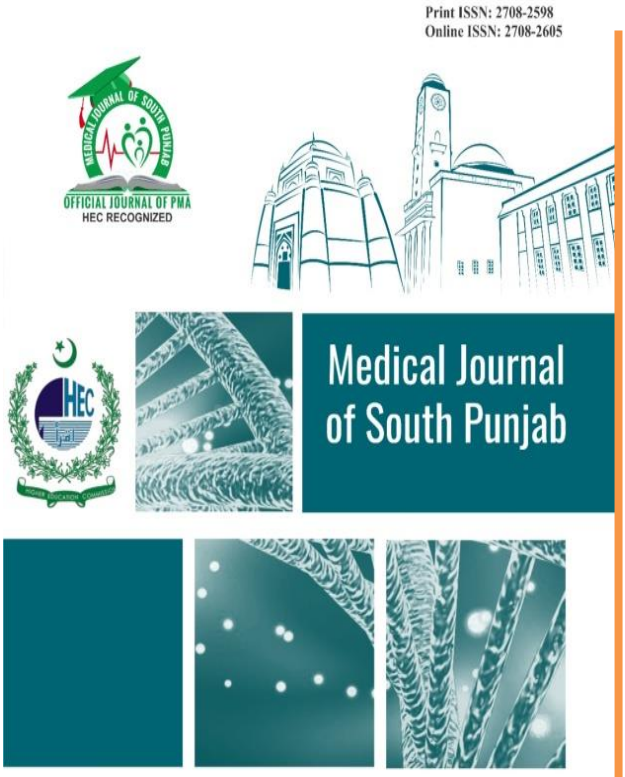
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Comparison between effects of core stability training and task-oriented motor training on postural control and gross motor function in children with spastic cerebral palsy

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Original Article

Comparison between effects of core stability training and task-oriented motor training on postural control and gross motor function in children with spastic cerebral palsy

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ABSTRACT

Objective: To compare the effects of core stability training and task-oriented motor training on postural control and gross motor function in children with spastic cerebral palsy.

Methodology: A randomized controlled trial was conducted at PSSHMC Hospital, Muzaffargarh, over four months. Sixty children aged 6–9 years with spastic cerebral palsy and Gross Motor Function Classification System (GMFCS) Level II was randomly allocated into two groups of 30 participants. Group A received core stability training, while Group B received task-oriented motor training. Both interventions were delivered for 40–45 minutes per session, three times weekly, for six weeks. Postural control and gross motor function were assessed before and after intervention using the Trunk Control Measurement Scale (TCMS) and Gross Motor Function Measure-88 (GMFM-88), respectively. Data were analysed using Wilcoxon signed-rank and Mann–Whitney U tests, with statistical significance set at $p<0.05$.

Findings: Both groups demonstrated statistically significant pre- to post-intervention changes in the assessed outcomes ($p<0.05$). Baseline comparisons showed no significant differences between groups in TCMS ($p=0.79$) or GMFM-88 scores ($p=1.00$). Post-intervention comparisons indicated significant between-group differences in TCMS ($p=0.002$) and GMFM-88 ($p<0.001$), with higher mean ranks reported for Group B on both outcomes.

Conclusion: Both core stability and task-oriented motor training were associated with significant changes in postural control and gross motor function among children with spastic cerebral palsy. Significant post-intervention differences were also observed between the groups. However, the direction and clinical magnitude of the comparative effects require confirmation through verification of the outcome-score coding and descriptive statistics.

