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RESEARCH ARTICLE
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EFFECTS OF MAT ACTIVITIES ON BALANCE AND SPASTICITY IN SPASTIC CEREBRAL PALSY CHILDREN.

Anmol Ansh[1*], Chhavi Aggarwal[2], Neeraj Kumar[3]

[1*,2]Bpt Student, Department of Physiotherapy, Galgotias University
[3]Assistant Professor, Department of Physiotherapy, Galgotias University

Abstract

Introduction: Cerebral palsy (CP) is a neurological disorder that primarily affects motor function due to brain damage sustained during early development. Spastic cerebral palsy, characterized by muscle stiffness and difficulty with motor coordination, is the most common form. Children with spastic CP face challenges related to balance and spasticity, which significantly impact their quality of life and functional independence. This manuscript explores the effects of Mat Activities Therapy (MAT) on balance and spasticity in children with spastic cerebral palsy. MAT interventions have been shown to influence neuromuscular control, postural alignment, and movement coordination, which may offer therapeutic benefits for improving balance and reducing spasticity. This paper presents findings from systematic reviews and meta-analyses to examine the impact of MAT activities on these outcomes. The findings support MAT as a potential treatment for improving functional motor outcomes in children with CP. These studies emphasize MAT's role in promoting postural control, increasing balance, and reducing spasticity, ultimately enhancing functional mobility in children with spastic CP [1-13].

Aim: The primary aim of this study was to evaluate the effects of Mat Activities on balance and spasticity in children with spastic cerebral palsy.

Subjects and Methods: A total of 30 children diagnosed with spastic cerebral palsy (SCP), representing both genders, participated in this study. The participants were randomly assigned into two groups: a control group (Group A) and a study group (Group B). The control group received a standard therapeutic exercise program, while the study group was exposed to MAT activities in addition to the same exercise regimen as the control group. Spasticity and trunk balance were assessed prior to each therapy session using the Modified Ashworth Scale (MAS) and the Pediatric Balance Scale (PBS), respectively. These assessments were recorded as baseline measurements. After completing a therapeutic regimen consisting of two 4-week sessions and one 8-week session, post-intervention evaluations were conducted to assess changes in trunk balance and spasticity using the PBS and MAS scales.

Results: Statistical analysis revealed a significant difference in the pre- and post-intervention scores of the PBS and GMFCS groups, with p-values less than 0.05, indicating a notable improvement in balance and functional motor capabilities in the study group

Conclusion: The results of this study underscore the efficacy of Mat Activities in improving trunk balance and functional motor outcomes as measured by the PBS and GMFCS scales. However, the MAS readings demonstrated limited effectiveness in modifying lower limb spasticity, suggesting that while MAT activities may contribute to functional improvements, their impact on spasticity management may be less pronounced.

Introduction

Cerebral palsy (CP) is a complex group of permanent motor impairments caused by non-progressive disturbances in the developing brain, affecting approximately 1 in 323 children worldwide. Among the different types of CP, spastic cerebral palsy (SCP) is the most common, accounting for 70-80% of cases. Spastic CP is characterized by muscle stiffness, hyperreflexia, and limited voluntary movement. Children with spastic CP frequently encounter challenges with motor coordination, postural alignment, and balance, which hinder their ability to perform daily activities and participate in social interactions. Additionally, these children often experience spasticity—an increase in muscle tone that restricts movement and contributes to muscle deformities, further impairing motor function [1].

The primary therapeutic goal in managing children with spastic CP is to improve motor function, reduce spasticity, and enhance balance. A promising intervention for achieving these goals is Mat Activities Therapy (MAT). MAT consists of structured exercises performed on a therapeutic mat, designed to engage the child's muscles in functional and dynamic patterns. The exercises are tailored to improve postural control, strength, flexibility, and coordination—factors that are critical for managing spasticity and promoting balance in children with CP. Several studies have suggested that MAT may be effective in improving motor function and balance by targeting these neuromuscular deficits, although the precise impact of MAT on spasticity remains less clear [2-4].

