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Feasibility of the *Challenge Assessment*, the *Gait Outcomes Assessment List* and *'Moving Together'* (*'Sammen I Bevægelse'*), a Group-Based Motor Skills Intervention for Independent School-Aged Children with Cerebral Palsy

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ABSTRACT

This single group pre and posttest study evaluated the feasibility of a new 10-week group-based motor skills enhancement intervention: *"Moving Together,"* and associated use of the *Challenge* assessment and *Gait Outcomes Assessment List (GOAL)*. Participant attendance/completion and satisfaction with the assessments and intervention were evaluated, and a first estimate of associated motor skill-related changes obtained. Ten ambulatory children with cerebral palsy (7–14 years) and their parents participated. Ninety percent of *Challenge* sessions were attended and 82.5% of *GOAL* questionnaires completed. Program attendance was 83% overall. Satisfaction with assessments was high for the *Challenge* and moderate for the *GOAL*, and intervention satisfaction was high. Mean change scores (95% CI) post-intervention for the *Challenge* and *GOAL* were 4.2 (–11.4 to 3.1) and 3.6 (–14.4 to 4.0) points (/100) respectively. *Challenge* and *GOAL* use was feasible and appropriate for *"Moving Together"* and associated with gains in motor skill performance and functional abilities.

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Introduction


Approximately two-thirds of children and youth (hereafter referred to as children) with cerebral palsy (CP) can walk independently.¹ While these children are said to be “high functioning,” they still experience limitations in terms of functional mobility and ability to participate in home, school and community activities.¹ Children with CP have the potential to enhance their motor function in response to motor training.^{2,3} However, interventions that target impairments of body structure and function do not guarantee associated improvements in a child's functioning which is influenced to varying degrees by other child, family and environmental factors.^{4,5} Evidence suggests that motor interventions should focus on real-life tasks that are meaningful and important to the child and their parents.^{3,6–9} Active practice and training that are directed toward personalized, targeted goals designed to enhance performance abilities in real-life settings may help to enhance functional outcomes.^{7,10}

The planning and implementation of interventions needs to reflect a broad perspective on the child's functioning. Within the overall context of the World Health Organization's International Classification of Functioning, Disability and Health (ICF), Rosenbaum et al. have also recommended that motor interventions need to focus on the six “F-words” that are essential to child development: “functioning,” “family,” “fitness,” “fun,” “friends” and “future”^{6,11} to support children's

participation and learning and goal achievement within the program. While there is evidence that attendance at and degree of involvement in physical activities can be increased by motor skills-based interventions in the short term, more studies are needed to investigate if these gains can be sustained.¹² Engagement in activities with peers afterward may influence continued participation, but the actual intervention components that will promote sustained gains in advanced motor skills and associated physical function and participation remain uncertain.¹²

To better understand the acceptability and impact of physical activity interventions, a child's attendance and the extent of program involvement and related satisfaction need to be captured in addition to the evaluation of associated immediate and longer-term outcomes,^{12,13} using assessments that address the outcome expectations of the intervention.^{14,15} The Gross Motor Function Measure (GMFM-66) is the most commonly used motor skills outcome assessment in this population, but when a program's focus is with school-aged children with CP who are independently ambulatory (i.e., in Gross Motor Function Classification System [GMFCS] Levels I and II), its use as an outcome tool is limited with participants in level I because of ceiling effect.^{16,17} Other assessments used are the Bruininks-Oseretsky Test of Motor Proficiency and Movement Assessment Battery for Children, however these are norm-based tools designed to compare children with typically

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developing peers, and not built to be outcome assessments for children with CP.^{18,19}

In addition to using a standard item observational motor skills measure, it is also important to consider a patient-reported outcome measurement (PROM) to capture a child's perspectives on their real-world performance of motor skills/activities that matter to them. The Canadian Occupational Performance Measure is often used as a generic PROM, but it is not intended for goals that have a specific motor skills focus, concentrating instead on the over-arching areas of self-care, productivity and leisure.²⁰ The Pediatric Evaluation of Disability Inventory assessment is a well-known parent proxy questionnaire that covers functional skills across four domains, one of which is mobility, to measure a child's ability to participate in daily life activities.²¹ However, its two-point response scaling for its items (unable/capable) lacks sensitivity to motor skill refinement (i.e., in a motor skills program, it would only capture new skills acquired and not performance changes in existing skills). Other child/parent-report measures that can be applied in physical activity programs are the Activity Scale for Kids, a tool that applies across diagnoses, and the Lifestyle Assessment Questionnaire-CP that is specific to children with CP.^{22,23} However, neither appears to be well-enough targeted to cover outcomes related to high-level motor skill intervention programs, nor are they available in Danish language which was essential for use by children in our study.^{24,25}

We found two new measurement options that we felt could address these identified gaps. The *Challenge* assessment was developed as an adjunct to the GMFM-66 to evaluate advanced motor skill performance in children with CP classified as GMFCS Level I or II ages 5–18 years, and has been validated with a sample of Danish children with CP.^{15–17,26–29} The Gait Outcomes Assessment List (*GOAL*) was developed as a PROM for use by school-aged ambulatory children with CP or their parents as proxy, for evaluation of gait function and daily activities using its total, domain or item score.^{30,31} Inclusion of a PROM in planning and evaluation is important as the involvement of the child and their parents provides a means to obtain their perspectives on the child's functioning.² Like the *Challenge*, it is available in Danish.^{27,32}

The primary aim of this study was to conduct a first ever investigation of the feasibility and acceptability of using the *Challenge* and *GOAL* together within a new group-based motor skills enhancement intervention named “*Moving Together*” (in Danish: “*Sammen i Bevægelse*”). The feasibility indicators chosen for this study targeted time use/attendance/completion and participant satisfaction related to the assessments that were conducted at four time points, and participant attendance and satisfaction with respect to “*Moving Together*”. As a secondary aim, we wanted to estimate the change on the *Challenge* and *GOAL* associated with this new intervention as a basis for future sample size determinations for a full scale clinical trial,^{33–35} and also to gain an idea of the potential for sustainment of motor-based gains in the longer term. We also wanted to evaluate the association between *Challenge* and *GOAL* scores to understand the value from an informational standpoint of using both measures within “*Moving Together*”. Finally, we hoped that this work would provide guidance for evidence-informed modifications to the program prior to its

potential implementation in clinical practice. To accomplish these aims, we used a single-group pre- and post-test repeated measures feasibility study design.^{33–35}

