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Original Article

Effectiveness of Task-Oriented Training Versus Conventional Physiotherapy on Gross Motor Function, Balance, and Functional Independence in Children With Spastic Cerebral Palsy: A Randomized Controlled Trial

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ABSTRACT

Background: Children with spastic cerebral palsy frequently experience impaired gross motor performance, postural instability, and dependence in daily activities. Task-oriented training emphasizes repetitive practice of meaningful functional activities and may promote greater transfer of motor gains than conventional physiotherapy. Objective: To compare the immediate effects of task-oriented training and conventional physiotherapy on gross motor function, balance, and functional independence in children with spastic cerebral palsy. Methods: In this parallel-group randomized controlled trial, 26 children were allocated equally to task-oriented training or conventional physiotherapy. Gross motor function was assessed using the Gross Motor Function Measure-88, balance using the Pediatric Balance Scale, and independence using the Functional Independence Measure for Children. Outcomes were evaluated at baseline and immediately after treatment. Between-group differences in change scores were reported with 95% confidence intervals, p-values, and standardized effects. Results: Task-oriented training produced greater improvements than conventional physiotherapy in GMFM-88 scores (10.5 ± 4.2 vs 4.9 ± 3.8; mean difference 5.6, 95% CI 2.4–8.8; p=0.002), Pediatric Balance Scale scores (9.6 ± 3.7 vs 4.3 ± 3.4; difference 5.3, 95% CI 2.4–8.2; p=0.001), and WeeFIM scores (10.4 ± 4.6 vs 4.7 ± 4.1; difference 5.7, 95% CI 2.2–9.2; p=0.003). No serious adverse events occurred. Conclusion: Task-oriented training was associated with larger immediate functional gains, although confirmation in larger, longer-term trials is required. Keywords: cerebral palsy; task-oriented training; gross motor function; balance; functional independence; physiotherapy

INTRODUCTION

Cerebral palsy is a heterogeneous group of permanent disorders of movement and posture caused by non-progressive disturbances in the developing fetal or infant brain. Although the underlying neurological lesion is non-progressive, its musculoskeletal, motor, and functional consequences may evolve throughout childhood and restrict mobility, self-care, education, play, and community participation (1). Cerebral palsy remains one of the most common causes of childhood physical disability worldwide, with prevalence, clinical presentation, and access to rehabilitation varying across geographical and socioeconomic settings (2). Spastic cerebral palsy is the most frequently reported motor subtype and is characterized by velocity-dependent hypertonia accompanied by muscle weakness, impaired selective motor control, abnormal postural responses, and reduced coordination. These

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impairments commonly limit sitting, standing, transferring, walking, running, stair negotiation, and other activities required for independent daily functioning.

Children with spastic cerebral palsy frequently experience deficits in both anticipatory and reactive postural control. These deficits may compromise static and dynamic balance, reduce movement efficiency, increase instability during functional activities, and heighten dependence on caregivers. Gross motor capacity, balance, and functional independence are closely related but represent distinct domains. Gross motor function reflects a child's ability to perform standardized motor activities, balance represents the capacity to maintain or restore postural stability during static and dynamic tasks, and functional independence reflects the amount of assistance required during everyday self-care and mobility. Rehabilitation should therefore address not only impairments in body structure and function but also activity limitations and the child's ability to perform meaningful tasks in daily environments, consistent with the International Classification of Functioning, Disability and Health framework (3).

Physiotherapy is a central component of multidisciplinary management for children with cerebral palsy. Conventional physiotherapy may include stretching, range-of-motion exercises, strengthening, positioning, postural-control activities, balance exercises, transitional movement practice, and gait training. These interventions can improve physical capacity, preserve joint mobility, reduce secondary musculoskeletal complications, and facilitate movement. However, improvement in an isolated impairment does not necessarily produce a corresponding improvement in functional activity or independence. Evidence from cerebral palsy rehabilitation indicates that changes at the level of body function may not automatically transfer to meaningful performance in home, school, and community settings unless functional tasks are practiced directly (4).