Keywords: Cerebral palsy, Core stability training, Gross motor functions, Postural control, Task-oriented motor training

1. INTRODUCTION

Cerebral palsy (CP) is one of the leading causes of physical disability during childhood and results from a non-progressive disturbance in the developing fetal or infant brain. Although the underlying neurological injury does not progressively worsen, its effects on muscle tone, posture, coordination and movement can substantially restrict children's functional independence[1]. Children with CP frequently experience difficulties with sitting, standing, walking and performing everyday activities. Spastic cerebral palsy represents the most common clinical subtype and is characterized by increased muscle tone, exaggerated reflexes and impaired voluntary movement. These abnormalities frequently contribute to muscle weakness, postural instability and restricted mobility[2]. The resulting functional limitations can affect children's participation in education, social activities and daily living. Therefore, appropriate physiotherapy interventions are essential for improving motor performance, preventing secondary complications and promoting functional independence among affected children[3].

Physiotherapy management has increasingly incorporated motor learning and neuroplasticity principles, emphasizing repetitive practice, meaningful movement experiences and task-specific activities. Core stability training focuses on strengthening the trunk muscles and improving proximal stability, which provides an essential foundation for maintaining posture and controlling limb movements. Previous research demonstrated that Swiss ball stabilization exercises improved trunk control, balance and gross motor performance in children with spastic CP[4]. Similarly, studies investigating trunk stabilization reported improvements in postural control and functional motor abilities[5, 6]. A study also identified beneficial effects of task-specific training on balance and functional performance among children with CP[7]. Task-oriented training emphasizes repeated practice of meaningful functional activities, including reaching, weight shifting, sit-to-stand movements, stepping and walking. Evidence from clinical research indicated that task-specific interventions improved functional mobility and gross motor performance[8, 9]. Furthermore, recent research supported the contribution of trunk-focused interventions to balance and gross motor function in children with CP[10]. Despite these findings, the comparative effectiveness of core stability training and task-oriented motor training remained insufficiently established, particularly within the local rehabilitation context.

The present study was conducted to compare the effects of core stability training and task-oriented motor training on postural control and gross motor function in children with spastic cerebral palsy. The specific objectives were to evaluate changes in postural control and assess changes in gross motor function following both interventions. The study also examined whether significant differences existed between the two treatment groups after six weeks of intervention. It was hypothesized that a significant difference would exist between core stability training and task-oriented motor training in improving postural control and gross motor function among children with spastic CP.

2. METHODOLOGY

A randomized controlled trial (RCT) was conducted. The study was conducted at Punjab Social Security Health Management Company (PSSHMC) Hospital, Muzaffargarh, Pakistan. The study was completed over four months following approval of the research synopsis.

A total of 60 children with spastic cerebral palsy were recruited using simple random sampling. The sample size was calculated using G*Power software.

Participants were divided equally into two groups, with 30 children in each group. Group A received core stability training, whereas Group B received task-oriented motor training.

Children aged 6–9 years with a diagnosis of spastic cerebral palsy and classified at Level II of the Gross Motor Function Classification System (GMFCS) were included. Participants were required to follow simple verbal instructions and participate in physiotherapy sessions. Children with ataxic, dyskinetic or mixed CP, recent orthopaedic surgery or selective dorsal rhizotomy within the previous six months were excluded. Children with severe visual, hearing or cognitive impairments and other neurological or musculoskeletal conditions affecting motor performance were also excluded.

Demographic information, including age and gender, was collected using a structured questionnaire. Postural control was assessed using the Trunk Control Measurement Scale (TCMS), which evaluated static sitting balance, selective trunk movement and dynamic reaching. Gross motor function was assessed using the Gross Motor Function Measure (GMFM-88), specifically Dimensions D (standing) and E (walking, running and jumping). The GMFM-88 assessed functional motor performance through an ordinal scoring system ranging from 0 to 3, with higher scores indicating better performance[11, 12]

Baseline assessments were performed before the commencement of treatment. Group A received core stability exercises, including pelvic tilts, bridging, modified curl-ups, quadruped arm and leg raises, trunk rotations and sitting balance exercises on a therapy ball. These exercises targeted trunk muscle activation, postural stability and controlled movement. Group B received task-oriented motor training consisting of reaching activities in sitting and standing, weight shifting, stepping, sit-to-stand practice, supervised walking, obstacle negotiation and stair stepping when appropriate. Both groups received supervised physiotherapy sessions lasting approximately 40–45 minutes, three times weekly, for six weeks. Each session included warm-up, therapeutic exercises and cool-down activities. Post-intervention assessments were performed using the same outcome measures to determine changes following treatment.