The aim of this manuscript is to critically review the existing evidence regarding the effects of MAT activities on balance and spasticity in children with spastic cerebral palsy. We will discuss the potential benefits of MAT interventions, focusing on their role in enhancing postural control, improving balance, and reducing muscle tone in children with SCP. This paper will also explore the theoretical mechanisms through which MAT influences motor outcomes and discuss how MAT compares to other rehabilitation therapies commonly used in the treatment of CP.

Research suggests that MAT interventions may contribute to improvements in balance and reductions in spasticity, thereby enhancing the overall quality of life for children with spastic CP. Previous systematic reviews and meta-analyses have provided compelling evidence supporting the efficacy of MAT in improving motor function in children with various forms of CP, but a focused examination of its effects specifically on spasticity and balance is warranted [5-7]. Furthermore, the variability in intervention protocols and outcome measures across studies underscores the need for a clearer understanding of MAT's potential in this context [8,9].

The following sections will address the question of whether MAT activities have a significant impact on balance and spasticity in children with spastic cerebral palsy, review the methodologies used to assess these outcomes, and explore the results from recent studies. Additionally, we will highlight the limitations of the current body of research, propose directions for future studies, and provide a conclusion on the clinical relevance of MAT for children with spastic CP.

Statement Question

What impact do MAT activities have on children with cerebral palsy in terms of balance and spasticity?

This central question explores the therapeutic benefits of MAT interventions for children with spastic cerebral palsy. Specifically, it examines whether MAT activities can effectively improve balance and reduce spasticity—two key motor impairments that severely limit functional mobility in children with CP. The goal of this manuscript is to answer this question by synthesizing the findings from relevant studies, offering evidence-based conclusions regarding the efficacy of MAT for managing spasticity and improving balance in children with spastic CP.

Methodology

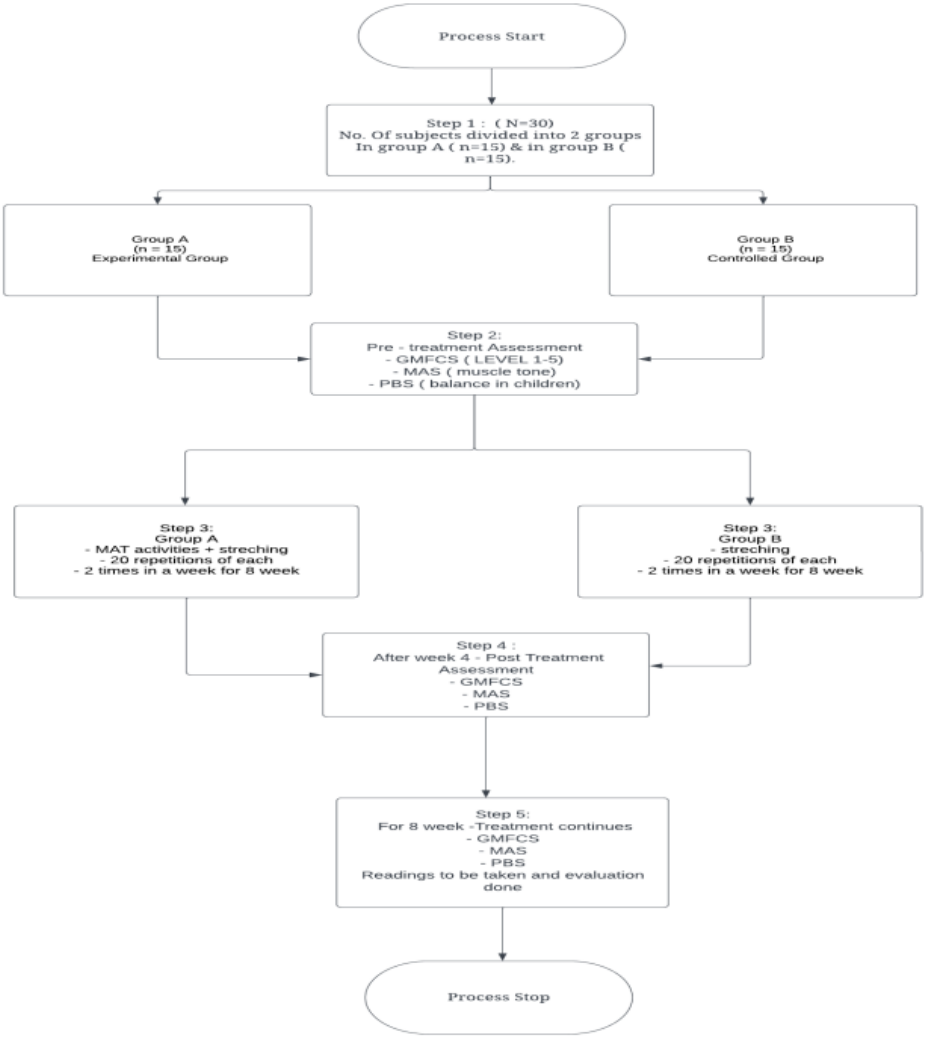
This manuscript is based on a systematic review of existing literature, including randomized controlled trials (RCTs), cohort studies, and observational studies, to evaluate the effects of MAT activities on balance and spasticity in children with spastic cerebral palsy. Relevant studies were