Material and Methods

Participants

Children with CP who were GMFCS Level I or II ages 7–14 years and followed at our Children's Orthopaedics Department were eligible for the study and during the 2-month enrollment period, received a study invitation when visiting the outpatient clinic.²⁹ The additional inclusion criterion was agreement to attend pre- and post-assessments and group-based training sessions of the new 10-week “*Moving Together*” intervention. Exclusion criteria were as follows: 1) recent or up-coming surgery planned within the study period, and 2) other planned appointments that would conflict with the scheduled assessments or the intervention. If interested in the study, further information was provided to the child by e-mail.

We decided on a sample of ten children which falls within sample size guidelines for feasibility studies.³⁶ This also aligned with the number of children that the first author felt, when designing the group-based motor skills intervention, was ideal from a child interaction and resource standpoint to run the program that all children would attend together. By definition, this feasibility study was not intended to determine the effectiveness of the intervention.³⁷

Once ten children had been enrolled into the single study group, the recruitment process was stopped. Written consent from the parents and oral consent from the children were obtained. Approval to conduct the study was granted by the Data Protection Agency of the Central Denmark Region (case no. 1-16-02-26-19).

Procedures and Data Collection

In this pre and posttest single group feasibility study, *Challenge* and *GOAL* assessments were conducted at four time points: baseline (T0), immediately after the intervention (T1), 3-month follow-up (T2) and 6-month follow-up (T3). From a clinical relevance standpoint and follow-up period typically used to assess carryover of effects beyond the intervention, these reassessment time periods align well with other functional mobility-focused pediatric physiotherapy intervention studies that had follow-up timelines of 3 and 4–6 months.^{38–41} At T0, children and their parents jointly completed the *GOAL* at home, accessing it via a secure link to an on-line version created on REDCap.^{42,43} They then attended the center for their *Challenge* assessment followed by individual goal setting with the principal investigator. The *Challenge* was conducted during an individually scheduled assessment appointment which took place in the same quiet hallway where its 10-meter-long testing track was set up. One *Challenge* certified physiotherapist assessor conducted these assessments at all four time points. This assessor was not involved in the development of the study, recruitment or intervention and was blinded to children's previous *Challenge* scores. After this

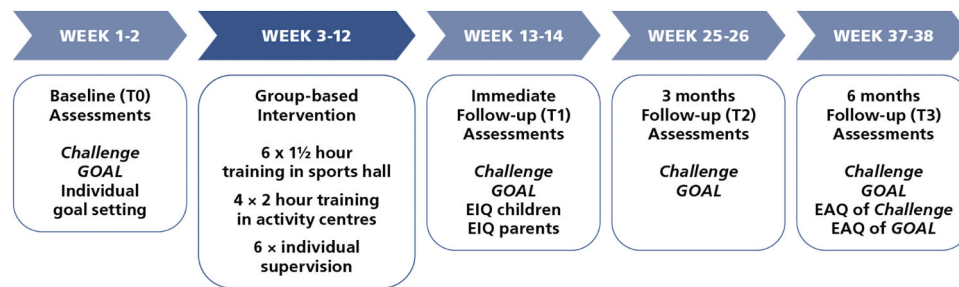


Figure 1. Flow chart with timeline of processes of the study, assessments, and intervention. Assessment time points: baseline: T0; immediate post-intervention: T1; 3-month follow-up: T2; 6-month follow-up: T3. Challenge 20-item version: Challenge, Gait Outcomes Assessment List: (GOAL). Experience of Intervention Questionnaire: EIQ, Experience of Assessment Questionnaire: EAQ 10-week group-based intervention programme, described in the TIDieR format: (see Appendix S1)

assessment, goal setting occurred with the physiotherapist principal investigator, and was set up as a continued knowledge process for the children, based upon their experience of the *Challenge* and *GOAL* assessments. One or two motor-skills related goals were established as part of their onboarding into the program and were set up as an open conversation and not brought into the measurement process to keep them more natural and reflective of a real-world practice. Thus, while the goals were important to talk about at the end of the intervention, there was no formal rating done, i.e., not used as a study outcome measure. At the three follow-up assessments (T1, T2 and T3), the *Challenge* and *GOAL* were administered again in the same manner by the same study assessor. All were blinded to the previous *Challenge* and *GOAL* scores.

To capture the study's feasibility indicators, attendance/completion/time taken for the assessments was documented by the assessor at each study time point, and intervention session attendance was tracked throughout the program by the physiotherapists who ran the intervention. Children and parents each separately completed a study-created intervention satisfaction questionnaire at T1 (post-program), provided in paper form to them by the study assessor. Children and parents jointly completed a study-created assessment satisfaction questionnaire at T3 to allow them to reflect on their experience with the assessments across the course of the four measurement sessions. This was provided in paper form by the study assessor. A flow-chart of the study processes and data collection is shown in Figure 1, and each measure is described in detail in the Assessments section.

"Moving Together" the Intervention

The 10-week "Moving Together" program that our physiotherapy group designed was intended to improve advanced gross motor skill performance, functional mobility, and participation. It consists of three main components: 1) group-based training in a sports hall (six weekly sessions), 2) experience from and participation in activities at community activity centers (four sessions) and 3) individual supervision (six sessions) (Appendix S1). The "Moving Together" program contents' key components were developed to span the ICF's body functions (e.g., balance, coordination, motor planning), activity (e.g., ball catch, dodging, walking and running with object control), and participation domains (e.g., group activities such

as floor ball, relay races, cool down stretches, sessions at adventure-motor-game center, trampoline park), and were linked directly with the relevant "F-words" of "functioning," "family," "fitness," "fun," "friends" and "future." Each key component was described with respect to the procedure, tailoring, who provided, where, how, when, how much and the associated "F-word" labels (see Appendix S1 for session outlines).¹¹ All parts of this intervention were planned and implemented by one experienced pediatric physiotherapist and four physiotherapist assistants. Group-training weekly of 1½-2-hour sessions in sports hall or activity centers and the individual supervision were delivered by same five professionals.

