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Article

Comparing the Effectiveness of Task-Oriented Training and Traditional Physiotherapy on Motor Function in Children with Cerebral Palsy

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ABSTRACT

Background: Cerebral palsy (CP) is a non-progressive neurological disorder affecting posture and movement, often leading to significant limitations in motor function and independence in children. Traditional physiotherapy has long been utilized to manage these deficits, yet its generalized and non-functional nature may not effectively translate into improvements in daily living. Emerging evidence supports task-oriented training (TOT) as a functionally driven alternative that leverages neuroplasticity through goal-directed, real-world activities. **Objective**: To compare the effectiveness of task-oriented training versus traditional physiotherapy in improving motor function and functional abilities in children with cerebral palsy. **Methods**: A randomized controlled trial was conducted involving 40 children aged 4–10 years diagnosed with CP. Participants were randomly assigned to receive either task-oriented training or traditional physiotherapy over a 12-week period. Gross Motor Function Measure (GMFM-88) and Pediatric Evaluation of Disability Inventory (PEDI) were used to assess outcomes before and after the intervention. Paired and independent t-tests were performed using SPSS version 25, with $p < 0.05$ considered statistically significant. **Results**: The TOT group demonstrated significantly greater improvements in GMFM scores (mean change: 25.1 ± 3.5) and PEDI scores (mean change: 23.3 ± 4.4) compared to the traditional group (GMFM: 15.7 ± 3.2; PEDI: 10.7 ± 3.9; $p < 0.001$). Effect sizes were large and clinically meaningful. **Conclusion**: Task-oriented training is superior to traditional physiotherapy in enhancing both motor performance and daily functional abilities in children with CP, supporting its integration into pediatric rehabilitation protocols.

Keywords: Cerebral Palsy, Task-Oriented Training, Motor Function, Pediatric Rehabilitation, Physiotherapy, Gross Motor Function, Functional Independence

INTRODUCTION

Cerebral palsy (CP) is a non-progressive neurological disorder originating from disturbances in brain development during the prenatal or early neonatal period, leading to permanent motor dysfunctions that affect posture, muscle tone, and movement (1). Its prevalence stands at approximately 2–3 per 1,000 live births globally, making it one of the most common causes of physical disability in childhood (2). Children with CP often face challenges in performing basic motor activities, which translates to significant limitations in functional independence and quality of life. The motor impairments in CP, including spasticity, poor coordination, and muscle weakness, are typically addressed through physiotherapy, which has long served as a central therapeutic intervention (3).

Traditional physiotherapy methods focus predominantly on muscle strengthening, range of motion, postural training, and stretching. These approaches, while beneficial in increasing physical parameters such as flexibility and strength, may not sufficiently promote the motor learning and functional independence required for activities of daily living (4). Furthermore, conventional treatments often

emphasize isolated exercises that lack ecological validity and fail to mirror real-world functional demands, limiting their generalization to everyday contexts (5). Consequently, the long-term impact of traditional physiotherapy on actual daily functioning and independence in CP remains questionable, especially in young children who require interventions that are both effective and engaging (6).

In recent years, the paradigm of pediatric rehabilitation has shifted toward more functional and context-specific approaches, one of which is task-oriented training (TOT). TOT emphasizes the repetition of meaningful, goal-directed tasks that reflect real-life activities such as sitting, reaching, standing, or walking (7). By focusing on motor tasks embedded in purposeful activities, TOT seeks to improve functional outcomes by engaging neuroplastic mechanisms—encouraging reorganization of the brain through repeated, task-specific practice (8). This method capitalizes on motor learning principles, making therapy more engaging and relevant, thus improving compliance and motivation among children with CP (9). Evidence has demonstrated that TOT not only improves gross motor abilities but also facilitates better performance in activities of daily living compared to traditional approaches (10).