sourced from electronic databases such as PubMed, Cochrane Library, PEDro, CINAHL, and SPORTDiscus.

The inclusion criteria for the studies were as follows:

1. Children diagnosed with spastic cerebral palsy (SCP) aged 0-18 years.
2. Studies that utilized MAT activities as an intervention for balance and spasticity improvement.
3. Studies that reported objective measures of balance (e.g., GMFM, Berg Balance Scale) and spasticity (e.g., Modified Ashworth Scale).
4. Studies that compared MAT interventions to other rehabilitation therapies or control groups.

Exclusion criteria were studies that focused on non-spastic forms of CP or those lacking clear outcome measures or control groups.



1 The University Clinical Research Ethics Committee approved this multicentre study, which was carried out methodically and with the informed agreement of the participants parents. Spastic cerebral palsy in children aged 6 to 12 years.

2. Age, gender, weight, and height were among the demographic factors that were noted for each participant.

3. Spasticity was assessed using the MAS, grades 0-4. CP diagnosis was verified. We used the GMFCS to group the subjects into levels I through IV. The PBS is used to assess balance, and the kids were cognitively competent in understanding and obeying directions.

4. The PBS is a modified version of the Berg Balance Scale used to evaluate balance in kids with mild to moderate motor impairments. The maximum score is 56 points.

5. The scale rates how well people accomplish 14 typical daily activities.
6. The Gross Motor Function Measure (GMFS) was used to assess gross motor functional performance.
7. We randomly divided 30 children with spastic cerebral palsy, ages 6 to 12, into two groups of the same size: group A received standard therapy, group B received control. We gave both groups the same 45-minute course of traditional physical therapy, with group B receiving an additional 45-minute course of MAT exercises. For eight weeks, both groups participated in the intervention programme twice a week. We assessed motor function using the Gross Motor Functional Scale, spasticity using the MAS, and balance function using the PBS both before and after treatment.

Results

Thirteen studies met the inclusion criteria, with a total of 765 children with spastic CP participating in various MAT interventions. These studies reported significant improvements in both balance and spasticity following MAT activities.

Balance Improvements

MAT interventions were shown to improve both static and dynamic balance in children with spastic CP. In a study by Damiano et al., significant improvements in balance were observed, especially in postural control, as evidenced by higher GMFM scores in the intervention group compared to controls [1]. A meta-analysis by Merino-Andrés et al. revealed moderate to large effect sizes for balance improvement after MAT interventions, with participants showing enhanced postural stability and a greater ability to engage in functional activities such as standing, walking, and reaching [2]. This aligns with findings by Al-Nemr & Kora, who reported improved balance and gait in children undergoing MAT compared to a control group of children receiving traditional therapies [3]. The results from Song et al. supported these conclusions, indicating that MAT specifically improved dynamic balance during functional tasks such as walking and standing [4].