Data were analyzed using SPSS version 27. Descriptive statistics, including frequencies, percentages, means and standard deviations, were calculated to summarize demographic characteristics. Data normality was assessed using the Kolmogorov–Smirnov test and Q-Q plots. As the outcome variables did not follow a normal distribution, non-parametric tests were applied. The Wilcoxon signed-rank test was used to compare pre- and post-intervention scores within each group, while the Mann–Whitney U test was used for between-group comparisons. A p-value of less than 0.05 was considered statistically significant[13].

3. RESULTS

A total of 60 children participated in the study, with 30 assigned to Group A (core stability training) and 30 to Group B (task-oriented motor training). The Kolmogorov–Smirnov test indicated that post-intervention TCMS ($D = 0.478$, $p < 0.001$) and GMFM scores ($D = 0.313$, $p < 0.001$) significantly deviated from normality. The Q-Q plots also demonstrated deviations from the reference line, supporting the use of non-parametric statistical tests.

The mean age was 7.53 ± 1.17 years in Group A and 7.23 ± 1.25 years in Group B. Both groups included children aged 6–9 years. Group A consisted of 14 boys (46.7%) and 16 girls (53.3%), whereas Group B included 16 boys (53.3%) and 14 girls (46.7%). Overall, the groups demonstrated relatively comparable age and gender distributions.

The Wilcoxon signed-rank test demonstrated statistically significant differences between pre- and post-intervention scores in all assessed variables in Group A (Core Stability Training). For standing, the median score increased from 5.25 to 6.50 ($p < 0.001$), indicating improvement following the intervention. In walking, running, and jumping, the median score decreased from 13.00 to 12.50 ($p < 0.001$). Static sitting balance maintained a median score of 2.00 at both assessments ($p < 0.001$), while dynamic sitting balance increased from 6.00 to 7.00 ($p < 0.001$). Dynamic reaching also showed an increase in median scores from 1.25 to 2.00 ($p < 0.001$).

Table 1: Within Group Analysis of Group A

Group A					
			Median (IQR) Pre	**Median (IQR) Post**	**P-value**
Standing	Post vs. Pre	Negative Ranks	5.250	6.5	<0.001
		Positive Ranks			
Walking Running Jumping	Post vs. Pre	Negative Ranks	13.00	12.5	<0.001
		Positive Ranks			
Static Setting Balance	Post vs. Pre	Negative Ranks	2.00	2.00	<0.001
		Positive Ranks			
Dynamic Setting Balance	Post vs. Pre	Negative Ranks	6.00	7.00	<0.001
		Positive Ranks			
Dynamic Reaching	Post vs. Pre	Negative Ranks	1.25	2.00	<0.001
		Positive Ranks			
TCMS Score	Post vs. Pre	Negative Ranks	1.00	1.00	<0.001
		Positive Ranks			
GMFM score	Post vs. Pre	Negative Ranks	1.00	0.00	0.008
		Positive Ranks			

Regarding the outcome measures, the median TCMS score remained at 1.00 before and after the intervention, although the difference was statistically significant ($p < 0.001$). Similarly, the GMFM median score decreased from 1.00 to 0.00, with a statistically significant difference ($p = 0.008$). Overall, statistically significant pre- and post-intervention differences were observed across all assessed variables in Group A.

The Wilcoxon signed-rank test revealed statistically significant differences between pre- and post-intervention scores across all assessed variables in Group B (Task-Oriented Training). For standing, the median score remained unchanged at 5.25 ($p < 0.001$).