Task-oriented training addresses this potential limitation by emphasizing the repetitive practice of meaningful, goal-directed activities within relevant functional contexts. Rather than concentrating primarily on isolated movement components, task-oriented programs involve active practice of complete tasks or task components, such as rising from a chair, reaching while standing, transferring, walking over different surfaces, stepping over obstacles, changing direction, and negotiating stairs. Task difficulty can be individualized by modifying environmental demands, repetition, speed, external support, task complexity, and the amount of therapist assistance. This approach is consistent with contemporary motor-learning principles, according to which motor performance is enhanced when practice is intensive, specific to the intended activity, progressively challenging, and meaningful to the learner (5).

The proposed advantage of task-oriented training is therefore not that impairment-based physiotherapy is ineffective, but that repeated practice of functionally relevant activities may promote a more direct transfer of therapeutic gains to everyday performance. Active task practice requires the integration of strength, selective motor control, balance, coordination, perception, and problem-solving within the same activity. Such integration may be particularly relevant for children with spastic cerebral palsy, whose functional limitations usually arise from the interaction of multiple impairments rather than from a single motor deficit. Task-oriented training may consequently produce broader improvements than programs in which comparable physical capacities are addressed without the same degree of task specificity, repetition, contextual variation, or goal-directed practice.

Previous research provides support for functional and activity-focused rehabilitation in children with cerebral palsy. A functional physiotherapy program evaluated by Ketelaar and colleagues improved motor abilities and performance of daily activities, suggesting that rehabilitation organized around functional goals can influence outcomes beyond isolated physical impairments (6). Salem and Godwin similarly reported improvements in mobility-related function following task-oriented training in children with cerebral palsy (7). Broader evidence syntheses have identified goal-directed, activity-based, and task-specific interventions as promising components of cerebral palsy rehabilitation, while also emphasizing substantial variation in intervention content, dose, methodological quality, and outcome selection across studies (8).

Despite these encouraging findings, uncertainty remains regarding the comparative effectiveness of task-oriented training and conventional physiotherapy. Existing studies differ in participant age, cerebral palsy distribution, Gross Motor Function Classification System level, treatment intensity, intervention duration, progression criteria, and the operational definition of task-oriented practice. Some studies have focused on a single outcome, such as walking, strength, or gross motor capacity, without simultaneously evaluating balance and independence in daily activities. Consequently, improvement in a standardized motor measure cannot necessarily be assumed to represent improved postural control or reduced need for caregiver assistance. Direct comparisons are also difficult when intervention groups receive unequal therapist contact, treatment intensity, or opportunities for active practice (9).

The population of interest comprises children with spastic cerebral palsy who are able to participate in structured physiotherapy; the intervention is a progressive program of repetitive, goal-directed functional activities; the comparator is conventional physiotherapy delivered for an equivalent duration and frequency; and the outcomes are gross motor function, functional balance, and independence in daily activities (10).

The objective of this randomized controlled trial was to compare the effects of task-oriented training and conventional physiotherapy on gross motor function, balance, and functional independence in children with spastic cerebral palsy. It was hypothesized that, immediately after the intervention period, children allocated to task-oriented training would demonstrate greater improvements in Gross Motor Function Measure-88 scores, Pediatric Balance Scale scores, and Functional Independence Measure for Children scores than children allocated to conventional physiotherapy..

MATERIAL AND METHODS

A parallel-group randomized controlled trial was conducted at Johar Child Poly Clinic, Lahore, Pakistan, to compare the short-term effects of task-oriented training and conventional physiotherapy on gross motor function, functional balance, and independence in children with spastic cerebral palsy. A randomized design was selected to minimize systematic differences between treatment groups and permit estimation of the comparative effect of the two rehabilitation approaches. Participants were allocated in a 1:1 ratio to either task-oriented training or conventional physiotherapy. Baseline measurements were completed before group allocation, and outcomes were reassessed immediately after completion of the assigned intervention. The trial was designed and reported in accordance with the principles of the Consolidated Standards of Reporting Trials for parallel-group randomized studies.

Children attending the pediatric physiotherapy service at Johar Child Poly Clinic were screened consecutively for eligibility. Children were eligible when they were between 4 and 12 years of age, had a medically confirmed diagnosis of unilateral or bilateral spastic cerebral palsy, were classified within levels I–III of the Gross Motor Function Classification System, could understand and follow simple verbal instructions, were medically stable, and were able to participate safely in structured physiotherapy activities. The Gross Motor Function Classification System was used to characterize functional mobility severity because it provides a standardized five-level classification of self-initiated movement in children with cerebral palsy (9). Children were excluded when they had undergone orthopedic surgery or selective dorsal rhizotomy within the preceding 12 months, had received botulinum toxin injections within the preceding 6 months, had uncontrolled epilepsy or another unstable medical condition, or had fixed musculoskeletal deformities or severe contractures that prevented performance of the intervention tasks. Children with severe visual, hearing, cognitive, or behavioral impairments that precluded valid assessment or participation were also excluded, as were children receiving another intensive rehabilitation program during the study period or those unable to attend treatment regularly.