Each 1½-hour long group-training session had 10–15 minutes of warm-up; 60 minutes of partner-activities, circuit training, repetitions, activities that required coordination, balance, strength, speed, ball tasks and whole-body activities, and ended with 15 minutes of cooling-down and stretching. As an entire group, we visited four different indoor activity centers in the community for children to experience and engage in possible new fun-and-play motor activities. The indoor facilities attended were an adventure-motor-fun-game center, a climbing facility, an ice-skating rink, and a trampoline park. Each of these facility sessions was of a 2-hour duration. Individual online supervision, either virtual or telephone provided coaching, individual encouragement, and adjustments of training were to motivate and support the participants in reaching their individual goals. Appendix S1 shows the intervention's key components, "F-words" links activities and aims as described in a Template of Intervention Description and Replication (TIDieR) list,⁴⁴ and pictures from group-training session and local facility attended are provided in Figure 2.

Assessments

The *Challenge* assesses ability related to a child's coordination, accuracy and speed as part of advanced motor skill performance.^{26,45} This validated observational assessment was designed for ambulatory children with CP aged 5–18 years, and has shown responsiveness to change associated with motor skills interventions.^{28,35} The *Challenge* has demonstrated excellent test-retest reliability (ICC 0.94 95% CI 0.88 to 0.97) in children with CP,^{26–28} minimum



Figure 2. Examples from group-training session and from local climbing facility.

detectable change (90% level) of 3 to 7 points, and mean change following a motor skills sport-based training program for children with CP in GMFCS Levels I and II of 2.5% points,³⁸ and 4.2% points.²⁸ Early-stage work on minimal clinically important differences has provided estimates of 3.57 (GMFCS II) and 5.4 (GMFCS I) % points.²⁸ Our study's *Challenge* certified physiotherapist assessor performed and scored the validated 20-item version of the Danish *Challenge*.²⁷ As per the *Challenge* guidelines, the assessor demonstrated each item after which the child had a practice trial. For each item, children performed three trials unless they achieved the maximum score in a prior trial or if they chose not to repeat the item. *Challenge* items are scored 0–4 (three items separately evaluate the right and the left side), yielding a total score ranging from zero (worst) to 92 (best),^{26,27,45} which is then converted into a percentage.^{27,45} *Challenge* best trial scores were calculated using the *Challenge's* Excel scoring spreadsheet.

The *GOAL* questionnaire is a self-administered PROM for children with CP consisting of 48 questions grouped into seven ICF domains.³¹ The *GOAL* has shown to be valid and reliable in its original English version, German version, and Danish version used in this study.^{31,46,47} Previously studies on test-retest reliability of the *GOAL* have reported ICC levels of 0.82 to 0.97, and SEM of 2.3 with a calculated minimum detectable change estimate equal to 6.4 points (/100).^{31,46,48–50} Although, it is important to notice, that if a child sets a goal to improve function in a specific item that item holds significant importance, as this translates into enhanced independence in the corresponding activity for that child.⁵¹ Domain A covers activities of daily living and independence; domain B, gait function and mobility; domain C, pain, discomfort and fatigue; domain D, physical activities, sports and recreation; domain E, gait pattern and appearance; domain F, use of braces and mobility aids; and domain G, body image and self-esteem.⁴⁸ The total *GOAL* and domain scores vary from 0 (worst) to 100 (best) and each item is score on a 7-point rating scale from 0 (extremely difficult) to 6 (no problem at all).⁴⁸ *GOAL* scores were calculated using the *GOAL* Excel scoring spreadsheet. We chose not to have the participants rate each of the *GOAL's* 48 items with respect to importance given the breadth of areas in the

measure versus the very specific advanced motor skills/physical activity focus of our intervention, thus removing the added cognitive load of doing these ratings and simplifying the *GOAL* process. It should be stressed though that these importance ratings are highly pertinent when the *GOAL* is used in a clinic assessment context when information about priorities is needed to decide on an intervention pathway. Instead, we set up an onboarding discussion with the child after completion of the *Challenge* and *GOAL* to identify motor-focused goals with the lead physiotherapist of this programme that would help to guide their activities and participation in “*MovingTogether*”

Feasibility of Assessments: Time Use, Attendance and Satisfaction

We evaluated three aspects of feasibility of the *Challenge* and the *GOAL*: 1) time required to complete each, 2) participants' assessment attendance at the *Challenge* appointment or completion of the *GOAL* questionnaire at each of the four time points, and 3) participants' satisfaction with the assessments. For the *Challenge*, the optimal time to complete was set as ≤ 60 minutes and acceptable time as < 90 minutes.²⁶ For the *GOAL*, optimal time to complete was set as ≤ 30 minutes and acceptable time as < 45 minutes.⁴⁶ These thresholds were established in accordance with previous investigation of these two assessments.^{26,46} The *Challenge* completion time was recorded by the assessing physiotherapist, while completion of the *GOAL* within REDCap allowed automated time tracking. For participants' assessment attendance (*Challenge*) or completion (*GOAL*), an acceptable level was considered to be 100% attendance/completion at T0 and T1, and $\geq 75\%$ attendance/completion at the 3-month (T2) and 6-month (T3) follow-ups. These *a priori* defined thresholds for attendance/completion were set arbitrarily as there were no reference benchmarks found for motor skills group programmes for school aged children.

