evidence based practice. The provision of direct support for parents and the possibility for them to watch and participate on CO-OP sessions were important to their learning on how to use cognitive strategies at home. Likewise, the addition of informative materials and one extra session for parents´ orientation contributed to the success of the intervention.

Parents' engagement in therapy sessions is important for transfer of cognitive strategies to untrained tasks outside CO-OP intervention. Future studies should focus on parental training and as a key component of CO-OP, and it is important to develop strategies to monitor objectively parents' participation as well as the role of environmental factors, including school. Further studies should also focus on training teachers and parents to support goals in daily-life contexts.

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