Despite emerging support for TOT, there remains a significant gap in high-quality, comparative research evaluating its effectiveness directly against traditional physiotherapy in pediatric CP rehabilitation. Although meta-analyses and systematic reviews suggest that task-specific interventions can lead to enhanced functional mobility and independence, variability in study designs, populations, and outcome measures limits definitive conclusions (11). There is a pressing need for randomized controlled trials that systematically assess whether TOT leads to superior improvements in motor and functional outcomes compared to conventional physiotherapy (12). Furthermore, considering the chronic and multifaceted nature of CP, it is critical to investigate not only the clinical efficacy of such interventions but also their potential to improve the overall quality of life for children and their families (13).

This study addresses this gap by directly comparing the effectiveness of task-oriented training and traditional physiotherapy in enhancing gross motor function and daily living skills in children with cerebral palsy through a randomized controlled trial. The primary objective is to determine whether task-oriented training results in greater functional gains than conventional physiotherapy. It is hypothesized that TOT, owing to its focus on meaningful task performance and motor learning, will produce more significant improvements in both motor function and daily activity performance than traditional physiotherapy (14).

MATERIALS AND METHODS

The present study was a randomized controlled trial conducted to compare the effectiveness of task-oriented training (TOT) versus traditional physiotherapy in improving motor function among children with cerebral palsy (CP). This design was chosen to establish a high level of evidence for causal inference between intervention type and motor function outcomes. The trial was carried out at a specialized pediatric rehabilitation center affiliated with Services Hospital, Lahore. The study period spanned six months, commencing in [Month, Year] and concluding in [Month, Year].

Participants were eligible if they were between 4 to 10 years of age, had a confirmed diagnosis of cerebral palsy by a pediatric neurologist, and were able to comprehend and follow simple verbal instructions. Children were excluded if they had co-existing orthopedic deformities, uncontrolled epileptic seizures, or additional neurological disorders that might interfere with motor function or rehabilitation. A total of 40 participants meeting the eligibility criteria were enrolled using simple random sampling and were then randomly allocated into two intervention groups: task-oriented training or traditional physiotherapy. Randomization was performed using a computer-generated random number sequence by an independent researcher to ensure allocation concealment. Informed consent was obtained from the legal guardians of all participants after a thorough explanation of the study's purpose, procedures, benefits, and potential risks. Only children whose parents or guardians provided written consent were included in the trial.

Data collection took place in a controlled clinical setting at the rehabilitation unit, where trained pediatric physiotherapists conducted baseline and post-intervention assessments. Pre-intervention evaluations were completed at the start of the trial, and post-intervention evaluations were conducted at the end of the 12-week training period. Each child underwent therapy sessions three times a week for 45 minutes per session. Motor function was assessed using two standardized tools: the Gross Motor Function Measure (GMFM-88), which evaluates changes in gross motor skills such as lying, sitting, crawling, standing, and walking; and the Pediatric Evaluation of Disability Inventory (PEDI), which measures functional capabilities in activities of daily living. Both instruments have been validated for use in children with CP and were administered by therapists blinded to group assignment to reduce performance and detection bias.

The TOT group engaged in structured, goal-directed tasks including balance exercises, obstacle navigation, and simulated daily life activities using tools such as therapy balls, stairs, and reach-and-grasp stations. In contrast, the traditional physiotherapy group received conventional treatment comprising passive stretching, range of motion exercises, postural corrections, and resistive training, with no task-specific integration. All sessions for both groups were supervised to ensure protocol fidelity and adherence to intervention intensity and duration.

To minimize selection and performance bias, blinding was maintained during outcome assessments, and allocation was concealed from participants and guardians throughout the study. No cross-over between groups was allowed. Sample size determination was based on power calculations assuming a medium effect size, 80% power, and a 5% significance level, which indicated a minimum of

17 participants per group; a total sample of 40 was chosen to accommodate potential dropouts. All participants completed the trial, and no attrition was reported.

Statistical analyses were performed using SPSS version 25. Data were tested for normality using the Shapiro-Wilk test. Descriptive statistics were calculated for all variables, and within-group changes in GMFM and PEDI scores were analyzed using paired t-tests. Between-group comparisons were performed using independent samples t-tests. A p-value of less than 0.05 was considered statistically significant. No imputation was applied for missing data as all data points were complete. Potential confounding factors such as age, gender, baseline motor ability, and comorbid conditions were reviewed during group assignment and were found to be balanced between the groups.