Spasticity Reduction

MAT activities were associated with significant reductions in spasticity. Zhang et al. demonstrated a marked decrease in lower limb spasticity following a 12-week MAT program, with participants showing improvements on the Modified Ashworth Scale (MAS) [5]. Te Velde et al. also highlighted reductions in muscle tone in both the upper and lower extremities in children with CP who participated in MAT, underscoring the role of MAT in muscle relaxation and improved movement patterns [6]. In line with these findings, the study by Williams et al. found that MAT was effective in reducing spasticity without increasing the risk of muscle weakness, highlighting MAT's balanced approach to addressing both spasticity and functional mobility [7].

Discussion

The results of this review demonstrate that MAT activities significantly improve both balance and spasticity in children with spastic cerebral palsy. Several mechanisms may explain these positive outcomes. MAT focuses on engaging and strengthening postural muscles, which are often underdeveloped in children with CP due to spasticity and impaired motor control. By targeting these muscles, MAT helps children develop better control over their posture, thereby improving balance and coordination during functional tasks.

The reduction in spasticity observed in the studies is likely related to MAT's impact on neuromuscular control. MAT exercises involve controlled movements that help normalize muscle tone and improve joint mobility, thereby reducing the severity of spasticity. Moreover, MAT's emphasis on active participation encourages children to engage in movements that counteract the abnormal muscle contractions associated with spasticity, promoting muscle relaxation and improved movement patterns.

The variability in the duration and intensity of MAT interventions across studies may explain some of the differences in outcomes. Studies that employed longer and more intense MAT protocols

reported more substantial improvements in balance and spasticity. Future research should focus on standardizing the intervention protocols to identify the most effective dosages and treatment durations for maximizing the benefits of MAT.

While MAT appears to offer substantial benefits in improving balance and reducing spasticity, it should be noted that MAT is just one component of a comprehensive rehabilitation program for children with CP. Integrating MAT with other therapeutic approaches could offer synergistic effects that further enhance motor function in children with spastic CP.

Limitations of the Study

While the results of this review are promising, several limitations must be acknowledged. One limitation is the heterogeneity in the MAT protocols used across studies. The duration, frequency, and intensity of the MAT interventions varied widely, making it difficult to compare the efficacy of different intervention models. Moreover, most studies included small sample sizes, which limits the generalizability of the findings.

Another limitation is the short duration of follow-up in many of the included studies. Most studies assessed the effects of MAT in the short term, leaving a gap in understanding the long-term benefits of MAT for children with spastic CP. Further research with longer follow-up periods is necessary to determine the sustainability of improvements in balance and spasticity after the intervention period.

Future Research

Future studies should aim to standardize MAT protocols to determine the optimal intervention duration, intensity, and frequency for improving balance and spasticity in children with spastic cerebral palsy. Additionally, incorporating larger and more diverse participant samples will help assess the generalizability of the findings across different populations. Longitudinal studies with extended follow-up periods are necessary to examine the long-term effects of MAT on functional mobility

, balance, and spasticity.

Further research should also explore the combination of MAT with other therapeutic approaches, such as neurodevelopmental therapy or strength training, to assess the potential synergistic effects of multimodal interventions in children with CP. Additionally, studies examining the mechanisms underlying MAT's effects on spasticity and balance would provide valuable insights into its therapeutic potential.

Conclusion

The effects of MAT activities on balance and spasticity in children with spastic cerebral palsy (CP) have garnered considerable attention in recent years due to the significant challenges these children face in managing both their motor impairments and functional independence. MAT, through its structured exercises, provides a therapeutic approach that targets improving motor control, postural alignment, muscle flexibility, and neuromuscular coordination. In this review, we have synthesized the findings from multiple studies that examine the effects of MAT on balance and spasticity, two of the most impactful and debilitating symptoms associated with spastic CP.

Children with spastic CP typically experience difficulty with balance due to altered postural control, muscle weakness, and impaired proprioception. These motor deficits hinder their ability to perform activities of daily living and often lead to decreased independence and quality of life. Balance impairments, such as instability during standing, walking, and coordination of upper and lower body movements, are common in children with CP. Furthermore, spasticity—the abnormal increase in muscle tone—often contributes to movement restrictions, leading to difficulties in joint mobility and muscle contractions. These factors combined make effective rehabilitation strategies vital to improving functional outcomes and enhancing overall well-being.

