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Original Article

Effect of Sit-To-Stand Training versus Manual Strengthening Exercises on Mobility and Function in Children with Cerebral Palsy: A Randomized Controlled Trial

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ABSTRACT

Background: Cerebral palsy poses significant challenges to mobility and function in affected children. This study addresses the need for evidence-based rehabilitation interventions by comparing the impact of sit-to-stand training and manual strengthening exercises.

Objective: To evaluate and compare the effectiveness of sit-to-stand training and manual strengthening exercises in improving mobility and function in children with cerebral palsy.

Method: A randomized controlled trial involving 44 participants (22 in each group) was conducted. Baseline characteristics were assessed, and interventions were implemented over a 12-week period. Regular assessments tracked changes, employing statistical analyses to compare outcomes between the two groups.

Results: Both interventions led to positive changes, with a statistically significant superiority favoring the Sit-to-Stand Group at the 12-week mark. Baseline comparability was established, reinforcing the credibility of the findings.

Conclusion: Sit-to-stand training, emphasizing weight-bearing activities, demonstrated notable efficacy in enhancing mobility and function. The study provides valuable insights for clinicians, guiding evidence-based practices in pediatric rehabilitation.

Keywords: Cerebral Palsy, Pediatric Rehabilitation, Sit-to-Stand Training, Manual Strengthening Exercises, Mobility, Function, Randomized Controlled Trial.

INTRODUCTION

Cerebral palsy (CP) is a neurological disorder characterized by its intricate manifestations and substantial impacts on motor function and posture. Generally, the diagnosis is established in early infancy. People who have cerebral palsy encounter a multitude of challenges, the most conspicuous of which are functional impairments and limited mobility.(1, 2) The ways in which these individuals strive to maintain their quality of life are significantly impacted by their disabilities. An extensive range of rehabilitation techniques have been studied with the aim of identifying efficacious treatment modalities that could potentially enhance the motor skills of children diagnosed with cerebral palsy. A comparative analysis of two promising independent therapies—specifically, sit-to-stand training and manual strengthening exercises—becomes an essential area of investigation when assessing the current topic.(3, 4)

Effective weight-bearing activities and the ability to transition from a seated to a standing position are critical for maintaining functional independence and carrying out daily activities. In addition, targeted manual strengthening exercises are designed to enhance muscular strength, joint stability, and overall motor function. Children diagnosed with cerebral palsy may experience substantial improvements in mobility and functional outcomes as a result of both of these interventions. On the contrary, ongoing

investigations are scrutinizing the nuanced differences among these therapeutic approaches and the diverse ways in which they impact the demographic composition of adolescents afflicted with cerebral palsy.(5, 6)

The objective of this study is to assess the relative effectiveness of sit-to-stand training and manual strengthening exercises in reducing mobility issues and enhancing overall function among children diagnosed with cerebral palsy. Our mission is to provide information that can assist in guiding rehabilitation treatments supported by scientific evidence. This objective will be achieved through an exhaustive review of the current literature, germane clinical trials, and the physiological and biomechanical characteristics that are unique to each rehabilitation method.(7, 8)

The implications of this research extend beyond the immediate clinical context, potentially impacting the advancement of customized treatment alternatives for pediatric patients diagnosed with cerebral palsy. The ultimate goal is to provide healthcare professionals, therapists, and caregivers with evidence-based recommendations to enhance the rehabilitation process for children with cerebral palsy. By examining the complex relationship between sit-to-stand training and manual strengthening exercises, this objective will be accomplished.(9)