Twenty-six eligible children were enrolled and assigned equally to the task-oriented training group or the conventional physiotherapy group, with 13 participants in each arm. Randomization was performed only after completion of the baseline assessment to reduce the possibility that knowledge of treatment allocation would influence initial outcome measurement. Treatment exposure was kept equivalent between groups with respect to the number and approximate duration of therapist-supervised sessions so that the principal contrast reflected intervention content rather than differential therapist contact. Participants continued to use their customary orthoses and mobility aids during the study when clinically required, and any concurrent treatment or change in assistive-device use was documented.

Gross motor function was assessed using the Gross Motor Function Measure-88. The instrument comprises 88 observational items organized into five dimensions: lying and rolling; sitting; crawling and kneeling; standing; walking, running, and jumping. Each item is rated on a four-point ordinal scale from 0, indicating that the child does not initiate the activity, to 3, indicating completion of the activity. Dimension scores and the total percentage score were calculated according to the standardized scoring procedure, with higher scores indicating better gross motor performance. The Gross Motor Function Measure was selected because it was specifically developed to quantify change in gross motor abilities in children with cerebral palsy (10).

Functional balance was evaluated using the Pediatric Balance Scale, a 14-item clinical measure assessing balance during sitting, standing, transfers, reaching, turning, object retrieval, and stepping activities. Each item is scored from 0 to 4, producing a total score between 0 and 56, with higher scores representing better functional balance (11). Functional independence was assessed using the Functional Independence Measure for Children, commonly referred to as the WeeFIM. The instrument evaluates the level of assistance required across self-care, mobility, and cognitive activities, with higher scores indicating greater independence and reduced caregiver assistance (12). The WeeFIM total score was used to represent overall functional independence. The same instruments and scoring procedures were applied at baseline and immediately after the intervention under standardized clinical conditions.

The primary efficacy outcome was the change in Gross Motor Function Measure-88 total percentage score from baseline to the immediate post-intervention assessment. Changes in Pediatric Balance Scale and WeeFIM total scores were treated as secondary outcomes. The treatment effect was operationally defined as the adjusted difference between groups in post-intervention scores after accounting for the corresponding baseline value. A positive adjusted difference favored task-oriented training. Safety outcomes included the frequency, severity, and intervention-relatedness of adverse events. Treatment adherence was analyzed using attendance as a percentage of prescribed sessions.

Several procedures were incorporated to reduce potential bias. Eligibility criteria and outcome definitions were established before participant enrollment, baseline assessment preceded randomization, and both groups received comparable therapist contact. The same assessment instruments, testing environment, standardized instructions, and scoring procedures were used for both groups at both assessment points. Parents were asked not to disclose the allocated intervention during outcome assessment. Intervention content and progression were documented on session-specific treatment forms, and attendance and adverse events were recorded contemporaneously rather than retrospectively. Baseline clinical characteristics were summarized to identify potentially important imbalances in age, cerebral palsy distribution, Gross Motor Function Classification System level, previous physiotherapy exposure, or assistive-device use. Baseline outcome values were incorporated into the principal comparative analyses to improve precision and reduce residual imbalance.

Data were entered into IBM SPSS Statistics and checked for completeness, range errors, internal consistency, and duplicate records before analysis. Each participant was assigned a unique identification code, and the analysis dataset contained no directly identifying information. Continuous variables were summarized using means and standard deviations when approximately normally distributed and medians with interquartile ranges when distributions were markedly skewed. Categorical variables were summarized using frequencies and percentages. Distributional assumptions were assessed using histograms, Q–Q plots, the Shapiro–Wilk test, and inspection of model residuals. Baseline characteristics were described by treatment group without using significance testing as evidence of successful randomization.