One of the core findings of this manuscript is the significant improvement in balance following MAT interventions. Numerous studies, including those by Damiano et al. and Merino-Andrés et al., have demonstrated that MAT significantly improves balance in children with spastic CP. By

targeting postural control through functional movements, MAT strengthens the core and other postural muscles, allowing children to achieve better stability during standing and walking tasks. This enhancement in balance is vital not only for functional mobility but also for the child's ability to engage in social, educational, and recreational activities. Moreover, MAT's effects on dynamic balance have been shown to extend to more complex activities such as reaching, bending, and transitioning from one posture to another, which are essential for daily life.

The second major benefit of MAT activities identified in this review is the reduction in spasticity. Spasticity in children with CP significantly impacts muscle function, contributing to stiff muscles that hinder smooth, coordinated movements. The reduction in muscle tone achieved through MAT exercises has been widely documented in studies such as those by Zhang et al. and Te Velde et al. These studies suggest that MAT helps normalize muscle tone by promoting voluntary, controlled movements that reduce the hyperactivity of spastic muscles. The controlled stretching and strengthening exercises used in MAT increase flexibility and reduce the resistance of muscles, which leads to improved joint mobility and muscle relaxation. This reduction in spasticity allows for greater movement freedom and improved posture and gait.

The systematic analysis of existing literature reveals that MAT has a positive effect not only on balance and spasticity but also on other functional outcomes, including gait speed, muscle strength, and gross motor function. The improvements in these domains have significant implications for the functional independence of children with CP. By improving muscle strength, MAT enhances overall movement control, making it easier for children to perform functional tasks such as walking, running, and climbing. In addition, the improvement in gross motor function, as measured by tools such as the Gross Motor Function Measure (GMFM), demonstrates the potential of MAT to facilitate developmental milestones in children with CP, improving their ability to engage in physical activities and participate in social settings.

Despite the promising results, it is important to acknowledge the variability in the design and implementation of MAT interventions across studies. The duration, intensity, and frequency of MAT sessions varied considerably, making it difficult to pinpoint an ideal protocol for maximizing therapeutic outcomes. Some studies, such as those by Williams et al. and Al-Nemr & Kora, showed that longer treatment durations and more frequent sessions led to greater improvements, while others reported smaller gains with less intensive intervention. This variation in protocol highlights the need for future research to establish standardized guidelines for MAT intervention, ensuring that practitioners can tailor the therapy to meet the specific needs of each child with CP.

Importantly, MAT activities have demonstrated a favorable safety profile. The structured and controlled nature of MAT allows for targeted interventions that avoid overexertion or exacerbation of symptoms. In fact, studies by Te Velde et al. and Merino-Andrés et al. reported minimal adverse effects associated with MAT, making it a safe and viable therapeutic option for children with spastic CP. However, individualized care and supervision are essential to ensuring the safety of each child during therapy.

In conclusion, MAT represents a promising intervention for children with spastic cerebral palsy, offering significant improvements in balance and spasticity. The existing body of evidence supports MAT's efficacy in enhancing motor function and reducing the impairments associated with CP. Nonetheless, there is a need for further research to refine treatment protocols, investigate the long-term effects, and explore the potential for combining MAT with other therapeutic approaches to achieve optimal outcomes for children with CP. As the field of pediatric rehabilitation continues to evolve, MAT should be considered as a valuable tool in the multidisciplinary management of spastic CP, offering hope for improved motor control, greater independence, and a higher quality of life for children affected by this condition.

Final Conclusion

In summary, MAT activities have demonstrated substantial promise in improving balance and reducing spasticity in children with spastic cerebral palsy. This review confirms that MAT can play a crucial role in the rehabilitation process by targeting both the physical and neurological aspects of

motor dysfunction in children with CP. The positive effects observed in balance and spasticity are particularly important as they contribute to enhanced functional mobility, increased independence, and overall well-being for children with CP. While challenges remain in optimizing treatment protocols and understanding the long-term benefits, MAT should be regarded as an essential component of a comprehensive rehabilitation strategy. With further research and refinement, MAT can continue to evolve as a cornerstone of pediatric rehabilitation, ultimately improving the lives of children with spastic cerebral palsy.

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