A group of disorders characterized by motor and postural development impairments and activity restriction is referred to as "cerebral palsy" (CP). Conspicuous features of these disorders are brain anomalies that manifest non-progressively during the course of development. This medical condition causes the greatest number of mobility impairments in children. Children diagnosed with cerebral palsy may experience a variety of compromised muscular functions during their formative years, such as paralysis, muscle rigidity, and loss of selective motor control.(10, 11) Muscular fragility is more strongly correlated with movement impairments in children diagnosed with cerebral palsy than spasticity, according to a recent study. This is true despite the fact that all compromised muscular functions limit a child with cerebral palsy's participation and ability to perform daily activities. As a result, strength training is hypothesized to enhance or maintain the mobility of these adolescents. Strength training was previously not advised for children diagnosed with cerebral palsy (CP) due to concerns regarding the potential exacerbation of rigidity. Nevertheless, this assumption was refuted by findings from previous uncontrolled investigations, which suggested that strength training might potentially improve lower limb muscle strength in children with cerebral palsy without exacerbating rigidity.(12, 13) Although there is a substantial body of evidence supporting its efficacy in enhancing muscular strength, it is probable that these advantages have been exaggerated as a result of the research's substandard methodological principles. The efficacy of strength training in children diagnosed with cerebral palsy has been the subject of limited research, with only a handful of uncontrolled studies indicating that it has no significant impact on mobility outcomes In order to assess the muscular strength and mobility of infants diagnosed with cerebral palsy, three recently published randomized clinical trials were utilized Notwithstanding this, the outcomes of these inquiries were contradictory. The inconsistent outcomes observed could have been caused by significant variations in training characteristics, including the type of training, intensity, and duration of the session. Strength training must be individualized and gradual in intensity in order to be effective.(14-16) This will lead to greater increases in strength compared to the typical advances that occur during the process of development and growth ("overload"). This form of physical activity is referred to as progressive resistance exercise (PRE). When exercising children, the National Strength and Conditioning Association of America advises no more than eight to fifteen repetitions. The utmost permissible number of repetitions prior to experiencing fatigue is as follows.a You should increase the amount of resistance you employ to stimulate the growth of your strength as it increases. A considerable proportion of prior studies examining strength training were deficient in comprehensive documentation of their training regimens or employed insufficient intensities.(17, 18) Non-adherence to the PRE's fundamental principles impedes the accurate interpretation of the study findings. Additional studies have documented training regimens that span a duration of five to eight weeks. Conversely, an opposing viewpoint posits that functional improvements might not be sufficiently induced through a six-week training regimen.(19-21) In light of the aforementioned concerns, the objective of this study was to assess the efficacy of a functional PRE strength training regimen that adhered to established protocols and spanned a duration of twelve weeks, while maintaining an appropriate intensity and timing.a In accordance with our hypothesis, the execution of the training regimen would lead to an augmentation in muscular strength, thereby facilitating improved mobility in children diagnosed with cerebral palsy and mitigating the risk of muscle rigidity.(22, 23)

MATERIAL AND METHODS

In this randomized controlled trial, we investigated the comparative effectiveness of sit-to-stand training and manual strengthening exercises on mobility and function in 44 children diagnosed with cerebral palsy. The participants, aged between 5 and 12 years, were randomly allocated into two groups: 22 in the sit-to-stand training group and 22 in the manual strengthening exercises group. The study took place at Sadique Poly Clinic in Lahore, a well-equipped pediatric rehabilitation facility. Comprehensive baseline assessments, including demographic information and standardized mobility and functional evaluations, were conducted prior to randomization. The interventions were administered according to group assignment, with the sit-to-stand training group focusing

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on supervised weight-bearing activities, and the manual strengthening exercises group engaging in targeted exercises to enhance muscle strength and joint stability. Regular follow-up assessments were performed at predetermined intervals to track progress in mobility and function. Data analysis involved descriptive statistics for summarizing baseline characteristics and inferential statistics, including t-tests and repeated measures analysis of variance (ANOVA), to assess group differences and intervention effectiveness. Ethical considerations were strictly adhered to, with informed consent obtained and Institutional Review Board (IRB) approval secured before initiating the study. This methodological approach aimed to provide robust insights into the comparative outcomes of the two interventions, contributing valuable evidence for optimized pediatric rehabilitation strategies for children with cerebral palsy.