Table 2: Within Group Analysis of Group B

Group B					
			Median (IQR) Pre	**Median (IQR) Post**	**P-value**
Standing	Post vs. Pre	Negative Ranks	5.25	5.25	<0.001
		Positive Ranks			
Walking Running Jumping	Post vs. Pre	Negative Ranks	7.50	8.25	<0.001
		Positive Ranks			
Static Setting Balance	Post vs. Pre	Negative Ranks	3.00	2.25	<0.001
		Positive Ranks			
Dynamic Setting Balance	Post vs. Pre	Negative Ranks	3.25	5.25	<0.001
		Positive Ranks			
Dynamic Reaching	Post vs. Pre	Negative Ranks	1.25	2.00	<0.001
		Positive Ranks			
TCMS Score	Post vs. Pre	Negative Ranks	1.00	1.00	<0.001
		Positive Ranks			
GMFM score	Post vs.	Negative Ranks	1.00	1.00	<0.001

	Pre	Positive Ranks			

Walking, running, and jumping showed an increase in median scores from 7.50 to 8.25 ($p < 0.001$). Static sitting balance decreased from 3.00 to 2.25 ($p < 0.001$), whereas dynamic sitting balance increased from 3.25 to 5.25 ($p < 0.001$). Dynamic reaching also increased from 1.25 to 2.00 ($p < 0.001$). For the main outcome measures, the median TCMS score remained at 1.00 before and after the intervention ($p < 0.001$). Similarly, the GMFM median score remained unchanged at 1.00 ($p < 0.001$). All assessed variables demonstrated statistically significant pre- and post-intervention differences in Group B.

Table 3: Between Group Analysis Group A and B (Pre Intervention)

Pre intervention					
Treatment Group		**N**	**Mean Rank**	**Median (IQR)**	**p- value**
Pre TCMS Score	**Core Stability Training**	30	30.00	1.00	0.79
	Task Oriented Training	30	31.00	1.00	
Pre GMFM score	**Core Stability Training**	30	30.50	1.00	1.00
	Task Oriented Training	30	30.50	1.00	

The Mann–Whitney U test was used to compare baseline TCMS and GMFM scores between the two treatment groups. The results showed no statistically significant difference in pre-intervention TCMS scores between Group A (mean rank = 30.00) and Group B (mean rank = 31.00), with a p-value of 0.79. Similarly, no statistically significant difference was found in baseline GMFM scores, as both groups had an equal mean rank of 30.50 ($p = 1.00$). These findings indicated that the groups had comparable baseline scores before the interventions.

Table 4: Between Group Analysis Group A and B (Post Intervention)

Post intervention					
Post TCMS Score	**Core Stability Training**	30	24.40	1.00	0.002426
	Task Oriented Training	30	36.60	0.00	
Post GMFM score	**Core Stability Training**	30	22.87	1.00	0.00
	Task Oriented Training	30	38.13	1.00	

The Mann–Whitney U test demonstrated statistically significant differences between the two groups in post-intervention TCMS and GMFM scores. For TCMS, Group A had a mean rank of 24.40, compared with 36.60 in Group B, with a statistically significant difference ($p = 0.002$). Similarly, for GMFM, Group A had a mean rank of 22.87, whereas Group B had a higher mean rank of 38.13 ($p < 0.001$). These findings indicated statistically significant differences in post-intervention outcome scores between the two treatment groups, with Group B demonstrating higher mean ranks for both outcome measures.

4. DISCUSSION

The present study compared the effectiveness of core stability training and task-oriented motor training in improving postural control and gross motor function among children with spastic cerebral palsy. The findings demonstrated statistically significant pre- and post-intervention differences within both groups. However, significant between-group differences were also identified after six weeks, with Group B demonstrating higher mean ranks for both TCMS and GMFM outcomes. These findings suggested that task-oriented motor training produced more favorable post-intervention rank distributions than core stability training in the present sample.