Participants' satisfaction with the *Challenge* and *GOAL* assessments was evaluated via a Danish language paper questionnaire named the Experience of Assessment Questionnaire (EAQ) that we created for the study since we were unable to find one in the literature that covered an assessment experience. An existing client report tool, the Experience of Service Questionnaire (ESQ)^{52,53} that was available in Danish and

measures satisfaction with services in child and adolescent mental health services, was used as a content and format foundation in the development of the EAQ by the lead physiotherapist and three experienced pediatric physiotherapists with >10 years of experience with children who have CP. A 7-item (statement) version of the EAQ was created, worded as “I” or “my child” to cover child and parents’ responses respectively (EAQ statements are shown in Tables 3 and 4). One statement was drawn from the ESQ, and the rest were created for this study. Statement wording was adjusted in separate versions to fit the observational (*Challenge*) versus self-report (*GOAL*) nature of the measures.

Scoring of each of the EAQ’s seven statements was via a five-point Likert response scale (strongly disagree to strongly agree). To summarize these scores, each statement’s responses were pooled into dichotomous ratings of “strongly agree plus agree” and “strongly disagree plus disagree,” and the neutral category was kept separate. The wording of the statement determined if the meaning of the response was coded as positive or negative, e.g., if the statement “*The questionnaire/test took too long to complete*” was rated as “strongly disagree or disagree,” the score was coded as a positive rating. The number of participants who rated each statement as positive or negative was tallied and presented as percentages. The target for satisfaction for each assessment time point was set *a priori* as 75% positive ratings for each measure.

Feasibility of the Intervention: Attendance and Satisfaction

We evaluated two feasibility aspects of the intervention: 1) attendance at the 10-week session component of the program, and 2) participants’ satisfaction overall. Attendance was documented by the lead physiotherapist at each session. Participants’ attendance rate was considered acceptable at 80% for the group-based intervention component of the program.⁵⁴ Satisfaction was evaluated by a paper questionnaire created in parallel with the EAQ and named the Experience of Intervention Questionnaire (EIQ). The children’s (seven statements) and parents’ (ten statements) EIQ ratings were via a three-point Likert response scale (not true, modestly true, and true). There were five statements that were similar in both questionnaires and two statements in the child version and five in the parent that were specific to their experiences/roles (as shown in Results Tables 3 and 4 that list the statements). Space was provided for free text comments, encouraging children and parents to write their perspectives on the intervention program. The EIQ was answered separately by children and parents at T1 (end of the intervention) as provided by the lead physiotherapist.

To summarize the EIQ data for analysis, the responses were categorized into dichotomous ratings of positive or negative from “True” and “Not true” respectively, and as with the EAQ, the phrasing wording of the question determined if the response chosen was a positive or negative rating (Table 4). The “moderately true” response was handled as a neutral category. The target for satisfaction was set *a priori* as $\geq 75\%$ positive ratings by children and parents. This *a priori* defined threshold for satisfaction was set arbitrarily as there were no reference benchmarks found for motor skills group programmes for school aged children.

Data Analysis

Attendance/completion of measures was calculated as number completed and presented as percentages. Attendance at the intervention sessions was counted and presented as a percentage for the 10 group sessions offered. Satisfaction was summarized the number of positive, negative, and neutral ratings of each question in the EAQ and EIQ and presented as percentages (Tables 3 and 4). Content analysis⁵⁵ of free text comments related to the intervention was coded in relation to the “F-words” terminology; “functioning,” “family,” “fitness,” “fun,” “friends,” “future” within the ICF framework.¹¹ Individual goals were categorized according to ICF codes.

Descriptive statistics for *Challenge* and *GOAL* were presented as means (SD) range and 95% confidence intervals (95% CI). Changes from baseline (T0) to follow-up (T1, T2 and T3) were calculated (means, SD). Change recorded from T0 to T1 was considered more important than change at the other time points as it captured any immediate group-based effect associated with “*Moving Together*”. Correlation between the *Challenge* and the *GOAL* was analyzed at each assessment timepoint and also for the change scores using Spearman Rho test. Stata 17.0 (StataCorp, Texas, USA) was used to conduct the statistical analyses.

Results

Six girls and four boys with CP in GMFCS level I or II participated (Table 1) and this sample was achieved in a two-month period during which 32 children had received detailed information about the study (31.3% enrollment rate). Due to health-related concerns unrelated to the intervention, one child dropped out after participating in the assessments at T0 and attending one training-session. There were no other drop-outs between T0 and T3.

Feasibility of Assessments: Attendance, Time Use and Satisfaction

Attendance/completion for the *Challenge* and *GOAL* in relation to the targets set are shown in Table 2. When the two participants who missed one or two *GOAL* or *Challenge* assessments were asked why they had not attended, their response referred to holidays or logistic challenges. There were no comments about the assessments themselves in these explanations. Total attendance/completion across the four time-points was 90% for the *Challenge* and 82.5% for the *GOAL*. The mean time required for *Challenge* completion was 61 minutes (SD = 18.3; range 40–90 minutes), and the *GOAL* took 23 minutes on

Table 1. Characteristics of the participants; children with cerebral palsy ($n = 10$).

Children $n = 10$	
Age, mean (SD)	10.3 (3.5)
7-9 years, n (%)	5 (50)
10-14 years, n (%)	5 (50)
Sex, girls/boys, n (%)	6/4 (60/40)
GMFCS Level I/Level II, n (%)	6/4 (60/40)
Diagnosis, unilateral/bilateral, n (%)	9/1 (90/10)

GMFCS: Gross Motor Function Classification System, SD: standard deviation.

Table 2. Attendance for the *challenge* assessment and *GOAL* completion.

	Baseline (T0) Target 100%	Intervention 10 weeks*	Post-intervention (T1) Target (100%)	Three-month follow-up (T2) Target (≥75%)	Six-month follow-up (T3) Target (≥75%)
Challenge. n (%)	10 (100)		9 (90)	8 (80)	9 (90)
GOAL. n (%)	10 (100)		9 (90)	7 (70)	7 (70)
Mean attendance rate (%), median (range) n		83, 9 (7-10)			

*Assessment time-points: baseline: T0; immediate post-intervention: T1; 3-month follow-up: T2; and 6-month follow-up: T3.