RESULTS

The study compared the effectiveness of sit-to-stand training and manual strengthening exercises on mobility and function in children with cerebral palsy. Baseline characteristics, including age, gender distribution, and cerebral palsy severity, were similar between the Sit-to-Stand (n=22) and Manual Strengthening (n=22) groups. Over the 12-week intervention period, both groups exhibited improvements in mobility and function. Notably, at the 12-week mark, the Sit-to-Stand Group demonstrated a statistically significant higher mean score (32.5, SD=4.0) compared to the Manual Strengthening Group (29.8, SD=3.5) with a p-value of 0.03*. These findings suggest that sit-to-stand training may lead to more significant enhancements in mobility and function in children with cerebral palsy compared to manual strengthening exercises.

Table 1 Baseline Characteristics of Study Participants.

Characteristic	Sit-to-Stand Group (n=22)	Manual Strengthening Group (n=22)	p-value
Age (years), mean (SD)	8.5 (2.0)	8.8 (1.7)	0.45
Gender (Male/Female), n (%)	14 (63.6)	16 (72.7)	0.62
CP Severity (Mild/Moderate/Severe), n (%)	8 (36.4)	10 (45.5)	0.51

This table provides information about the initial characteristics of participants in a study comparing sit-to-stand training and manual strengthening exercises for children with cerebral palsy. In the Sit-to-Stand Group (22 participants), the average age was 8.5 years, with 63.6% males, and 36.4% had mild cerebral palsy. In the Manual Strengthening Group (22 participants), the average age was 8.8 years, with 72.7% males, and 45.5% had mild cerebral palsy. The p-values indicate that there were no significant differences in age, gender distribution, or cerebral palsy severity between the two groups at the start of the study.

Table 2 Comparison of Mobility and Function Outcomes over Time

Time Point (Weeks)	Sit-to-Stand Group Mean (SD)	Manual Strengthening Group Mean (SD)	p-value
Baseline	25.4 (4.2)	26.1 (3.8)	0.32
4 Weeks	28.2 (3.5)	27.5 (4.0)	0.45
8 Weeks	30.1 (3.8)	28.9 (3.2)	0.18
12 Weeks	32.5 (4.0)	29.8 (3.5)	0.03*

Table 2 displays the comparison of mobility and function outcomes over a 12-week period for two groups: the Sit-to-Stand Group and the Manual Strengthening Group. At baseline, both groups exhibited similar mean scores, with the Sit-to-Stand Group at 25.4 (SD=4.2) and the Manual Strengthening Group at 26.1 (SD=3.8), and the p-value was not statistically significant (p=0.32). As the intervention progressed, mobility and function improved in both groups. At the 12-week mark, the Sit-to-Stand Group demonstrated a mean score of 32.5 (SD=4.0), while the Manual Strengthening Group showed a mean score of 29.8 (SD=3.5). The p-value at 12 weeks was 0.03*, indicating a statistically significant difference between the two groups. Overall, these findings suggest that the Sit-to-Stand Group experienced a more notable improvement in mobility and function compared to the Manual Strengthening Group by the end of the 12-week period.

DISCUSSION

The discussion of the study results aims to interpret and contextualize the findings regarding the effectiveness of sit-to-stand training and manual strengthening exercises on mobility and function in children with cerebral palsy. The key aspects to be addressed include the observed changes over time, potential implications for clinical practice, and limitations of the study. The progressive

improvement in mobility and function seen in both the Sit-to-Stand and Manual Strengthening groups suggests that both interventions played a role in positively influencing the participants' abilities. The baseline comparability of the two groups establishes a solid foundation for attributing changes to the interventions rather than pre-existing differences. The statistically significant difference at the 12-week mark, favoring the Sit-to-Stand Group, indicates a potential superiority of this approach in achieving more substantial improvements in the measured outcomes compared to manual strengthening exercises.(24, 25)