Participation was voluntary, written informed consent was obtained from parents or legal guardians, and assent was sought from children capable of providing it. Confidentiality was protected through coded study identifiers, restricted access to study records, and reporting of aggregate results. Treatment activities were modified or discontinued when a child experienced pain, excessive fatigue, instability, or another safety concern. Any serious adverse event was to be referred for medical assessment and documented in the study record.

RESULTS

Twenty-six children were randomized in a 1:1 ratio to task-oriented training or conventional physiotherapy. All randomized participants completed the assigned intervention and immediate post-intervention assessment and were included in the analysis. No participant withdrew, was lost to follow-up, or was excluded after randomization.

The demographic and clinical characteristics of the participants are presented in Table 1. The treatment groups were broadly similar at baseline with respect to age, sex, cerebral palsy distribution, Gross Motor Function Classification System level, duration since diagnosis, and previous physiotherapy exposure. Because of the small cell frequencies, categorical characteristics were evaluated using Fisher's exact test, whereas continuous variables were compared using independent-samples t-tests.

Table 1. Baseline demographic and clinical characteristics of the participants

Characteristic	Task-oriented training (n = 13)	Conventional physiotherapy (n = 13)	Between-group statistic	p-value
Age, years, mean ± SD	8.08 ± 2.02	8.23 ± 2.13	Mean difference: −0.15 years	0.855
Sex, male, n (%)	8 (61.5)	7 (53.8)	Fisher's exact test	0.691
Sex, female, n (%)	5 (38.5)	6 (46.2)	—	—
Spastic diplegia, n (%)	9 (69.2)	8 (61.5)	Fisher's exact test	0.680
Spastic hemiplegia, n (%)	4 (30.8)	5 (38.5)	—	—
GMFCS level I, n (%)	3 (23.1)	3 (23.1)	Fisher's exact test	0.967
GMFCS level II, n (%)	6 (46.2)	5 (38.5)	—	—
GMFCS level III, n (%)	4 (30.8)	5 (38.5)	—	—
Duration since diagnosis, years, mean ± SD	5.92 ± 1.98	6.08 ± 2.10	Mean difference: −0.16 years	0.844
Previous physiotherapy, n (%)	11 (84.6)	10 (76.9)	Fisher's exact test	0.619

SD, standard deviation; GMFCS, Gross Motor Function Classification System. The p-values for sex, cerebral palsy distribution, and GMFCS level represent omnibus comparisons across all categories of the corresponding variable. Dashes indicate that a separate test was not performed because the category formed part of the preceding omnibus comparison. Baseline scores for gross motor function, functional balance, and functional independence are reported in Table 2. No marked baseline differences were observed between the groups. Baseline values were retained as covariates in the planned outcome analyses because a non-significant baseline comparison does not establish equivalence between randomized groups.

Table 2. Baseline outcome scores by treatment group

Outcome	Task-oriented training (n = 13), mean ± SD	Conventional physiotherapy (n = 13), mean ± SD	Unadjusted mean difference	95% CI for mean difference	p-value
GMFM-88 total score, %	58.4 ± 8.1	57.9 ± 8.4	0.5	−6.2 to 7.2	0.878
Pediatric Balance Scale score	30.2 ± 6.4	29.8 ± 6.7	0.4	−4.9 to 5.7	0.877
WeeFIM total score	74.5 ± 10.2	73.8 ± 10.8	0.7	−7.8 to 9.2	0.866

CI, confidence interval; GMFM-88, Gross Motor Function Measure-88; SD, standard deviation; WeeFIM, Functional Independence Measure for Children. Positive mean differences favor the task-oriented training group. Confidence intervals are presented for descriptive assessment of baseline precision.

Both groups demonstrated increases in GMFM-88, Pediatric Balance Scale, and WeeFIM scores between baseline and the immediate post-intervention assessment. The pre-intervention scores, post-intervention scores, mean within-group changes, confidence intervals, and within-group p-values are presented in Table 3. These within-group analyses describe change over time but were not used as the principal evidence of comparative treatment effectiveness.