*10-week group-based intervention including individual supervision.

**Ten-week group-based intervention, described using the TIDieR format (Appendix S1).

average (SD = 3.8; range 12–27 minutes). These completion times were within the *a priori* time thresholds set.

Overall, children and parents were positive about the *Challenge*, with four of seven EAQ questions reaching the target of 75% positive responses. Only question 6 was negatively rated (Table 3). Two of seven EAQ questions reached the target of 75% positive responses for the *GOAL* assessment, however overall children and parents rated the experience as more positive than negative (Table 3, green shaded boxes).

Feasibility of the Intervention: Attendance and Satisfaction

The intervention mean attendance was 83%. As noted above, one child stopped after one session due to issues not associated with the study. Overall, children's and parents' EIQ satisfaction ratings were high, although parents generally rated it more positively than the children (Table 4). Parents' most frequent positive free-text statements were in the "F-word" categories of "functioning" ($n = 8$), "friends" ($n = 7$), and 'family' ($n = 5$). Additionally, having individual supervision was reported as important by seven parents (Appendix S2). Children's most frequent positive free-text statements were in the

"F-word" categories of "fun" ($n = 5$) and "friends" ($n = 3$). Of the 17 goals sets at the start of the intervention, 16 fitted into the ICF Activity and Participation category and one into Body Function and Structure category (Appendix S3).

Outcome Measure Scores

The *Challenge* and *GOAL* mean (SD) scores from T0 to T3 are presented in Table 5, and participants' individual changes over time are shown in Figure 3. The mean change from T0 to T1 of 4.2 points on *Challenge* was within the defined minimal detectable change (MDC) of 4 to 5 points.²⁶ The mean change on *GOAL* was 3.6 points from T0 to T1. No minimal clinically important difference has yet been determined for *GOAL*,^{31,47} however these gains measured immediately after participating in the intervention program were paralleled by improvements perceived by most of the children and parents as reflected in their answers to the EIQ (Table 4).

There was no more than a weak positive correlation between the *Challenge* and the *GOAL* single point in time scores and change scores (maximum $R_s < 0.25$) (Table 6).

Table 3. Evaluation of the feasibility of using the *challenge* and the *GOAL*, jointly answered by children and parents: (%) on a five-point likert scale, at T3 (end of program) ($n = 9$ child/parent dyads).

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total positive	
<i>Challenge</i>	1. The purpose of the test was clear to me/my child			11%	89%	100%	
	2. The test is suitable to assess my/my child's motor skills		11%	33%	56%	89%	
	3. The test was fun for me/my child		22%	45%	22%	67%	
	4. I think the test is relevant to use when we talk to the physiotherapist about planning my/my child's training			44%	56%	100%	
	5. I think the test is relevant to use to evaluate progress/decline of my/ my child's motor skills			44%	56%	100%	
	**6. The test was too easy for me/my child	33%		22%	44%	33%	
	**7. The test took too long	56%		44%		56%	
<i>GOAL</i>	1. The purpose of the questionnaire was clear to me/my child		23%	11%	33%	33%	66%
	2. It was easy to understand the questions in the questionnaire			22%	56%	22%	78%
	3. The questionnaire was suitable to evaluate my/my child's gait and daily physical function abilities	11%	22%	11%	44%	11%	55%
	4. *I think the questionnaire is relevant to use when we talk to the physiotherapist about planning my/my child's training		33%	22%	22%	11%	33%
	5. *I think the questionnaire is relevant to use to evaluate progress/decline of my/my child's gait and daily physical functions		33%	33%	22%		22%
	6. **The questionnaire was difficult for me/us to answer because it was electronic	89%	11%				100%
	7. **The questionnaire took too long to complete	33%	11%	33%	11%	11%	44%

Results shown as percentages in all columns: Target set at 75% as Positive result.

*Missing response or more than one response given explains why answers shown do not sum to 100%.

**Questions with "strongly disagree or disagree = positive result (reverse scoring). Green color = positive scores, red color = negative scores.

Table 4. Children's and parents' EIQ satisfaction ratings of "moving together" the intervention ($n = 9$ children and $n = 9$ parents).

		Not true	Modestly true	True	Total positive
Children	1. The intervention helped me. (C+P)**	0%	67%	33%	33%
	2. The intervention helped us as a family (C+P)	22%	45%	33%	33%
	3. If a friend of mine were in the need of this kind of intervention, I would recommend it to her/him (C+P, adapted from the ESQ)	11%	11%	78%	78%
	4. The physiotherapists understood my most important problems and challenges	0%	33%	67%	67%
	5. I had confidence in the physiotherapists (C+P)	11%	22%	56%	56%
	* 6. The intervention led to a decline in my functioning (C+P)	89%	11%	0%	89%
	7. After this intervention, I feel more like being together with others during physical activities	0%	89%	11%	11%
Parents	1. The intervention helped my/our child (C+P)	0%	22%	78%	78%
	2. The intervention helped me/us as parents (C+P)	0%	22%	78%	78%
	3. If a friend were in the need of this kind of intervention, I/we would recommend it to her/him (C+P, adapted from the ESQ)	0%	0%	100%	100%
	4. I/we felt we were appropriately informed about the meaning and purpose of the intervention	0%	0%	100%	100%
	5. I/we can better help my/our child now than before the intervention	10%	45%	45%	45%
	6. During the course of the intervention, I/we became better able to change my/our support for our child in a positive way	11%	22%	67%	67%
	7. During the course of the intervention, I/we gained a better understanding of my/our child's physical abilities	22%	11%	67%	67%
	8. I/we had confidence in the physiotherapists (C+P)	0%	0%	100%	100%
	*9. The intervention led to a decline in my/our child's functioning (C+P)	100%	0%	0%	100%
	*10. This intervention caused me/us to become less able to support our child in physical activities	100%	0%	0%	100%

Results shown as percentages in all columns: Target set at 75% as Positive result.