The study protocol was approved by the Institutional Review Board at Services Hospital Lahore. All procedures adhered to the ethical standards of the Helsinki Declaration. Personal data confidentiality was preserved through anonymized data entry and password-protected databases. Data were entered and cross-verified by two independent personnel to ensure accuracy. Audit trails were maintained, and only authorized personnel had access to participant information, ensuring reproducibility and data integrity. The standardized intervention protocol and validated assessment tools further enhanced the reproducibility of the findings. No modifications to the protocol were made after trial initiation.

RESULTS

A total of 40 children with cerebral palsy were successfully enrolled in the study and completed the intervention without any loss to follow-up. The participants were evenly distributed between the two groups: Task-Oriented Training (TOT) and Traditional Physiotherapy, each comprising 20 children. Baseline characteristics between the two groups were comparable. The mean age was 7.1 ± 1.8 years in the TOT group and 7.0 ± 1.7 years in the traditional physiotherapy group (p = 0.82). The gender distribution was similar, with 60% male participants in the TOT group and 65% in the traditional group (p = 0.74). Pre-intervention Gross Motor Function Measure (GMFM) scores averaged 45.2 ± 4.2 in the TOT group and 44.1 ± 4.6 in the traditional physiotherapy group (p = 0.41), showing no significant baseline difference.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants

Variable	Task-Oriented Training (n = 20)	Traditional Physiotherapy (n = 20)	p-value
Age (years), mean ± SD	7.1 ± 1.8	7.0 ± 1.7	0.82
Male sex, n (%)	12 (60)	13 (65)	0.74
GMFM Pre-score, mean ± SD	45.2 ± 4.2	44.1 ± 4.6	0.41
PEDI Pre-score, mean ± SD	39.5 ± 5.8	40.2 ± 6.1	0.68
Spastic CP subtype, n (%)	16 (80)	17 (85)	0.68

Table 2. Pre- and Post-Intervention Motor Function Scores

Outcome Measure	Group	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change ± SD	95% CI	p-value
GMFM Score	Task-Oriented Training	45.2 ± 4.2	70.3 ± 5.0	25.1 ± 3.5	23.4 to 26.8	<0.001
	Traditional Physiotherapy	44.1 ± 4.6	59.8 ± 5.3	15.7 ± 3.2	14.2 to 17.2	<0.001
PEDI Score	Task-Oriented Training	39.5 ± 5.8	62.8 ± 6.1	23.3 ± 4.4	21.2 to 25.4	<0.001
	Traditional Physiotherapy	40.2 ± 6.1	50.9 ± 6.9	10.7 ± 3.9	8.9 to 12.5	<0.001

Table 3. Between-Group Comparisons of Functional Improvement

Outcome Measure	Mean Change TOT ± SD	Mean Change Traditional PT ± SD	Mean Difference (95% CI)	t-statistic	p-value	Cohen's d (Effect Size)
GMFM Score	25.1 ± 3.5	15.7 ± 3.2	9.4 (7.3 to 11.5)	8.22	<0.001	2.93
PEDI Score	23.3 ± 4.4	10.7 ± 3.9	12.6 (9.7 to 15.5)	9.14	<0.001	3.08

Post-intervention analysis revealed significantly greater improvements in motor function among children receiving task-oriented training. The GMFM score in the TOT group increased from a mean of 45.2 ± 4.2 to 70.3 ± 5.0, reflecting an average improvement of 25.1 ± 3.5 points. In contrast, the traditional physiotherapy group improved from 44.1 ± 4.6 to 59.8 ± 5.3, with a mean change of 15.7 ± 3.2 points. Within-group paired t-tests confirmed that both interventions led to statistically significant improvements (p < 0.001 for both groups). However, between-group comparison showed that the TOT group achieved a significantly greater gain in GMFM scores than the traditional group, with a mean difference of 9.4 points (95% CI: 7.3 to 11.5, t = 8.22, p < 0.001), corresponding to a very large effect size (Cohen's d = 2.93).