Table 3. Within-group changes from baseline to immediate post-intervention assessment

Outcome	Group	Baseline, mean ± SD	Post-intervention, mean ± SD	Mean change ± SD	95% CI for mean change	p-value
GMFM-88 total score, %	Task-oriented training	58.4 ± 8.1	68.9 ± 7.7	10.5 ± 4.2	8.0 to 13.0	<0.001
GMFM-88 total score, %	Conventional physiotherapy	57.9 ± 8.4	62.8 ± 8.1	4.9 ± 3.8	2.6 to 7.2	<0.001
Pediatric Balance Scale score	Task-oriented training	30.2 ± 6.4	39.8 ± 5.9	9.6 ± 3.7	7.4 to 11.8	<0.001
Pediatric Balance Scale score	Conventional physiotherapy	29.8 ± 6.7	34.1 ± 6.3	4.3 ± 3.4	2.2 to 6.4	0.001
WeeFIM total score	Task-oriented training	74.5 ± 10.2	84.9 ± 9.6	10.4 ± 4.6	7.6 to 13.2	<0.001
WeeFIM total score	Conventional physiotherapy	73.8 ± 10.8	78.5 ± 10.1	4.7 ± 4.1	2.2 to 7.2	0.002

CI, confidence interval; GMFM-88, Gross Motor Function Measure-88; SD, standard deviation; WeeFIM, Functional Independence Measure for Children. Positive change values indicate improvement. The p-values represent paired within-group comparisons.

The between-group treatment effects are presented in Table 4. The prespecified primary outcome was change in the GMFM-88 total percentage score. The task-oriented training group showed a larger mean GMFM-88 improvement than the conventional physiotherapy group. Larger changes were also observed for the secondary outcomes of functional balance and functional independence. Effect estimates are reported with 95% confidence intervals, p-values, and standardized mean differences.

Table 4. Between-group comparison of changes in primary and secondary outcomes

Outcome	Task-oriented training change, mean ± SD	Conventional physiotherapy change, mean ± SD	Between-group mean difference	95% CI	p-value	Cohen's d	Effect-size interpretation
GMFM-88 total score, % — primary outcome	10.5 ± 4.2	4.9 ± 3.8	5.6 percentage points	2.4 to 8.8	0.002	1.40	Large
Pediatric Balance Scale score — secondary outcome	9.6 ± 3.7	4.3 ± 3.4	5.3 points	2.4 to 8.2	0.001	1.49	Large
WeeFIM total score — secondary outcome	10.4 ± 4.6	4.7 ± 4.1	5.7 points	2.2 to 9.2	0.003	1.31	Large

CI, confidence interval; GMFM-88, Gross Motor Function Measure-88; SD, standard deviation; WeeFIM, Functional Independence Measure for Children. Positive between-group differences favor task-oriented training. The reported p-values were obtained from independent-samples comparisons of change scores. Cohen's d values of approximately 0.20, 0.50, and 0.80 correspond to small, moderate, and large standardized effects, respectively. The secondary-outcome analyses should be interpreted as supportive because no adjustment for multiple comparisons was applied.

Treatment attendance and adverse events are summarized in Table 5. Attendance exceeded 94% in both groups. Mild, temporary muscle fatigue was reported in both treatment arms, whereas no falls, injuries, severe pain, or serious adverse events were recorded.

Table 5. Treatment attendance and adverse events

Outcome	Task-oriented training (n = 13)	Conventional physiotherapy (n = 13)	Comparative measure	p-value
Mean attendance, % of scheduled sessions	95.6	94.8	Difference: 0.8 percentage points	Not tested
Participants with temporary mild muscle fatigue, n (%)	2 (15.4)	1 (7.7)	Risk difference: 7.7 percentage points	1.000
Falls during treatment, n (%)	0 (0.0)	0 (0.0)	No between-group variation	Not estimable
Treatment-related injuries, n (%)	0 (0.0)	0 (0.0)	No between-group variation	Not estimable
Severe pain, n (%)	0 (0.0)	0 (0.0)	No between-group variation	Not estimable
Serious adverse events, n (%)	0 (0.0)	0 (0.0)	No between-group variation	Not estimable

The adverse-event comparison for mild fatigue was evaluated using Fisher's exact test. Attendance was summarized descriptively because participant-level session counts were not included in the reported aggregate dataset. A p-value cannot be estimated when both groups contain zero events.