*Questions with "Not true" = negative result *Questions with "Not true" = positive result.

** (C+P) denotes statements that cover similar ideas in both the child and parent versions on the EIQ.

Green color = positive scores, red color = negative scores.

Table 5. Descriptive statistics on *challenge* and *GOAL* mean scores (Sd's) and range at the four time-points, and change over time for the *challenge* and *GOAL*.

Assessment and Timepoint	n	Mean (SD)	Range
Baseline (T0)			
<i>Challenge</i>	10	34.4 (23.2)	3.6-78.3
<i>GOAL</i>	10	73.5 (10)	60.0-90.9
Baseline (T1)			
<i>Challenge</i>	9	35.9 (22.6)	6.0-75.7
<i>GOAL</i>	9	77.6 (13.8)	56.0-93.9
Baseline (T2)			
<i>Challenge</i>	8	43.7 (19.1)	17.2-83.5
<i>GOAL</i>	7	77 (14.7)	50.9-96.7
Baseline (T3)			
<i>Challenge</i>	9	44.0 (26.0)	10.9-93.1
<i>GOAL</i>	7	79.8 (15.9)	53.2-95.5
Change over time	T0 to T1 ($n = 9$)	T0 to T2 ($n = 8$)	T0 to T3 ($n = 9$)
<i>Challenge</i> , mean (95% CI)	4.2 (-11.4; 3.1)	7.2 (-14.6; 0.2)	12.3 (-18.9; 5.6)
T0 to T1 ($n = 9$)		T0 to T2 ($n = 7$)	T0 to T3 ($n = 7$)
<i>GOAL</i> , mean (95% CI)	3.6 (-11.5; 4.3)	2.4 (-13.7; 8.9)	5.2 (-14.4; 4)

Assessment time points: baseline: T0; immediate post-intervention: T1; 3-month follow-up: T2; 6-month follow-up: T3
10-week group-based intervention programme, described in the TIDieR format: (see Appendix S1)
Refer to Figure 2 for details on the participant composition of each n.

Discussion

Our findings indicate that *Challenge* and *GOAL* were feasible and acceptable measures of motor skill-related outcomes in the context of this 10-week group-based motor skills enhancement "Moving Together" intervention, and that programme was both viable and applicable with this sample of independently

walking school-aged children with CP. Furthermore, given the magnitude of the associated positive change scores overall, the results suggest that participants were able to enhance their advanced gross motor skills and related function during the "Moving Together" programme.

The mean completion times for *Challenge* and *GOAL* were within the targeted times. None of the individual *Challenge*

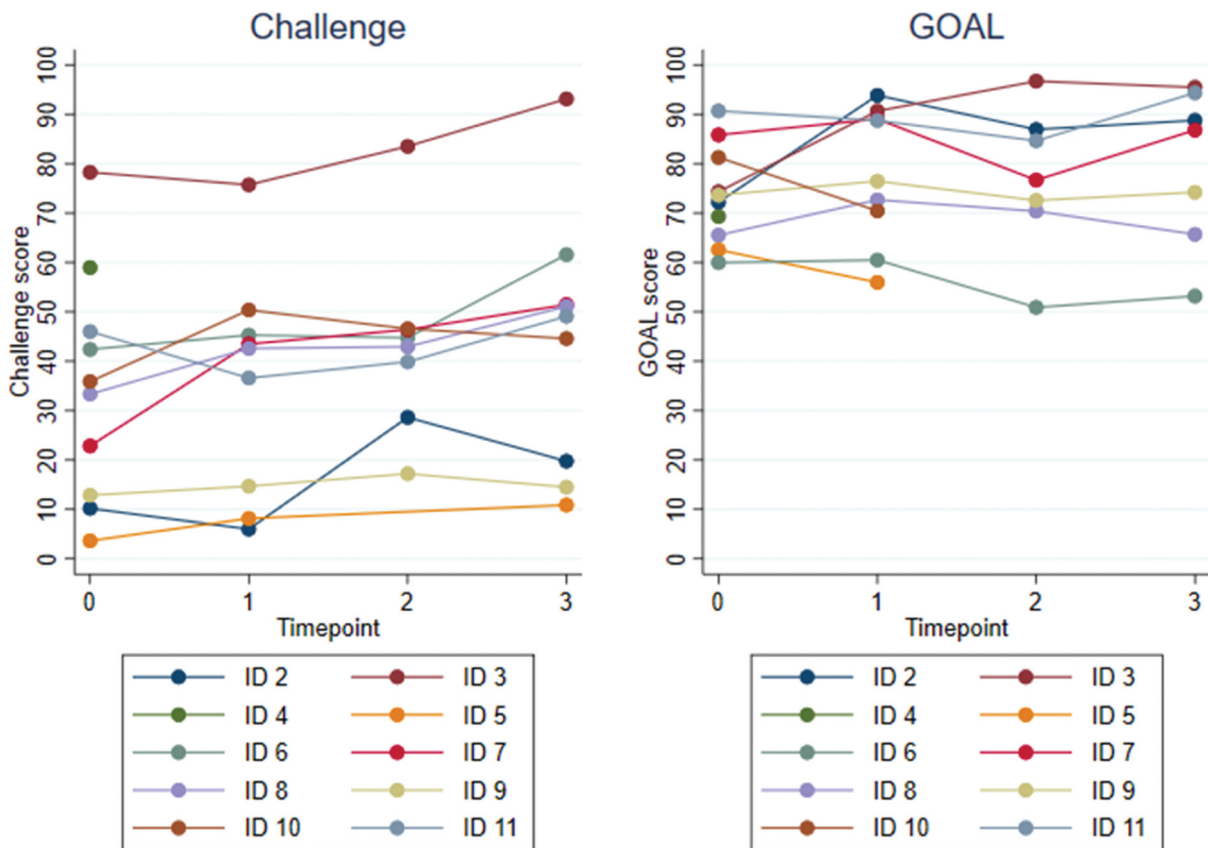


Figure 3. Total scores on the Challenge and GOAL (%) at the four time points. Results shown from nine children, each child with individual colour. One child dropped out after baseline assessment (“green” ID 4. Challenge (mean score) percentage out of 100% at four time points: baseline (T0), post-intervention (T1), 3-month follow-up (T2) and 6-month follow-up (T3). One child did not complete Challenge at the 3-month follow-up (“yellow” ID 5). Gait Outcome Assessment List (GOAL) (mean score) percentage out of 100% at four time points: baseline, post-intervention, 3-month follow-up and 6-month follow-up. Two children did not complete GOAL at the 3-month follow-up and the 6-month follow-up (“brown” ID 5 and “yellow” ID 10).