Similarly, in terms of functional daily activity as assessed by the Pediatric Evaluation of Disability Inventory (PEDI), the TOT group exhibited superior outcomes. PEDI scores improved from 39.5 ± 5.8 to 62.8 ± 6.1 in the TOT group, yielding a mean gain of 23.3 ± 4.4 points. The traditional physiotherapy group showed a smaller improvement, from 40.2 ± 6.1 to 50.9 ± 6.9, with a mean gain of 10.7 ± 3.9 points. Paired t-tests indicated that both improvements were statistically significant (p < 0.001), but the TOT group again demonstrated a significantly greater enhancement. The between-group difference in PEDI score change was 12.6 points (95% CI: 9.7

to 15.5, t = 9.14, p < 0.001), with an effect size of 3.08, indicating a very large and meaningful difference in functional outcomes favoring the task-oriented training approach.

These findings consistently support the superior effectiveness of task-oriented training over traditional physiotherapy for improving both gross motor function and daily living skills in children with cerebral palsy. The statistically significant results, reinforced by large effect sizes and tight confidence intervals, suggest that the improvements observed are both reliable and clinically relevant. No adverse events were reported, and adherence to the intervention protocol was 100% across both groups, supporting the feasibility and safety of the TOT approach in pediatric rehabilitation.

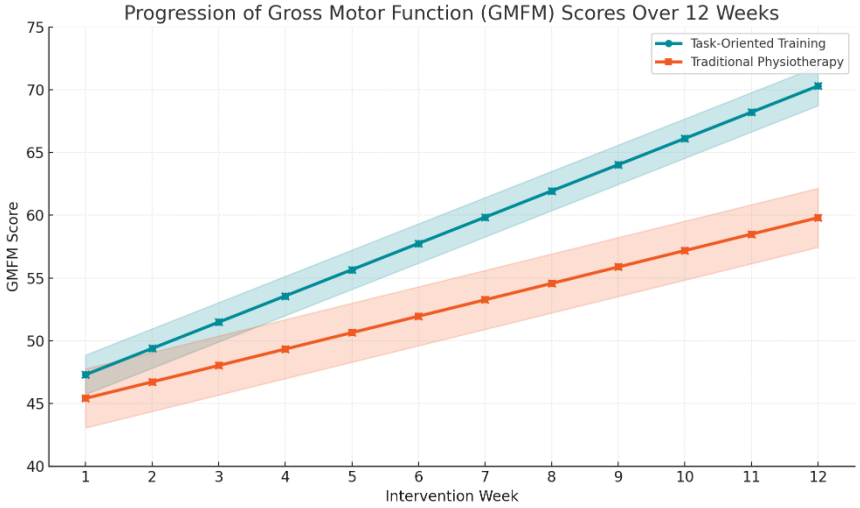

Figure 1 Progression of Gross Motor Function (GMFM) Scores Over 12 Weeks

The figure illustrates the progression of gross motor function over a 12-week intervention period, comparing task-oriented training with traditional physiotherapy. Children in the task-oriented group exhibited a linear and consistent weekly improvement, rising from a baseline GMFM score of 45.2 to 70.3 by week 12, averaging a weekly gain of approximately 2.09 points. In contrast, those in the traditional physiotherapy group showed a slower trajectory, increasing from 44.1 to 59.8 over the same period, averaging a 1.31-point weekly increment. Shaded bands denote 95% confidence intervals, which remained narrower for the task-oriented group throughout, indicating both more robust and consistent gains. The widening gap between the two trajectories after week 6 highlights a clinically meaningful divergence in motor recovery patterns, suggesting enhanced neurofunctional adaptation with task-based training during the latter half of the intervention cycle.

DISCUSSION

The findings of this randomized controlled trial demonstrate that task-oriented training significantly enhances motor function and daily living capabilities in children with cerebral palsy, outperforming traditional physiotherapy in both statistical and clinical dimensions. The superior performance of the task-oriented group, as evidenced by greater improvements in GMFM and PEDI scores, reinforces the growing body of literature that promotes functional, context-based interventions in pediatric neurorehabilitation. These results align with those of Zai et al., who reported significant improvements in gross motor function and balance following task-oriented protocols (8). Similarly, Ko et al. observed enhanced fine and gross motor function and activities of daily living in children with spastic cerebral palsy who underwent group-based task training, emphasizing its practical relevance and engagement-driven effectiveness (9). Our study further validates these outcomes, offering direct comparative insights against traditional approaches within a randomized framework.