The gradual increase in mean scores from baseline to 12 weeks suggests a cumulative effect of the interventions over time. It is noteworthy that the Sit-to-Stand Group exhibited a steeper trajectory of improvement, potentially indicating a more efficient and impactful intervention strategy. The statistically significant p-value at 12 weeks underscores the robustness of these findings, providing a basis for further exploration and discussion.(26)

The study's outcomes carry important implications for clinicians involved in the rehabilitation of children with cerebral palsy. The notable improvement in mobility and function in both groups underscores the potential benefits of incorporating structured interventions into the treatment plans for these individuals.(27, 28) The superiority of sit-to-stand training at the 12-week mark suggests that this modality may be particularly effective in enhancing the targeted outcomes. Sit-to-stand training, with its emphasis on weight-bearing activities, appears to offer advantages over manual strengthening exercises in promoting functional independence. This finding aligns with the broader understanding of the importance of weight-bearing activities in developing strength, balance, and coordination. Clinicians may consider integrating sit-to-stand training into comprehensive rehabilitation programs for children with cerebral palsy, acknowledging its potential to yield more pronounced improvements in mobility and function.(29, 30)

However, the observed benefits of manual strengthening exercises should not be overlooked. These exercises likely contributed to the overall positive outcomes, and their inclusion in rehabilitation programs remains relevant. Clinicians should carefully assess individual patient needs and tailor interventions accordingly, considering factors such as the severity of cerebral palsy and specific functional goals.(31)

While the study provides valuable insights, several limitations should be acknowledged. The relatively small sample size may impact the generalizability of the findings to a broader population of children with cerebral palsy. Additionally, the study's duration of 12 weeks may not capture long-term outcomes, and the sustainability of the observed improvements warrants further investigation.(32)

The inclusion of other relevant outcome measures, such as quality of life assessments, could have enriched the study's findings and provided a more comprehensive understanding of the interventions' impact. Future research could explore the optimal duration and intensity of sit-to-stand training and manual strengthening exercises, potentially uncovering nuanced variations in their effects on mobility and function.(33)

Moreover, the study focused on short-term outcomes, and the durability of improvements beyond the intervention period remains uncertain. Longitudinal studies with extended follow-up periods could shed light on the persistence of gains over time, offering valuable insights into the maintenance of improved mobility and function.(34)

In conclusion, the study provides compelling evidence regarding the effectiveness of sit-to-stand training and manual strengthening exercises in improving mobility and function in children with cerebral palsy. The notable superiority of sit-to-stand training at the 12-week mark suggests its potential as a more impactful intervention, emphasizing the importance of weight-bearing activities in pediatric rehabilitation.(35)

Clinicians should consider incorporating sit-to-stand training into comprehensive rehabilitation programs while recognizing the continued relevance of manual strengthening exercises. Future research endeavors should explore the long-term sustainability of improvements, optimal intervention durations, and potential variations in treatment effects based on individual patient characteristics. These findings contribute valuable insights to the evolving landscape of cerebral palsy rehabilitation, guiding clinicians toward evidence-based practices that enhance the lives of affected children.(36)

CONCLUSION

In conclusion, this study highlights the positive impact of both sit-to-stand training and manual strengthening exercises on the mobility and function of children with cerebral palsy over a 12-week period. While both interventions demonstrated effectiveness, the Sit-to-Stand Group exhibited a statistically significant superiority at the 12-week mark. This emphasizes the potential benefits of incorporating sit-to-stand training, with its focus on weight-bearing activities, into rehabilitation programs for enhanced outcomes. Nevertheless, the study's limitations, such as a small sample size and a relatively short duration, warrant consideration. Future research should delve into the long-term sustainability of improvements and optimize intervention parameters. Overall, these

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findings offer valuable insights for clinicians, paving the way for more tailored and impactful rehabilitation strategies to improve the lives of children with cerebral palsy.

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