Table 6. Spearman’s Rho correlation between *challenge* and *GOAL* at each assessment time point and for change scores.

	n	R (95%CI)	p-value
Single point in time correlation			
T0 – Challenge and GOAL	10	0.24 (–0.46;0.75)	.51
T1 – Challenge and GOAL	9	–0.05 (–0.69;0.64)	.90
T2 – Challenge and GOAL	7	0.14 (–0.68;0.81)	.76
T3 – Challenge and GOAL	7	0.07 (–0.72;0.78)	.88
Change score correlation			
T0-T1 – Challenge and GOAL	9	–0.28 (–0.78;0.47)	.46
T0-T2 – Challenge and GOAL	7	0.11 (–0.70;0.80)	.82
T0-T3 – Challenge and GOAL	7	–0.32 (–0.87;0.57)	.48

STATA Warning: This method may not give valid results with small samples ($n \leq 10$) for rank correlations.

assessments went beyond the maximum 90 minutes and in no case did answering *GOAL* exceed the 45-minute threshold. The attendance targets for the assessments were met overall. One child dropped out of the study due to other health-related conditions after T0 and their absence deflated the overall completion rates from there on. As shown in Figure 3, child ID 5 missed attending their *Challenge* assessment at T2 but missed completing *GOAL* at both T2 and T3. It is possible that the independence of doing *GOAL* at home (i.e., without clinician involvement) factored into the missed completions. However, the children did have to come to the center to do

the *Challenge* versus being able to complete the *GOAL* electronically at home, so we were uncertain at the outset if this added travel/time burden might have reduced their satisfaction with the *Challenge*. The rate of completion of the *GOAL* might be elevated if the questionnaire was set up to be completed in the clinic on the same day that the *Challenge* was completed. The reason we had decided not to do this was we felt that it might reduce attendance at the session as it would then need to be longer and potentially more difficult to schedule. Also, since the *GOAL* is to be self-administered, it made more sense to use the home completion option via the REDCap platform.

Notably, children's and parents' ratings of satisfaction for the *GOAL* appeared lower than for the *Challenge* for which satisfaction ratings were high overall. It is perhaps not surprising that participating and being engaged in a game-based measure such as the *Challenge* is more satisfying than answering a questionnaire. However, while the positive and negative ratings of questions in the EAQ for the *GOAL* had a wide range, more than half of participants answered that they understood the purpose and the questions and found it suitable to evaluate gait and physical function. Only a few participants had stated they found the *GOAL* took too long to do.

The *GOAL* scores were all above 50 (/100), but there was no sign of a ceiling effect for the sample and there was evidence of intervention associated change on it as well. For the *Challenge*, while the results showed a wide range of ability scores at baseline, 44% of participants rated it in the EAQ as being too easy. However, a child's/parent's perceptions of how they did on the *Challenge* may not line up with the scores given its dynamic adaptive testing approach and the positive conversation after *Challenge* assessment that focuses on strengths and opportunities of skills to work on rather than actual scores.²⁶ Hence, the lack of ceiling effect and notable change scores both in the immediate and longer term follow-up carry the greatest weight in the evaluation of this assessment's value in this intervention context. Previous studies with the *Challenge* have also provided evidence of its lack of ceiling effect and ability to detect change in conjunction with motor skills programs.^{28,35}

The EIQ ratings indicated high satisfaction overall with the intervention and participation in "*Moving Together*" (Table 4), and most of the children and all parents confirmed that they would recommend it to others. Children's response on the intervention-related statements 1 and 2 (EIQ) were modestly positive and notably indicated that they liked the program, would recommend it to others, and they were confident with the physiotherapists whom they felt understood them. However, they did not feel any change from the intervention regarding future participation in physical activities (statement 7). Parents' statements were positive on outcome and enjoyment of the intervention for the child. But in alignment with the children about the future, statements 5, 6, and 7 on knowing what to do for their child related to future activities and sports were rated lower. These uncertainties about what next point to a need to add parent and child education into the program to enhance the knowledge (cognitive) aspect of "*Moving Together*" beyond its motor skills competence (physical) component to assist sustained physical activity (behavior) post-program.⁵⁶ While child and parent education occurred in relation to the motor skill (physical competence) changes associated with the intervention, when thinking about building physical literacy more broadly, knowledge about how to get more active and motivation and confidence to do this could be increased to support getting these children into meaningful and enjoyable physical activity participation that will be sustained and keep building through the life course.^{57,58} These components should be considered more fully in the programme aspects of our "*Moving Together*" intervention and evaluated in a future study.

Children's attendance at our group intervention was higher than the target set but is in line with a previous study that

reported an 80% attendance rate in an physical literacy based motor skills intervention programme for children of diverse abilities.⁵⁴ This attendance success may be linked with parents and some children's appreciation of the opportunity to train in a fun program with others "like my child." This training opportunity was also perhaps the foundation for a comment from three parents to the first author that was shared after the program about their next steps action of establishment of a parent-driven weekly training together as a group of four children with CP. The parents' involvement in some parts of the intervention seemed to have an important impact beyond the "*Moving Together*" programme with real-world connection to the "F-words" and reinforces the extended value of having parents involved directly in the program.