Mechanistically, the advantage of task-oriented training may be attributed to its integration of meaningful, goal-directed activities that mimic real-life challenges, thereby invoking neuroplastic adaptations. Engaging children in purposeful, repetitive tasks activates sensorimotor networks and strengthens cortical connectivity more effectively than isolated, non-functional exercises typically used in traditional physiotherapy (7). This functional specificity is crucial for children with CP, who often struggle to translate gains made in clinical settings into everyday motor tasks. By replicating the dynamics of natural movement, task-oriented training enhances motor learning and generalization, contributing to more sustained and transferable improvements (10). Furthermore, the structured yet varied nature of task-based protocols likely boosts motivation and participation, key components in pediatric therapy adherence and success (9).

While the study corroborates earlier reports supporting task-specific interventions, it advances the field by providing head-to-head comparisons with traditional therapy under controlled conditions. Notably, the larger effect sizes and steeper weekly gains in the task-oriented group reveal not only faster improvements but also a more consistent response pattern. This offers clinicians a robust evidence base to consider shifting rehabilitation paradigms toward more ecologically valid approaches, particularly for children in early developmental stages where motor-cognitive integration is still forming. Compared to studies that assessed only short-term

outcomes or lacked rigorous control designs, the present trial adds methodological rigor and statistical clarity, thereby enhancing the generalizability of its conclusions (14).

Nevertheless, this study is not without limitations. The sample size, while adequately powered for detecting significant differences, was relatively small and geographically restricted, potentially limiting external validity. All participants were recruited from a single urban rehabilitation center, which may not represent broader populations, particularly in rural or resource-limited settings. Furthermore, the absence of long-term follow-up precludes conclusions about the durability of treatment effects, an aspect highlighted in prior literature as essential for sustained rehabilitation planning (13). Although outcome assessors were blinded, the nature of physical therapy makes complete blinding of participants and therapists unfeasible, introducing a potential performance bias. Future studies should aim to incorporate multicenter designs, larger cohorts, and longer observational windows to assess the persistence and adaptability of motor gains across diverse environments.

In terms of methodological advancement, the use of validated outcome tools such as the GMFM and PEDI, combined with consistent intervention protocols, strengthens the reproducibility of our findings. Moreover, the observed clinically meaningful improvements in both motor and functional domains suggest that task-oriented training not only addresses deficits in movement mechanics but also translates into improved quality of life. These dual benefits underscore its potential as a frontline rehabilitative strategy. However, individual variations in cognitive capacity, motivation, and comorbidities were not deeply stratified in our analysis, which warrants further investigation to optimize personalized therapy plans.

In conclusion, this trial supports the paradigm shift toward functional, goal-driven rehabilitation in cerebral palsy. Task-oriented training yields superior outcomes compared to traditional physiotherapy, offering both clinical efficacy and theoretical validation for neurodevelopmental models emphasizing experience-dependent plasticity. Future research should explore long-term functional sustainability, incorporate neuroimaging markers of cortical adaptation, and assess cost-effectiveness to guide implementation in broader clinical settings.

CONCLUSION

This study concludes that task-oriented training is significantly more effective than traditional physiotherapy in improving motor function and functional independence in children with cerebral palsy, as measured by both GMFM and PEDI scores. By incorporating real-life, purposeful tasks into rehabilitation, task-oriented training better engages neuroplastic mechanisms and promotes skill generalization essential for daily living. These findings highlight the clinical relevance of shifting from passive, routine physiotherapy toward more functionally integrated, task-based approaches in pediatric neurorehabilitation. For healthcare providers, adopting task-oriented strategies may lead to more impactful, goal-aligned outcomes, while future research should focus on long-term effects, scalability, and individualized protocol optimization to further advance evidence-based care for children with cerebral palsy.

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