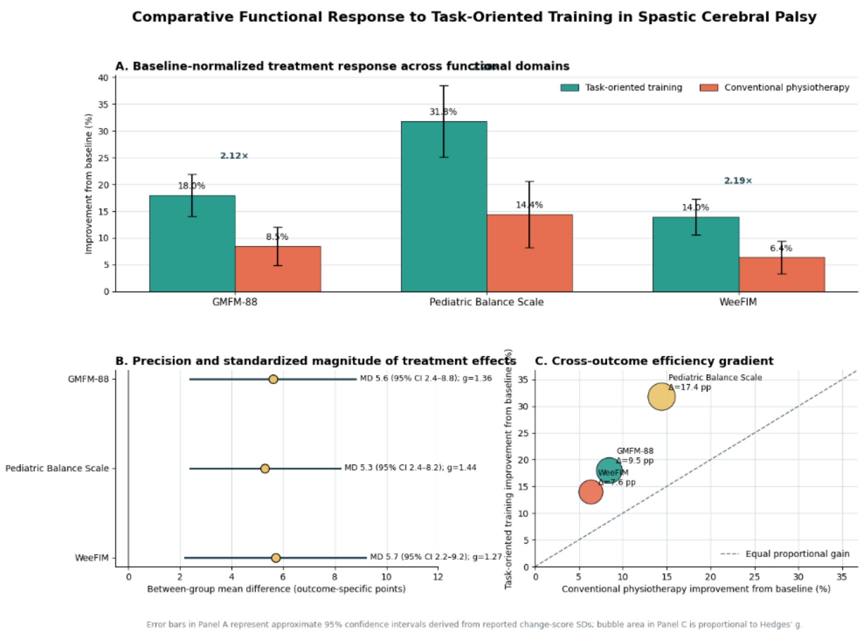

Figure 1 Comparative Functional Response to Task-Oriented Training in Spastic Cerebral Palsy

Across all three outcomes, task-oriented training produced approximately twice the baseline-normalized improvement observed with conventional physiotherapy: 18.0% versus 8.5% for GMFM-88, 31.8% versus 14.4% for Pediatric Balance Scale, and 14.0% versus 6.4% for WeeFIM. The largest incremental proportional benefit occurred in balance, with a 17.4-percentage-point advantage and the highest standardized effect (Hedges' g = 1.44), while GMFM-88 and WeeFIM showed advantages of 9.5 and 7.6 percentage points, respectively, with similarly large effects (g = 1.36 and 1.27). All outcome points lie well above the line of equal proportional gain, indicating a coherent cross-domain response rather than an isolated endpoint effect; however, the confidence intervals remain relatively wide, consistent with the small sample size and the resulting uncertainty around effect magnitude.

DISCUSSION

The present randomized controlled trial compared task-oriented training with conventional physiotherapy in children with spastic cerebral palsy and found larger short-term improvements in gross motor function, functional balance, and functional independence among children assigned to task-oriented training. The between-group difference in GMFM-88 change was 5.6 percentage points, while the corresponding differences were 5.3 points for the Pediatric Balance Scale and 5.7 points for the

WeeFIM. The standardized between-group effects were large across all three outcomes, indicating a consistent treatment-response pattern rather than an isolated improvement in one functional domain. When changes were considered relative to baseline values, task-oriented training produced approximately twice the proportional improvement observed with conventional physiotherapy across gross motor function, balance, and independence. These findings support the hypothesis that repetitive, goal-directed practice of meaningful functional tasks may enhance the immediate transfer of therapeutic gains to activities relevant to mobility and daily functioning (13)

The greater improvement in gross motor function observed after task-oriented training is clinically plausible because the intervention required repeated performance of activities closely related to the standing, transfer, walking, and mobility tasks represented within the GMFM-88. Functional rehabilitation programs that organize treatment around meaningful activity goals have previously produced improvements in motor performance among children with cerebral palsy. In a cluster-randomized trial, Law and colleagues showed that interventions directed toward child-level motor capacities and those focused on environmental context could both improve function, emphasizing that rehabilitation outcomes depend on the interaction between the child, the task, and the performance environment (13). Goal-directed therapy has similarly been associated with improvement in individualized functional performance when treatment activities are explicitly linked to meaningful objectives (14). The present findings extend this rationale by suggesting that a structured task-oriented program may produce greater short-term gross motor gains than a conventional program delivered with comparable therapist contact.