This group-based intervention strove to offer functional training related to the "F-words" within the ICF framework, and the free text comments connection with the six "F-words" categories is shown in Appendix S2, shedding light on important views related to these words. Some participants expressed that they appreciated the programme because it was "fun", and it was important to engage in training with peers experiencing similar challenges: "friends". Some parents valued the individual supervision and goals because they got ideas and support for home training: "*functioning and family*". From the above elaboration, we consider that the intervention met some of the "F-word" requirements. Although no firm conclusions about content may be drawn in this study given the exploratory nature of this work, next step refinements of the "*Moving Together*" should take these "F-words" findings into consideration to even more fully embrace the concept.

The *GOAL* total scores correlation with the *Challenge* total scores were only weak for the single point in time and align with the similar weak correlations found in the previous Danish validation study comparing the two assessments.³² And while there was change on both measures associated with the intervention, the weak degree of correlation between change scores for the three time points suggests that only a few items in the seven domain *GOAL* connect directly with advanced motor skill performance and changes in these abilities as measured by the *Challenge*. Thus, the two assessments provide different information, with the *GOAL* capturing a much wider range of activities from children's and parents' experience of the real-world motor function, whereas the *Challenge* quantifies a child's motor function on observable skills that, while foundational to performance linked with gait, sports and play, are only one of part it. Hence, our findings suggest the value of using the *Challenge* and *GOAL* together as they were found to provide complementary and important outcomes information that we do not get from either tool alone.

Guidelines on how to improve motor skills function for children with CP recommend that interventions directly address functional goals.⁷ Two of the recommendations from the guidelines proposed from Jackman et al. emphasize that interventions need to be enjoyable, motivating and that practicing should be possible within a child's home and community.⁷ Addressing a functional mobility problem is not necessarily tantamount to addressing the social aspect of

participation with peers in sports and leisure activities. Often, children with CP are offered individual physiotherapy focused on advanced motor skills, yet physical activity opportunities and practice also need to occur when they are together with peers as also noted by our participants (Appendix S2).⁵⁹ Other studies have highlighted that context may play an important role in achieving high adherence, motivation and participation compared with individual therapy.^{59–61}

Developing group-based interventions involving sports skills linked training is a challenge when aiming to create motivational group activities with functional goals while also ensuring that children's individual goals are taken into account.⁶² The individual supervision of our program was valued as important, as shown in parents' comments. The rehabilitation process needs to be person-centered,⁶³ with individualized treatment goals and, personalized monitoring with adjustments to goals and activities.^{64,65} While there is good evidence now to support work on gross motor function skills to improve activity and participation outcomes in ambulatory children with CP,³ the individuality of each child with CP and their needs must be recognized within the context of any group intervention that is created and built into its implementation to optimize its outcomes and impact and perceived value.

Limitations

The small convenience sample and lack of a control group limit the generalizability of the findings of the present study and the attribution of cause and effect as far as outcomes. However, knowledge about time use and attendance/completion and satisfaction of the *Challenge* and *GOAL* assessments and outcomes estimates obtained from this group-based intervention may be helpful in setting evidence-informed benchmarks for similar programs in future research and clinical practice.

The original ESQ was not validated for use in children with CP and their parents, and no other satisfaction PROM is available in Danish language. Therefore, there was a need to develop questions to fit our population. While expert pediatric physiotherapists created these questionnaires to facilitate best evaluation of satisfaction, we acknowledge that validation work has yet to be done with this measure. Similar measurement gap issues have been experienced in other recent physiotherapy intervention research. A study published after we had conducted ours assessed satisfaction in a motor skills program for children with CP using a study-created 0–10 point rating scale and summarized results as satisfied or not satisfied. Souto et al. also rated satisfaction using a study-designed measure in their feasibility study of a practitioner-led sports program with children with CP.^{35,41} These evaluation actions exemplify the need for a standard measure to investigate satisfaction with the experience of participating pediatric intervention programmes in the same way that the Measure of Processes of Care exists for evaluation of experiences with overall pediatric services provided to a family.⁶⁶

We did not evaluate the *GOAL*'s feature of rating the “importance of an item” which was created in this tool to assist in subsequent shared decision making and goal setting. As we

noted above, we wanted to have the child and parents come up with their own goals, after the experience of doing both the *Challenge* and the *GOAL*. Hence, individual goal setting following the *Challenge* and *GOAL* assessments was done as a pragmatic reflective part of the entire assessment process that directed the physiotherapists' guidance of each child in the program activities and served as a foundation for discussions during the supervision. The importance rating feature of the *GOAL*, while adding “thinking burden” to the child's completion of the *GOAL*, would give a chance to look at a broader range of priority goals and the value and fit of that within the context of a specific intervention should always be considered prior to implementation of the measure.

We only counted training hours in the programme 1½–2 hours per week for 10 weeks but “Moving Together” also encouraged each child to do daily activities and training in school and in the home environment through individual supervision. Training intensity is crucial when a physiotherapy programme aims for functionality.^{40,67} To measure the real programme intensity, individual activity and additional training should be captured through child logs and added documented as supplementary intervention time in future programme implementation.

Finally, we do not know from this one group design if the continuing gains had anything to do with being in the program, but the apparent responsiveness to change at least give us an indication of the potential of both assessments to be used in the longer-term evaluation context with programs like this. And while children in our study were engaged and participated fully, we cannot know from our study whether this intervention will facilitate their participation in recreational activities and sports during leisure time in the longer term.

Conclusion

In conclusion, the *Challenge* and *GOAL* were found to be feasible and suitable as companion measures for assessment of school-aged high-functioning children with CP at GMFCS Level I and Level II as reflected in results regarding time, attendance/completion, and satisfaction. The study also indicated potential gross motor functional improvements after “Moving Together” a 10-week group-based intervention programme with individual supervision. While promising, evaluation of outcomes directly attributable to this intervention requires use of a randomized trial methodology with extended follow-up, and an integrated qualitative component (mixed methods approach) to also capture the experiences and views of children, parents and physiotherapists who take part in our evidence-informed updated version of “MovingTogether”.

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