The improvements observed following core stability training were consistent with the findings of Dehkordi et al., who reported significant improvements in trunk control, balance and gross motor

performance following Swiss ball stabilization training in children with spastic CP[4]. Their findings supported the importance of strengthening trunk musculature to improve postural stability. Similarly, Tiwari et al. reported significant relationships between trunk control and balance in children with bilateral spastic cerebral palsy, highlighting the functional importance of proximal stability[5]. These findings provided a clinical explanation for the changes observed in the core stability group. Exercises such as bridging, pelvic tilting and quadruped movements encouraged controlled trunk activation and postural adjustments, which were important for maintaining balance during functional activities.

The findings also supported previous evidence regarding the effectiveness of task-oriented motor training. Karnadipa et al. identified beneficial effects of task-specific training on balance performance in children with CP[7]. Repeated practice of functional movements allowed children to develop movement strategies through activity-specific experience. Similarly, Srabone reported improvements in gross motor function following task-oriented exercises in children with spastic cerebral palsy[8]. Roy et al. also reported positive effects of task-oriented learning on functional mobility and balance among children with CP[9]. These findings were consistent with the favorable post-intervention mean ranks observed in Group B in the present study.

An important aspect of the present findings was the difference between the two intervention approaches. Core stability training primarily targeted trunk muscle activation and proximal postural control, whereas task-oriented training incorporated functional activities that required coordinated movement, balance adjustments and practical motor performance. Activities such as sit-to-stand practice, stepping, walking and obstacle negotiation directly addressed movements required in everyday life. This functional specificity may have contributed to the higher post-intervention mean ranks observed in Group B. The findings were also supported by Li et al., who emphasized the role of task-oriented practice in improving motor performance through repeated, goal-directed activities, although their research involved stroke patients rather than children with CP[14].

The importance of movement repetition and experience-dependent neural adaptation also provided a possible explanation for the observed outcomes. Kachmar et al. described neuroplasticity as an important mechanism underlying rehabilitation in children with cerebral palsy[15]. Repeated functional practice may support the development of more effective motor strategies, particularly when activities involve meaningful movement and active participation. Kurz et al. also demonstrated motor-practice-related changes in sensorimotor cortical activity among young people with CP[16]. Therefore, the functional activities included in task-oriented training may have provided opportunities for practicing coordinated movements directly relevant to daily mobility.

Previous research on trunk-focused rehabilitation also supported the clinical relevance of both interventions. Lim et al. reported beneficial effects of trunk interventions on gross motor function and balance in children with CP[17, 18, 19]. Similarly, Mohamed et al. found improvements in standing ability and functional motor performance following core stability training[20]. These findings indicated that core stability exercises remained valuable components of physiotherapy rehabilitation. However, the present comparison suggested that interventions involving direct practice of functional activities may have offered additional benefits for the measured outcomes.

The findings had practical implications for physiotherapy services, particularly in settings where children with spastic CP required improvements in standing, walking and functional independence. Task-oriented

activities could be incorporated into rehabilitation programmes to provide opportunities for practicing movements required in everyday environments. Nevertheless, core stability exercises could also be included as complementary interventions to address trunk weakness and postural instability. An individualized rehabilitation programme that considered children's functional abilities and treatment needs would therefore remain important.

This study had several limitations. First, the sample included only 60 children from a single hospital, which limited the generalizability of the findings. Second, the intervention period was restricted to six weeks, and long-term maintenance of treatment effects was not assessed. Third, the study included only children aged 6–9 years classified at GMFCS Level II, limiting applicability to children with other functional levels and age groups. Fourth, the study assessed postural control and selected GMFM dimensions but did not investigate other aspects of daily living, participation or quality of life. Finally, the study did not include follow-up assessments to determine whether the observed changes were maintained after treatment completion.

5. CONCLUSION

Both core stability training and task-oriented motor training demonstrated statistically significant pre- and post-intervention differences in children with spastic cerebral palsy. However, task-oriented motor training demonstrated higher post-intervention mean ranks for TCMS and GMFM outcomes, suggesting more better functional outcomes.

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