The observed effect on gross motor function may reflect the specificity, repetition, and progression embedded in the task-oriented intervention. Children practiced sit-to-stand transfers, multidirectional stepping, obstacle negotiation, changes in direction, stair activities, and walking under varying environmental demands. These activities required the simultaneous integration of strength, balance, selective motor control, coordination, and motor planning. An ecological approach to functional therapy proposes that movement should be practiced within the environmental and task conditions in which performance is expected to occur, rather than being addressed exclusively through isolated movement components (15). Repeated exposure to progressively demanding tasks may therefore have enabled participants to develop more efficient movement strategies and apply them across related gross motor activities. Nevertheless, the study did not directly measure motor-learning processes, movement quality, cortical adaptation, or task-transfer mechanisms, and these explanations should be regarded as plausible interpretations rather than demonstrated causal pathways.

The largest proportional response was observed for functional balance. Children receiving task-oriented training improved by 9.6 points on the Pediatric Balance Scale, compared with 4.3 points in the conventional physiotherapy group. This difference may be related to the dynamic postural demands of the intervention, which included reaching beyond the base of support, controlled weight shifting, directional stepping, turning, obstacle crossing, and walking over variable surfaces. Unlike static balance practice, these activities require continuous adjustment of the body's center of mass in response to changing task and environmental constraints. Exercise programs can improve physical capacity and mobility in children with cerebral palsy, although effects vary substantially according to training specificity, dosage, and outcome selection (16). The current results suggest that balance may respond particularly well when postural control is embedded within purposeful mobility tasks rather than trained as an isolated ability.

Conventional physiotherapy also produced statistically significant improvements in gross motor function, balance, and independence. This finding is consistent with evidence that strengthening, stretching, postural control, weight-bearing, and gait-related exercise can contribute to improved physical function in children with cerebral palsy. Progressive resistance exercise has demonstrated beneficial effects on muscle strength, although transfer to mobility outcomes is not always uniform (17).

Earlier systematic evidence has likewise shown that strength-training programs may improve force-generating capacity without consistently producing equivalent gains in functional activity (18). The improvement observed in the conventional group should therefore not be interpreted as evidence of an ineffective comparator. Rather, the between-group pattern suggests that adding greater task specificity, contextual relevance, repetition, and progression may enhance the functional impact of physiotherapy.

The improvement in WeeFIM scores indicates that the benefits of task-oriented training may have extended beyond standardized motor performance to the level of assistance required during daily activities. This is important because gains in physical capacity do not necessarily reduce caregiver support unless the child practices tasks that resemble real-life self-care and mobility demands. The task-oriented program included transfers, standing, walking, object carriage, and mobility activities relevant to home and school environments. Repeated practice of these activities may have improved the child's ability to initiate and complete functional tasks with less physical assistance. However, the WeeFIM total score includes cognitive as well as motor domains, and the present analysis did not separate domain-specific effects. The observed change should therefore be interpreted as an improvement in overall measured independence rather than as definitive evidence that all dimensions of daily functioning improved equally.

The pattern of benefit across GMFM-88, Pediatric Balance Scale, and WeeFIM is consistent with the International Classification of Functioning framework, in which changes in body functions, activity performance, and participation-related independence are conceptually connected but not interchangeable. The findings suggest that an intervention directed primarily at activity-level performance may influence several related functional domains. Nevertheless, participation in school, play, family life, and community activities was not directly measured. It cannot therefore be assumed that improvements observed under clinical testing conditions translated fully into broader participation or quality-of-life gains.

The magnitude of the reported between-group effects warrants careful interpretation. Large standardized effects were observed, but estimates derived from only 13 participants per group are inherently imprecise and may be vulnerable to sampling variation. Small trials can overestimate treatment effects, particularly when outcomes are numerous, intervention delivery is difficult to blind, and analyses are not adjusted for multiplicity. Although confidence intervals indicated a consistent direction of effect, the secondary outcomes should be regarded as supportive because a formal multiple-comparison adjustment was not applied. The clinical importance of the observed differences should also be evaluated against established minimal clinically important differences or minimal detectable change values for the relevant age groups, GMFCS levels, and outcome instruments. Statistical significance alone does not establish that every participant experienced a meaningful functional benefit.

Several methodological considerations may have influenced the findings. Blinding of participants and treating therapists was not feasible because the two physiotherapy programs were behaviorally distinct, creating a risk of performance effects related to expectation, engagement, or therapist enthusiasm. The task-oriented intervention may also have been more motivating because it incorporated functional play, environmental variation, and goal-directed activities. If outcome assessment was not fully blinded, knowledge of treatment assignment could additionally have influenced scoring of observational measures. Standardized instructions and scoring procedures reduce this risk but do not eliminate it.

