

Title: Effectiveness of Motor Learning Interventions for lower limbs on walking performance, activity levels, participation and quality of life in ambulant children with cerebral palsy: A Systematic Review.

Introduction: Cerebral Palsy (CP) causes impaired gait that can impact on physical activity and participation(1). Interventions to improve walking typically target the body structure, such as muscle strength, rather than the motor skill of walking and studies that target walking use treadmills or robots to increase repetition but don't commonly include other motor learning principles (2). Motor learning theory (MLT) provides a framework for improving motor skills(3). MLT Interventions are shown to improve upper limb function in children with CP and are widely used(4). Interventions that target motor learning for lower limbs could potentially improve walking in children with CP.

Methods: Cochrane CENTRAL, PubMed, CINAHL, PEDro and Embase were searched up until October 2025. Randomized controlled trials (RCTs) comparing lower limb MLT interventions to other interventions, which measured a walking outcome in ambulant children with CP, were included. Screening and data extraction were completed by two reviewers using Covidence.org. Methodological quality was assessed using the Cochrane Risk of Bias Tool (Version2).

Results: From 3061 references identified, 24 RCTs were included, providing data for 788 participants in 16 countries with sample sizes ranging from 10 to 78. MLT-based interventions included a variety of approaches including; task-oriented training, motor learning coaching, action-observation training and motor imagery and adjuncts such as treadmills and Nintendo Wii. Methodological quality was poor with a high risk of bias in 74.5% of 51 outcomes assessed and none achieving a low risk of bias rating.

Conclusion: Conclusions on effectiveness cannot be drawn due to poor methodological quality. However, the wide variety of interventions explored using different MLT strategies can inform future higher quality RCTs that could combine the strategies for a more targeted MLT intervention.

1. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. *Developmental medicine and child neurology*. 2007;49(109):8-14.
2. Novak I, Morgan C, Fahey M, Finch-Edmondson M, Galea C, Hines A, et al. State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children with Cerebral Palsy. *Current neurology and neuroscience reports*. 2020;20(2):3.
3. Kafri M, Atun-Einy O. From Motor Learning Theory to Practice: A Scoping Review of Conceptual Frameworks for Applying Knowledge in Motor Learning to Physical Therapist Practice. *Physical therapy*. 2019;99(12):1628-43.
4. Taghizadeh A, Webster KE, Bhopti A, Hoare B. Development and content validation of the Upper Limb-Motor Learning Strategy Tool for cerebral palsy. *Disability and Rehabilitation*. 2024:1-9.