The distinction between the two treatment arms also requires cautious interpretation because conventional physiotherapy included balance, gait, transitional movement, and strengthening activities that overlapped conceptually with components of task-oriented practice. The true treatment contrast was therefore not simply functional activity versus non-functional exercise. It more likely involved differences in the organization, repetition, contextual relevance, progression, and goal orientation of treatment. Detailed treatment-fidelity data would be necessary to determine whether the observed effects were attributable to task specificity itself, a greater number of active repetitions, reduced therapist assistance, more challenging environmental conditions, or other differences in delivery.

The study had several further limitations. The sample was small and recruited from a single clinical setting, which limits precision and generalizability to children with different ages, cerebral palsy distributions, functional severity, cognitive abilities, or access to rehabilitation. Only children within GMFCS levels I–III were represented, and the results should not be extrapolated to children with more severe mobility limitations. Outcomes were assessed immediately after treatment, so the persistence of improvement and the extent of skill retention remain unknown. No longer-term follow-up was available to determine whether gains were sustained, generalized to home or school, or influenced subsequent participation.

The analysis was also limited by the absence of sufficiently powered subgroup comparisons. Treatment response may vary according to GMFCS level, unilateral or bilateral involvement, baseline balance ability, age, previous physiotherapy exposure, or use of assistive devices. The trial was not large enough to estimate these interactions reliably. In addition, participation, health-related quality of life, caregiver burden, child satisfaction, and goal attainment were not measured. These outcomes would provide a broader understanding of whether statistically observed motor gains translate into changes that children and families consider meaningful.

The safety findings were reassuring, with no serious adverse events and only temporary mild muscle fatigue reported. However, the small sample and short intervention period limit the ability to detect uncommon adverse events. Future trials should use standardized adverse-event definitions, report events by participant and exposure time, and distinguish expected exertional fatigue from clinically relevant treatment-related harm. Monitoring of pain, falls, overuse symptoms, and treatment burden would be particularly important in studies using higher training intensities.

Future research should evaluate task-oriented training in larger, prospectively registered, multicentre trials with concealed allocation, blinded outcome assessment, treatment-fidelity monitoring, and a prespecified primary endpoint. Baseline-adjusted analyses should be accompanied by confidence intervals, standardized effects, and appropriate control of multiplicity. Longer follow-up is required to examine retention, transfer, and continued development after treatment completion. Studies should also compare different doses of task-oriented practice and determine whether combining it with progressive strengthening, caregiver-supported home practice, environmental modification, or technology-assisted rehabilitation produces additional benefit. Systematic reviews of physiotherapy interventions in children with cerebral palsy have emphasized the heterogeneity and variable methodological quality of the evidence base, reinforcing the need for adequately powered and transparently reported trials (19).

From a clinical perspective, the findings suggest that physiotherapy for ambulatory children with spastic cerebral palsy may be strengthened by incorporating repetitive, progressively challenging tasks that directly reflect each child's mobility and independence goals. Conventional approaches addressing flexibility, strength, alignment, and postural control remain relevant, particularly when impairments constrain safe task performance. The results therefore support an integrated rehabilitation model in which impairment-focused treatment is linked explicitly to meaningful task practice. Given the limited sample and immediate post-treatment assessment, this implication should be viewed as preliminary rather than as definitive evidence of long-term comparative superiority.

CONCLUSION

Task-oriented training produced greater immediate improvements than conventional physiotherapy in gross motor function, functional balance, and functional independence among children with spastic cerebral palsy. The consistent direction and large magnitude of the observed effects across GMFM-88, Pediatric Balance Scale, and WeeFIM outcomes suggest that repetitive, progressive, and goal-directed practice of meaningful activities may facilitate broader transfer of rehabilitation gains to functional performance. Conventional physiotherapy also produced measurable improvements, indicating that impairment-focused and general mobility interventions remain clinically relevant; however, integrating task-specific practice may enhance their functional impact. These findings should be interpreted cautiously because of the small single-centre sample, immediate post-intervention assessment, overlapping treatment components, and absence of long-term follow-up. Larger multicentre randomized trials with concealed allocation, blinded outcome assessment, prespecified primary outcomes, treatment-fidelity monitoring, and extended follow-up are required to confirm the clinical importance, durability, and generalizability of these effects.

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